SOCIOLOGICAL AND ECOLOGICAL STUDIES ON THE TROPICAL WEED VEGETATION OF PASURUAN (THE ISLAND OF JAVA)

by

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INTRODUCTION.

In every country where agriculture is in a highly developed state, a need has been felt for a simple method of typifying and classifying lands according to their use-value for agricultural purposes. In the island of Java too, trials have been made to find a scientific basis for typifying lands. Marr (1912) for instance divided lands according to the degree of weathering; Mohr (1910) according to the size of soilparticles; van Deventer (1908) according to the hygroscopic moisture. All these divisions have the same drawback, however; they are based on one single quality of the soil only and are accordingly artificial. Although similar divisions, based on one quality, may be of some value for a type of soil of a definite origin and way of weathering, none of them has been applied on a large scale.

It is difficult to give a simple basis according to which the soil may be typified. The number of properties of a soil and the many possible combinations make every surveyable classification more or less artificial. If, in addition to the results, obtained by the mechanical analysis of the size of the particles, the geological origin is also taken into consideration, a better judgment of the agricultural value of the soils may be formed. A reconstruction of the geological process, preceding the present-day condition, is always more or less hypothetical and leaves therefore much scope for personal opinions. Moreover, one does get an opinion of larger regions taken generally, but the smaller fluctuations in the quality of the soil are difficult to classify. These very fluctuations give most difficulties in a country where agriculture is in a highly developed state, especially to the cane-planter when selecting the cane-varieties to be planted out. Besides, practice often demands a *quick* answer to its questions, whereas the agro-geological view is only obtained after a long study and a thorough knowledge of the area.

The weed-vegetation gives those who are familiar with it, immediate useful information and therefore the question is obvious as to what extent it may be a reliable basis in the judgment of soils. The vegetation is correlatively connected with practically all soil-factors, so that a judgment based on it would not suffer from the drawbacks of artificial classifications.

The use of the vegetation as an indicator of the agricultural value of the soil is by no means new. In Scandinavia it has been tried at an early date to typify woodlands in this way. Wellknown is for instance the work of Cajander, "Ueber Waldtypen" (1909), in which he tries to characterize woodtypes of South-Germany by a few "Leitpflanzen" repeatedly occurring in a certain type. But in America especially, the method was applied in judging lands, reclaimed for the first time. In the classical work in the domain of indicator-plants, H. L. Shantz, "Natural vegetation as an indicator of the capabilities of land for crop productions in the Great Plains area" (1911), the advantages of this method are clearly explained. From the great work of Clements, "Plant indicators. The relation of plant-communities to process and practice" (1920), it appears, especially in the United States of America in the last few years, how generally this way of indicating the agricultural value of the soil was applied. In the island of Java, Beumée (1922) has tried to connect "the sub-vegetation in artificially planted teak plots" with the development of the teak.

The above-mentioned publications were examples of investigations in which the authors tried to solve questions put by practice by means of examining the correlation between the vegetation and the soil. More numerous are the researches, which, apart from possible practical applications, study the correlation between the vegetation and the external factors in general, of which "the soil" takes up an important place.

The aim of my research is to contribute to the knowledge of culture-weeds in connection with the soil. Between practically all the above-mentioned researches and mine, there is a difference in the nature of the studied vegetation. My predecessors occupied themselves almost exclusively with the "natural vegetation", that is to say the vegetation which has been disturbed as little as possible by man. Especially in Scandinavia and America untouched areas still occur, where for centuries the vegetation has practically maintained itself undisturbed. "Unwillkürlich ist man bestrebt gewesen .... wo der Mensch eingreift, das Künstliche und weniger Interessante zu sehen", says Rübel c.s. in "Programme für geobotanische Arbeiten" (1916) and for the study of the vegetation as a soil-indicator little notice was taken of the "culture-weeds".

The plain of Pasuruan, bearing on my investigation, is exclusively agricultural. A natural, virgin flora is no longer to be found anywhere. So, if one wants to try and find a connection between the vegetation and the soil, the weeds, growing on spots which are cultivated for the greater part of the year, should be considered as vegetation. These weed-communities will develop only during a few months, for a year and a half at most (as a rule for a much shorter period only), to be thoroughly afterwards destroyed by man again. The vegetation to be discussed in this publication, therefore differs in many respects from that which others used for their researches after its value as an indicator. Nevertheless I will try to prove that the weed-flora of the district examined by me is equally suited for acquiring an insight into the agricultural value of the soil. There are even indications that the pioneer-communities are better indicators than the later successions. As the vegetation grows older, it becomes more homogeneous and differences in the soil are less and less typified by the flora. Therefore in American researches often the question is asked whether the soil in general, is more or less useful for crops, whether "dry-farming" or rather "irrigation-farming" should be applied, to what extent the soil has deteriorated by constant grazing etc. Attempts have been made to get an answer to those questions by examining the natural vegetation.

I, however, want to put other questions. As to the cultivated area in the district of Pasuruan there is no need to find out, whether the lands in general are suitable for sugar-cane or not. I want to know, whether the nature of the vegetation is connected with the greater or smaller capabilities of the soils for a definite "variety" of sugar-cane. The fluctuations to be typified in the soil, will therefore be smaller than those with the questions which others, for instance the American investigators, had to answer.

The nature of a weed-vegetation, especially in a tropical country, largely differs from that of a natural vegetation. There hardly any change of appearance, here an ever changing aspect. There the dominating influence of local conditions side by side with the climate, here, moreover, the influence of the circumstances under which the weed-communities arose, often differing considerably from those under which they maintain themselves. From the beginning of this investigation, I remained as neutral as possible towards all kinds of hypotheses, which have been formed about the correlation between the natural vegetation and the conditions influencing it; I have tried to determine inductively to what extent correlations were to be found. The vegetation, its classification into communities, was the primary datum, *the explanation* of this classification was to come true, if possible, in the course of the investigation.

The investigation was carried out in the years 1922—1925. The first year was chiefly devoted to the floristic study of the district, so that, for the greater part I could finally identify the plants also if they were sterile, which is an essential condition for such an investigation. The second year was used for a preliminary orientation in the study of the weed-communities. Only the data afterwards obtained, chiefly of 1924 and 1925, were included in this publication.

This treatise should be considered as a mere introduction to a discussion of the indicator-value of a tropical weed-vegetation, carried out on a limited scale. I have rather aimed at finding a suitable method and obtaining a general insight, than at giving a complete description of the weed-vegetation of the whole plain of Pasuruan. The attention was more especially concentrated on the vegetation of the light and medium-light soils.

I repeat that the aim of this study was first and foremost, to try and supply a practical need, that is to say, to determine the agricultural value of the soil on behalf of the cultivation of cane. I hope that it will give at the same time a closer insight into the course of development of a tropical weed-flora about which so little is yet known.

I. TOPOGRAPHY OF THE DISTRICT OF RESEARCH.[1])

The area of investigation is situated between Long. 112° 44′ and 113° 5′ E. and Lat. 7° 34′ and 7° 48′ S. In the direction east-west the distance between the extreme points of the investigated district amounts to about 40 K.M.; in the direction north-south about 30 K.M.

The area comprises the plain of Pasuruan, which passes gradually into the gently sloping foot of the Ardjoeno- and Tengger-mountain-range; these two volcanoes border on the district respectively west and south. Bounded on the north by the river Porrong and by the straits of Madura, the district joins on the east the plain of Probolinggo, from which it is separated by a low hill, the erosion-remnant of the extinct volcano of Semongkrong, 11 K.M. east of Pasuruan, of which the highest point lies 84 M. above sea-level. The whole area is comparatively flat. Immediately behind the coast near Bangil and Pasuruan and between the latter and the Semongkrong lie fish-ponds, where at high tide the seawater may be let in and carried off at low tide, Here and there only, a formation geologically somewhat older, forms elevations which sometimes assume the character of hills and which are generally not above 100 M. A similar range of hills begins about midway between Pasuruan and Bangil and continues from there in a western and southern direction. Separated from it by a more level strip near Bangil a hilly district begins again, extending west- and southwards. The Goenoengsari, about 7 K.M. W.S.W. of Bangil, is a hill of about the same origin, the highest point of which rises 147 M. above sea-level.

The area is intersected by a few rivers. The principal of those are the Welang, flowing into the sea between

[1]) See the map at the back of this publication.

Pasuruan and Bangil, and the Redjoso, issuing 5 K.M. east of Pasuruan.

The district of research is therefore to be characterised as a littoral plain, gently rising west and southward with locally a few elevations of a comparatively small height. In this district lie a number of sugar-factories in the middle of their sugar-cane-plantations. On the high-road from Pasuruan to Malang, situated about 50 K.M. S.W. as the the crow flies, we first come to the factory Pleret at a distance of rather more than 6 K.M. from the coast and about 15 M. above sea-level. Farther south are the factories Wonoredjo and Alkmaar respectively 85 M. and 180 M. above sea-level. Some way south of the sugar-factory Pleret is Waroengdowo, where a road, largely running west-east, crosses the Pasuruan-Malang road, mentioned before. Starting from Waroengdowo, we find to the east in. succession, the factories Pengkol, Gayam and Winongan, all at a distance of about 8—9 K.M. from the coast. Nearer to the coast (6 K.M.) on the high-road from Pasuruan to Probolinggo, 7 K.M. east of Pasuruan, is factory Kedawoeng. Gayam lies 21 M. above sea-level, the other factories are still lower. The plant-areas of all these factories are practically adjacent; so in reality the whole plain is covered with sugar-cane-fields, but owing to the rotation-system, only about a third part of the soils suited for sugar-cane, is planted every yar.

Going westwards from Waroengdowo, one arrives at Ngempit, a sugar-factory of former days; it is now closed, but joined with Winongan, where the cane is crushed at the present time.

Near Bangil, 15 K.M. W.N.W. of Pasuruan, lies the factory Soemberredjo, rather close to the coast; to the south its area joins that of the factory Pandäan, lying 160 M. above sea-level at the foot of the Ardjoeno; still farther southwards lies the factory Soekoredjo.

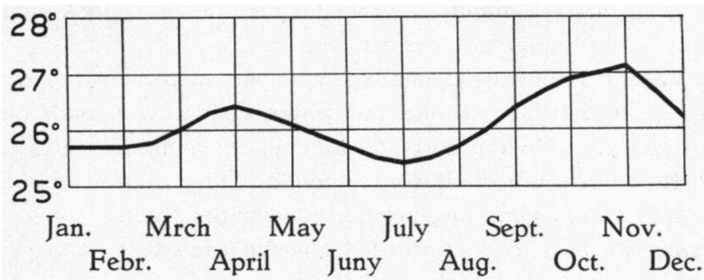
West and southwest of Semongkrong lies finally a complex of sugar-cane-fields, forming the section Ngoeling of the factory Winongan. Between the cane-fields of Ngoeling and those of Kedawoeng is the Lake of Grati; an old crater lake, yielding water for the irrigation of a part of the lands which are more to the north of it.

In-this study the plain of Malang is occasionally mentioned, although it really lies outside the field of inspection proper. It is a plateau in the northern part of which lies Malang and which gently slopes down as far as the Southern range of limestone-mountains; its height above sea-level graduates from 440 M. in the north to 320 M. in the south. In this area is for instance the factory Sempalwadak (400 M. above sea-level) spoken of a few times in this essay.

II. GENERAL SURVEY OF THE FACTORS INFLUENCING THE VEGETATION.

A. Climatic factors.

The most characteristic features of a tropical climate is indeed its monotony in contrast with the changeability of the weather conditions in temperate zones. Nearly all climatic factors have a periodicity, which is very constant from day to day, as well as in its annual course. An investigation aiming at the explanation of the variety in the vegetation of a certain area is therefore easier in a tropical climate than in the temperate zones. A number of factors, which may be very important in explaining the different flora in the temperate zones owing to their irregular progress during the period of vegetation and also their change from place to place, may, in my opinion, be neglected in the tropics owing to their equability; for instance *the temperature of the air* needs not to be considered. From day to day as well as in its annual course, it always has the same period, which has a slight amplitude only. The graphic figure below shows the annual course of the monthly temperature at Pasuruan (the average during a period of five years: 1914—1918) (Braak, pag. 283).



Graphic figure of the average of the monthly air-temperature at Pasuruan (1914—1918).

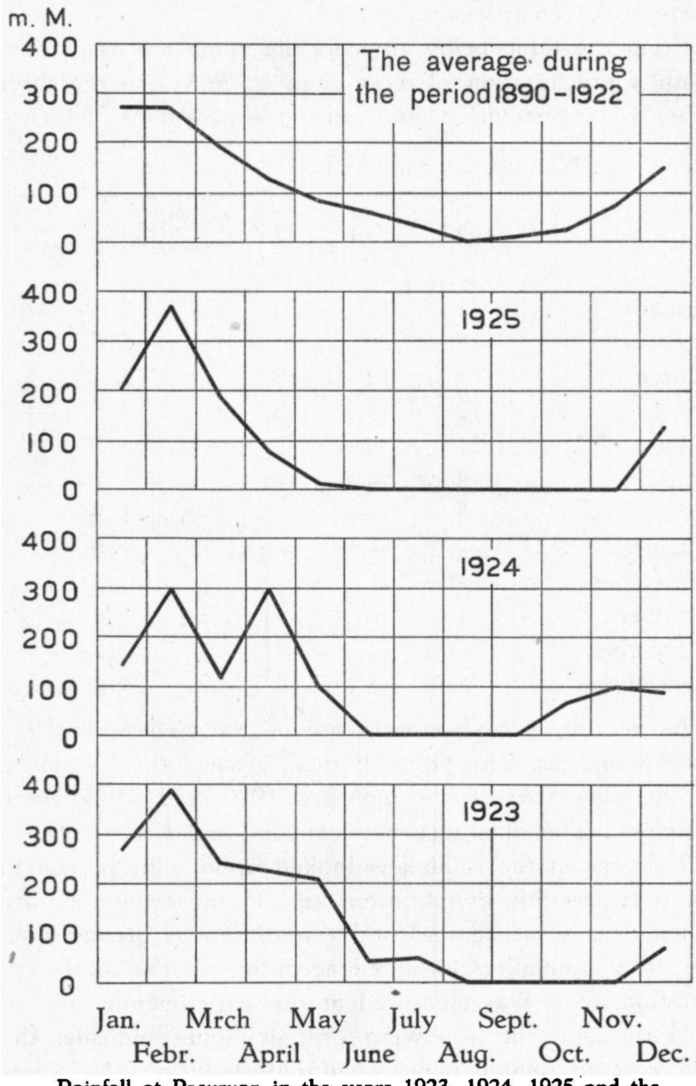
Table XXV gives an idea about the daily course of the temperature.

The changes in height within the field of investigation are so slight that the differences in temperature, resulting from them, may be neglected. Finally a remark about the temperature of the soil. From measurings at Pasuruan and Batavia (Braak, pag. 332) the temperature of the soil to a depth of 3 cm. appears to be about 3° higher than the temperature of the air; in the lower layers it is at first 0.5° C higher, but it remains practically constant from 15 cm. to 110 cm. below the surface. Just like the temperature of the air, the temperature of the soil has two maxima and two minima, of which the extremes, 30 cm. below the surface, differed 1,5° C at Pasuruan (July and December). In this respect too, the conditions in the tropics are much more equable than in the temperate zones, where a similar parallel between the temperature of air and soil is wanting (see e. g. Firbas, 1924).

The temperatures of the air given above have a value only as a typification of the climate. Ecologically, that is to say, with respect to the heat-proportions of the plant, they only have a relative significance (see Rübel, 1922; Firbas, 1924).

Just like the temperature, the *atmospheric pressure* has only a slight amplitude, which amounts to a few mm. only in its daily and annual course.

Water is one of the most important factors in the life of a plant. In the tropics the water is exclusively available for the plant in the form of rain and air-moisture; rain is the more important source by far. The *rainfall* in this district has a very large amplitude in the course of the year, so that the contrast between the west- and the east monsoon, that is to say, between the wet and the dry periods impresses its stamp upon the whole vegetation. The rather heavy precipitation in the months of the west-monsoon, together with the high temperature, enables the plants to grow vigorously, and to rise often to more than 1 M. within a few months. A great contrast forms the east monsoon when there is hardly any rainfall in 5 to 6 months in the district of Pasuruan. Apart from trees and shrubs, only the more drought-resistant plants, which arose among others in the west monsoon, can maintain themselves in the east monsoon. The majority of the plants which are drought-resistant, are the grasses. The growth too has practically come to a standstill in the latter half of the dry period. The vegetation of this district germinates as long as the substratum is wet enough; so chiefly in the west monsoon and it either maintains itself in the east monsoon or it does not. In this way, it may be explained that on the range of hills behind the coast, where the heavy clay forms such a bad soil, that it cannot be used for agricultural purposes, a savannah-like vegetation has arisen, so a formation entirely determined by the dry season. Below will be found a graphic figure of the average monthly rainfall of the experimental station at Pasuruan during a period of 33 years (1890—1922) (Boerema, 1925, p.p. 68—69). The course of the rainfall in the years



Rainfall at Pasuruan in the years 1923, 1924, 1925 and the average during the period 1890—1922.

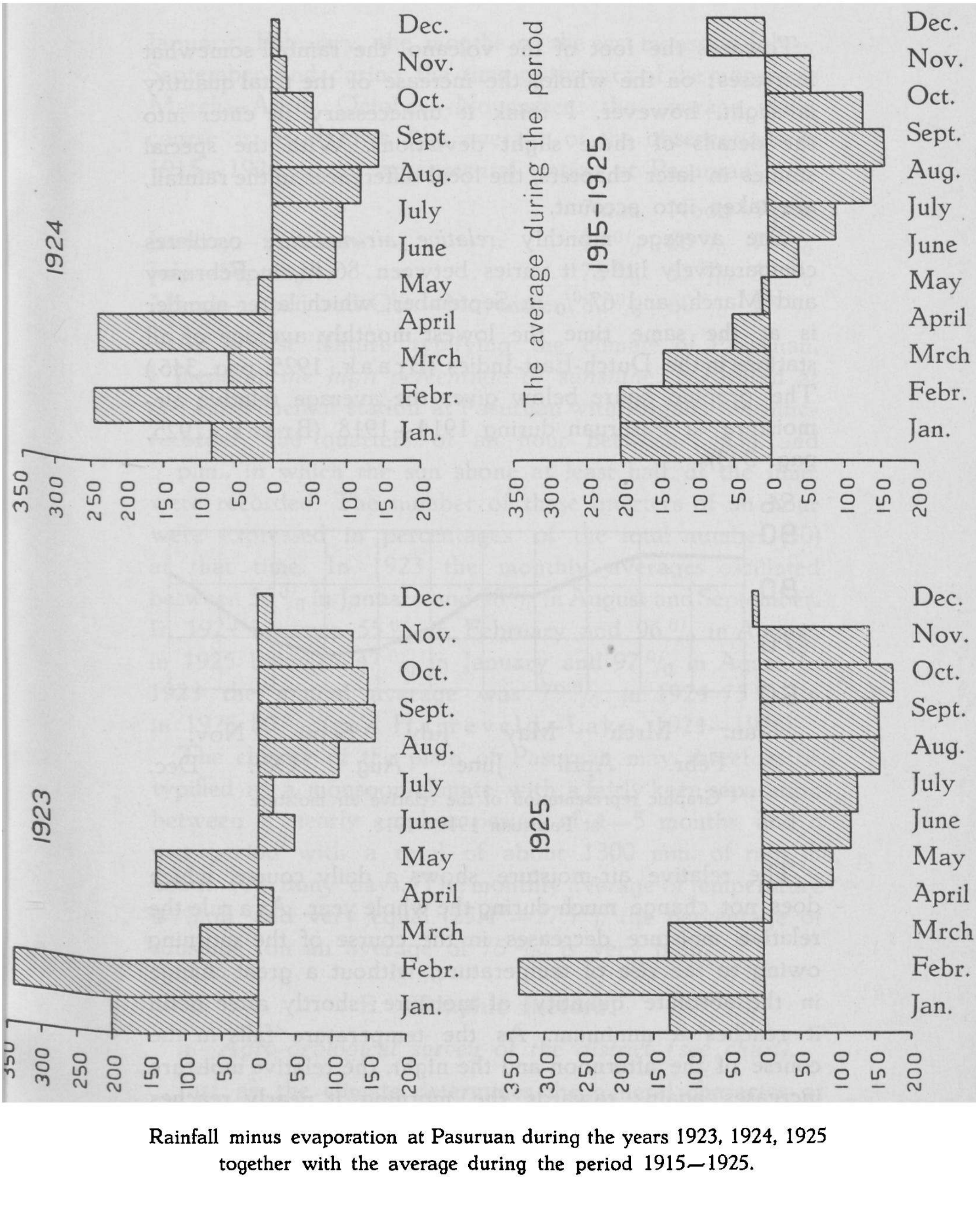
of experiment (1923, 1924, 1925) according to observations at the experimental station at Pasuruan, was added for purposes of comparison.

From the table below appears the number of rainy days (with a precipitation of more than $^{1}/_{2}$ m.M.) in the three years of investigation and during a period of 35 years.

Number of rainy days at Pasuruan.

	1923	1924	1925	The average during a period of 35 years
January . . .	21	19	20	18.5
February . . .	18	20	21	18.8
March	14	14	13	15.5
April	12	15	5	9.5
May	11	4	2	6.7
June	4	—	—	4.7
July	8	—	—	1.9
August	—	—	—	0.6
September . .	—	—	—	0.5
October . . .	1	3	—	1.6
November . .	—	11	—	5.7
December . .	8	8	7	14.0

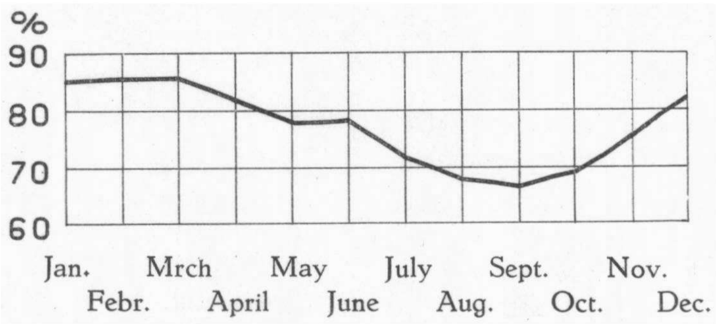
As a rule 4 to 5 months are nearly rainless, in 1925 even 8 months. The point of time, at which the dry season begins, may vary some months; 1923 and 1925 were extremes. The difference between dry and wet months is still clearer, if the rainfall is looked upon with respect to the total monthly evaporation, and if those months are called dry, in which the total evaporation is greater than the total rainfall. Calculated according to the total evaporation, as it was measured at the experimental station at Pasuruan, the following graphic figure indicates the difference in rainfall minus evaporation during the years 1923—'25, together with the average during 10 years.



Rainfall minus evaporation at Pasuruan during the years 1923, 1924, 1925 together with the average during the period 1915—1925.

Towards the foot of the volcano, the rainfall somewhat increases; on the whole, the increase of the total quantity is slight, however. I think it unnecessary to enter into the details of these slight deviations. With the special studies in later chapters, the local differences in the rainfall, are taken into account.

The average monthly *relative air-moisture* oscillates comparatively little, it varies between 86 % in February and March, and 67 % in September, which latter number is at the same time the lowest monthly average of all stations in the Dutch-East-Indies (Braak, 1925, pag. 346.) The graphic figure below gives the average relative air-moisture at Pasuruan during 1914—1918 (Braak, 1925, pag. 343).



Graphic representation of the relative air moisture at Pasuruan 1914—1918.

The relative air-moisture shows a daily course, which does not change much during the whole year. As a rule the relative moisture decreases in the course of the morning owing to the rise of temperature, without a great change in the absolute quantity of moisture; shortly after noon it reaches a minimum. As the temperature falls in the course of the afternoon and the night, the relative moisture increases again; towards the morning it nearly reaches its points of saturation. In the months of the west monsoon

January, February, the months of the east monsoon July—September and during the time of the turn of the monsoons March—April, October—November, the average daily course is as follows (the average of the observations in 1915—1924 at the experimental station at Pasuruan):

	7 a.m.	Noon	5 p.m.
January—February.	90 %	66 %	78 %
July—September.	78 %	53 %	57 %
March—April and Oct.—November	82 %	60 %	68 %

As a last feature typifying the climate of Pasuruan, I mention *the high percentage of sunshine.* Measured at the experimental station at Pasuruan with Jordans sunshine-recorder, the quarters of an hour between 7 a.m. and 5 p.m., in which the sun shone at least half of the time, were recorded. The number of these quarters of an hour were expressed in percentages of the total number (40) at that time. In 1923 the monthly averages oscillated between 56 % in January and 98 % in August and September. In 1924 between 55 % in February and 96 % in August, in 1925 between 47 % in January and 97 % in Agust. In 1923 the annual average was 79 %, in 1924 75 %, in in 1925 80 % (van Harreveld—Lako, 1924—1926).

The climate of the plain of Pasuruan may therefore be typified as a monsoon-climate with a fairly keen separation between a nearly rainless period of 4—5 months and a wet period with a total of about 1300 mm. of rain in about 100 rainy days. The monthly average of temperature is high and very equal (25.4°—27.1°), the percentage of sunshine (on an average of 75 %) is very high.

B. Edaphic factors.

a. Agro-geological survey of the district (see chart).

Just as the climate determines the general character of the vegetation, so are the edaphic differences — that is to say the differences in the soil — the cause of the variety in the local flora. A general survey of the formation of the soil of the field of inspection is therefore not out of place here.

What was remarked in sub A for the climatic factors, also holds good for the geology of our area. In the plain of Pasuruan, the variety is much smaller than in most other districts, where up till now a similar investigation was made. Central-Europe for instance, often gives us on a small scale, a sample card of formations from different geological periods; but the plain of Pasuruan is a volcanic formation from the Quarternary period, older layers do not crop out. The Ardjoeno and the Tengger are the volcanoes, the eruptives of which built up the present-day plain of Pasuruan. Neither volcano has supplied any important eruptions in historic times. The Ardjoeno-complex has in the crater of its top, the Welirang, only a number of solfatars; only the Bromo, the present-day eruption-point of the Tengger, occasionally erupts small quantities of ashes and stones. Just like all the younger volcanoes in the island of Java, the Ardjoeno and the Tengger only produced basic eruptive materials (andesites and basalts with their transitions) (V e r b e e k and F e n n e m a, pag. 125 and pag. 136 and following).

The oldest soils of the plain of Pasuruan mostly occur in the form of slight elevations of the area, often as low ridges, slightly projecting above the landscape, but not yet covered with later eruptive material. This so-called *old-quaternary clay*, (in contrast with the younger quaternary deposits) is very heavy, impermeable in a high degree, cracks deeply when it is dry (often 1 M. and more), is often poor in phosphate and forms a very bad soil for culture. Calcium-carbonate concretions, varying much in number, are found in these soils. Sometimes the calcium-carbonate is dissolved again; at the same time a washing and a shifting of the material of these ridges occurs, so that the nearest surroundings may be covered with heavy material without any concretions. To this "old-quaternary type" belong e. g. the hills, already mentioned in the topographic description, along the coast between Kraton (J 4) [1]) and Bangil (E 2) with their ridges projecting to the south-east. South of Pasuruan, a slight elevation is also found near Kedjajan (J 8), south-east of Babadan (L 6) and further on to the foot of the Tengger at Dawoehan (L 10), Kèpoeh (J 10), Ambilambil (G 8) etc. Nearly or entirely non-calcareous soils of this type also lie between the river Porrong, the fish-ponds along the coast and the high-road Bangil-Gempolsoerat.

Where the black cover has washed away, the underlying tuffs weathered into red soils. If, as is possible in a district made hilly by erosion, the black layer has locally remained, black calcareous and red uncalcareous clay is found almost side by side, such as e.g. in the neighbourhood of Kepoeh (J 10), Soemberbantang (H 9) and Ambilambil (G 8).

South of the factory Wonoredjo and east of the high-road to Malang, similar red clay cover a larger surface.

It is very probable that the old-quaternary clay forms the subsoil of the whole plain of Pasuruan. V e r b e e k and F e n n e m a, in whose opinion these soils are of a marine origin, state on page 977 of their work that the upheaval of the island of Java in the Quaternary period amounted to 100 to 120 M. at the most; old-quaternary soils at a greater height will therefore not be met with. It is very peculiar that near the dessah of Blimbing, north of Lawang, at the high-road Pasuruan-Malang, situated 360 M. above sea-level (B 13), so at the slope

[1]) The letters and numbers in brackets indicate the situation of the dessahs (villages) on the map, at the back of this publication.

of the volcano, I came across the same calcareous black soil.

The mud-flows, erupted by the volcanoes at a later date, are caked to tuffs; the upper layer of this tuff weathered into soil, so that an important part of these soils in this district has arisen residuarily. The tuff is therefore to be found at several depths under the soil-layer, depending on the sloping of the area and on the leaching. Where this weathering occurred under a dense vegetation and sub-hydrically (e. g. in marshes along the shore), black soils arose; where, at a higher level, the weathering took place, the colour became more or less red.

Both volcanoes, the Ardjoeno as well as the Tengger, took their share in this overlying; and they gave soils in several places which have about the same qualities from an agro-geological point-of-view.

The soils weathered sub-hydrically, originated in this way, have been indicated on the chart as heavy, black, residuary clay arisen from tuff, never calcareous. This clay is found in the northern part of the plain east of Pasuruan in a wide strip along the shore; west of the town the streams have struck upon the old-quaternary hills. What share the Ardjoeno and the Tengger-complex each have had in the making of the plain, has not been quite settled everywhere. The direction of the altitude-lines and the course of a few rivers may give some indication that the Ardjoeno-materials have flowed into a wide stream in a north-easterly direction, and have contributed most to form the northern part of the plain of Pasuruan, probably even of the part between Pasuruan and the Semongkrong. That the Ardjoeno was active after the Tengger, appears for instance from the course of the river Welang, which was shifted eastwards and pressed against the foot of the Tengger in its upper course. It may therefore be assumed that all the material, west of this river, originates from the Ardjoeno; rather more to the east, in the district of

Kedawoeng, Winongan and Gayam, the Ardjoeno and Tengger-deposits have joined and therefore it is not easy to distinguish between them.

South of this strip of sub-hydrically weathered black clay lies — speaking generally — the soil has a more or less brown colour. This soil is lighter, often somewhat sandy, but when it gets too wet, as in the west monsoon, or owing to ample irrigation, it easily becomes plastic. Where there was much leaching, the soil-layer is thin, with a great deal of andesite-gravel; in other places, where the material was somewhat washed together, for instance in depressions of the ground, the soil-layer is thicker and more equable. East of the Welang these soils lie in a wide strip south of the line which may be drawn straight to the east from the factory Pengkol. These are almost exclusively Tengger-soils.

Originating from the Ardjoeno are the lighter soils (notorious by the frequent occurrence of root-rot in the cane-variety EK 28) between the road Pasuruan-Kedjajan and the heavy clay more westward. These soils belong for the greater part to the area of the factory Pleret; they are grey to ruddy-grey, are level and consist of a light clay.

The youngest Tengger-formations, consisting of a light, brown soil, cover the type mentioned above in the most southern part of the district. They have been washed down from the slope by the rivers and the rains. These soils are deepest in the southernmost part of the area of the factory Gayam, for instance near Getah (L 11) and locally in the area of the factory Pleret near Kemirahan (J 9) and Wangkal wetan (J 10). Farther east, for instance near Sroewi and Djeladri (O 11) the strip becomes narrower and generally the soil is also less deep. Locally, for instance near Pandan (P 10) and Plososari (R 10), a heavier brown soil is found, which is an older uncovered formation.

The larger rivers have formed the same light type of soil in their lower course, in the case of inundations, e.g. the Redjoso over a fairly large area south-west of Kedawoeng.

In the area of the factory Pandäan and Soekoredjo the brown soils, arisen residuarily from tuff, were covered by lahars of the Welirang; these were so-called cold lahars, streams of mud, arising in the tropics on the slopes of volcanoes after eruptions, during heavy rains, and carrying ashes and stones etc. down from the slopes. They also reached the present-day western parts of the Wonoredjo and Alkmaar-plantations and covered them. These lahars consist of medium-light to medium-heavy soils with many big and small stones. The covering is often very thin, so that in many parts the old layer of "padas" (tuff) is soon struck upon. The extremity of the lahar consists of a strip of light and fine material, practically free from stones, because the big stones had been dropped already with a decrease in the strength of current; the soil-layer is thicker there, e.g. at Djatigoenting and its neighbourhood (F 8) in the area of the factory Wonoredjo and at Pakem (D 11) and Djatisarie (D 12) in the area of the factory Alkmaar.

In all the types mentioned here, is a rather great fluctuation with regard to texture and structure. The nature of the soil is not only determined by its age, but to a large extent likewise by the way of weathering. Whether the latter process took place with much or little moisture, whether the eruption-material weathered residuarily or was shifted by water later on, may, with equal age of the formations, finally produce soils, which are entirely different from an agro-geological point-of-view.

As has been said before, the Redjoso is the river which, in its lower course often inundates the surrounding land and which therefore covers it with silt; other rivers too have similar formations on a smaller scale. Besides, it should be born in mind that the irrigation-water invariably carries silt, so that as a rule a piece of land has a layer of silt on the side where the irrigation-water runs in [1]), and there is no such layer on the side where the water is carried off; it even frequently shows a washing. As the silt is exclusively of a volcanic origin, most soils are improved by it.

b. Physical and chemical composition of the cane-soils.

After what was discussed in the agro-geological survey, little needs to be said about the *physical composition* of the soil. The *texture* of the soil will be explained here and there by means of a few texture-diagrams, when describing the communities. The mechanic analysis was made at the Experimental Station at Pasuruan according to the method of Mohr, which has been included in the codified methods of soil-research in the Dutch East-Indies of 1913 (Archives Sugar Industry Neth. Indies 1913 Vol, 21, p. 1319). [2]) The first to the fifth fraction inclusive (2—0.05 mm.) we may take together under the name of "sand"; the sixth and the seventh fraction (0.05—0.005 mm.) under the name of "silt", the eighth, ninth and tenth fraction (0.005—0.0005 mm.) under the name of "lutum" (Mohr, 1910 and 1915). Coarse soils, in which the sand dominates with respect to the other fractions, hardly occur in the field of investigation; especially the fractions 1—3 appear in very small quantities only. The light and medium-light soils are typified by the dominating of the fifth-eighth fractions, whereas the ninth and tenth fractions stand little in the foreground. In the diagrams of the heavier soils the ninth and tenth fractions take up a more important position. In order to typify the qualities of the soil in a closer manner,

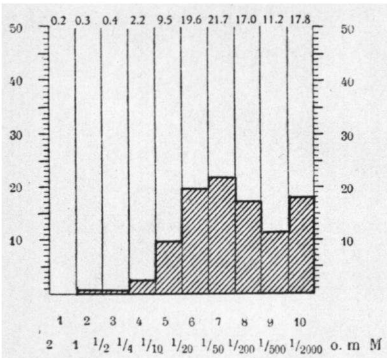
1) In the following pages this place will be called "afflux-side" and its opposition "deflux-side".

2) For a more detailed description of this method I refer to Mohr, 1910. See also Van Harreveld-Lako, 1916.

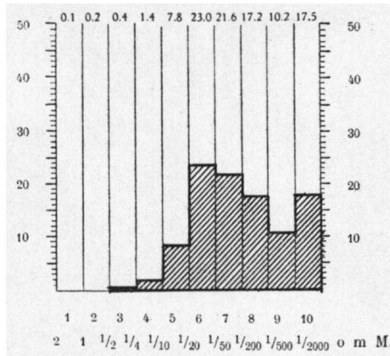
the way of division of the various fractions over the diagram should be looked into, and moreover the nature of the weathering of the particles — of the ninth and tenth fractions in particular — should be known; the texture-diagrams give no information about this way of weathering.

Through a study of the Atterberg figures of a number of soil-samples in connection with the texture-diagrams, Mohr (Mohr, 1915) came to the conclusion that the old central-European idea: the greater the percentage of lutum fraction, the heavier the soil, cannot be applied to Indian soils in several cases. Moreover he points to the fact that one should distinguish between soils which are heavy or light in a dry and in a wet condition. Therefore Mohr speaks of dry-light, wet-light, dry-heavy and wet-heavy, which terms are also occasionally used in this publication. From the investigation of Mohr about the Atterberg figures in connection with the texture-curves it appears that a soil is *wet-heavy*, if the percentage of lutum, the fractions < 0.005 mm., amounts to more than 10 % and becomes heavier as the percentage increases. This holds good only if the lutum fraction is indeed clayey. A high percentage of humus lessens the plasticity. Humus, however, is as a rule very little met with in the Indian soils adapted for agriculture and is especially rare in the plain of Pasuruan. The plasticity is likewise lessened by brown ferric hydroxide, that is to say side by side with the percentage of lutum, other qualities also, determine whether the soil will be more or less heavy.

Let us therefore compare the two texture diagrams given below.



No. 4057
Poekoel (H 8)

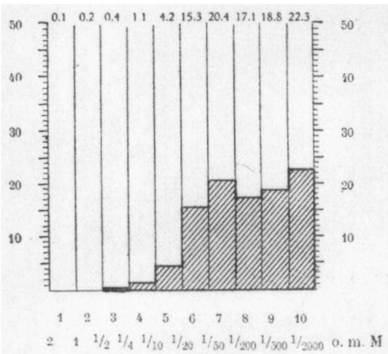


No. 3684
Gratitoenon (P 9)

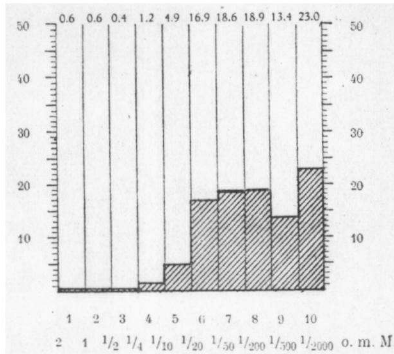
The percentage of lutum of both soils is nearly the same; also with regard to the other fractions, the differences are slight. The soil of Gratitoenon, however, is black, that of Poekoel brown. In this connection the soil of Gratitoenon is very plastic in a wet condition, which quality the soil of Poekoel possesses in a much lesser degree. In other respects too, both soils are very different. On Gratitoenoen the weed-flora forms the Panicum reptans-Gymnopetalum leucostictum — community and in concordance with it, only the stronger cane — varieties succeed. Poekoel is typified by the Panicum reptans-Polanisia viscosa-community and also sensitive cane-varieties, such as E K 28, yield good results here [1]).

A soil is *dry-heavy*, if the sixth to the ninth inclusive fractions form the main constituent and these four fractions are to be found in practically the same measure. The more this is the case, the greater will be the tenacity of the component parts in a dry condition. If the colour turns brown or ruddy, or if the lutum fraction rises for instance over 30 %, the soil becomes less heavy when dry.

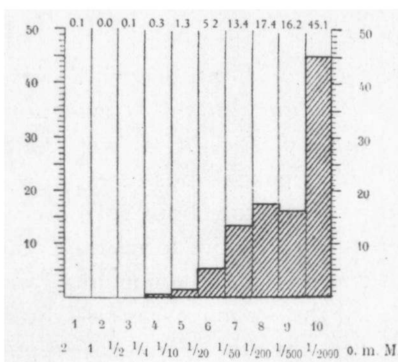
[1]) For the qualities of the cane-varieties see p. 27 and following.



No. 1414 b.
Pekoentjen (L 5)



No. 3718
Sroewi (O 11)



No. 1669
Selorawan (B 1)

Above I have given texture-diagrams of the brownish-black soil of Pekoentjen and of Selorawan and of the reddish-brown soil of Sroewi. In spite of the great similarity in the texture-curve, the soil of Pekoentjen forms hard clods when dry, and is therefore dry-heavy; that of Sroewi on the other hand is far more friable when dry and is therefore dry-light. In a moist condition the former soil is much more plastic than the latter. The soil of

Selorawan with 45 % lutum-fraction is wet-heavy, but it easily falls to pieces, however, after the drying-up process and is accordingly medium-light when dry.

Besides the sandy soils, the laterite soils are also *wet-light*, although the lutum-fraction forms a high percentage of it.

Dry-light are the sandy soils and moreover the soils of which the finest lutum-fraction is above 45 %.

Chemical composition.

The soil of the plain of Pasuruan has arisen from the weathering produce of basic eruptives, especially andesite and basalt, which the volcanoes have erupted in the form of ashes, sand and fine material. Accordingly the chemical composition of these soils is much more uniform than that of the Central-European soils for instance [1]). In other respects too, these soils of the island of Java show typical differences from the European ones. A fundamental difference is the almost complete absence of quartz sand. What is called sand here, consists of mineral fragments, which easily weather and which produce nutriment for the plants. The weathering, which is already quickened by the high temperature and the fairly heavy rainfall, is still more likely to take place here, because the material is basic. As the region is young, speaking geologically, and the rivers convey every year great quantities of silt as a component part of the irrigation-water, it is an explainable fact that in general all nutritive substances for the plant are present in a sufficient quantity. The percentage of the various component parts is sometimes lower than in Europe, without such nutriment appearing as a minimum-factor. The percentage of *potassium* is 0.072 % on an average, dissoluble in muriatic acid and 0.027 % dissoluble in citric acid, but sugar-cane does not yet react

[1]) Marr: Archives, 1912, p.p. 1251—1312 and Archives, 1913, p.p. 1243—1285.

on a manuring with potassium. This is probably owing to the presence of potassium in plagioclase, which may easily be desintegrated; and the silt of the irrigation-water, with which the district of cultivation is watered, provides again and again a new supply of it. Also the amount of phosphate is low; on an average the soils contain only a few tenth parts of percentages of it. It occurs in the soil in the form of apatite, calcium phosphate and iron phosphate. Whereas European soils containing 0.02—0.04 per cent of phosphate, soluble in muriatic acid, are known to be very poor, numerous experiments have proved that as a rule, the soils of the island of Java only strongly react on a manuring of phosphate, if the percentage of P_2O_5 in H Cl lies below 0.026 % and in citric acid below 0.009 %. In the description of the communities a few results of phosphate-determinations have been included. In the plain of Pasuruan the soils poor in phosphate, are chiefly confined to the old-quaternary and red mountain-clay. The remaining nutritive substances do not need to be discussed in detail, all of them occur sufficiently. As was said before, the soils of the island of Java are poor in humus; in the upper 30 cm. of the surface soil the average amounts to 2 per cent only.

C. Biotic factors.

Among the biotic factors, man, from his very nature, takes up the first place with a culture-weed-vegetation. Only in districts which lie fallow for a fairly long time, the grazing cattle plays a part as well.

As the occasion for this study was my daily contact with the cultivation of sugar-cane, I shall point out in the first place what part this cultivation plays in the succession of the crops in the investigated district.

The cultivation of the sugar-cane (Saccharum officinarum) is in the area, discussed by me, a European culture which is carried on on irrigated fields. It is planted at the end of the west monsoon and in the first part of the east monsoon, chiefly from May till August and grows, on an average, during 12—14 months. Only after 3, sometimes 2 years, sugar-cane is planted again on the same field. In the meantime the field is planted with rice; or so-called second-crops (maize, beans etc.) by the natives. This rotation of crops generally takes place as follows:

the first year	April	till the second year June—October: sugar-cane;
,, second ,,	June	,, November: maize, beans etc.;
,, ,, ,,	November	,, the third year April: rice;
,, third ,,	May	,, November: maize, beans etc.;
,, ,, ,,	November	,, the fourth year April: rice;
,, fourth ,,	April: sugar-cane.	

This outline concerns a triennial rotation of crops; with a so-called bi-annual rotation there is one rice and second-crop harvest less. With a triennial rotation, every year, a different third part of the soils of a native village is used for cultivation.

The so-called "varieties" of the sugar-cane, are vegetatively propagated individuals and should therefore be looked upon as clones. The names under which these are known, such as D I 52, E K 28 etc. are abbreviations and are mostly derived from the plantation where they were first grown or from the person who hybridized them. Through practical experience and numerous experiments on the field we know on which soils and with what percentages of water the different varieties succeed best.

E K 28 is the most productive variety, but the best lands are required for it, that is to say sufficiently pervious soils, with good drainage, a deep surface soil, a low level of ground-water and a constant degree of moisture. On soils where an excess of water causes consolidating or a scarcity of oxygen, or, where moisture-content of the soil changes quickly, the variety is out of place. Especially a too high level of ground-water makes cultivation impossible. Its root-system is very sensitive and easily shows symptoms of dying-off on similar soils; a disease known under the name of "root-rot" arises then.

D I 52 and S W 3 are varieties unsuitable for really heavy soils. Especially D I 52 constantly wants moisture; so it can be grown on good soils which are too moist for E K 28. S W 3 succeeds on most E K 28-soils, but it is less sensitive to changes in moisture and is satisfied with somewhat poorer soils. On heavy, drying up, clay soils D I 52 and S W 3 quickly decline at the setting-in of the east monsoon and frequently die off even in the beginning of the year of harvesting.

The *P O J-varieties* (P O J = Experimental station East-Java) have a strong root-system, can resist less favourable conditions and can therefore be planted on the worst soils, that is to say heavy clay, on too wet areas and on soils which dry up very soon.

For the cultivation of sugar-cane, the soil is deeply tilled and it gets an opportunity to dry up thoroughly. The cane is planted in trenches which are dug from 25 to 35 cm. deep as the circumstances may be and which are $3^1/_2$ to 4 feet from centre to centre and about 50 cm. wide. The plant is irrigated regularly and by means of a deep drainage, the superfluous water is carried off. In the trenches near the plant sulphuric ammonia is administered as manure; on a few areas a manure of phosphate should be added as well. When the crop develops, it is earthed up, that is to say the earth which has first been dug up and has dried up well, is in the meantime heaped against the plants, so that the original trenches form low ridges. At the time of harvesting, the cane is mostly cut off under the surface; after the dry leaves etc. have been removed or burned, the native plants his crops again.

We now pass on to discuss the native cultures.

In the plain of Pasuruan, in the west monsoon, 60 % of the agriculture soils is used for growing rice, which is exclusively done by the natives. Only 3 % of the sawahs is planted with sugar-cane, so rice is by far the most important culture.

The tillage of the sawahs causes the entire destruction of the earlier flora. Through the wet ploughing the soil is changed into a miry pool and after planting the young rice, the sawah is watered so much, that the ground is *not to be seen anymore*. The nature of the weeds growing among the young rice, is to a large extent independent from the quality of the soil. The very moist substratum, poor in oxygen in which they grow, is the limiting factor for their vitality. In the first month after planting, weeding takes place, which is generally left off afterwards. Owing to the fact that they sow on nursing-beds in the island of Java and then transplant the young rice-plants on the sawah, the crop has an advantage over the weed from the beginning. As the rice grows a great part of the sawah-weeds — those wanting more light — dies off. Only where the crop is in a poor condition and where there are open spaces, a few heliophilous weeds can maintain themselves, such as Monochoria vaginalis, the Jussieua- and Ludwigia-species, Limnocharis flava, Hydrolea zeylanica etc. These are plants which in their shoots and root-system, are adapted to meet the scarcity of oxygen in this substratum (development of aerenchyma or airchannels, respiratory-roots), but which are only met with along the sides of a densely grown rice-field. Only a few plants grow quicker than the rice itself, for instance Panicum Crus Galli L. — a grass just rising above the rice with its dark-brown plumes and which therefore succeeds in growing on. The flora maintaining itself among the rice and needing less light, has still fairly important fluctuations in its composition. An investigation of non-weeded sawahs led to the preliminary conclusion that, under equal conditions of the soil and with irrigations from the same system, the height of the water-level above the ground, and the changes in the quantity of water (the sawah is often occasionally drained in between), are the principal causes of the differences of composition.

If a sawah-flora on very heavy, old-quaternary clay, is compared with one on the light Tengger-soil. the extremes in the condition of soil appear to cause indeed some difference in the composition of the weed-vegetation; the conformity in the composition, however. predominates in a high degree. We cannot enter into a closer discussion of the sawah-flora, however important it might be. The aim of this publication is, to typify the soil, by means of the weed-vegetation and the sawah-flora is of no use for this.

When the rice is reaped after 4-6 months (a short time before, the land is drained) the field is practically free from weeds, except along the borders. Soon, however, a new flora arises. A few communities, which will be described later on, are very characteristic, but these too depend comparatively slightly on the nature of the soils. The soil has consolidated owing to the fact that it lay under water for such a long time, it is very poor in oxygen and also for the weeds growing immediately after the reaping of the rice, these conditions are limiting factors. If, in the coming east monsoon the vacant field is to be planted with cane requiring a very good soil, a very intensive tillage will be necessary. Whether the field is ploughed or furrowed, the weed-growth will always be entirely destroyed. After this tillage the soil gets time enough to dry up, the crumb-like structure returns and the cane may be planted. A cane-plantation is useless for research with regard to the value of the flora as an indicator of the soil.

The plantation is constantly weeded, in the trenches as well as between them and if necessary the cane is watered, in so far as the available water makes this possible. It is these inconstant factors which partly determine the composition of the weed-vegetation which may still be found there. The growth on the paths in the plantation is only often typical at a later time, when the typical composition and other qualities of the weed-communities are sufficiently known. If the cane of a fully grown plantation is reaped after 12 to 14 months, the field remains free from weeds, with an exception of the paths and the borders. On moist fields only some climbers grow, climbing high round the older cane, chiefly Convolvulaceae. If the reaping has taken place at a later time, for instance in September or October, the field is often not tilled until rice is planted on it again in the west monsoon.

In the course of these 3 to 4 months — al least if the soil is moist enough — all kinds of weed-communities develop, which are only disturbed by man with the tilling of the sawah. Such well-developed weed-communities, arisen after the reaping of the cane, are met with in an excellent condition in the northern part of the plain of Pasuruan, where the level of the ground-water is generally high. If the cane is removed at an earlier date, for instance in the months of May-July, the soil is mostly used for some native culture. But I shall return to this subject later on. At the end of December, as a rule, the rice is on the field again. After reaping it, in March-May, in well irrigated districts, rice is planted again, the east monsoon-rice, but in most cases other native cultures, taken together under the name of "second crops" (polowidjo) get their turn.

A few general remarks on these second crops may follow. As a rule the natives do not take much trouble with the tillage of the soil; with a crop resistant to unfavourable soil conditions, such as Glycine Max. (= Gl. Soja) tillage is entirely neglected. In this respect little difference is to be seen; ploughing once or twice with the primitive Javanese plough will do, according to his idea. Manuring is but seldom done; only in a few dessas several cultures are an exception to this rule; to be quite safe, these dessas were excluded from the study of the flora. With regard to the method of planting, the number of times of weeding and watering, the time of earthing up etc., little may be said which holds good in general. A number of dessas lying near each other, often follow the same rule. The method of cultivating also depends on the crop, although in a lesser degree than in Europe. If the data which De Bie in his work: "The Agriculture of the Natives in the island of Java" and Heyne in his book "The Useful Plants of the Dutch East Indies", give about this, are tested by practice, we see that in East-Java these data are generally unlike the real state of affairs. Evidently in West-Java from whence those data have been taken to a large extent, the native second-crop-cultivation is carried on more intensively than in East-Java. In all cases where my description of the methods of cultivation differs from the one stated by both authors mentioned above, it is based on my own observations. When discussing the native plantation on the dry soils (tegallans), it will appear that still less care is taken there. As has been said already, the tillage of the soil after the reaping of the sawah is fairly shallow; after reaping the cane, the field is often not ploughed at all, but the remnants of cane-stalks are simply taken out. Sometimes the tillage is so bad that a part of the previous weed-flora of the borders and paths remains. In the young plantation a mixed community develops, which can sometimes hardly be recognized as such later on. This is one of the causes of the chaotic mixture which a weed-flora seems to show on the initial study of it. Weeding takes place once mostly, when the growth is still young (Vigna sinensis, Phaseolus radiatus), sometimes twice (Arachis hypogaea, Zea Mays), in a few cases there is no weeding at all, which is practically the rule with Glycine Max. A few crops, such as tobacco, Capsicum-varieties and onions, are constantly weeded and are therefore useless for a study of weeds. In some districts the population looks better after his fields and goes on weeding till the plantation shows no open spaces or has grown so high that hardly any weed develops (the neighbourhood of Bajeman, a few dessas in the district of Ngempit etc.); here too a study of the weeds is impossible. In a few districts, especially where there is little water for irrigation-purposes, they often plough between the rows, especially with Zea Mays. So, rules holding good, about the number of times of weeding, even of one kind of crop, cannot be given. Whether a field has a well-developed undisturbed weed-community, suitable for a study of its composition, must therefore appear from the whole aspect and cannot be assumed beforehand. When at first I was insufficiently acquainted with the weed-communities, it was those differences in the working-methods of the population which gave most trouble in the investigation. In the number of times of watering too, there are rather great varieties. The watering is influenced both by the available quantity and by the nature of the crop. Zea Mays requires far less water for its growth than Arachis hypogaea; Glycine Max wants more than Dolichos Lablab. In general it may be said that the second crops require little water, not nearly so much as the sugar-cane. The native irrigates the plantation 2—5 times and this seems to be sufficient evidently.

The given quantity is in most cases also sufficient for a strong growth of weed, so that on well-irrigated fields, the water is not a minimum factor, at least at first. Besides on fields with a normal level of subsoil-water, the greatest quantity of water given, is never so much above the normal condition, that changes in the weed-vegetation appear. If plants occur pointing to great moisture, the presence of this always seems to be connected with a higher level of subsoil-water or a lower situation of the field, and not with an accidentally more profuse irrigation; the native never gives so much water.

For the study of well-developed communities only those fields were used where the crop had not grown so high or had not formed such a dense covering that the weeds were deprived of a sufficient quantity of light and space. As to the extent of deprivation of light and covering of the soil, the culture-crops are very different mutually. A two month-old plantation of Arachis hypogaea takes far less light from the weed than a culture of Zea Mays of the same age, whereas the covering of the soil with the first plantation is often more extensive. Whether the culture-crop occurs competitively and accordingly influences the composition of the weed-vegetation, can only be ascertained by looking at the field itself. Infallible rules cannot be given for this either. Not only is it influenced by the distance of the planting-rows, but also by the age and the degree of development of the plant connected with it; in general it may be said that at the age of one or two months the culture plants have no disturbing effect on the floristic composition of the weed-community. A good insight into this question is obtained by a comparison of the flora on non-planted fields, with planted fields lying in between and for the rest being under the same conditions. It appears that in the beginning, only the *amount* of weed is less on the planted fields, but the floristic composition of planted and non-planted plots is the same. As the culture-crop grows the *proportion* in the number of the various weeds changes first of all, because those plants wanting more space decrease in number with respect to the smaller ones, such as for instance the grasses, which increase in number for a considerable time after. Later on the growing culture-crop has a *selective* effect, a number of weeds wanting more light die off and the others gain the upper hand. Related weed-communities,—the floristic differences of which, are due to differences of soil, — approach each other ever more in composition in this stage. Finally, with tall-growing crops, such as cassave and maize, the crop deprives so much light that practically all weeds die off and after reaping the soil is nearly free from weed. From this it follows that of the fields planted with second crops in the east monsoon, only a small part is suitable for a comparative study of the weed-communities.

Above I have spoken about the unequal selective effect which crops equally old, but different, exercise on the weed-vegetation; as a result of this difference in growth and way of growing and the greater or smaller detraction of light resulting from it. This has nothing to do with the well-known fact, that, at least in Europe, certain weeds are always found along with certain culture-crops. Linkola (1916) mentions weeds, which are almost exclusively tied to autumn-rye, others to the cultivation of oats or vetch, others again growing especially in potato-fields. Among the Dutch weeds too we have examples of this. I never came across such relations on my second-crop-fields. With for the rest equal proportions of moisture and soil, the weed-flora of a young maize-field, of an Arachis hypogaea-field or of a Phaseolus lunatus-plantation are quite the same.

Let us now continue the discussion about the succession of the cultures in the course of the year.

After the first second-crop-harvest has been gathered in, another second crop is often planted before the west monsoon-rice, if time allows. Of these fields too a part is unsuitable for the study of weeds, that is to say those fields which were badly ploughed before the new planting and which, accordingly, partly kept their old weed-flora. Later on the new growth of plants mingles itself with this old flora.

After this possible second polowidjo-harvest, the planting of rice gets its turn again, next polowidjo once more, till with an intervening space of about three years (sometimes two), the field is planted again with sugar-cane.

The tegallans (the fields, which cannot be irrigated) lie chiefly at the foot of the Tengger. They are planted with native crops, that is to say at the beginning of the west monsoon and towards the time that the rains are to stop. Only a very small part of these fields are suited to the study of the weed-communities of the west monsoon. In the first place the culture-crop grows so quickly in the wet season, that soon a shading appears, and after a short time, only those plantations will be found which are too old for the study of weeds; and besides, the tilling of the soil of the tegallans is generally so insufficient that a destruction of a possible preceding vegetation, is entirely out of the question. On the fields which are planted at the end of the rainy season, a kind of dry-farming system is applied, that is to say, during the east monsoon the soil between the rows of plants is spaded several times and then the weeds are removed also. Only the tegallans, which are fallow for some time — often for a year — are very suitable for the study of successions of the vegetation, even though this study is limited to the flora of light soils, owing to the nature of these tegallans.

After this general discussion a short summary of a few of the principal native second-crops in the plain of Pasuruan will be sufficient. The most usual native names are given in brackets.

Zea Mays L. (djagoeng) is grown on light as well as on heavy soils, it is also the chief crop on the tegallans. The maize is planted in rows at a distance of 2—3 feet from each other. It is sometimes weeded twice, the first time when it is about 3—4 weeks old, and then once more 6 weeks after planting. Weeding once often suffices, when the crop is 4 or 6 weeks old; it is generally earthed up at the same time. After about 3 months the maize is reaped.

Arachis hypogaea L. (katjang tjina) is generally planted on medium light to medium heavy soils, requires a fair quantity of water before the flowering, especially in the second half of the period of growing, but wants little water after the flowering. On too heavy soils it does not set much fruit. Katjang tjina is planted throughout the east monsoon, often too on fields after the sugar-cane has been reaped. On tegallans it is only planted towards the end of the west monsoon, often together with maize, just as is done on irrigated fields. It is generally planted in rows, 3 feet from each other, with a planting-width in the row of about 2 feet. The katjang tjina is mostly weeded once at the age of about 6 weeks and it is then sometimes earthed up at the same time. In about 4 months it is reaped.

Glycine Max Merr. (= Gl. Soja Bth) (katjang kedele) is a much grown, very resistant second-crop. The soil is hardly tilled. The rice-stubbles are often not removed and sprout again between the crop, while also a great part of after-sawah weeds grow on luxuriously. For this reason a „kedele" field is in most cases of no use for the study of the weed-communities. After the fourth month the crop may be reaped.

Vigna sinensis Endl. (katjang pandjang) is likewise a crop not requiring a good soil and which is therefore grown on all kinds of soils. The soil is frequently only spaded for planting or it is not tilled at all. It occurs in a great number of varieties, climbing as well as creeping ones, and is grown both on irrigable and on dry soils, in the latter case generally towards the end of the west monsoon. For the same reason, which was given for Glycine Max, fields with Vigna sinensis are mostly unsuitable for a study of weeds; moreover the large leaf soon covers the ground.

Phaseolus radiatus L. (katjang idjo) is also grown in some varieties and on all kinds of soils. It is also frequently seen on tegallans, where it is generally planted towards the end of the wet season. Some varieties rise to a height of half a meter; proper care is taken to the tillage of the soil.

Phaseolus lunatus L. (kratog), a climbing herb often grown on tegallans.

Dolichos Lablab L. (katjang kara) likewise a climbing herb, is more frequently grown than the varieties mentioned above and generally on tegallans towards the end of the rainy season.

Manihot utilissima Pohl. (ketella pohon, kaspé), a crop rising to a great height, which is exclusively grown on tegallans in the plain of Pasuruan, often towards the end of the wet season. It is often planted at a distance of 3 to 4 feet in rows, which are 4 feet from each other. In 3 to 4 weeks when the first foliage appears, it is weeded, which is repeated when the crop is two months old. On dry soils they mostly plough between the rows when the plantation develops. In 8—12 months the crop is generally reaped.

Also cultivated are: tobacco, onions, Capsicum annuum (lombok), Cucumis sativus and Cucumis melo, Citrullus vulgaris, Cajanus cajan, Sesbania grandiflora, Psophocarpus tetragonolobus, Dioscorea-varieties, Ipomoea Batatas etc. I am not going to discuss the methods of cultivation of these crops, as they are of minor importance for this research.

III. GENERAL REMARKS ABOUT THE CONNECTION BETWEEN FLORA AND SOIL. METHODICS.

A superficial study already teaches us that the distribution of weeds is not accidental, but is, among other things, connected with certain conditions for growing. For instance Sphaeranthus indicus, Pentapetes phoenicea, Melochia corchorifolia and Athroisma laciniatum are practically limited to heavy clay-soils, whereas Amarantus spinosus, Ageratum conyzoidus and Portulaca oleracea prefer fairly light soils. Dactyloctenium aegyptium, Tridax procumbens and Eragrostis amabilis are met with on the driest soils in the east monsoon; Marsilia crenata, Dentella repens and Monochoria vaginalis on the other hand are found on very moist areas.

On closer study it appears that the ecological amplitude of the separate species is too wide for a satisfactory typification of the properties of a soil. Polanisia Chelidonii thrives both on the heaviest, black, old-quaternary clay and on the medium-heavy, grey soils north of the road Waroengdowo to the factory Gayam. Polanisia viscosa does equally well on the light Tengger-soils where the cane-variety E K 28 always gives high products, and on the fairly light soils, in the district of Ngempit, where that variety is always affected by root-rot. Finally on the brownish-grey soils immediately north of the factory Pengkol, Polanisia Chelidonii and Polanisia viscosa occur side by side; elsewhere analogous cases are likewise met with.

With a superficial study of many weeds, one gets the impression that they grow nearly everywhere, even though they differ in number. The weed-communities, as they have been defined by me below, appear to have a much smaller ecological amplitude. Shantz (1911, p. 15) rightly says: "The entire vegetation, or plant cover as a whole, is a more reliable indicator of conditions than the presence or the condition of any single species". On crossing the field of research in all directions, certain combinations of plants appear to occur again and again. *Combinations having about the same floristic constitution and giving nearly a similar impression, we call "weed-communities"* or "communities" for the sake of brevity. If the influence of human cultivation is looked upon as a biotic factor, as has been done here, these communities are units given to us by *nature,* in other words, weed-communities, as defined above, are not *composed* by the investigator, but *recognized* as such after due practice.

Not every combination of plants forms a community especially not in a cultivated district. Remains of a vegetation partly destroyed and combinations formed incompletely, are not comprised in the definition. Some communities are easy to distinguish, others, forming a small minority, are not so sharply delimited. For our research the community-idea has been taken in a fairly wide sense. I emphasize, however, that the demarcation of the communities was *exclusively* based on their floristic constitution and general physiognomy. A change in the ecological conditions did not influence the *distinction* between the communities. The vegetation itself is the only primary datum; the ecological conditions under which the communities occur, are secondary data, which are only determined later on. As a *result* of the investigation it may appear that a certain complex of ecological factors are correlatively connected with a certain community. After a community had been recognized and had been studied on parts of the plain of Pasuruan lying as far apart as possible, I tried to set down what plants contributed to the comparative similarity in floristic constitution and in what degree they did so [1]).

[1]) In this connection I especially refer to the work of Du Rietz, Fries, Osvald and Tengwall (1920), in which the bases were laid for an inductive method for the study of communities, which is also followed in principle in this essay.

The inspections were chiefly made in the east monsoon on irrigated fields, where the crop was so young or so open that it hardly influenced the development of the weed. Where a community had developed optimally, all plants met with in any square of 10 by 10 M., arbitrary put out, were noted. If no portion of land of that size, florally developed in a similar way occurred, smaller pieces of land lying in each other's immediate vicinity, were combined till the total area amounted to 100 M^2.

Experience taught me that an area of 10 by 10 M. was wide enough for a complete formation of the cummunities. It appeared later on, that, with regard to a few communities, (not nearly all) a smaller square would have sufficed. A Polanisia viscosa-community gives already the same result with 5 by 5 M. I did not make use of the working-method introduced by the sociological school at Upsala in the study of natural communities to fix a minimum-area. This fixing requires a study in itself, which may be important from a theoretical stand-point, but which is not necessary for my purposes. Only if the square is smaller than the minimum-area, an incomplete insight into the floristic composition of the community is obtained; with a square of 100 M^2., this is certainly not the case. It is a fact that for the majority of communities the minimum-area is much larger than 4 M^2., which was the maximum square in the Scandinavian researches of a natural flora. The small covering capacity of the studied vegetation is probably connected with this. An accurate floral inspection of an area of 100 M^2., appears to be practically impossible to most investigators of a natural flora.;This drawback asserted itself only in a less degree in my case, owing to the different nature of the vegetation. Half an hour or three quarters was sufficient time to investigate a square of 100 M^2. in a one month-old vegetation, so closely that a repetition on the next day gave the same list of species.

The principle was adopted that a definite square was only once investigated for determining the composition of the weed-flora. The places where a community was studied, were as widely apart as possible, or were at least always separated by other communities. In this way a good insight into the fluctuation of the floristic composition of the community, over the entire field of study, may be obtained with a comparatively small number of squares.

The plants, which, on listing the inspections of the community, appeared to occur in 81 % to 100 % of all squares, are called by me "constants".[1]) The plants occurring in the middle classes are called "accessory species", the rest are the "casual species". At each inspection, the nature of the soil, the proportions of moisture, and the crop with which the square was planted, were noted down. By doing so, an insight into the ecological amplitude of the community was obtained while listing these inspections.

At the same time, while investigating a square, one of the figures 1—5 was put in brackets behind the names of the plants, to give an idea of the number of individuals of each species. These figures[2]) have the following meaning:

5 abundant,
4 fairly abundant,
3 frequent,
2 fairly frequent,
1 occasional.

1) The class 81 % to 90 %, which, unlike the Scandinavians, I still grouped among the constants, is always hardly developed and is in most cases entirely absent, It may probably be explained by the fact that with the inspection a species occurring very sporadically, was overlooked, which is not impossible owing to the size of the square; an exception is Cynodon Dactylon with a frequency of 90 % in the Panicum reptans-Gymnopetalum leucostictum-community (see p. 63).

2) I often made use of the figures 2—3, 3—4 etc,, substituted in the tables by $2^1/_2$, $3^1/_2$ etc, to indicate the abundancies lying in between.

Plants with an abundancy lower than 1 were not marked and were indicated in the tables with the figure ×. Although a similar notation is used by the majority of sociological investigators (see for instance Rübel, 1922, p.p. 196 and following), I was all the time aware of their subjectivity. Fairly abundant and frequent, abundant and excessivement abundant, socialis and copiosus, in Unzahl and in Menge, are all favourite expressions which have only a relative meaning. Apart from gravimetric and counting methods, (which require, in my opinion, much more labour and give only seemingly a greater accuracy), the "Deckungsgrad"-method (Deckungsgrad = degree of covering capacity) seems to me one of the most objective methods (see e.g. Du Rietz, 1921, p.p. 224 and following). I could not make use of this method, because in the first place trees and shrubs are totally absent in my weed-squares, and big herbs are rare, so that the degree of covering capacity of the studied plants is very slight, some creeping ones excepted. In most cases, the degree of covering capacity 1 would be found in my squares, even though the number of specimens of the species would differ strongly. This method would therefore insufficiently typify the vegetation to be discussed here. Another great drawback is the size of the square, which is partly covered with a culture-crop besides. Du Rietz thinks an estimation already very difficult with squares of 4 M^2. (Du Rietz, 1921, p. 225). With a square of 100 M^2. the method cannot be applied in practice.

In the description of a community with a sufficient number of inspections the constitution-diagram was added. With this method which I adopted from the Upsala-school (see Du Rietz c.s., 1920), the number of species is represented graphically in every class of constancy.

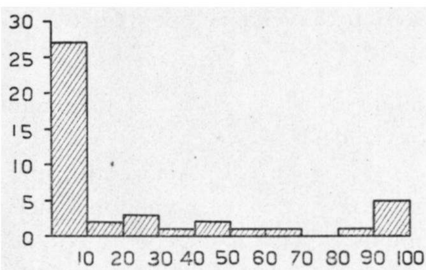
In conclusion I will add some words about the nomenclature of my communities. In the nomenclature of the stationary associations it is customary to give the name of the dominating species (plural or singular). If the number of these species amounts to one or two, such a name may be comparatively short (see for instance Osvald, 1923). This is mostly not the case, however, in the pioneer-communities to be discussed here. Often 3 or 4 constants have nearly an equal average abundancy, so that according to the usual way of nomenclature, the name would be very long. For this reason, I chose the name after one or more striking plants, often to emphasize the connection with other communities, although the selected constants were not always of the highest abundancy. It is possible that this name will not be thought logical by everybody, but, in my opinion, this question is of minor importance; it is the diagnosis and not the name which should typify a community.

The general methodics, followed here, have now sufficiently been explained. With special researches in later chapters, the methodics applied there will be made clear.

IV. WEED-COMMUNITIES ON FALLOW RICE-FIELDS (SAWAHS) AFTER REAPING WEST MONSOON- OR EAST MONSOON-RICE.

In the discussion of the native cultures, I have explained the conditions of the sawah-weeds between the growing rice. While the plants are young and a sufficient quantity of light can penetrate, only those weeds arise which are adapted to the substratum poor in oxygen. The poverty of the soil in oxygen is the chief factor for these plants and the influence of the quality of the soil is only apparent, if the extreme (very heavy and very light) soils are compared. As was said before, weeds disappear when the rice develops, owing to lack of light and therefore, after reaping the crop, the field is almost free from weeds. On these fallow fields new communities soon arise again, of which I will describe a few typical ones.

One of the most striking surely is the Eragrostis japonica-community. Still strongly influenced by the poverty in oxygen of the sawah-soil, this community has a wide ecological amplitude and is therefore rather indifferent as regards the quality of the soil, provided that the preceding sawah was fairly deeply under water all the time. In Table I 12 inspections of this community will be found. From this it will appear that Ammania baccifera (2), Ammania octandra ($^1/_2$), Bergia oryzetorum ($2^1/_2$), Eragrostis japonica ($4^1/_2$), Fimbristylis miliacea ($3^1/_2$) and Sphaeranthus indicus (3) are the constants. [1])



Constitution-diagram of the Eragrostis japonica-community.

The Eragrostis japonica-community thrives both on old-quaternary clay with or without calcium-carbonate (inspection Nos. 1, 3 and 10), on heavy, red mountain-clay (inspection No. 2) and on the medium-light soils (inspection 4, 5, 6, 7, 8, 9, 11). On very light Tengger-soils, transported by water, as for instance in a part of the areas named J 9, J 10, K 10, L 9 etc. it is never found. After the water has been carried off, these soils take in oxygen so quickly

[1]) Here and in future the average abundancy of each species has been placed in brackets behind the name. It was only calculated for the constants, and an abundancy smaller than 1 was indicated as 0.

again, that other communities wanting more oxygen, can develop immediately after the harvest. For the investigation of these communities a few experimental squares of 15 by 15 M. were laid out on Wangkal wetan (K 11), Kemirahan (K 10), Ngawoedjasem (K 10), Kepoeh (I 11) etc. These squares remained fallow, but for the rest they were treated as rice-fields. That is to say, they lay under water either constantly or with certain intervals. The weeds, developed during the condition under water, were regularly removed. After the square at Wangkal wetan had been deeply under water all the time from the end of December 1923 till the 20th of May following, the water was carried away. On the 1st of August succeeding, the community (I) mentioned below appeared to have developed on a surface of rather more than 80 M^2.

Community I		Community II	
Ageratum conyzoides	x		
		Amarantus spinosus	$2^1/_2$
Cynodon Dactylon	4	Cynodon Dactylon	5
Cyperus rotundus	1	Cyperus rotundus	4
Digitaria sanguinalis	3	Digitaria sanguinalis	2
Eleusine indica	3	Eleusine indica	x
Eragrostis ambilis	3		
„ japonica	1		
Euphorbia hirta	1	Euphorbia hirta	x
Phyllanthus Niruri	1	Phyllanthus Niruri	2
Physalis angulata	x		
„ minima	x		
		Polanisia viscosa	3
Polytrias amaura	5		
		Portulaca oleracea	$2^1/_2$
Vernonia chinensis	x		

When it had been dry for rather more than a month (the end of June), on the one half of this square community I was removed, by ploughing the soil very shallowly. This community was partly destroyed by pulling out the plants one by one. It proved that on these light soils the ploughing did not alter the conditions in such a way, that the weed-vegetation arising after the tillage was influenced. There was no difference in physiognomy between the ploughed part and the plot where the plants were only pulled out.

Community I has nothing to do with the Eragrostis japonica-community; only Eragrostis japonica occurring with an abundancy 1 reminds one of it. It is a succession-form of the Polanisia viscosa-community to be dealt with later on. This succession develops here immediately, which is connected with the less favourable circulation of oxygen as a result of the preceding sawah-condition. After rather more than a month the condition of the soil had, however, become normal again, as the development of community II proves on the part where community I had been destroyed. Community II is indeed the normal Polanisia viscosa-community, which, on this soil-type in the east monsoon, is always found on fields where no cultivation of rice preceded, or where the soil was immediately ploughed after harvesting and had an opportunity to dry up.

To check this, several similar squares were laid out in this district, and all gave the same results under equal conditions. So, the fact that in August 1924 the communities I and II occurred side by side in the square, was not a result of a *difference in ecological conditions prevailing there*, in other words of a different "habitat", but exclusively the result of the dissimilar conditions under which these communities formed themselves at the *beginning*. Here there is an opportunity to direct attention to the general rule: if at a certain point of time no connection is to be seen between the conditions prevailing on the spot at that time and the flora, this is by no means a proof that the vegetation *is not determined ecologically*. All the factors which were active at the time of, and after the *arising* of the community, should be taken into account.

Not on all soils where in normal conditions the Polanisia viscosa-community appears, the weed-flora is after the rice-harvest a succession-form of this community. On many soils of a *quality somewhat inferior to* the Wangkal-type, but still situated within the ecological amplitude of the Polanisia viscosa-community, the Eragrostis japonica-community even develops, provided the previous sawah has always been deeply under water. The inspections 6 and 7 in Table I are examples of it. With soils on the boundary of the ecological amplitude of the Polanisia viscosa-community, differences occur already in the succession-form which for Wangkal wetan was discussed above, if the rice-field has been under water for a comparatively short time. This will be evident from the discussion of some experimental squares.

The square Ngawoedjasem A (J 9) has a ligt soil which cracks a little during its drying process, becomes somewhat plastic in a moist condition and is known to be less suited for the cultivation of cane than the soil of the square Wangkal wetan. The square was under water from the middle of January till early May 1924. During that time it was, however, drained at intervals, that is to say about 16 days in February, a fortnight in March and during the former half of April. After the beginning of May, when the water had been definitely carried away from the square, the subsoil remained very moist for a long time, so that on August 1 1924 at a depth of 13 cM. the degree of moisture amounted to 44 %. In the table below an inspection will be found on August 1 1924 of community I, developed after the drainage of early May; and of community II, which developed, after community I had been destroyed on the one half of the square in early July.

Community I		Community II	
Ageratum conyzoides	1		
		Amarantus spinosus	$3^1/_2$
Cynodon Dactylon	$4^1/_2$	Cynodon Dactylon	4
Cyperus Iria	x		
„ rotundus	x	Cyperus rotundus	3
Digitaria sanguinalis	2	Digitaria sanguinalis	2
Eclipta alba	x	Eclipta alba	x
Eleusine indica	3	Eleusine indica	x
Eragrostis amabilis	$2^1/_2$		
		Eragrostis pilosa	x
Euphorbia hirta	2	Euphorbia hirta	x
Ilysanthes veronicifolia	x		
Leptochloa chinensis	x		
Merremia emarginata	$2^1/_2$		
Oldenlandia diffusa	1		
Phyllanthus Niruri	1	Phyllanthus Niruri	1
		Physalis minima	$1^1/_2$
Polytrias amaura	$4^1/_2$		
		Polanisia viscosa	3
		Portulaca oleracea	4
Tridax procumbens	x		
Vernonia chinensis	x		

II is again the common Polanisia viscosa-community as it was found on Wangkal wetan (see pag. 46) I differs in one respect from the succession-form occurring there, viz. through the presence of Merremia emarginata ($2^1/_2$), a species which is never met with in the successions of the Polanisia viscosa-community. The plant is only found in those communities and their successions which grow on soils of an inferior quality.

Square Ngawoedjasem B was situated 4 M. north of square A, dealt with above, and lay constantly fairly deeply under water from the middle of January till the beginning of May. When the field became dry, the soil cracked much deeper than on square A. After draining the water in earlv May 1924, the following community arose. [1])

Cynodon Dactylon	3
Cyperus rotundus	2
Dentella repens	2
Eclipta alba	x
Eragrostis japonica	1½
Euphorbia hirta	1
„ reniformis	1
Merremia emarginata	2
„ gemella	1½
Moschosma polystachyum	2
Panicum colonum	1
„ reptans	1
Phyllanthus Niruri	x
„ Urinaria	x
Polytrias amaura	2
Sphaeranthus africanus	2
„ indicus	x

This vegetation forms the Moschosma polystachyum-Sphaeranthus africanus-community (see table X). In the east monsoon on second-crop-fields this community is never found on such light soils. Then it is exclusively met with on easily consolidating, medium-heavy to fairly heavy soils, which get very dry superficially and which are very moist deeper down. It is evident that the long sub-aquatic condition of the square give rise to such circumstances as were met with on the latter soils. Just as in square A, half of the vegetation was destroyed here in early July.

[1]) On a small portion of the southern corner of the square, lying higher than the rest and which had accordingly often been dry, the succession of the Polanisia viscosa-community, mentioned before, arose; this part is left out of consideration here.

On this half not one single kind of vegetation arose, but a mosaic of two communities; intermingled, but sharply delimited, plots of the normal Polanisia viscosa-community and of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community arose, which is generally typical of less good soils. This mosaic formation also occurs elsewhere, likewise if no sawah preceded; later on this phenomenon will be discussed more in detail.

The communities appearing after the sawah, show clearly that the sub-aquatic condition of the lands has more influence on soils of the Ngawoedjasem-type than on those of the Wangkal wetan-type.

As a third example I mention the squares A and B of Kemirahan at a mutual distance of 8 M. Kemirahan lies about 1 K.M. west of Ngawoedjasem. The quality of the soil is far inferior to that of the latter place. On the second-crop-fields the Polanisia viscosa-community never develops here in the height of the east monsoon, but another, typical of less good light soils, viz. the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community (see table VI). Kemirahan square A was laid under water quite as long, and with the same intervals of dry periods as Ngawoedjasem square A and for the rest treated in the same way.

On August 1 the vegetation was as follows:

Community I.		Community II.	
Ageratum conyzoides. . . .	2		
		Amarantus spinosus	x
Cynodon Dactylon.	4	Cynodon Dactylon.	4
Cyperus rotundus	1	Cyperus rotundus	3
Dentella repens	2		
		Digitaria sanguinalis	x
Eclipta alba	1		
Eragrostis japonica	3		

Euphorbia hirta	1	Euphorbia hirta	x
„ reniformis	x	„ reniformis	1
Fimbristylis miliacea	1		
		Gymnopetalum leucostictum	x
Heliotropium indicum	x	Heliotropium indicum	x
		Ipomoea triloba	1
Merremia emarginata	2		
Moschosma polystachyum	$2^1/_2$		
Oldenlandia diffusa	1		
Panicum colonum	2	Panicum colonum	$2^1/_2$
„ reptans	1	„ reptans	$3^1/_2$
Phyllanthus Niruri	1	Phyllanthus Niruri	2
„ Urinaria	x		
		Polanisia viscosa	$2^1/_2$
Polytrias amaura	1	Polytrias amaura	1
		Portulaca oleracea	3
Sphaeranthus africanus	2		
„ indicus	1		

Community I is the Moschosma polystachyum-Sphaeranthus africanus-community, which developed on Ngawoedjasem in square B, the square therefore which lay *constantly* under water.

Community II is the Panicum reptans- Polanisia viscosa- Portulaca oleracea-community, developed after community I had been destroyed in early July. As was said above, this community also arises in this district on irrigated second crop-fields in the east monsoon.

Kemirahan square B was constantly under water and was treated in the same way as Ngawoedjasem square B. On August I community I had the normal physiognomy of an Eragrostis japonica-community (compare table I inspection 6); vegetation II was just as in square A the Panicum reptans- Polanisia viscosa- Portulaca oleracea-community with practically the same composition.

So, even if the Eragrostis japonica-community occurs most frequently, other communities may arise as well after harvesting the rice. It appears that this occurrence of other communities does not depend only on the quality of the soil (which manifests itself for instance in the nature of the east monsoon-communities), but also on the duration and the intensity of the irrigation of the rice-fields.

We will now continue the course of development of the Eragrostis japonica-community, when the soil gets dry. This drying-process has a longer or shorter duration in proportion to the force with which the upper layers retain the moisture and the level of the subsoil-water. Whether, with a sufficient moisture-content, the community can maintain itself, depends in the first place on the degree of covering of the dominating species, in this case especially on the Eragrostis japonica (which grows to a great height). On red mountain-clay I once observed that this community maintained itself for eighteen months, after which it was ploughed down. Round the place where this vegetation had been destroyed a long time before, entirely different communities had arisen. So the Eragrostis japonica-community only maintained itself in this place, because it grew there already and by no means because the prevailing ecological conditions remained optimal for this community. In most cases, however, in a few months or at any rate at the end of the east monsoon, the Eragrostis japonica-community has almost died off through want of moisture. Eragrostis japonica has shallow roots, that is to say, the roots reach only 20 c.m. below the surface soil. The roots are often curled round and at a depth of a few centimeters they grow on parallel lines with the surface, which should evidently be considered as an adaptation to the substratum so poor in oxygen. If the upper layer gets drier gradually, the constants disappear in about the following order: Fimbristylis miliacea, Ammania baccifera, Eragrostis japonica, Sphaeranthus indicus and Bergia oryzetorum. Especially the last-mentioned species often increases in number for a time during the dying process of the community, so that rice-fields drying-out are found, covered with thousands of individuals of this Bergia, which might give the impression that they form a separate community. At that time Blumea lacera often becomes prominent already, which species had established itself already before on the ditches of the sawah; it never occurs socially however.

If the drying-process is of a very short duration and the rice-fields are for instance harvested in the middle of the dry season, on plots with a low level of subsoil-water, the Eragrostis japonica-community often begins to appear but it soon dies off again, If no new crop is to follow, such a harvested rice-field remains practically free from weed till the west monsoon.

Another community is the Glinus lotoides-community, the occurrence of which is connected too with a substratum poor in oxygen. It consists of only one single constant, Glinus lotoides, strongly dominating. With its tall, prostrate, strongly branching shoots and numerous grey-haired leaves, this species may in some districts give a special note to the landscape in the east monsoon, owing to the fact that it is there the only conspicuous and often very dense weed-vegetation (for instance in square P 6 in 1925). Developed optimally, the community is met with on heavy clay which is at first very moist and later on very dry. As plants of frequently 1 M. in diameter, this Glinus is found on the old-quaternary clay, which especially where this community has developed, cracks to quadratic clods, down to a depth of more than one M. In such places rice has either preceded or depressions occur in the general level of the ground, in which the rainwater has remained during the west monsoon. In any case the Glinus lotoides-community only grows in places which were very wet at first and dried out quickly later on. Now an Eragrostis japonica-community precedes and the Glinus lotoides-community occurs in the late east monsoon, now with a rapid drying-proces, the later arises inmediately after the sawah, as first vegetation. If depressions in the ground are formed, Eragrostis japonica c.s, in other places generally preceding, is mostly entirely absent. Sphaeranthus indicus, scattered among the Glinus lotoides-community, often occurs with a solitary Heliotropium indicum and on very heavy clay in greater numbers: Sporobolus tremulus; they are not constant, however. Far less strongly developed, but for the rest, of the same physiognomy, we find the Glinus lotoides-community also on medium-light soils soon drying up and then cracking, most of all in depressions, although after sawah too. It occurs for instance in the neighbourhood of the factory Winongan on the medium-light and medium-heavy soils, with a high level of groundwater of the squares M 10, N 9, N 10, O 9. In the ecological amplitude of the Glinus lotoides-community, there is much left which cannot be explained, however. It also occurs regularly for instance on the medium-light soils of the areas E 8 and F 8 in the neighbourhood of the factory Wonoredjo (which soils cake on the surface when dried and which are subject to cracking a little); and indeed on a level soil, with a low level of subsoil-water, after rice-fields which exclusively depend on the rains of the west monsoon. At the end of October 1923, I found here for instance a well developed Glinus lotoides-community stretching for miles, which throve in spite of prolonged drought; only the plants were much smaller than is the rule on heavier soils. Even on the very dry non-irrigated soils (tegallans) in the south section of the factory Gayam, for instance on Getah (L 11) the community is met with. These soils are very light, have a deep similar soil-layer and a level of the subsoil-water at a depth of more than

10 M. In shallow depressions the Glinus lotoides-community is formed, but its surface does not exceed a few square meters. That this plant is very drought-resistant, if it has once established itself, is evident everywhere and in this respect it forms a great contrast to Eragrostis japonica. Glinus lotoides has a very deep strong main root which, with big specimens on old-quaternary clay, may grow to a depth of more than 1.20 M. and which no doubt penetrates still deeper. This length of root I once observed with a plant $4^1/_2$ months-old (15 May—1 October).

V. WEED-COMMUNITIES ON IRRIGATED SECOND-CROP-FIELDS.

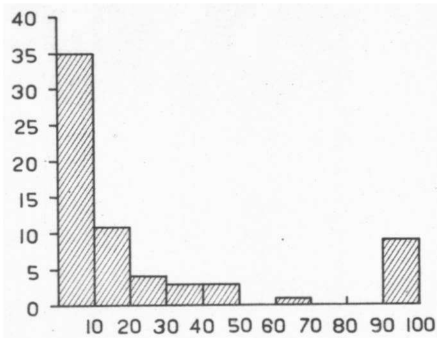
We now pass on to the discussion of the east monsoon-weed-communities as they are composed when developing under optimal conditions on sufficiently irrigated second-crop-fields, of which the plantation is so young or so open that it does not materially influence the weed-vegetation. The aspect of the communities in the west monsoon will also be given in broad outline, although the number of inspections fit for use is slight during that time. In order to have a general survey I shall discuss the communities in groups according to the types of soil on which they occur most frequently. A classification according to the similarity in floristic composition might be followed equally well, which, as it will appear, however, will nearly coincide with a classification according to the soil-types.

A. Weed-communities on light and medium-light soils.

1. *The Polanisia viscosa-community* (Table II).

This community with which I will start, covers a comparatively small area in the plain of Pasuruan and at the foot of the volcanoes. It occurs exclusively on recent, very permeable, little or non-cracking, light soils, which hardly cake on the surface. These soils have a strong capillary lifting power, so that the plantation of cane remains fresh for a long time, with comparatively little water; they are known to planters as the best soils of the field of investigation; with a normal way of cultivation no root-rot is met with in E K 28. The community occurs in the following districts: the sugar-factory Pleret, certain plots between Sindopati and Wangkal wetan on the road to Pasrepan (J 9, J 10, K 9); the factory Gayam, a few plots on the road to Tosari (Kersikan, Winong, L 9, K 10 and K 11) a part in the South (Getah and neighbourhood L 11, L 12, M 10 and M 11); the factory Winongan a few small portions of land in the south (neighbourhood of Djeladri P 12); the factory Kedawoeng, a few parts of land near Poetoek (P 9), Bedjimakan (O 9), the neighbourhood of Kambingan west of the lake of Grati (Q 10) and Djatisari south-east of this lake (S 10); the factory Wonoredjo, a few small parts near the dessah Sambisirah (G 8 and G 9); the factory Alkmaar, in the south near Sentoel and Simping (B 15 and B 14), the factory Pandaän a. o. near Lebaksari (A 6). On the recent Kloet-soils of Kediri, at a distance of 100 K.M. west of Pasuruan, where inspections were made in October 1923, appears a Polanisia viscosa-community with the same constants (inspections Nos. 7, 8, 9 and 10), whereas on the light, but older Wilis-soils, the community is absent, as far as I could observe.

From table II it appears that the 9 following plants are constant: *Amarantus spinosus* ($2^1/_2$), *Cynodon Dactylon* ($4^1/_2$), *Cyperus rotundus* (4), *Digitaria sanguinalis* ($2^1/_2$), *Eleusine indica* (1), *Euphorbia hirta* ($^1/_2$), *Phyllanthus Niruri* ($1^1/_2$), *Polanisia viscosa* ($2^1/_2$) and *Portulaca oleracea* (3).



Constitution-diagram of the Polanisia viscosa-community.

From the above constitution-diagram the concentration of the number of species in the highest and lowest constancy-classes is evident. The separation between accessory and constant species is clear. Several constants have a fairly high average abundancy. One might think that all constants have this latter quality, but this is not the case for. Eleusine indica, Euphorbia hirta and Phyllanthus Niruri *always* do occur in a square of 10 by 10 M., but often *only a few specimens of them.* The constancy of these plants only appeared after composing the tables.

If the soil is decidedly moist through a relatively higher level of the subsoil-water, Panicum colonum always occurs with a rather high figure of abundancy (inspections Nos. 6, 16 and 22). The sudden numerous occurence here and there of Trianthema Portulacastrum, also in lower abundancies *often* together with Panicum colonum, is remarkable. The plant shows this phenomenon in all kinds of communities, on heavy soils too (see e.g. Table III, inspection 34) and mostly quite local.

The inspections 6, 11 and 22 form extremes in the ecological amplitude of the community. In these three inspections occurred small, clearly delimited plots of other communities, which are peculiar to soils of an inferior quality. By summarising the inspections of a great number of similar plots, it appeared, that in the district where inspection 11 was made, these plots belonged to the Panicum reptans-Polanisia viscosa-community (see where this has been discussed) and in the inspections Nos. 6 and 22 to the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community. The last-mentioned community also occurs in a pure state in the neighbourhood of the inspections Nos. 6 and 22 (see table VI inspections 10 and 3). Real transitions between the Polanisia viscosa-community and the other communities mentioned just now, do not occur however; here one case of a sharp demarcation is met with. The spots discussed above are very peculiar in the community which is homogeneous for the rest. Both in the Panicum reptans-Polanisia viscosa-community and in the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community, Panicum reptans dominates; this is also the state of things in the plots. In several plots Euphorbia reniformis came to the fore, a constant of both communities, but exclusively there and *never* in the large, pure spots of the Polanisia viscosa-community. The one peculiar thing in the inspections Nos. 6 and 22 is the low abundancy, respectively of Digitaria sanguinalis and of Amarantus spinosus, which is the rule in the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community. At a higher level above the sea, the composition of the Polanisia-viscosa-community changes. In the neighbourhood of Simping and Sentoel or thereabouts at a sea-level of respectively 345 and 360 M. (inspection No. 18, B 14 and No. 3, B 15) *Ageratum conyzoides* and *Galinsoga parviflora* begin to occur as variant-constants, whereas all other constants still remain, 10 K. M. more south, between Lawang and Singosari at a height of about 480 M. Polanisia viscosa makes way for another Capparidaceae, *Gynandropsis gynandra* and occurs itself only very rarely or not at all.

The following list gives a good idea of the average composition at that height.

18 August 1924 Garangan. Between Singosari and Malang at a sea-level of about 450 M., the factory Alkmaar. Friable, light-permeable, non-cracking, brown mountain-soil. A plantation of young Zea Mays.

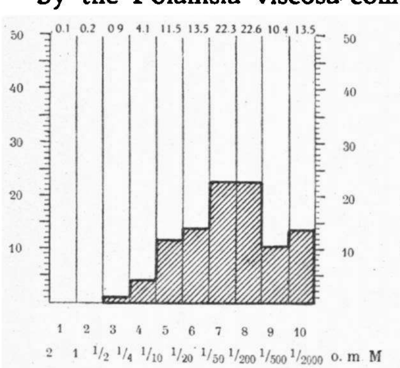
Amarantus lividus	1
„ *spinosus*	*4*
Ageratum conyzoides	*2½*
Centella asiatica	x
Cynodon Dactylon	*4*
Cyperus rotundus	*3*
Digitaria sanguinalis	*3*
Drymaria hirsuta	*2*
Eleusina indica	x
Eragrostis pilosa	1
Euphorbia hirta	*1*
Galinsoga parviflora	*2*
Gynandropsis gynandra	*3*
Leucas lavandulifolia	1
Nicandra physaloides	x
Phyllanthus Niruri	*2*
Portulaca oleracea	*4*

The plants in italics are constant there, that is to say eight of the nine constants of the low-lying plain and three variant-constants (*Ageratum conyzoides, Galinsoga parviflora* and *Gynandropsis gynandra*).

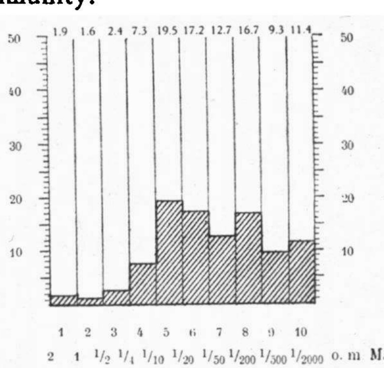
Farther south lies the plateau of Malang, at about the same height above sea level, where the 12 constants remain intact. It is remarkable that there, in one place only, at Srigading, in the area of the factory Sempalwadak, the pure Polanisia viscosa-community of the low-lying plain appears again on transport-soil with a subsoil of medium-heavy clay. On the light soils, both north and south of it, however, the variant exclusively occurs. Taking into account the quality of the soil on Srigading, the Polanisia viscosa-community, would certainly not have occurred, if it were situated in the low-lying plain. So it seems that edaphic factors have been partly replaced by climatic ones, a fact often stated in literature (for instance Rübel, 1922).

Finally a few remarks about the west monsoon-aspect of this community. [1]) Between this (see the inspections 1, 2, 12, 13 and 14) and the east monsoon-aspect there is no fundamental difference. In the west monsoon a little shifting in abundancy takes place, Polanisia viscosa for instance comes less to the fore. Besides a few more typical west monsoon-plants appear, such as: Cyperus compressus, Cyperus pumilius, Fimbristylis annua, Ilysanthes serrata, Ilysanthes veronicifolia, Ipomoea Pes tigridis, Lindernia crustacea, Lindernia glandulifera and Mollugo pentaphylla. None of these plants, however, is constant over the entire amplitude of the community.

In conclusion a few texture-diagrams of soils typified by the Polanisia viscosa-community.

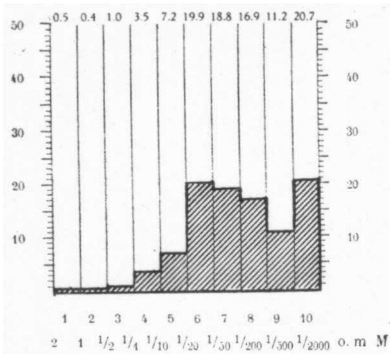


No. 3411
Percentage of gravel 0.2 %



No. 3688
Percentage of gravel 4.7 %

[1]) I shall come back to this subject when dealing with the west monsoon-squares.



No. 4071
Percentage of gravel 0.4 %

Of the above soils and a few others, on which the Polanisia viscosa-community occurs, the percentage of phosphate and the moisture-content is given in the table below.

Number	Place	Sugar-factory	Area	P_2O_5 in 22.9 % H Cl	P_2O_5 in 2 % citric acid	Moisture [1]
3411	Getah	Sf. Gayam	L 12	0.072 %	0.018 %	7.8 %
3688	Sindopati	„ Pleret	J 9	0.061	0.025	5.1
4071	Simping	„ Alkmaar	B 14	0.058	0.014	7.0
4062	Sambisirah	„ Wonoredjo	G 9	0.070	0.022	6.7
3689	Karangtengah	„ Gayam	M 10	0.124	0.048	4.9
4040	Kambingan	„ Kedawoeng	P 9	0.078	0.009	4.8
4046	Wangkal wetan	„ Pleret	J 10	0.071	0.028	6.4

2. *Panicum reptans-Gymnopetalum leucostictum-community.* (Table III).

In order to show the relation between the communities on the fairly light soils still to be discussed and those which occur exclusively on medium-heavy and fairly heavy

[1]) Here and in future „moisture" gives the percentage of moisture of the air-dry soil determined by means of drying at 105° C.

soils, I shall first deal with the Panicum reptans-Gymnopetalum leucostictum-community. This community has a wide ecological amplitude: it occurs both on medium-heavy soils liable to consolidate and on the heaviest old-quaternary clay. On medium-light soils of inferior quality occur a number of communities which have more constants in common with the Panicum reptans-Gymnopetalum leucostictum-community as those medium-light soils approach the heavier ones in characteristics (which are more subject to cracking, have a slighter degree of permeability and which cake on drying).

In table III, 39 inspections of the community will be found, distributed over the variants A and B and C. Five constants, viz. *Euphorbia reniformis, Gymnopetalum leucostictum, Merremia emarginata, Panicum reptans* and *Phyllanthus Urinaria* follow the community throughout its entire amplitude. *Cynodon Dactylon* too, occurs in 90 % of the inspections, nevertheless I did not class this plant among the constants. In variant C (Nos. 32—39) it occurs only in 4 of the 8 cases. It is my experience that 15 inspections are sufficient to classify a community. If, to the 8 above-mentioned squares of variant C, 7 should be added, in each of which Cynodon Dactylon occurs, it would appear in 11 of the 15 or about 73 % of the cases, so it would not belong to the constants of variant C. The fact that Cynodon Dactylon occurs in 90 % of the total number of inspections, is caused by the absolute constancy of this species in variants A and B (Nos. 1—31), of which the inspections strongly predominate in number, because variant C occurs comparatively little.

The Polanisia viscosa-community has not a single constant in common with the Panicum reptans-Gymnopetalum leucostictum-community.

We shall first discuss variant A (inspection Nos. 1—18). Of the 6 constants Merremia emarginata ($3^1/_2$) and Panicum reptans ($3^1/_2$) contribute most to the typical quality in its physiognomy. Cynodon Dactylon has a much varying share in the total aspect. Above 200 M. sea-level, where the relative humidity of the air is higher than down below, this grass *always* takes up an important position (compare the inspections Nos. 3. 5 and 8). For the rest, there is on various soils a considerable difference in the abundancy between the east and the west monsoon-aspect; in general this abundancy is low in the latter half of the east monsoon, and high in the west monsoon. The inspections in the east monsoon Nos. 9 and 12 took place on most soils; the abundancy is also high there. But if, on the other hand, on bad heavy clay, the soil is very damp (owing to insufficient drainage or some other reason) variant C appears, in which Cynodon Dactylon has a low abundancy and is no more constant. The moisture-content in connection with the nature of the soil appears to be of great importance for the occurrence of this grass.

Euphorbia reniformis, a plant which is constant in all communities on medium-heavy or medium-light soils, with bad properties (especially the smaller permeability) never reaches a higher abundancy than 3 (mostly lower) even in spite of conditions which appear to be particularly favourable.

Gymnopetalum leucostictum is a very striking species owing to its creeping growth and greyish-green leaves, which sometimes occur very sporadically. With the inspection No. 5 I was unable to find it in spite of careful searching, with inspection No. 9 only 1 specimen occurred, with No. 12 but 2 in a square of 10 by 10 M. Phyllanthus Urinaria never reaches a high abundancy with absolute constancy. This plant too often appears in very few specimen, such as for instance one individual with inspection No. 13 and 2 with inspection No. 8. This *constant* occurrence, even though in very few specimens, was a surprise to me at first. It is a proof that — at least for this community —

the minimum-area cannot be much smaller than 10 by 10 M.

Here, it appears that a species which is accessory in one variant, often becomes constant in another. This is true for instance for Borreria setidens with 51 % in the entire community, 33 % in variant A and constancy in variant B; and for Heliotropium indicum with 64 % in the entire community, 50 % in variant A and constancy in variant B; Eclipta alba and Phyllanthus Niruri, on the other hand, remain accessory over the whole amplitude of the community with a striking similarity in frequency (46 % resp. 48 % in the entire community, 39 % in variant A, 54 % in variant B).

Above 200 M. sea-level Panicum repens and Senecio sonchifolius become constants (inspections 3, 5 and 8); the latter plant was also constant in the Polanisia viscosa-community on greater heights.

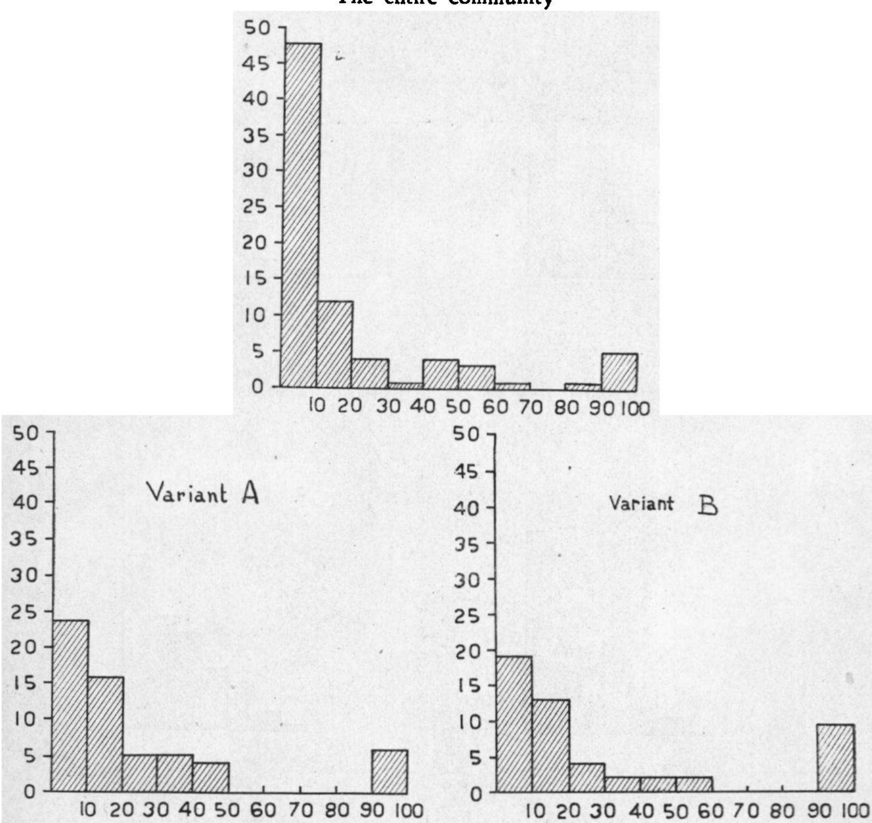
Variant A occurs on medium-heavy soils, often of a brown to a blackish-brown colour, and which are often moderately moist during the *originating* of the community, and which crack heavily and deeply when getting dry and are likely to fall into hard clods. For the sensitive roots of the cane-variety E K 28 they are not suited, and D I 52 soon dies off after the dry season setting in; the dampest parts are suitable for S W 3. In any case they are the better soils within the amplitude of the entire community; with strong P O J-varieties they yield a good sugar-produce.

Variant B (Merremia gemella-variant, inspections Nos. 19—31), has, besides the constants of variant A, three more, that is to say: *Borreria setidens* (×), *Heliotropium indicum* (×) and *Merremia gemella* ($2^1/_2$) The typifying new constant is Merremia gemella which never occurs in great numbers in the other variant. Borreria setidens and especially Heliotropium indicum mostly occur in few specimens only; the constancy of these species was only apparent when constituting the table. This variant is not very different from variant A in the abundancy of the other constants, so that a discussion is not necessary. Only the constantly higher abundancy of Cynodon Dactylon ($3^1/_2$) compared with variant A (2) is remarkable.

Variant B occurs exclusively on heavy black or blackish-brown, calcareous and non-calcarious soils, which are notorious for their bad properties for the cultivation of cane. They are soils with a low water-level, which are much drier without irrigation than the soils on which variant A occurs. Only the hardiest cane-varieties will grow here and on the setting-in of the dry season, there is a rapid deterioration in the condition of the crop,

Variant C (Portulaca oleracea-variant, inspections Nos. 32—39) occurs comparatively little and the number of inspections is therefore too slight for a sufficient typification of this community. Besides the constants, already mentioned with variant A, *Cyperus rotundus, Panicum colonum* and *Portulaca oleracea* are probably also constants. The last-mentioned plant typifies this variant more especially, because it only occurs sporadically in the two other variants. As this variety always occurs together with Panicum colonum and Cyperus rotundus which are accessory both in variant A and B, variant C may be clearly delimited. It is remarkable that in 4 cases out of 8, Amarantus spinosus occurs. This plant and in a less degree Portulaca oleracea too, is mainly met with on light to medium-light soils. Both are constant in the Polanisia viscosa-community. It seems indeed that from an ecological point of view a medium-light soil is for some plants more or less of the same value as a medium-heavy but very moist soil; we shall frequently come across similar indications. The fact that Dentella repens which is an indicator of moisture, becomes accessory, is clearly connected with the habitat of the community. For, the ecology of variant C may be best typified by considering the latter to be the moisture-variant of the Panicum reptans-Gymnopetalum leucostictum-community. It occurs both on medium-heavy soils of variant A (Nos, 35—39) and on the heavy soils of variant B (Nos. 32, 33, 34) provided they are moist, with a comparatively low level of subsoil-water, they are good S W 3-soils. With a high level of subsoil-water the Polanisia Chelidonii-community, to be discussed later on occurs on a part of these soils.

The entire community

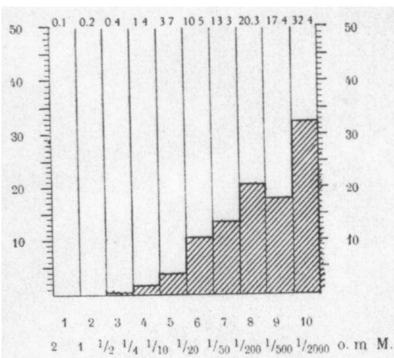


Constitution-diagram of the Panicum reptans-Gymnopetalum leucostictum-community, From the above diagrams the sharp demarcation between constants and accessory species is evident and likewise between the 0—20 % and the 20 %—60 % classes.

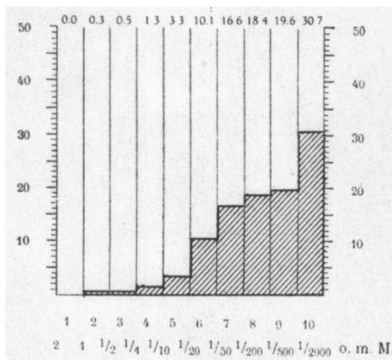
The number of inspections of variant C is too small for the composition of a diagram.

Finally some texture-diagrams and analyses of soils on which the variants occur.

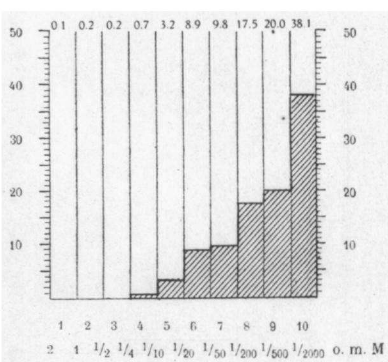
Variant A.



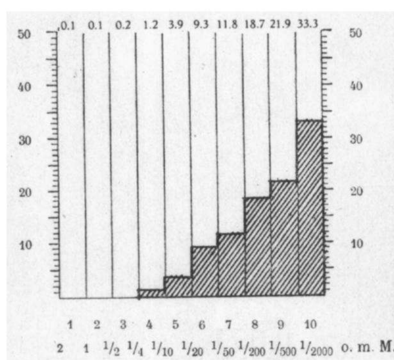
No. 4053
Percentage of gravel 0.2 %



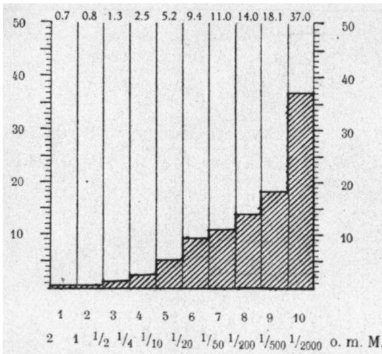
No. 4055
Percentage of gravel 0.01 %



No. 4044
Percentage of gravel 0.08 %



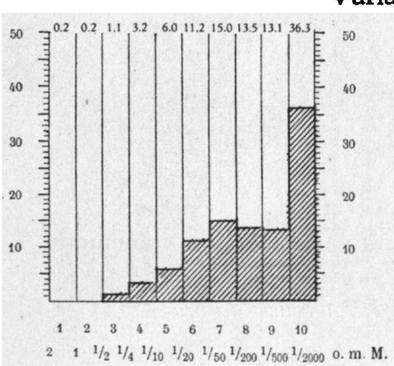
No. 4054
Percentage of gravel 0.02 %



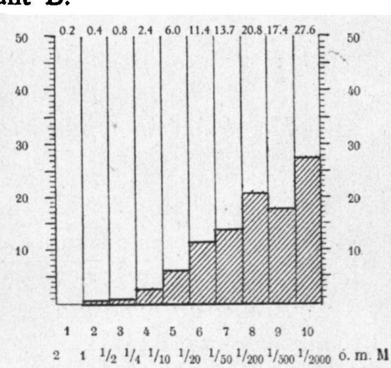
No. 4059
Percentage of gravel 0.4 %

Number	Place	Sugar-factory	Area	P_2O_5 in 22.9 % H Cl	P_2O_5 in 2 % citric acid	Moisture
4053	Djambangan	Sf. Pleret	K 8	0.076 %	0.020 %	8.3 %
4055	Moelioredjo	„ „	J 7	0.050	0.019	8.5
4044	Badjangan	„ Pengkol	K 7	0.071	0.028	8.3
4054	Soesoekan	„ Pleret	J 7	0.037	0.015	8.6
4059	Karangasem	„ Wonoredjo	F 8	0.054	0.019	7.9
681	Kloewoet	„ „	G 7	0.041	0.015	9.6

Variant B.



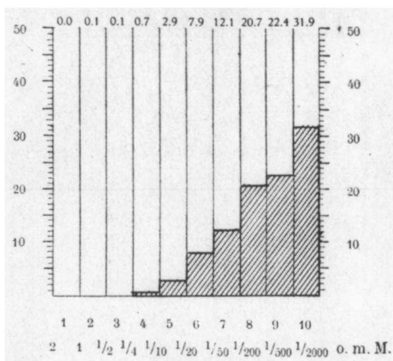
No. 1272
Percentage of gravel 0.3 %



No. 3412
Percentage of gravel 0.2 %

Number	Place	Sugar-factory	Area	P_6O_2 in 22.9 % H Cl	P_6O_2 in 2 % citric acid	Moisture
1272	Blimbing	Sf. Wonoredjo	F 9	0.018%	0.003%	11.4%
3412	Dawoehan	„ Gayam	L 10	0.043	0.018	10.3

Variant C.



No. 3409
Percentage of gravel absent.

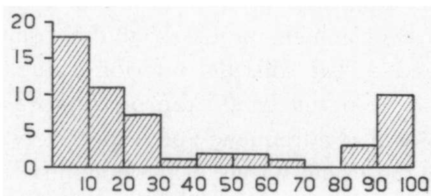
Number	Place	Sugar-factory	Area	P_2O_5 in 22.9 % H Cl	P_2O_5 in 2 % citric acid	Moisture
3409	Manik	Sf. Gayam	M 7	0.050%	0.027%	11.8%

3. *The Panicum reptans-Polanisia viscosa-community.* (Table IV).

The community has no fewer than 13 constants; 9 of which are in common with the Polanisia viscosa-community. The four constants newly occurring are: *Cyperus Iria* ($^1/_2$), *Eragrostis pilosa* ($^1/_2$), *Panicum colonum* ($1^1/_2$) and *Panicum reptans* ($3^1/_2$).

In spite of the great number of constants which they have in common, this community may be clearly distinguished from the previous one. It is true that Cyperus Iria, Eragrostis pilosa and Panicum colonum are accessory species in the Polanisia viscosa-community, which pleads for the fact that the Panicum reptans-Polanisia viscosa-community might be looked upon as a variant of that community, but the Panicum reptans ($3^1/_2$), generally predominating in great strength in the Panicum reptans-Polanisia viscosa-community, is entirely absent in the former one.

Panicum reptans occurs first in the series of constants typifying the Panicum reptans-Gymnopetalum-community and the share of which increases in the communities still to be discussed, as the soils get inferior in quality. It may be explained that Cyperus Iria, Eragrostis pilosa and Panicum colonum, which had a frequency of respectively 37 %, 63 % and 41 % in the Polanisia viscosa-community, occur as constants in the Panicum reptans-Polanisia viscosa-community. These three species require some more moisture, which demands are met with in the soils of the Panicum reptans-Polanisia viscosa-community retaining more water. In concordance with this other species too, which are still fonder of water (which appears from the comparison of related communities) get a higher frequency such as, Dentella repens (respectively 4 % and 22 %), Eclipta alba (resp. 18 % and 33 %), Leptochloa filiformis (resp. 18 % and 28 %) and Mollugo pentaphylla (resp. 22 % and 50 %). Euphorbia reniformis here accessory (a frequency of 55 %) is entirely absent in the Polanisia viscosa-community. Its occurrence is no doubt connected with the slighter permeability of the soil; it was mentioned as a constant already in the Panicum reptans-Gymnopetalum leucostictum-community and is also constant in all the communities still to be discussed on inferior medium-light soils. Through a comparison of those communities it will likewise appear that the occurrence of Merremia emarginata (here with a frequency of 17 %) is a further step to the total amount of the qualities of the soil, typical for the occurrence of the Panicum reptans-Gymnopetalum leucostictum-community; as the soil crumbles less readily and the top-soil is drying to a hard-caked surface, this Convolvulacea occurs in greater quantities. Physalis angulata and Physalis minima have a far higher frequency than in the Polanisia viscosa-community (resp. 61 % and 55 % as against 37 % and 33 %). The concurrence of these species, also in several other communities, is remarkable.



Constitution-diagram of the Panicum reptans-Polanisia viscosa-community.

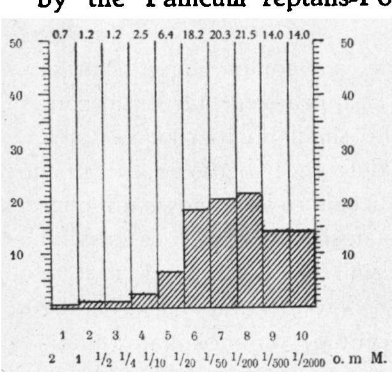
From the diagram the sharp demarcation between the casual species and the middle-classes and between the latter and the constants may be seen.

The fact that Cyperus Iria and Eragrostis pilosa reach to a constancy of only 80 %9—0 % in the table, is probably due to a mistake in the observation. Both species often occur in a few specimens only. In a sterile condition Eragrostis pilosa might be easily mistaken for Eragrostis amabilis.

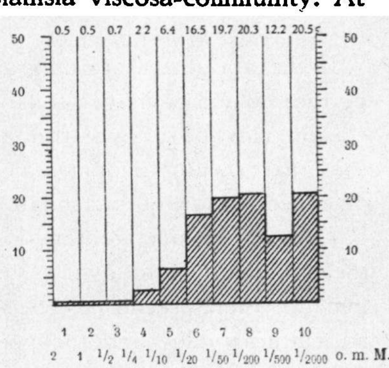
The ecological amplitude is small, agreeing with the great number of constants. The community is met with on light, brownish, little or non-cracking soils, which often cake on the surface and are somewhat plastic in a moist condition. These soils are good for the cultivation of cane, although inferior to those on which the Polanisia viscosa-community thrives. The cane-variety E K 28 gives satisfaction and root-rot is rare or it does not occur at all. With sufficient irrigation those soils are excellent for D I 52.

Finally the inclination to a formation of mosaic with other related communities, which the Panicum reptans-Polanisia viscosa-community often shows, should be pointed out. In an extreme form, plots of two communities apparently distributed without any system and always much smaller than 10 by 10 M., are met with. In the neighbourhood of inspection No. 11, no entirely pure square of 100 M^2. was present. In the inspected square a plot of about 1 M^2. of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community occurs. Round inspection No. 13, we may almost speak of a typical mosaic-formation with that community and likewise with the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community. The inspected square was a combination of three adjacent pure parts. In inspection No. 12 two parts had to be combined owing to the alternation with the Panicum reptans-Polanisia viscosa-Merremia emarginata-community. The neighbourhood of the inspections Nos. 16, 15, 14, 9, 6 and 3 were entirely pure, however.

Below follow a few texture-diagrams of soils typified by the Panicum reptans-Polanisia viscosa-community. At

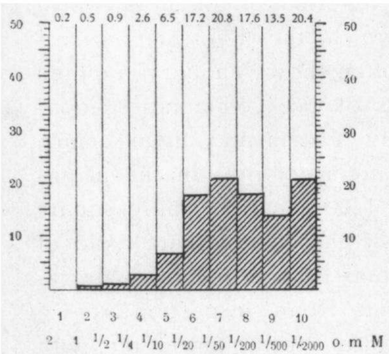


No. 3410
Percentage of gravel 0.8 %

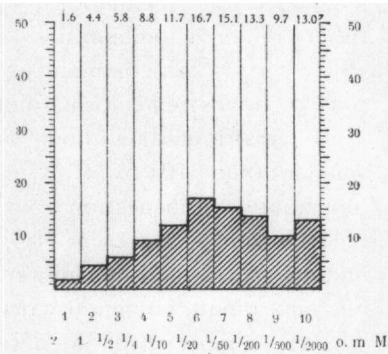


No. 4048
Percentage of gravel 0.5 %

the same time the percentage of P_2O_5 and the moisture-content of these samples is given.



No. 4065
Percentage of gravel 0.2 %



No. 4076
Percentage of gravel 2.3 %

Number	Place	Sugar-factory	Area	P_2O_5 in		Moisture
				22.9 % H Cl	2 % citric acid	
3410	Kili	Sf. Gayam	L 9	0.089%	0.041%	9.7 %
4048	Kepoeh Kidoel	„ Pleret	I 10	0.145	0.034	5.0
4065	Djatigoenting	„ Wonoredjo	F 9	0.107	0.049	6.5
4076	Tampoeng	„ Winongan	F 6	0.075	0.037	4.9
4057	Poekoel [1])	„ Pleret	H 8	0.072	0.023	7.1

If the above texture-diagrams are compared with those of the Polanisia-viscosa-soils, it appears, as far as a conclusion may be drawn from the small number of samples, that there is no fundamental difference between the two. The percentage of phosphate seems to be somewhat higher on the Panicum reptans-Polanisia viscosa-soils. With the communities following, it will be clearly seen that *in general* there seems to be no connection between the agricultural value and the percentage of phosphate; it ap-

[1]) See texture-diagram on p. 23.

pears that there is only a connection if *extremes* are mutually compared.

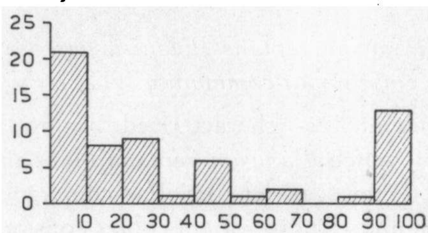
4. *The Panicum reptans-Polanisia viscosa-Merremia emarginata-community.* (Table V).

This community is characterized by no less than 14 constants, of which *Panicum reptans* (4) is the dominating species, as is the case in the Panicum reptans-Polanisia viscosa-community; none of the other constants reaches an average abundancy of 3. It is striking that in general the plants of this community are not so strongly developed, which give on the whole, a peculiar, more or less thin aspect.

From table VII — in which the constants of the communities on the medium-light soils have been placed side by side — it is evident that, with this community the abundancies of the constants of the Polanisia viscosa-community, have in general still more decreased than was already the case in the Panicum reptans-Polanisia viscosa-community. Panicum reptans now takes up the place where Cynodon Dactylon and Cyperus rotundus were before in the Polanisia viscosa-community

The closer relationship to the Panicum reptans-Gymnopetalum-community appears from the fact that three of the four new constants: *Euphorbia reniformis, Merremia emarginata* and *Phyllanthus Urinaria*, are also constant in that community, whereas the fourth, *Eclipta alba* is an accessory species there (a frequency of 46 %). Eleusine indica and Eragrostis pilosa are no longer constant and do not occur any longer, as such, in the other communities.

Of the accessory species, Alternanthera sessilis and Heliotropium indicum are most predominating, both with a frequency of 64 %. The first reached in the communities Nos. 1 and 3 a frequency of hardly 10 % and belonged therefore to the casual species; in the Panicum reptans-Gymnopetalum leucostictum-community, however, it has an average frequency of 41 %; it never becomes constant in any community, as far as I know.



Constitution-diagram of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community.

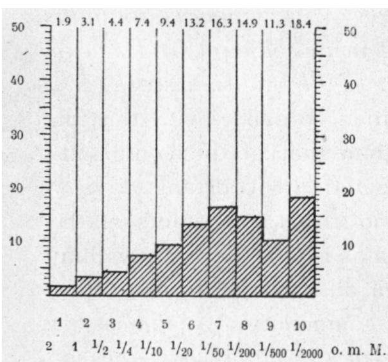
The diagram clearly shows the separation between the constants and the accessory species.

As usual, we can only give a general discussion of the ecology of this community. We cannot point out either, which factors are most important, the complex of them is typical, however. There is no doubt about it that such a complex determines the originating of a community. After destroying the vegetation or its successions, the same physiognomy with slight modifications appears again and again.

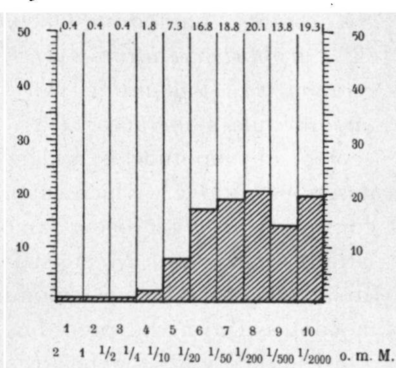
The community is met with on residuary soils, arisen from tuff, weathered with little water, which are fairly moist *at first*. The colour is sometimes greyish-brown (No. 10), on most cases purely brown to ruddy-brown. This type generally loses its moisture quickly after irrigation, and forms afterwards on the surface, a fairly hard cracking layer. Deeper down the soil remains plastic, however. After tillage the soil easily crumbles, gets friable and is seemingly of good quality. With much water this type becomes plastic; it does not easily regain its crumblike-structure. On the afflux-side of the plantations with this soil-type i.e., where, through the silt of the irrigation-conduct the soil-layer has improved, the Panicum reptans-Polanisia viscosa-community is often found; the community discussed, forms likewise occasionally a mosaic with it; transitions are, however, never met with.

The results obtained with our test cane-variety EK 28 are very variable on this soil-type. Sometimes there was a good sugar-produce, occasionally, however, the plantation is a complete failure on the same plot of ground, owing to root-rot. As the soil generally dries up very quickly, the DI 52, sensitive to drought, is not quite in its place here; strong cane-varieties do best on this type of soil.

Below two texture-diagrams of soils are given, on which this community occurs. Besides, the percentages of phosphate and of moisture of a few samples were determined.



No. 4068
Percentage of gravel 1.1 %



No. 4041
Percentage of gravel 0.7 %

Number	Place	Sugar-factory	Area	P_2O_5 in 22.9 % H Cl	P_2O_5 in 2 % citric acid	Moisture
4068	Klodjen	Sf. Alkmaar	D 11	0.122%	0.060%	4.1 %
4041	Soemberandong	„ Kedawoeng	R 9	0.158	0.122	5.8
3718	Sroewi [1])	„ Winongan	N 11	0.082	0.018	7.0
3685	Menangas [1])	„ Kedawoeng	P 10	0.115	0.052	6.8

When comparing the texture-diagrams of this community with those of the Panicum reptans-Polanisia viscosa-

[1]) See the texture-diagram of Sroewi on p. 24 and of Menangas on p. 207.

community, it appears that there is no striking difference. The diagram of Klodjen strongly calls to mind that of Tampoeng (p. 74). The moisture-content of both is the same, the percentage of phosphate of Klodjen is higher, in spite of this the agricultural value of the soil is far lower than that of Tampoeng. The percentage of phosphate seems to be generally higher in this community than it was in the previous communities on a light soil.

5. *The Panicum reptans-Polanisia viscosa-Portulaca oleracea-community*. (Table VI).

Over the entire amplitude this community is typified by 8 constants, *Cynodon Dactylon* ($1^1/_2$), *Cyperus rotundus* (2), *Eurphorbia reniformis* (2), *Panicum colonum* (3), *Panicum reptans* (4), *Phyllanthus Niruri* (2), *Polanisia viscosa* ($2^1/_2$) and *Portulaca oleracea* ($2^1/_2$). In accordance with this, the ecological amplitude is wider than that of the community described above, which numbered 14 constants. The 8 constants likewise occur among the 14 constants of this latter community. Most striking is the constantly high abundancy of Panicum colonum all through the amplitude, in contrast with the preceding community (3 as against $^1/_2$). This agrees with the fact that *in the latter case*, the soil is more retentive for moisture and *in the former case*, it dries up very quickly indeed. Two clearly different variants may be distinguished.

Variant A (inspections Nos. 1-11) has ten constants all of which are likewise found in the Panicum reptans-Polanisia viscosa-Merremia emarginata-community. Two of the 4 remaining constants of the latter community are accessory in this case, viz. Digitaria sanguinalis (45 $^0/_0$) and Eclipta alba (45 $^0/_0$); of the remaining two constants Merremia emarginata occurs in 9 $^0/_0$ only and Phyllanthus Urinaria in 18 $^0/_0$ of the cases.

The soils on which this variant occurs, do not get dry quickly. During this process, the soil becomes very slightly or not at all hard and does not as a rule crack much or only superficially. In a moist condition it has no great plasticity. The colour is sometimes brown, in most cases greyish-brown and the soil seems to have weathered in a little more damp condition than the type on which the Panicum reptans-Polanisia viscosa-Merremia emarginata-community, which has a lower agricultural value, occurs. These qualities of the soil explain the fact that Merremia emarginata, which, when dry, prefers a heavier or harder soil, scarcely ever occurs. The comparatively high abundancy of Phyllanthus Niruri ($2^1/_2$) and the constancy of Euphorbia hirta are also made clear by this. Amarantus spinosus does very poorly here; this fact is just as inexplicable as the non-constancy of Digitaria sanguinalis and Eleusine indica. This may be connected with the slighter degree of permeability of these soils in a dry condition, in contrast with the soil-type on which the Panicum reptans-Polanisia viscosa-Merremia emarginata-community occurs, although the general agricultural value of the soils typified by that community is decidedly lower. The cane-variety E K 28, however, also often gets root-rot here, but in most cases in a less degree. They are good D I 52-soils, if they are sufficiently watered.

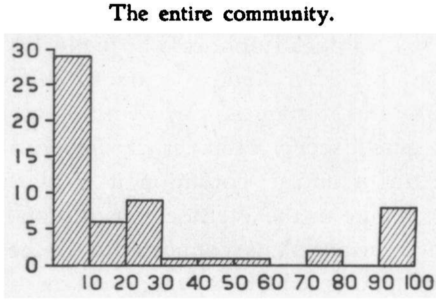
Variant B has 9 constants, Amarantus spinosus becomes accessory (54 %), so does Euphorbia hirta (46 %); Merremia emarginata, on the other hand, occurs as a new constant. The ecology of this variant agrees with this. When drying-up, the soil gets harder, often cracks much and is fairly impermeable; in a moist condition it is plastic. For the rest too, the change in the average constitution of variant B with regard to variant A, is connected with these qualities. The following plants which are constant or accessory in the communities on better soils, came to belong to a lower class of frequency.

Digitaria sanguinalis from 45 % down to 23 %
Eleusina indica. . . „ 45 % „ „ 15 %
Eragrostis pilosa . . „ 45 % „ „ 15 %

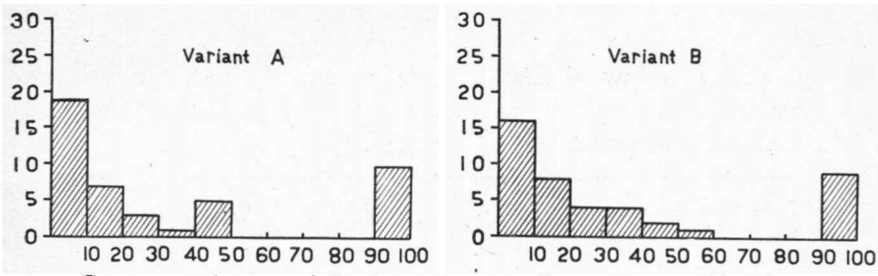
Phyllanthus Urinaria, on the other hand went up from 18 % to 38 % and came to belong therefore to a higher class of constancy now.

The soil on which this community occurs is often of a brown to a brownish-red colour; in a dry condition it is hard and it cracks widely on the surface, when moist it is plastic; after shattering the clods, it gets friable. Variant B occurs fairly often at that side of the plantations where the water is carried off, on which plantations variant A occurs where the water is supplied. For the sensitive E K 28 roots these soils are still less suited than those on which the Panicum reptans-Polanisia viscosa-Merremia emarginata-community appears. The last-mentioned soil-type is indeed often somewhat heavier when moist, but in a dry condition it does not become so hard and does not crack so much. The best plots whithin the amplitude of this variant (inspections Nos. 14, 22 and 23) are still suitable for the cane-variety D I 52, which, in other cases dies off rapidly on the setting-in of the dry season. Only strong cane-varieties may be planted without any risk.

The entire community.



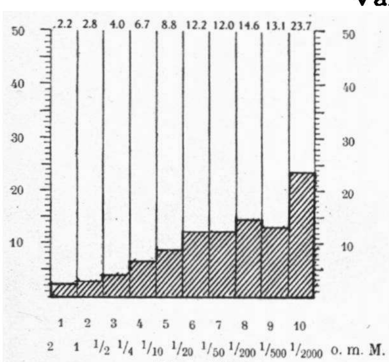
Constitution-diagram of the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community.



Constitution-diagram of the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community.

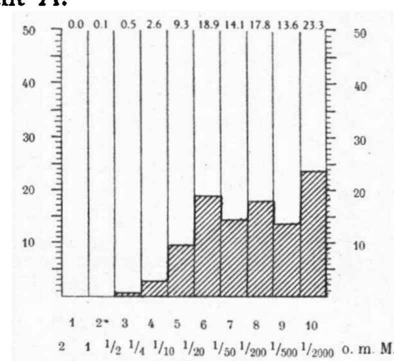
Both in the diagram of variant A and in that of variant B the typical way of concentration of the species in the various constancy-classes is clearly manifested again.

Variant A.



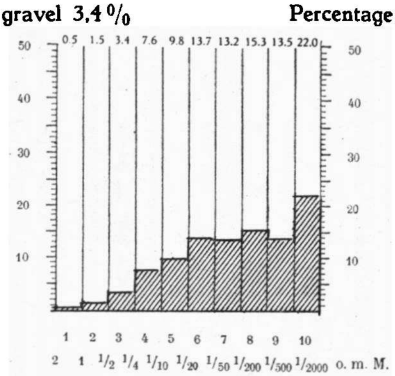
No. 4061

Percentage of gravel 3,4 %



No. 4052

Percentage of gravel 0,1 %



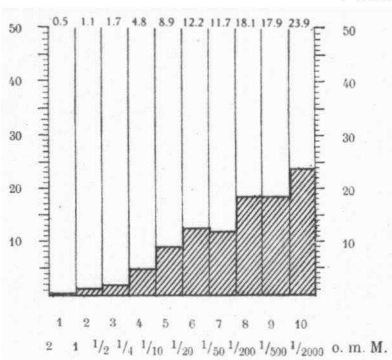
No. 4060

Percentage of gravel 1.8 %

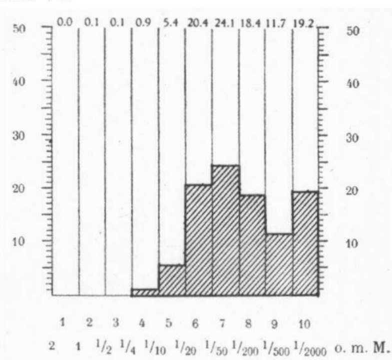
Below follow a few texture-diagrams of soils typified by this community; the percentages of phosphate and moisture have been likewise stated.

Number	Place	Sugar-factory	Area	P_2O_5 in 22.9 % H Cl	P_2O_5 in 2 % citric acid	Moisture
4061	Tjobensari	Sf. Wonoredjo	F 9	0.052%	0.016%	5.5 %
4052	Djolodaran	„ Pleret	J 6	0.068	0.022	7.7
4060	Sambisirah koelon	„ Wonoredjo	G 8	0.093	0.041	6.4

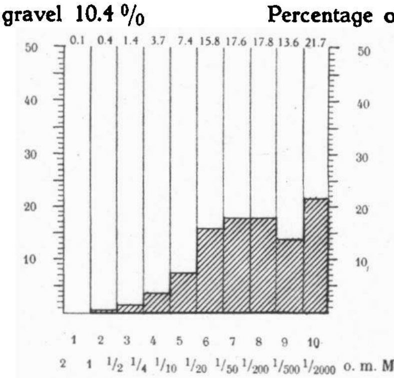
Variant B.



No. 4049
Percentage of gravel 10.4 %



No. 4073
Percentage of gravel 0.01 %



No. 4051
Percentage of gravel 0.9 %

Number	Place	Sugar-factor	Area	P_2O_5 in 22.9 % HC 1	P_2O_5 in 2 % citric acid	Moisture
4049	Sladi	Sf. Pleret	J 7	0.217%	0.184%	7.2 %
4073	Plingisan	„ Winongan	I 6	0.077	0.025	7.4
4051	Djolodjaran deflux-side	„ Pleret	J 6	0.060	0.019	7.3

No typical differences between variants A and B are to be seen in the texture-diagrams, at least not in these few examples. The same thing appears on a comparison of the diagrams of the adjacent plots of Djolodjaran, where the variants A and B were clearly delimited. That the ecological conditions are nevertheless the determining factors for the occurrence of the two variants there, is proved by the fact that every time after destroying the vegetation, about the same constitution returns, as I have observed for three successive years.

Compared with the previous communities on light soils, the average tenth fraction is somewhat higher in these diagrams.

The percentages of phosphate and moisture do not show any typical features either.

We have now dealt with the most important pioneer-communities of the light and fairly-light soils. The remaining communities spread in such a small area in the plain of Pasuruan, that they are unsuited for a statistic study.

In table VII will be found a survey of the constants (with the average abundancy) and the corresponding accessory species (with their frequency) of the discussed communities on light and fairly light soils compared with the Panicum reptans- Gymnopetalum leucostictum-community of heavy soils.

B. Weed-communities on medium-heavy and heavy soils.

Of the communities belonging to this group the Panicum reptans- Gymnopetalum leucostictum-community was already dealt with.

6. *The Polanisia Chelidonii-community* (Table VIII).

This community was only met with on constantly moist, fairly to very heavy clay.

On soils where the Athroisma laciniatum-variant (C) occurs, the surface-soil always remains very moist down to 5—10 cm below the surface, also in the middle of the east monsoon. Especially of the latter soils, the drainage is very difficult and the plantation will thrive best when comparatively little irrigation-water is applied. When the soil gets drier, the Panicum reptans- Gymnopetalum leucostictum-community develops on these soil-types (see the place where this community is dealt with). In the opposite case, however, the Polanisia Chelidonii-community is not always found on the types where the Panicum reptans-Gymnopetalum leucostictum-community occurs, with a greater moisture of the soil; for instance not on medium-heavy soils and no more on the brown or brownish-red, more lateritiously weathered soils.

In this community three variants may be distinguished. Over its entire ecological amplitude it has 9 constants, of which *Dentella repens* ($2^1/_2$) *Fimbristylis miliacea* ($2^1/_2$) and *Polanisia Chelidonii* (3) have the highest average abundancy. It has three constants in common with the Panicum reptans- Gymnopetalum leucostictum-community viz. *Euphorbia reniformis, Gymnopetalum leucostictum* and *Phyllanthus Urinaria*. This complex of 3 species occurs on all little permeable, dry as well as moist soils. For the second plant only the restriction should be made that at least the upper surface soil should be more or less dry (see for this also the Eragrostis japonica and the Moschosma polystachum- Sphaeranthus africanus-communities, in which Gymnopetalum leucostictum never occurs, the Dentella repens- Lippia nodiflora-community and the Lippia nodiflora- Phaseolus trilobus-community, in which the plant is seldom found).

Panicum colonum is only constant in the Portulaca oleracea-variant of the Panicum reptans-Gymnopetalum leucostictum-community. This is easily explainable, as this Portulaca-variant, comes nearest to the Polanisia Chelidonii-community as to its demands of the moisture of the soil. Of the constants with the highest abundancy, Dentella repens Fimbristylis miliacea and Polanisia Chelidonii, there is not a single one in any variant of the Panicum reptans-Gymnopetalum leucostictum-community: the soils on which the last-mentioned community is found, are too dry.

Variant A of the Polanisia Chelidonii-community occurs on heavy to fairly heavy soils, and more especially on the least moist ones in the ecological amplitude of the community. It is therefore only this variant which is often found side by side with the Panicum reptans-Gymnopetalum-community, on the lowest spots of the area.

Variant A may easily be distinguished from variant B, because in the latter Phyllanthus Niruri occurs in much larger quantities; and likewise from variant C, because Athroisma laciniatum is very conspicuous in it. Sporobolus tremulus is a plant, typical of the heaviest soils, in places getting very dry after a previous condition of high moisture. For instance it occurs pretty often in the Glinus lotoides-community, which may appear under the same conditions in that respect.

Variant B, (the Phyllanthus Niruri-variant) is typical for the less heavy soils which are more permeable and moist. It occurs comparatively little on the heavy clay in the district of Pasuruan, over larger extents, and is usually limited to the spots, where the supply of water of the plantations happens to be. Phyllanthus Niruri, which was no longer constant on the drier soils of the Panicum reptans-Gymnopetalum leucostictum-community thrives very well here owing to the greater moisture-content, it even has a rather high abundancy. Exactly the same thing happens in the case of Amarantus spinosus and Portulaca oleracea. We have observed several times that some plants react in about the same way on a fairly heavy, moist soil as on a fairly light, dry soil; these three plants give a new illustration of this rule.

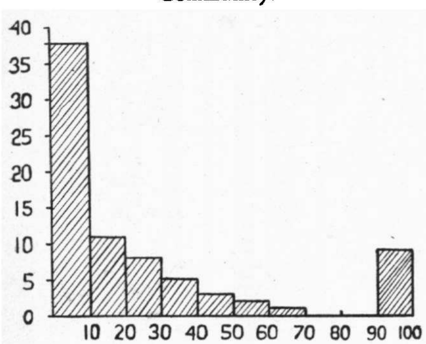
Merremia emarginata and Panicum reptans which were constant in the Panicum reptans-Gymnopetalum leucostictum-community, exclusively require a very dry top-layer, no matter whether the soil is more or less moist deeper down. These medium-heavy soils come up to that demand, because superficially they rather soon dry up. The medium-heavy soils of variant B are on the whole too moist on the surface for these plants.

Variant C, (the Athroisma laciniatum-variant) was exclusively found on heavy, very moist clay. It is practically limited to non-saline soils between the main road and the coast.

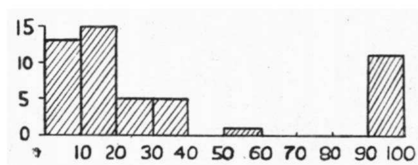
Of this variant only the number of inspections made was sufficient to determine the constants. The occurrence of Athroisma laciniatum as a constant, is very peculiar. I rarely came across this plant in the two other variants and in that case only in a very small quantity. Very peculiar is also Lippia nodiflora which is always met with in this variant, albeit invariably in few specimens. When describing the Dentella repens-Lippia nodiflora-community, we shall see that a high moisture-content is necessary for the development of this plant.

In agreement with the great moisture of the soil, Dentella repens and Fimbristylis miliacea reach the highest abundancy of the community, in this variant.

Community.



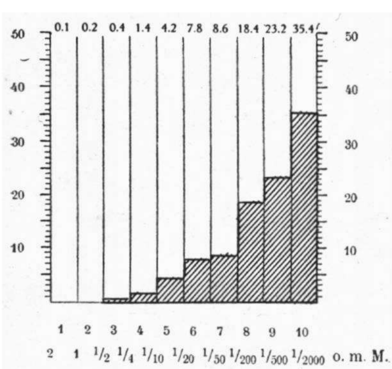
Variant C.



Constitution-diagram of the Polanisia Chelidonii-community.

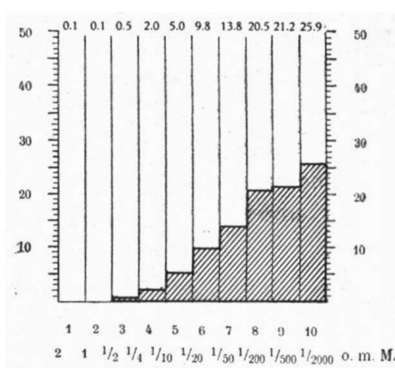
By way of example I give below a texture-diagram of each variant together with the percentage of phosphate and the moisture-content.

Variant A.



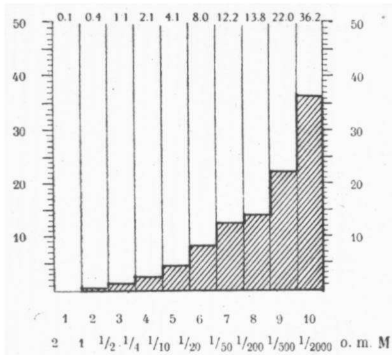
No. 4045.
Percentage of gravel 0.07 %.

Variant B.



No. 4050.
Percentage of gravel 0.1 %.

Variant C.



No. 1665.
Percentage of gravel 0.04 %.

Number	Place	Sugar-factory	Area	P_2O_5 in		Moisture
				22.9 % H Cl	2 % citric acid	
4045	Tambakredjo	Sf. Rengkol	L 6	0.042%	0.019%	9.0%
4050	Temanggoengan	„ Pleret	K 6	0.039	0.017	8.1
1665	Blawi	„ Soemberredjo	G 2	0.046	0.039	11.1

7. *Dentella repens-Lippia nodiflora-community* (Table IX).

This community chiefly occurs in the northern part of the plain of Pasuruan, on fairly heavy to heavy soils which are very damp owing to their position and which dry up very slowly on the surface only; they are often the lower parts of an area. The community never appears *immediately* after a sawah. Only much later on, when the upper layer has still more dried up, the Polanisia Chelidonii-community can develop here. During the development of the Dentella repens-Lippia nodiflora-community, the surface-layer is still too wet for this and even if Polanisia Chelidonii might be met with sporadically when the community is 4—6 weeks old, there are a few very young specimens only.

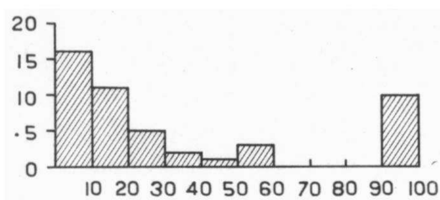
Owing to the fact that this community occurs comparatively little, the number of inspections is too slight for a statistic study. It is very probable that the 9 plants printed in italics in the table are constants. Of these Dentella repens, Eclipta alba and Panicum colonum are only moisture-indicators; they are also met with on light, moist soils. Marsilia crenata, likewise a moisture-indicator, grows especially on swampy soils. Euphorbia reniformis and Phyllanthus Urinaria occur in all communities on fairly heavy soils. For Merrima emarginata and Gymnopetalum leucostictum the substratum on which the Dentella repens-Lippia nodiflora-community occurs, is generally too moist. However, on the fields of inspections 2 and 8, Gymnopetalum leucostictum was found together with Merremia emarginata and Polytrias amaura.

8. *The Moschosma polystachyum- Sphaeranthus africanus-community.* (Table X).

The community has 10 constants of which 7 are in common with the Dentella repens- Lippia nodiflora-community. Both communities are found on moist, medium-heavy to fairly heavy soils, although the centre of the amplitude for the Moschosma polystachyum- Sphaeranthus africanus-community, has somewhat shifted to the medium-heavy type and the soil need not be so damp. A typical difference is, that the soil-layer, nearer to the surface, is always still in a more or less sour condition, when this community develops, a condition, therefore, where the Dentella repens- Lippia nodiflora-community does not occur. The ecology of the community explains that many plants are found in it which form typical constants in the Eragrostis japonica-community (Ammania octandra 18 %, Bergia oryzetorum 18 %, Eragrostis japonica 55 % Sphaeranthus indicus 100 %). It is often formed after sawahs which were left dry for a long time, as was already discussed in the description of the communities immediately appearing after a sawah (Chapter IV). It is, however, also found on lower spots of the area which lie occasionally under water during the westmonsoon.

The constants which this and the preceding community have in common, need not be discussed more fully. The newly arisen constants: *Moschosma polystachyum, Sphaeranthus africanus* and *Sphaeranthus indicus* little occur in the Dentella-Lippia-community, as is the case in the above-discussed community with Lippia nodiflora. Panicum repens which was constant in the former community, is an accessory species here.

The constitution-diagram below has its ordinary characteristic appearance.



Constitution-diagram of the Moschosma polystachyum-Sphaeranthus africanus-community

9. *Lippia nodiflora- Phaseolus trilobus-community.* (Table XI).

This community is exclusively met with on heavy soils of bad quality, chiefly on old- quaternary and also on brown or brownish-red soils. It occurs there in places where a quick drying process followed a previous state of great moisture; it is accordingly fairly often found on a sloping surface. Even the hardiest cane-varieties yield a bad produce in similar places. The moisture is at first lower than during the originating of the Dentella repens-

Lippia nodiflora-community and superficially the soil must be more dry than is the case with the Moschosma polystachyum- Sphaeranthus africanus-community. The level of the subsoil-water is mostly very low. If the soil is somewhat drier at first, the Panicum reptans- Gymnopetalum leucostictum-community is met with, if it is rather wet the Dentella repens- Lippia nodiflora-community is found; if, along with this, the level of the subsoil-water is high, the Polanisia Chelidonii-community germinates in the late east monsoon-months.

At the end of the east monsoon the communities mentioned above may be met with side by side, but the ecological conditions then prevailing on that spot — the habitat — offer no explanation for these differences in vegetation; only the conditions under which these communities *arose*, were entirely different.

The Lippia nodiflora- Phaseolus trilobus-community occurs comparatively rarely in a pure state, so that the number of inspections is not sufficient for a reliable typification. Presumably the eight species, printed in italics in table XI, are constant. The occurrence of Merremia emarginata and the disappearance of Dentella repens and Panicum colonum as constants are undoubtedly connected with the severe drying-up of these soils. Phaseolus trilobus hardly occurs in the other communities on heavy soils, except in communities pointing to the presence of calcium-carbonate, which will be discussed later on. This fact is difficult to account for.

VI. *General remarks about the east monsoon-communities discussed.*

The east monsoon-communities discussed by me occurred on young second-crop-fields, not older than 4 to 6 weeks. The watering was sufficient for their growth, the crop gave no shade yet, the land had not been weeded before and no remains of a preceding vegetation were to be found.

The constitution and the spreading of the communities appeared to be tied to certain rules, from which it follows that from the very moment of their originating, they were already formed, as such. These facts lead to the conclusion that the germination of certain plants takes place within a certain ecological amplitude.

The germination itself was not studied, that is to say, I did not examine whether the seeds of the absent plants in a certain community did not germinate at all or whether the germination stopped in a very early stage. The possibility that the latter supposition might be the case, is therefore not excluded here. I only state that in these pioneer-communities in which no mutual competition has occurred yet, no other, that is to say no very young plants either were to be found, except those noted down by me, which fact I formulated for the sake of brevity: the *germination* of certain plants takes place within a certain ecological amplitude.

I did not examine whether the seeds of the non-germinated plants were present, nevertheless. It is not very plausible, however, that this would not be so. Apart from the question whether these seeds were spread by rain or irrigation-water, by the wind or in another way, no way of spreading may be imagined, in which on one part of an area certain seeds are spread and on another part (lying near or adjacent) the same seeds would not be deposited at all. It may be imagined, however, that the *quantity* of seed and consequently the *abundancy* of a certain plant, is different on the two areas, as they always bore a different vegetation.

Besides in some places germinative seed of plants, not found on that soil, was put, after the plants which were already growing there, had been removed. This seed was scattered on a soil sufficiently damp. To control the germinative power, the same seed was deposited on a soil on which the plant occurred regularly. As it merely concerns a preliminary study, only extreme cases were examined. I only state the sowing-experiments in the Polanisia viscosa-community in the following places:

I. Merremia emarginata in the experimental square of Sindopati A (J 9), sown in May 1924 (see p. 94).

II. Polanisia Chelidonii, Merremia emarginata, Phyllanthus Urinaria, Euphorbia reniformis and Gymnopetalum leucostictum in the experimental squares of Wangkal wetan B and C (J 10), sown in January 1924 and March 1925.

III. Polanisia Chelidonii, Panicum reptans, Panicum eruciforme (a calciphilous plant), Phyllanthus Urinaria, Euphorbia reniformis, Merremia gemella and Gymnopetalum leucostictum in the experimental square of Ngawoedjasein A (J 9), sown in early August 1924.

In the above cases it appeared by means of the test-experiment, that the seed was germinative. In the beginning the development was checked every other week on an average; later on every month. The results were the following. In I there was no germination. In II one specimen of Phyllanthus Urinaria germinated and two specimens of Euphorbia reniformis which had died in 14 and 20 days respectively; for the rest no results. In III 3 specimens of Panicum reptans, all of which died in a month. No other plant germinated.

In a special study attempts will be made to find out what factors prevent the growth of these plants. In those cases in which a certain plant is constant in one community and casual in another, a determination of the percentage of germination, — in both communities, examined in many places — will have to provide a closer insight. A few more examples by way of illustration will be given.

At a mutual distance of about 20 M., experimental squares were laid out by me, in places were a different community always developed. Compare for instance square Sindopati A, in which the Polanisia viscosa-community occurred, with square Sindopati B (J 9) in which the Panicum reptans-Polanisia viscosa-Merremia emarginata-community arose. I never saw on Sindopati A, the constants only peculiar to the last-mentioned community, such as Panicum reptans (occurring in Sindopati B in hundreds of specimens), Phyllanthus Urinaria, Merremia emarginata etc. in the Polanisia viscosa-community. My other squares all gave a similar result. [1])

On Wotgalih with a light Tengger-soil (T 10) the factory-track rests on a transported subsoil of heavy calcareous clay, a few meters wide. Two meters from this track lais an experimental square. The influence of this never-weeded railway-flora on my square was clearly evident. On the heavy clay grew indeed a great many Cyperus rotundus, which thrives too on light soils, but, which, through whatever cause, is very scarce in this whole district. In this square, especially on the side turned to the track, a broad strip of Cyperus rotundus had germinated, which maintained itself. However, not a single specimen of Phyllanthus Urinaria, Phyllanthus maderaspatensis, Goodenia Koningsbergeri, Merremia emarginata, Merremia gemella, Euphorbia reniformis, etc. developed in my square, although they likewise occurred in great numbers on the soil of the track.

A more detailed description was given of the above facts, concerning the ecological amplitude of the germination,

[1]) During the three years of study I observed one exception. On the light Tengger-soil of Getah in square B (L 10), I saw in the Polanisia viscosa-community two specimens of Phyllanthus Urinaria, which were a few centimeters high on March 3 1925; in early August only they had disappeared.

because the reverse opinion is generally met with in literature. It is believed that under equal climatic-, moisture- and light-conditions, the germination is more or less independant of the properties of the soil (it stands to reason that the plants adapted to a special way of living, are excluded).

In so far as the literature was at my disposal out in the East-Indies, Clements seems to me one of the few who hold a deviating view about this. The following words are his: "The influence of the habitat upon germination is often decisive. Seeds may be carried into a number of different formations, any one or all of which may offer conditions unfavourable to germination" and "The probability of germination is usually greater in vegetation than in denuded areas etc." (Clements 1907 pag. 264). He does not state that (apart from want of light, moisture, etc.) the structure and the texture of the soil are the most decisive factors in this case. In the following quotations the more usual conception is favoured.

"Die Pflanzen sind offenbar im allgemeinen gegen den Boden ziemlich gleichgültig, wenn man gewisse extreme chemische und physikalische Verhältnisse (z. B. groszen Salzgehalt, groszen Kalkreichtum, groszen Wasserhalt) ausnimmt, *so lange sie keine Mitbewerber haben* [1]; nur einige wenige Pflanzen kann man vielleicht als in einer oder in anderer Hinsicht obligat ansehen; die allermeisten sind fakultativ, und ihr Vorkommen hängt von den Mitbewerbern ab." (Warming—Graebner, 1918. Nicht illustrierte Ausgabe p. 104).

"It is indeed probably infrequent for a species typically confined to one kind of soil to be totally unable to grow on any other soil than that on which it usualy occurs, because of its direct inimical action, though extreme soil-types such as the highly acid peats of our own country or the alkali-soils of the United States afford instances

[1]) The italics are mine.

where such direct action obviously occurs". (Salisbury 1921 pag. 202).

"Bodenstete Pflanzen gedeihen auf anderen Böden *bei Ausschaltung des Wettbewerbs.* [1]) So z. B. wachsen Salzpflanzen ganz gut auf salzfreiem Boden, Kalkpflanzen auf kalkfreiem Boden." (Rübel 1922 pag. 163).

To make these views plausible the adherents of this opinion draw our attention to the fact that practically every plant grows in botanical gardens, provided all competition is excluded (Schimper 1908 pag. 102, Warming-Graebner l.c. pag. 104, Pickworth Farrow 1917 p. 156 etc.). Fitting 1922 p. 21, discussing this competition-hypothesis in a general sense, says: "Ob die Vorstellungen richtig sind, wird aber auch erst die geographische Physiologie *experimentell* (italicized by me) zu entscheiden haben". Such an experiment should be made in the open, therefore under natural conditions.

The words of Salisbury (1921 p. 212) are not out of place here: "Culture experiments are essential but the fact that a species will tolerate certain chemical or physical conditions under the artificial protection of a laboratory experiment is no criterion of its success in competition with other species under these same conditions". Field-experiments, confirming the above-quoted opinions, are not mentioned, however.

The faulty idea of most authors concerning the ecological amplitude of the germination, chiefly finds its cause in my opinion, in the fact that, for the study of the plant-communities, they did not as a rule start from fallow lands and by doing so paid too little attention to the first stages of development. In a more stable vegetation on the other hand, the mutual competition for space and light will determine first and foremost whether the germination and

[1]) The italics are mine.

the development of the obtruding plants will be possible and the influence of the conditions of the soil will naturally be of minor importance.

From the diagnosis of the communities it appears that the number of constants, taken generally, is great. The following communities have:

Polanisia viscosa-community	9	constants.
Panicum reptans-Polanisia viscosa-community	13	„
Panicum reptans- Polanisia viscosa- Portulaca oleracea-community	8	„
Panicum reptans- Polanisia viscosa- Merremia emarginata-community	14	„
Panicum reptans- Gymnopetalum leucostictum-community	5	„
Polanisia Chelidonii-community.	9	„
Lippia nodiflora- Phaseolus trilobus-community	8	„
Dentella repens- Lippia nodiflora-community	9	„
Moschosma polystachyum- Sphaeranthus africanus-community	9	„

The communities with variants clearly circumscribed often have fewer constants, such as the Polanisia Chelidonii-community. It stands to reason that this rule is not revertible, the Glinus lotoides-community with a small ecological amplitude has only one single constant.

Accessory species of the entire community often appeared to be constant in one of the variants. This is, however, not always the case. There are even plants which seem to remain invariably accessory, such as Alternanthera sessilis which, in nearly all communities, on less good, fairly light and fairly heavy soils, varies between the constancy-classes of 30 %—50 %, without ever becoming constant.

The connection between accessory species and constants for the stationary communities was first brought into notice by the members of the Upsala-school (see for instance

Du Rietz 1921). Among other things they discuss whether, in case of enlargement of the square, accessory species will invariably become constant. My squares of 100 M^2. are very large as it is, nevertheless the accessory species in these pioneer-communities behave in the same way as in the stationary associations in squares of 16 M^2. at most. In a few cases one might be pretty sure that, even if the squares should be enlarged in our case (which is impossible, as such large homogeneous plots do not occur in nature) some accessory species would never become constant, because they are entirely absent in some districts of my experience (see for this also Du Rietz 1921 p. 182). It is probable that a few constants in several communities would become accessory, if the squares were made smaller. [1])

If the determinations for the minimum-area which Du Rietz gives as an example, are inspected (Du Rietz 1921 p.p. 148 and following) it will be noticed that there too a slight rise in the frequency of the accessory species above the minimum-area (which has been used) will be found. In a few cases, however, it is proved that nevertheless no new constants occur in the event of enlargement of the squares (Du Rietz 1925).

From the constitution-diagrams of the communities the peculiar distribution of the number of species over the different constancy-classes, was evident. The sharp demarcation between the great number of species in the classes of 90 %—100 % and the middle-classes is very striking. The middle-classes are not nearly so strongly developed, especially in the classes of 60 %—80 %, the number of species is particularly slight; on the other hand a new rise occurs in the classes of the minor frequencies. The question of these gaps in the constitution-diagram was

[1]) In the Panicum reptans-Gymnopetalum leucostictum-community, Gymnopetalum loses its constancy already at 8 by 8 M. (see p. 65).

likewise first brought into notice by the members of the Upsala-school (see du Rietz, Fries, Osvald, Tengwall 1920 and Du Rietz 1921). The rule which reminds one somewhat of the one given by Raunkiair (1918) as "loi de distribution des fréquences" (Raunkiair 1918), was represented by Nordhagen (Nordhagen 1922) as a manifestation of the homogeneity of the community. The curve of the constitution-diagram was called by him. "Homogenitätskurve" [1]). There is no doubt that this curve is connected with the homogeneity of the community, hence the fact that it occurs both in my communities and in the stationary associations of Scandinavia. This curve of homogeneity was not found by most of the Swiss investigators (see for instance Brockmann-Jerosch 1907, Rübel 1912). The supposition of Du Rietz (Du Rietz 1921 and 1923 b.), that this is owing to wrong methodics, is confirmed by the results of this study. This supposition is more plausible than that of Braun-Blanquet (1921) which gives other qualities to the Scandinavian flora than to the Swiss. The weed-flora examined by me would then have those qualities in common with the Scandinavian.

My investigation gives an answer to the question of Braun-Blanquet whether „dieser Verteilungsart allgemeine Gültigkeit zukommt" (Braun-Blanquet 1921 p. 325). It may at the same time remove the doubt about the possibility of a general application of the statistic method of the Upsalaschool (Braun-Blanquet 1921 p. 328).

We are a long way still from a biological-mathematical explanation of the curve of homogeneity. In a discussion of this problem, Du Rietz (Du Rietz 1925) thinks it necessary, in one of his latest publications, to assume for the time present that this typical distribution of dispersion holds

[1]) Du Rietz afterwards preferred the name of "Frequenzverteilungsregel" (Du Rietz 1925 p. 9).

good only for a natural, stationary vegetation; so this supposition appears to be wrong. [1]).

He also states that his later experiments „entschieden andeuten, dass die verschiedene Intensität der Bestreuung mit Ausbreitungs-einheiten der verschiedenen Arten aus der umgebenden Vegetation eine sehr wichtige Rolle spielt" (l. c. pag. 10). Now that we have seen that even for a pioneer-weed-community the homogeneity-curve holds good, neither this factor, nor the competition, nor historical factors can be of essential importance for this. Romell (Romell 1920 and 1923) succeeded in obtaining a few curves by calculation, which were in accordance with the èmpiric ones. For instance, he started from the premise that the plant-individuals react *independently* of one another on the ecological conditions. This hypothesis may certainly be applied to my pioneer-communities and then the homogeneity-curve of a similar vegetation would be explained, at least if Romell's second hypothesis, that the ecological factors combine and vary according to the rules of probability would also be right which is, in my opinion, generally very improbable.

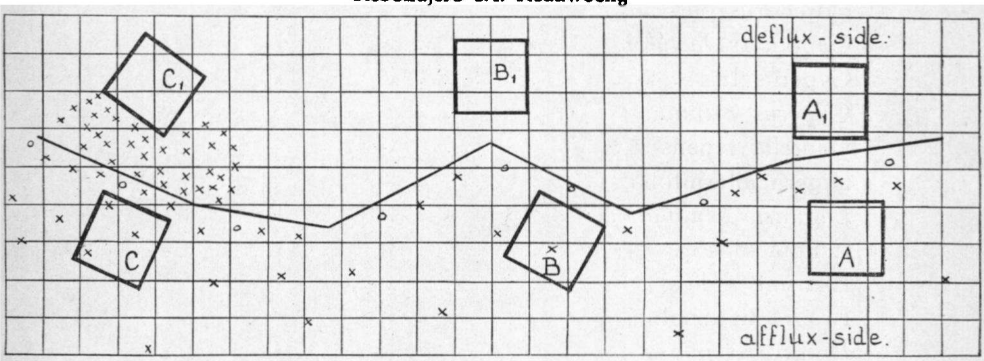
Another question concerns the delimiting of the communities, and the boundaries of plots of adjacent communities in the field. The delimiting of the communities is comparatively simple; with a few exceptions they are typical in their physiognomy.

The boundaries of plots of adjacent communities are also very sharp. A detailed example by way of illustration

[1]) It is probable that the rule does not hold good for mixed communities, which for instance develop on partly destroyed djati-woods (Tectona grandis) adjoining cultivated land. There an old vegetation partly maintained, is mingled with young culture-elements, the obtrusion of which is chiefly dependent on an accidentally greater or smaller space, so that very heterogeneous communities arise.

follows. At Kebondjero (P 10), factory Kedawoeng, lies on a fairly light soil which cracks when dry, a permeable layer of silt, which regularly gets thinner from the afflux-side of the plantation to the deflux-side. On September 22 1924 the land bore a regular Arachis hypogaea-plantation of about a month old. On the afflux-side the Panicum reptans-Polanisia viscosa-community had developed, on the deflux-side the Panicum reptans-Polanisia viscosa-Merremia emarginata-community. In the sketch below the boundary of both is indicated according to the difference in physiognomy; this boundary was sharply delimited, surely within 1 M. Phyllanthus Urinaria is a constant of the second community which never occurs in the first one, not even as a casual species. Merremia emarginata is likewise constant in the second-mentioned community and occurs in the first with a frequency of 17 % (see the tables). The spots where the last specimens of Phyllanthus Urinaria occurred are indicated to scale in the sketch.

22 September 1924
Kebondjero s. f. Kedawoeng



× Merremia emarginata   o Phyllanthus Urinaria
scale 1 m.m. is 1 Meter

From the sketch we see that the extreme specimens are always less than 2 meters from the boundary of the two communities. Within a strip of 30 meters from the boundary to the afflux-side, the place of the Merremia emarginata-plants was also indicated. In order to emphasize the contrast in abundancy, all specimens of this plant were drawn between the boundary and square C. The difference is very striking indeed. In the places indicated three squares were likewise laid out on each side. Below I have reproduced the inspections of the squares in detail; square A is inspection no. 9. of the Panicum reptans--Polanisia viscosa-community, square B inspection No. 7 of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community. All inspections are of September 21 1924.

Panicum reptans-Polanisia viscosa-community.

	A	B	C
Abutilon indicum	—	x	—
Acalypha boehmerioides	1	—	x
„ indica	—	x	—
Alternanthera sessilis	—	—	x
Amarantus spinosus	$1^1/_2$	2	2
Corchorus olitorius	—	x	—
Cynodon Dactylon	x	1	$1^1/_2$
Cyperus Iria	x	x	x
Cyperus rotundus	4	3	3
Dentella repens	x	—	—
Digera alternifolia	—	—	x
Digitaria sanguinalis	1	1	1
Eclipta alba	x	x	—
Eleusine indica	x	x	1
Eragrostis amabilis	x	—	—
Eragrostis pilosa	—	x	x
Euphorbia hirta	x	x	x
Euphorbia reniformis	—	—	x
Gymnopetalum leucostictum	x	—	—
Heliotropium indicum	x	—	x

Ipomoea triloba	2	x	—
Leptochloa filiformis	x	1	—
Leucas aspera	1	x	—
Merremia emarginata	—	x	x
Panicum colonum	x	1	x
Panicum reptans	5	$3^1/_2$	3
Phyllanthus Niruri	3	$2^1/_2$	3
Physalis angulata	x	—	x
Physalis minima	x	—	—
Polanisia viscosa	3	2	2
Polytrias amaura	2	—	x
Portulaca oleracea	$3^1/_2$	3	3
Tridax procumbens	—	x	—
Vernonia chinensis	—	—	x

Panicum reptans-Polanisia viscosa-Merremia emarginata-community.

	A_1	B_1	C_1
Abutilon indicum	—	—	1
Acalypha boehmerioides	—	x	—
Acalypha indica	—	1	x
Alternanthera sessilis	x	—	x
Amarantus gracilis	—	x	—
Amarantus spinosus	1	1	$1^1/_2$
Celosia argentea	x	—	—
Corchorus olitorius	1	x	x
Cynodon Dactylon	1	x	1
Cyperus Iria	x	—	x
Cyperus rotundus	4	4	3
Digera alternifolia	—	—	1
Digitaria sanguinalis	1	2	1
Eclipta alba	x	x	x
Eleusine indica	—	x	x
Euphorbia hirta	x	x	x
Euphorbia reniformis	1	2	2

Heliotropium indicum	x	—	x
Ipomoea triloba	1	2	—
Leptochloa filiformis	—	2	x
Leucas aspera	—	1	—
Lourea reniformis	x	x	x
Melochia corchorifolius	—	—	x
Merremia emarginata	2	1	3
Nasturtium indicum	x	—	—
Panicum colonum	1	x	x
Panicum reptans	4	5	5
Phyllanthus Niruri	2	3	2
Phyllanthus Urinaria	1	1	$1^1/_2$
Physalis minima	1	—	x
Polanisia viscosa	$2^1/_2$	2	2
Polytrias amaura	1	x	—
Portulaca oleracea	4	4	3
Senecio sonchifolius	—	x	x
Tridax procumbens	—	—	x
Vernonia chinensis	—	—	x

The plants printed in italics in both communities are constant. To emphasize this clearly, I have given in the table below the frequency and abundancy which these plants have on an average in both communities.

	Pan. rept.-Pol. visc.-comm.		Pan. rept.-Pol. visc.-Merr. em. comm.	
	K %	A	K %	A
Amarantus spinosus	100 %	$2^1/_2$	100 %	$1^1/_2$
Cynodon Dactylon	100	3	100	$1^1/_2$
Cyperus Iria	83	$^1/_2$	43	
„ rotundus	100	3	100	$2^1/_2$
Digitaria sanguinalis	100	1	93	1
Eclipta alba	33		86	×

	Pan. rept.-Pol. visc.-comm.		Pan. rept.-Pol. visc.-Merr. em. comm.	
	K %	A	K %	A
Eleusina indica . . .	94 %	1/2	57 %	
Eragrostis pilosa . . .	88	1/2	43	
Euphorbia hirta . . .	94	1/2	93	1/2
„ reniformis .	55		100	2
Merremia emarginata .	17		100	2 1/2
Panicum colonum . .	88	1 1/2	93	1/2
„ reptans . . .	100	3 1/2	100	4
Phyllanthus Niruri . .	94	2 1/2	100	1 1/2
„ Urinaria .	0		93	1/2
Polanisia viscosa . . .	100	2 1/2	100	1 1/2
Portulaca oleracea . .	100	3	100	2 1/2

If it should be asked what the causes of the occurrence of the communities are, the answer must undoubtedly run that the ecological conditions are the determining factors. The fact that every year, under equal conditions, on the same places, the same communities appear again with about the same composition, is a sufficient proof of this. I do not mean to say that it is always possible to indicate which factors or rather which complex of factors play the leading part in it. On the contrary, our knowledge is too slight for this. The words of Tansley may be applied in this case (Tansley 1921 p. 128); "It is a question of range of conditions, climatic, topographic, edaphic and biotic, within which the community does (and eventually can) exist, on the very fact that that range has limits, renders the habitat definite, though it may, in the present state of our knowledge, be impossible to define accurately." The conditions in which the community exists may of course be generally typified and therefore this has been done as much as possible in the descriptions; the soil-texture and-structure especially appeared to be the determining factors for the occurrence of a certain community. It was also evident that the experiences obtained by the cultivation of cane about the agricultural value of the soils, agree with the occurrence of certain communities. Reversely an idea of the greater or slighter success of certain cane-varieties on those soils may be formed beforehand, from the occurrence of certain communities.

When at the Brussels Congress (1910) "einheitlichen Standortsbedingungen" was included in the definition as a quality of the association and it was added that it was an ecological unit "durch den Standort bestimmt" (Flahault und Schroeter 1910 p. 24), "Standortsbedingungen" (habitat) were taken to mean the locally prevailing conditions, in so far as they influence the plants. Apart from the other objections which I have against this definition, I should not feel inclined to accept it because of this very conception of the habitat (see in this connection for instance Du Rietz, Fries and Tengwall 1918 and Yapp 1922). There are in the methodics of the inductive examination of phenomena of life and the factors influencing them, hard and fast rules which should not be ignored if one does not want to arrive at faulty conclusions. In this particular case they sinned against the rule that the factors which have influenced the phenomenon *from the originating down to the moment of observation*, should always be taken into account. From the moment that the community germinates till it is observed, a series of factors influence it, which will only exceptionally remain constant during that course of time and of which, nevertheless, the *last* link was looked upon as the *determining* one at the moment of observation. Even though — in a vegetation unchanged for ages under the equalling influence of time — that last chain may often — perhaps in most cases — be the determining-complex of factors, the essential side of the question is not changed. Also the technical impossibility in a stationary flora of experimentally linking afterwards the whole chain of factors of which the first links lie in the past, makes no difference to the inaccuracy of the conception criticised here. On the contrary the fact that we realise our scanty knowledge concerning this will be a warning against too hasty conclusions about the existence or non-existence of a connection between ecology (taken in my sense) and the flora, and it will instigate us, more than up till now, to try and see the *originating* of an association and to *watch* its course of life. [1])

If an investigator convinced of the correctness of the Brussels view, should visit my district, he would arrive at the conclusion that there is no connection here between the communities and the habitat. On the fairly heavy soils, for the rest under entirely equal ecological conditions, he might found side by side the Eragrostis japonica-community, the Glinus lotoides-community, the Moschosma polystachyum- Sphaeranthus africanus-community, the Panicum reptans- Gymnopetalum leucostictum-community and the Flemingia lineata-community. He would also find next to each other on the fairly light soils, the same Eragrostis japonica-community and the Glinus lotoides-one, but now together with the Polanisia viscosa-community. And yet

1) Du Rietz cum suis 1918 p. 155 give a few examples of associations occurring side by side and which are clearly separated, whereas the conditions prevailing locally are exactly the same. From this they conclude "Der entscheidene Factor scheint auch in diesem Falle ganz einfach in dem Umstand zu liegen, welche Art zuerst aufgetreten ist." Until it has been examined whether these associations also *originate* under equal conditions, we may — in my opinion — only conclude from the facts observed that the habitat *at the moment of observation* is not the only determining factor.

it appeared in this study that all the communities mentioned here have been determined ecologically. The first links of the chains of factors were entirely different, only the final ones are the same. The different complex of factors in the first period of their course of life was the cause of difference in constitution at the time of observing the communities, from which it also appeared, that they could *maintain* themselves under equal ecological conditions (habitat).

If the facts lead to the acceptation that the ecological factors (taken in my sense) determine the communities, how to explain then the sharp boundaries in equably changing external conditions. The same problem is a burning question in the stationary flora, in the "associations". This refers at least to those investigators, who know or assume that slow transitions are exceptions, which opinion has, however, been gaining ground the last few years. One of the few who goes deeper into the possible causes is Du Rietz. He feels strongly inclined to use the mutual competition between the associations, as an elucidating principle with which he imagines that the constants have the leading part (Du Rietz 1921, pp. 200 and following). In order to be able to use the competition as a principle of explanation, however, a complete insight as to how the associations originate, how they develop and *in what way* the competition within the association and between the associations mutually acts, is necessary first and foremost. The studies on which this insight should be based, are, however, unknown to me. Without that knowledge, the "competition" remains a kind of magic wand by which everything one wishes to have, is made to appear. In my opinion the very mistakes in present-day investigations of the associations are that too little pains are taken to see the originating of the association within view of the investigator, as we have discussed above. Some investigators do not see any problems in the sharp boundaries of the communities. Cajander (1909 p. 10) asserts the following: "Dass die Pflanzenvereine ihre grosse Regelmässigkeit und ihre scharf markierte Grenzen dem Kampfe ums Dasein verdanken, geht auch daraus hervor dass dort, wo jeglicher Kampf fehlt, der Vegetations-Teppich sehr bunt ist, sowie aber der Kampf beginnt, wird die Pflanzendecke gleich viel regelmässiger". Gleason (1917 p. 469) says that in districts with an open vegetation, the transition of one association to another, has an equally gradual course as it has in the variation of conditions. Only in the event of mutual competition between the associations there is a narrow transition-zone. In that case: "The adjacent association meets with a narrow transition-zone even though the variation in physical environment from one to the other is gradual" (l. c. p. 470). Whatever leading part the mutual competition may play in the natural, stationary vegetation, the narrow transition-zones nevertheless occur in my pioneer-communities and therefore they cannot exclusively be the result of this. I do not mean to say that the original transition-zones cannot or will not be modified owing to mutual competition. The opinion that pioneer-communities are not sharply delimited I attribute to the fact that they have not been examined up till now. My communities may probably be compared with the first stages of communities in stationary flora-districts, where a part of the vegetation has entirely been destroyed owing to inundations, or catastrophies of another kind. That in my case we have to do with an imported flora is of little or no interest (at least with respect to what has been discussed here).

If we want to find the cause of the narrow transition-zone of one pioneer-community to another, we shall have to find them exclusively in the ecological conditions themselves. In physiological processes a fairly sharp delimiting of a reaction with a gradual change of the conditions is well-known, it is called the occurence of a "limiting factor". The plant-community reacts on a certain complex of factors, as one whole, which is testified by the great number of constants occurring almost continually. This complex of factors may vary within a certain amplitude, without the group of constants changing in the least. It is therefore still called the same community, although it is quite possible, even very probable that it is the non-constants that vary dependent on the grouping of the factors within that amplitude.

The way of reaction of the group of constants may also be looked upon as a physiological process. If one of the factors of the total complex comes in the minimum, a new group of constants occurs as a reaction on the new combination of factors, in spite of the continual change of the other ones. With the intense coherence of the original group of constants, there is an odd chance that in the new combination too. a great part of the old constants will not disappear or becomes in any case accessory. The new group has of course another amplitude of the complex of factors, with which other accessory species and other numbers of abundancies are connected. The boundaries of two communities are determined by the different physiognomy on both sides and this very physiognomy is frequently first of all caused by the modification of a few constants and the transition into accessory species of others. The explanation agrees with the facts; only the occurrence of a minimum-factor is a hypothesis, which is difficult to prove.

The phenomenon of the formation of mosaic, on some soils, about which was spoken before (see for instance

p. 73 and following), is, in this area always found on spots where two or more soil-types meet and mix (for instance in the squares I 7, J 7, J 10 etc.). The phenomenon is also met with on the deflux-side of plantations where a thin silt-layer rests on a fairly heavy subsoil, which may be locally very unequal in thickness. On the setting- in of the dry season, the moisture-content appears to be very different on the spots where the formation of mosaic is found. So it is probable that the spots of the mosaic-vegetation depend on the fluctuation in the ecological conditions and the narrow transition-zone of the spots could be explained in the same way as has been done above.

An obvious question is why the general name of "communities" was used, instead of "associations", if as far as we could trace, fundamentally, the same laws hold good for both. I have not done this for two reasons. In the first place my communities have no value at all for the distribution of plant-communities on the earth. They have been formed from elements which have been imported more or less accidentally, from other countries in the course of centuries.

A great part of them can only maintain themselves in the cultivation-area proper; outside this area they are seldom or never met with. A second reason is that I will not add to the confusion already existing in the nomenclature of the sociology of plants. However differently the "association" may be defined, it has been included in the definition, or mentioned emphatically (Du Rietz c.s. 1918, Flahault and Schroeter 1910 etc.) that this term is exclusively meant for a more or less "natural" flora and therefore my communities do not fall under it. The term community (in French "groupement", in German "Verein" or „Gesellschaft") is entirely neutral.

VII. THE SUCCESSIONS OF THE WEED-COMMUNITIES.

The successions of the weed-communities will be met with especially in districts where the irrigation-water is limited or entirely wanting. Here parts of the area often lie fallow for a long time, so that the successions may gradually be seen to originate. If the last harvest took place in the east monsoon, the field remains practically free from weed, till the falling of the rains, owing to the influence of the drought, as we shall see confirmed later on in special experimental squares. The communities originating in the west monsoon on non-irrigated fallow-fields do not differ fundamentally, when young, from the east monsoon-communities on irrigated lands of the same nature. Differences in the proportions of the abundancies of the species occur, in a degree which is more or less dependent on the situation of the area and the nature of the kind of soil. This sometimes leads to the substitution of a single east monsoon- by a west monsoon-constant (as for instance Panicum reptans by Polytrias amaura); we shall refer to this when discussing the west monsoon-squares. Moreover special west monsoon-plants are seen to occur, which live for a short time only, and disappear at the setting-in of the dry season. The successions are formed very quickly and in a short time (a year at most) a comparative balance has already formed in which the changes are completed in a much slower way. I know little about this later period, as small plots only lie fallow in the area of cultivation for more than one or two years. In such a comparatively stationary succession, the west monsoon causes periodical modifications in the floral composition, which modifications decrease as the community grows denser. In this respect we may speak of an east and a west monsoon-aspect of the communities.

In the agro-geological description of the area it has been pointed out already that non-irrigated lands (tegallans) occur especially at the foot of the Tengger; there they consist almost exclusively of fairly light soils. Besides non-irrigable areas occur on the old-quaternary clay; a more special study was only made of the successions on fairly light soils; the squares laid out for that purpose will be discussed later on. A few succession-communities occurring more generally, will be dealt with below.

The Polytrias amaura- Vernonia chinensis- Tridax procumbens-community.

This community is a succession-form of the Polanisia viscosa-community, the Panicum reptans- Polanisia viscosa-community, the Panicum reptans- Polanisia viscosa- Merremia emarginata-community and the Panicum reptans- Polanisia viscosa- Portulaca oleracea-community. The ecological amplitude of this succession-community is therefore much wider than that of the preceding communities.

In Table XII a few inspections will be found in which a distinction was made between an east-and a west monsoon-aspect, surveyed respectively in the months of August to October and February to May.

Each succession-community is connected by transitions with the community from which it arose. The moment at which it is called a „succession" is, in my opinion rather a question of personal taste; the general physiognomy of the community was considered in the very first place here.

The following plants are constants for the whole year (see table): *Alysicarpus nummularifolius, Cynodon Dactylon, Euphorbia hirta, Lourea reniformis, Polytrias amaura, Tridax procumbens* and *Vernonia chinensis.*

The three last-mentioned ones contribute most to the general aspect. They are competition-proof and have a wide ecological amplitude, of which Polytrias amaura and Tridax procumbens are particularly drought-resistant. Vernonia chinensis sometimes gets bushy. In those cases the figure of the abundancy was underlined, by which I meant to express that in the estimation of that figure the degree of covering capacity was taken into account (see for further explanation p. 146 and 147).

In the west monsoon-aspect (inspections 9-16) Digitaria sanguinalis becomes constant and Amarantus spinosus occurs in greater numbers. The abundancy of these plants is among other factors dependent on the age and the density of the development of the vegetation. They can maintain the competition with the species already established for a short period only, and at the end of the west monsoon most of them have entirely disappeared. The plants which occur on tegallans only in the west monsoon, meet with the same fate, such as Aneilema nudiflorum, Cyperus compressus, Cyperus pumilus, Fimbristylis annua, Ilysanthes serrata, Lindernia crustacea and Lindernia glandulifera. These plants do not become constant, however, in the west monsoon-aspect.

Before the vegetation has assumed the typical physiognomy of the succession, transitions occur, which are often very characteristic. Dependent on the age and the proportions of competition these transitions can maintain themselves for a short or a long time. Very striking is a transition-form in which Digitaria sanguinalis predominates. I refrain from a fuller description, because, when describing the experimental squares, the subject of the development of these transitions will be mentioned again.

To the inspections Nos. 5, 12, 14 and 15 preceded the Panicum reptans-Polanisia viscosa-community, to No. 16 the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community, to Nos. 7 and 8, the Panicum reptans-Polanisia viscosa-Merremia emarginata-community. In the other inspections, the Polanisia viscosa-community preceded. The succession-form into which these communities finally pass, is the same for all. In inspection No. 16, where the vegetation was younger, Merremia emarginata and Panicum reptans still bring to mind the preceding community; however, under the influence of mutual competition both plants soon disappear.

The Polytrias amaura-Tridax procumbens-community sooner or later, dependent upon the nature of the soil, the preceding succession passes into the Polytrias amaura-Tridax procumbens-community. In my area of examination this stage is very rarely reached. Only on medium-light soils of inferior quality, and also when there is a very long period of dry weather (as in 1925) this succession is formed within a year.

The inspections in table XIII give an insight into the constitution.

On very plastic, brown, fairly light and on heavy soils strongly intermixed with lighter material, Hyptis suaveolens often predominates in great numbers. Of this Polytrias amaura-Tridax procumbens-Hyptis suaveolens-community, the following inspection gives an idea.

Semamboeng (Q 8), factory Kedawoeng. July 22 1924. Fairly heavy clay mixed with sand and gravel; unirrigable, fallow area:

Cynodon Dactylon	2
Euphorbia reniformis	x
Hyptis suaveolens	3
Leucas aspera	x
Lourea reniformis	2½
Polytrias amaura	5
Rhynchosia minima	x
Sida rhombifolia	x
Tridax procumbens	3
Vernonis chinensis	x

After some space of time the Polytrias amaura-Tridax procumbens-community passes on very dry spots into the Polytrias amaura-Tridax procumbens-Themeda arguens-community. The community assumes an entirely different aspect owing to Themeda getting dominant. It only occurs over small expanses on elevations of the area, on wide, little- trodden paths etc.; it is mostly disturbed.

The following inspection gives an example of this succession-form. Getah, factory Gayam (L. 11). August 17, 1925. Light Tengger-soil with much gravel and stones. A sloping area, unirrigable and always fallow.

Alysicarpus nummularifolius . .	x
Boerhavia diffusa.	2
Cynodon Dactylon	1
Desmodium triflorum	x
Euphorbia hirta	x
Ipomoea obscura.	x
Lourea reniformis.	1
Polytrias amaura.	3
Themeda arguens.	5
Tridax procumbens	2

The Polytrias amaura- Flemingia lineata-community (table XIV).

Just as the Polytrias amaura- Tridax procumbens- Vernonia chinensis-community is the most important succession on the fairly light soils, so is the Polytrias amaura- Flemingia lineata-community the most predominant one on fairly heavy soil-types. The formation of this succession has a rather slow process, so that the inspections took place on areas which had been lying fallow for some length of time. As these areas are almost exclusively limited to old-quaternary clay, this community could not be surveyed over its entire ecological amplitude.

Alysicarpus nummularifolius, Cynodon Dactylon, Desmodium triflorum, Euphorbia reniformis, Flemingia lineata, Merremia emarginata and *Polytrias amaura* are probably constant. Of these plants Alysicarpus nummularifolius, Cynodon Dactylon and Polytrias amaura are in common with the Polytrias amaura- Tridax procumbens- Vernonia chinensis-community. Lourea reniformis was substituted by Desmodium triflorum. Merremia emarginata appears to be more competition-proof here than on fairly light soils. In the neighbourhood of Kepoeh (I 11) for instance a variant rich in Hyptis suaveolens occurs on heavy, brown, calcareous clay.

The Flemingia lineata-Themeda arguens-community.

Although the communities which are formed on heavy, red clay were generally not discussed, I make an exception for this very typical succession. The community is limited to red clay. On old-quaternary clay too I occasionally met with a Themeda arguens-variant, which had, however, a different floristic composition.

The inspections were of course limited to the non-irrigated fallow areas, mostly parts lying higher, in the area of the Alkmaar-plantation. To this fact it may partly be attributed that the number of constants (that is to say 10) is so unusually great (see Table XV).

Along the roadsides, in yards etc. a number of successions occur which are entirely under the influence of the constantly returning cutting of the grass. I refrain from a discussion of these communities.

VIII. THE HALOPHILOUS AND CALCIPHILOUS FLORA.

For various reasons it is desirable to deal with the halophilous and calciphilous plants in a separate chapter. This vegetation is so widely different from the one described up to the present, its apparent state of being tied to one chemical factor (sodium-chloride or calcium-carbonate) is so typical, that this alone justifies already a special discussion.

A great part was studied on fallow fields. Saline soils are little suited for cultivation or not at all, especially in the east monsoon, when the salt-content of the surface soil increases owing to the water rising capillarily. Where the conditions are most favourable, sugar-cane and maize are occasionally grown with varying success. Also on soils with a higher salt-content the native occasionally grows rice and maize in the west monsoon; even in the east monsoon maize or watermelon (Cucumis sativus) is sometimes grown in similar places. The plantation is often a failure and the fields remains fallow for the rest of the time.

The investigation into the calciphilous flora took place almost exclusively on the non-irrigated, calcareous old-quaternary hilly soils of Bangil as far as the village of Kraton together with a few small isolated, non-irrigated elevations of the area (Kedjajan I 8—J 8, Kepoeh I 9—I 10, Dawoehan K 10 and L 10, Blimbing 2, B 13 and C 13).

A. The Halophilous flora.

Along the north coast, from the extreme east-point of the field of investigation beyond Bangil in the west, behind the fish-ponds, lies a strip of heavy, non-calcareous or calcareous clay, of which the percentage of Na Cl (and sometimes N_2 CO_3) is so high in some places that the cultivation of sugar-cane and other crops suffers from it, or sometimes fails entirely.

The places where crops are occasionally grown and which were therefore examined, have a percentage of Na Cl ranging between $\pm$ 0.7 % and nearly 0 %. Varying with this, at the same distance from the coast, areas are found which are practically salt-free. The salinity of the surface-soil also changes with the season: in the rainy period it is considerably lower than in the east monsoon.

The constitution of the halophilous vegetation is dependent on:

1. The percentages of $NaCl$ and Na_2CO_3 (and very likely the percentage of Na_2SO_4).
2. The moisture-content of the surface-soil and the level of the subsoil-water.
3. The texture of the soil.
4. The age of the community (place in the series of succession).

The combination of these factors makes the study of the ecology and of the analysis a very difficult one. For a statistic study of communities, the area is not suited at all; the number of places where a certain community occurs, is too slight for this; this objection may also be raised for a study of the ecology. An insight into the ecology of the communities would also have required a separate, elaborate study. I have experienced that among other things the conditions during the originating of the vegetation, have a great influence on its future composition. Since the amount of salt of the surface strongly varies, as has been said above, one would for a thorough investigation in the first place have to dispose of a great number of soil-analyses from the time of the originating of the community down to the moment of observation. As such an elaborate investigation could not be made for the present a simple description of the vegetation should suffice.

On heavy calcareous as on non-calcareous, very moist, saline soils (the subsoil-water to a depth of 40 cm. at most) the *Bacopa Monnieria-Lippia nodiflora-community* is formed. Besides the two plants from which the community derives its name and which are mostly dominant in the dampest places, several Fimbristylis-species are met with, such as Fimbristylis glomerata, -complanata and -ferruginea. For the rest occur for instance Zoysia Matrella and Sporobolus virginicus, in particular on fairly dry spots within the ecological amplitude of the community, Panicum repens and Eriochloa ramosa too are mostly met with.

The community *as a whole*, occurs exclusively on saline soils. In my field of study Bacopa Monnieria [1]) is chiefly limited to saline soils. The plant was only exceptionally found on non-saline, very moist, heavy clay and only a few specimens of it; in other districts in the island of Java with a short east monsoon, it is regularly met with on non-saline soils, however. Fimbristylis glomerata also grows on heavy soils which are very moist in the west monsoon and get very dry in the east monsoon; it is social under these conditions on the old-quaternary clay of the hilly district round Bangil. Eriochloa ramosa and Panicum repens too occur on every kind of heavy, non-saline soils (see the Polanisia Chelidonii-community). Lippia nodiflora is one of the constants of the Dentella repens-Lippia nodiflora-community and the Lippia nodiflora-Phaseolus trilobus-community. On saline soils, the plant has a somewhat different physiognomy; the leaves are smaller, less deeply indented and succulent; its entire structure is more compact. Bacopa Monnieria has a typical salt-physiognomy (Warming-Graebner 1918, p. 315 and following). This plant has creeping shoots and glabrous, non-indented, fleshy leaves.

It is striking that in this very hygrophilous community, Dentella repens, which likes moist soils, does not occur; it seems to be halophobous.

On heavy, fairly moist, saline soils (light, saline soils are entirely absent in my area) having a lower level of ground-water [2]) than the soils in the before mentioned community, the *Bacopa Monnieria-Sporobolus virginicus-community* is

[1]) This plant never bears fruit in the island of Java and multiplies itself only vegetatively by means of its creeping shoots. The same holds true for Panicum repens, which propagates itself only by means of its deep-lying rhizomes.

[2]) For instance at a level of ground-water to a depth of 1.25 M. in the west monsoon.

met with. In this community Sporobolus virginicus, which I found exclusively on saline soils, is dominant. Bacopa Monnieria and Lippia nodiflora still occur in fairly large numbers, especially in the west monsoon, on the dampest spots within the ecological amplitude of the community; they occur only sporadically on the driest places. Zoysia Matrella also occurs much, where as Cynodon Dactylon, Cyperus rotundus, Eriochloa ramosa and Panicum repens are likewise always to be found. The soil is generally too dry for the Fimbristylis-species.

If the area lies somewhat higher, so that the soil dries sooner, the *Zoysia Matrella-Lippia nodiflora-community* is sometimes found, typified by a bed of Zoysia with Lippia scattered regularly. Sporobolus virginicus, Eriochloa ramosa and Merremia emarginata occur with an occasional specimen of Bacopa Monnieria. Zoysia Matrella mostly grows rather near to the coast; it is not limited, however, to saline soils. On the soils which are typified by this community, the crop grows irregularly, but it does not die off. On fairly moist spots of the same area. Diplachne polystachya, a grass, which seems to point to the presence of salt, occasionally forms, as most dominant species, a community.

On the highest and driest spots of the area Sporobolus virginicus is sometimes social. This "*Sporoboletum virginici*" (Warming—Graebner 1918 p. 330) was also met with on a light soil with a thin surface-soil behind the mangrove, east of Probolinggo. Sporobolus virginicus seems to be limited to saline soils.

The *Xerochloa imberbis-community* frequently occurs near the sea, for instance, between the fish-ponds and behind the mangrove. In the area of cultivation it is rarely met with and if at all, exclusively in places where the crop dies off entirely. I found it where depressions occur in the general level of the ground and where the soil had a jelly-like aspect and the soil-water was yellow. The community is nearly completely composed of Xerochloa imberbis itself and is only occasionally mingled with other halophytes, occurring sporadically. It strikes one at once, because it is quite different from its surroundings and is sharply delimited.

On May 27 1924 near Tampoeng (P 6), on nearly 2 K.M. from the coast a sample of the ground-water was taken, right in the middle of this community (at a depth of about 15 cm.). This water was yellow and had a strong alcalic reaction. The amount of sodium-chloride was 0.093 %, and of carbonate, expressed as Na_2 CO_3, 0,325 %. With a narrow transition of a few decimeters from the Xerochloa-community, a finely developed Bacopa Monnieria-Lippia nodiflora-community occurred. Samples in the middle of the spot, at a distance of about 15 M. from the Xerochloa-sample, the analyses of the ground-water at the same date indicated a percentage of salt, expressed as Na Cl, of 0.020 %; the water was colourless and had a neutral reaction; a good illustration of a rapid variation of conditions "auf kleinstem Raum" (Kraus 1911). No crops are ever grown on either spots. Nothing is known about the salt-contents which *determined* the occurrence of the community (0.020 % is peculiarly low). It was only stated that the community could *maintain itself* at this percentage.

Where the soil is constantly or periodically permeated with salt water, so especially near the sea, between or in the fish-ponds, the Paspalum vaginatum-community, with Paspalum vaginatum as the strongly dominating species occurs on not too dry spots. In the area of cultivation this community only occurs — at least in the west monsoon — on saline soil lying under water. Other social plants, still nearer to the coast, such as Suaeda maritima and Sesuvium Portulacastrum, I shall not deal with here, as they are not met with in the area of cultivation. The fern

Acrostichum aureum, which often forms a typical community behind the mangrove, I occasionally found on low, saline spots in a cane-plantation (K 3, L. 3). The Acanthus ilicifolius-community which is found within and behind the mangrove is not limited to wet, saline soils; it occurs along river-sides even at a sea-level of 300—400 M., as far as the Southern mountain-range.

In the beginning of this chapter it has been already stated that, in the area discussed here, spots occur where the soil is so salt that the crop dies off, whereas it has a normal growth quite near and the weed-vegetation does not point to salinity either.

In literature the opinion is often held that halophytes are limited to saline soils exclusively because there only they are able to withstand the competition with other plants. So it is imagined that if competition is excluded, halophytes will also thrive on non-saline soils and halophobous plants on saline soils. In chapter VI, when dealing with the ecological amplitude of the germination in general, I already emphasized this. Now I still cite the opinion of Schimper (Schimper 1908 p. 102). "Die Concurrenz stärkerer Formen schlieszt aber die Halophyten von allen Standorten, mit Ausnahme der salzreichen aus." The same opinion will be found for instance in Jost 1924 I, p. 161.

As the conditions of the area in this district are very favourable for such an investigation, I tried to obtain a closer insight into this question. For this purpose some experimental-squares were laid out.

The three following squares, each of 100 M^2, lay at about 2 KM. from each other, in one line from east to west, about 3 KM. from the coast.

1) Tampoeng (P 6), a very moist, saline part, level of the ground-water about 30 cm. below the surface.
2) Petoegoeran[2], (O 6) a very moist spot, with fairly

heavy, non-saline clay, and level of ground-water at 40 cm. below the surface.

3) Djarangan (N 6), a sufficiently moist part on heavy saline clay with a level of ground-water of 1.25 M. below the surface.

Before the squares were laid out, the Bacopa Monnieria-Lippia nodiflora-community was met with on 1); on 2) the Polanisia Chelidonii-community; on 3) the Bacopa Monnieria-Sporobolus virginicus-community. On the spots where the squares were laid out, the vegetation was carefully pulled out in December 1923, after which the soil was ploughed up a few times. After this tillage the surface was entirely free from plants. It is very likely that deep-lying subterranean organs of plants, such as Panicum repens, Sporobolus virginicus and Cyperus rotundus were, very probably, partly left behind in the soil, this may too have been so with fragments of creeping shoots and runners, which probably remained partly vital. This is of no interest to us because my aim was to make only the surface free from plants, through which there might be an opportunity to all weeds to germinate and to develop further. What seeds were to be found in the soil of the squares was not examined. Apart from the question whether the spreading of these seeds is mostly caused by rain or irrigation, by the wind or by animals, it would not seem likely that on the saline spots the seeds and rhizomes of halophilous plants would be found and on the non-saline spots exclusively those of the halophobous plants, especially because plots of both kinds occur side by side and arbitrary scattered. (see in this connection also chapter VI).

The vegetation re-established itself much slowlier on the saline squares 1 and 3 than on the non-saline square 2.

In the middle of June 1924 the half of each square was again ploughed up and cleaned — I call this the "east monsoon-half" as against the "west monsoon-half", which had been allowed to develop undisturbed since Dec. 1923.

The non-saline square on *Patoegoeran* will be first dealt with. Owing to the surrounding sawahs the square lay at first under water. In early April 1924 the water had disappeared and a normal Dentella repens-Lippia nodiflora-community developed. After the middle of June it was still rainy and also owing to a high level of ground-water, the soil was so moist that on the east monsoon-half too this community developed (the constitution on December 7 1924 will be found in table IX, inspection No. 4). If the east monsoon had set in earlier, the soil would have dried superficially so much that on the east monsoon-half the Polanisia Chelidonii-community might have been expected. Now Polanisia Chelidonii germinated in early November only and so much room had already been taken up then by the strongly developed Dentella-Lippia-community that no more than a few plants appeared.

Although saline plots with a halophytic vegetation were found at a near distance, not a single halophilous plant developed in the non-saline square. The Dentella repens-Lippia nodiflora-community had the same constitution here as in other places in the neighbourhood of which no halophytic vegetation is to be found at all.

Square Djarangan. The sugar-cane died off entirely in the year 1923 where this square was laid out; maize too is often a failure here. The soil is drier than in the two other squares; besides the level of the ground-water is nearly 1 M. lower than on Tampoeng. On June 10 1924 the analysis of the ground-water gave following results:

Dry matter (measured by drying at 105° C.). .	1.07 %
Chlorides (expressed as Na Cl).	0.70 %
Sulphates („ „ $Na_2 SO_4$)	0.29 %

The water was colourless and neutral and contained a fair amount of calcium-carbonate. In early January 1924 the square was ploughed and cleaned, as has been described above for the square of Patoegoeran. Here too, half of the flora was removed at the end of June. The development had a slow process, although it was in the middle of the wet season. On February 11 1924, more than a month after it had been cleaned, less than 5 % of the field was covered. Sporobolus virginicus formed small groups, scattered at a regular distance and it had most individuals. Then followed Panicum repens with about 30 specimens (all of them included, even the very young ones). There were about the same number of Cynodon Dactylon; Lippia nodiflora and Bacopa Monnieria had each about 10 specimens. Next one specimen of Eriochloa ramosa, 5 of Zoysia Matrella, 2 of Cyperus rotundus; one Dentella repens, one Glinus Spergula Pax (a plant which occurs little here in contrast with Glinus lotoides L.), for the rest *nothing at all*. The number of specimens increased very slowly. As new plants occurred Portalaca oleracea (one specimen). Eragrostis japonica (a few specimens), Gymnopetalum leucostictum (one specimen), Eclipta alba (3 specimens), Panicum colonum (one specimen) and finally a fairly great number of Merremia emarginata and Sphaeranthus africanus. The one specimen of Dentella repens soon turned yellow and died off; Portulaca oleracea too lived for a few months only.

Towards the end of May the vegetation in the square had practically reached its full development. On May 22 1924 the flora was as follows:

	May 22 1924	November 25 1924
Bacopa Monnieria	2	$1^1/_2$
Cynodon Dactylon	2	2
Cyperus rotundus.	2	2
Eclipta alba	(3 spec.)	(1 spec.)
Eragrostis japonica	(5 „)	(dead)
Eriochloa ramosa	1	1

Glinus Spergula	(1 spec.)	(1 spec.)
Gymnopetalum leucostictum	(1 „)	(1 „)
Lippia nodiflora	3	$3^1/_2$
Merremia emarginata . . .	$1^1/_2$	1
Panicum colonum	(1 spec.)	(3 spec.)
„ repens	2	2
Portulaca oleracea	(1 spec.)	(dead)
Sphearanthus africanus . .	$1^1/_2$	x
Sporobolus virginicus . . .	2	3
Zoysia Matrella	3	4

So after June there was little change in the constitution. Only Zoysia Matrella and Sporobolus virginicus had rather strongly increased in number. Of Bacopa Monnieria a few specimens were dying off or had died off with peculiarly big, brown spots on the leaves; I did not count these. Merremia emarginata too had a fairly large number of dead, brown withered specimens, just like Sphaeranthus africanus. On the east monsoon-half, where the west monsoon-flora had been removed in the middle of June, a Zoysia Matrella-Lippia nodiflora-community had developed.

On November 25 1924 the east monsoon-half bore the following plants:

Alternanthera sessilis . . .	(1 spec)
Bacopa Monnieria	(a few small specimens)
Cynodon Dactylon	x
Cyperus rotundus	1
Eriochloa ramosa	x
Lippia nodiflora	$2^1/_2$
Merremia emarginata . . .	1
Panicum repens	x
Sporobolus virginicus . . .	2
Zoysia Matrella	5

Neither in this square did a single plant develop which one might not have expected there and which ought to be expelled later on by the competing halophilous flora more adapted to the soil. [1]) Eragrostis japonica is a plant which always occurs on saline sawahs; it is quite natural that it died off about October. No more was the one specimen of Portalaca oleracea expelled by competitors, it probably died off because the salt-concentration became too high. Bacopa Monnieria may finally have died off for the same reason. Sphaeranthus africanus withered, which it did likewise on non-saline spots in the neighbourhood. The constants of the Dentella repens-Lippia nodiflora-community (those, which are not found in the halophilous communities) which, owing to the moisture-conditions in the west monsoon might have occurred, just like those of the Polanisia Chelidonii-community in the east monsoon, were not met with at all or only one single specimen.

Tampoeng. This square has a very moist soil and a low level of ground-water down to a depth of about 30 cm. below the surface. The sugar-cane had failed here before. The square was opened in December 1923, just like the two other squares. To prevent repetitions I shall refrain from a detailed description of the development. It was striking that the flora developed still more slowly here than at Djarangan.

Panicum repens appeared first, then there was a stand-still; nex came Bacopa Monnieria, Eriochloa ramosa, Lippia nodiflora, Fimbristylis ferruginea and-glomerata, then another stand-still etc. Below a few examples of the composition of the flora are given.

[1]) On the heavy, saline soils of Djarangan and Tampoeng were also sown germinative seeds of Polanisia Chelidonii, Phyllanthus Urinaria, Heliotropium indicum, Eclipta alba and Dentella repens. Of the three first-mentioned species not a single one developed; of the two last only a very slight percentage, which, however, died off, after some time, without a single exception. In a special study and with more material it will be examined, to what factors this bad development is due.

	July 30 '24	Nov. 7 '24	Febr. 28 '25
Bacopa Monnieria . . .	3	3	$2^1/_2$
Chloris barbata	—	x	—
Cynodon Dactylon . . .	$1^1/_2$	2	1
Eriochloa ramosa. . . .	x	1	1
Fimbristylis complanata .	$2^1/_2$	3	2
„ ferruginea .	1	1	1
„ glomerata. .	2	2	$2^1/_2$
Ipomoea verrucosa . . .	x	x	—
Lippia nodiflora	2	3	2
Panicum repens	2	$2^1/_2$	3
Paspalum scrobiculatum .	1	1	—
„ vaginatum . .	x	2	2
Sporobolus virginicus . .	—	x	x
Zoysia Matrella	x	—	x

When comparing the list of Nov. 7 1924 and February 28 1925 the influence of the mutual competition is evident. *But this competition acts only within the group of salt-resistant plants.* A destruction of other plants outside this group was not observed. On the east monsoon-half on Nov. 7 1924 only a few specimens of Panicum repens and one specimen of Xerochloa imberbis had developed, in spite of the soil being very moist. This bad growth is probably due to the high salt-content in the superficial soil-layer in the east monsoon, owing to which the soil was covered with a white thin incrustation of salt.

Finally in a part of *Djarangan* I examined the development of the Polanisia Chelidonii-community on non-saline spots, in comparison with those of the Bacopa Monnieria-Sporobolus virginicus-community on saline spots, lying quite near or amongst them. The occasion for this study was the very unequal growth of the sugar-cane on these spots in the year 1923-'24. Owing to constant weeding and the more or less shading effect of the crop later on, a possible relation between the flora and the condition of the cane could not be observed; the bad and good spots were, however, noted down. When the cane had been reaped, a part was planted with maize, with fallow spots in between. On Nov. 26 1924, when the maize had grown about $2\frac{1}{2}$ months, the weed-communities were inspected and were at the same time sampled on sodium-chloride. In October and November 1924 it had rained and the sodium-chloride had partly washed out to be sure. [1]). Except near sample No. 6, where there was a sudden depression in the surface and an entirely different halophytic community occurred, the field was entirely flat. On the flat part the level of the ground-water water was 1.25 M. below the surface.

The sketch below indicates the place of the samples:

Djarangan Sf. Kedawoeng.

26 November 1924
20 m.M. = 100 M.

The first number in parentheses indicates the percentage of Na Cl, the second, the percentage of $Na_2\,SO_4$.

6 (0.13, 0.16)

..............................depression in the area

square

(0.36, 0.65) 4 — 5 (0.04, 0.08)

2 (0.04, 0.10)

(0.20, 0.89) 1 — 3 (0.04, 0.13)

7 (trace, trace)

[1]) The field was several times irrigated too.

The samples 1—2, 4—7 were taken at a depth of 45 cm. [1]). Sample 3, on the same spot as sample 2 was taken at a depth of 15 cM. by way of comparison; the result of the analysis is about equal to that of the sample at a depth of 45 cm. With sample 1 the ground-water was also examined (1.25 M. below the surface).

It contained 0.28 % $Na\,Cl$ and 0.43 % $Na_2\,SO_4$. It appeared that bad plots of the maize agreed with the bad plots of the sugar-cane surveyed before, and the analyses indicated there the highest amount of salt. Sample 6 was an exception. The condition of the crop was worse here than the percentage of salt (according to the analysis) would lead us to expect. It is possible that the salt had washed away sooner here during the rains than on higher-lying areas; as has been said before, the vegetation was also different here. How much higher the salt-content was before, appears from the sample taken on June 10 1924 in the square on the level part. At that date the ground-water contained an amount of $Na\,Cl$ of 0.70 % and of $Na_2\,SO_4$ of 0.29 %.

I had followed the development of the flora on the various sample-plots ever since its originating.

A few floristic inspections were made round each sample-plot, where the vegetation had an equable development and where the crop had no shading effect. Round sample 1 the condition of the maize was bad, the crop had not yet died off, however. The sugar-cane died off locally. The vegetation formed the Bacopa Monnieria-Sporobolus virginicus-community. The same community was found round the spot of sample 4, where the maize had nearly died off, just like the sugar-cane before. At sample 6 Diplachne polystachya occurred socially, Zoysia Matrella

[1]) The measurements of the percentage of dissoluble chlorides and sulphates in the soil, took place by shaking the air-dry soil with five times the quantity of distilled water for an hour.

and Sporobolus virginicus were frequent. On the spots where samples 2, 5 and 7 had been taken, the condition of both the maize and the sugar-cane were nearly or entirely normal; on all these spots was to be found the Polanisia Chelidonii-community, variant A, which save for the presence of a few specimens of Sporobolus virginicus and Zoysia Matrella, was entirely normal. As an example I give one inspection round sample 1 and one round sample 7.

Sample 1. NaCl 0.20 %, Na_2SO_4 0.89 %, entirely dissolvable in water 1.12 %.

The Bacopa Monnieria-Sporobolus virginicus-community.

Bacopa Monnieria	3
Cynodon Dactylon	4
Cyperus rotundus	2
Eriochloa ramosa	x
Euphorbia reniformis	1
Gymnopetalum leucostictum	x
Lippia nodiflora	$3^1/_2$
Panicum repens	$2^1/_2$
Sporobolus virginicus	$2^1/_2$
Zoysia Matrella	$3^1/_2$

Sample 7. A trace of NaCl, a trace of Na_2SO_4, entirely dissolvable in water 0.11 %.

Polanisia Chelidonii-community, variant A.

Cynodon Dactylon	x
Cyperus rotundus	$2^1/_2$
Dentella repens	1
Euphorbia reniformis	2
Fimbristylis miliacea	1
Gymnopetalum leucostictum	1
„ quinquelobum	x
Heliotropium indicum	x

Ipomoea obscura	x
Lippia nodiflora	x
Merremia emarginata	$1^1/_2$
Panicum colonum	1
Phyllanthus Urinaria . . .	1
Polanisia Chelidonii . . .	$3^1/_2$
Sporobolus tremulus	x
Zoysia Matrella	x

From the examination on Djarangan finally appears the following:

1. On the sample-plots with a higher amount of salt a halophilous community invariably developed; on the spots with a low or a very slight percentage of salt a practically normal Polanisia Chelidonii-community was found (apart from the few specimens of Sporobolus virginicus with a percentage of NaCl of 0.04 %).
2. The communities are sharply delimited, no transitions occur.
3. The communities are pure, that is to say on the non-saline plots no halophytes develop, neither does the reverse occur.

In consequence of the preceding, the conclusion may therefore be drawn, at least in this area, that the facts do not confirm the opinions held in the quotations on page 123.

My observations did not give any countenance to the conception that, mutual competition excluded, halophilous and halophobous plants would form an intermingled vegetation on soils, where, apart from salinity, the conditions are equal. It is possibly, although it seems very unlikely to me, that a small number of halophobous seedlings developed in the saline squares (and reversely in the non-saline ones), which died off soon. Even if this had been so, these seedlings would have died off, because the soil-conditions were too unfavourable for them and not owing to mutual competition, which could only occur much later on, both in the squares and in the weed-communities.

From the above, it does not follow of course, that the plants constituting the halophilous communities, should be limited to saline soils. On the contrary, any plant may occur within a certain ecological amplitude (see chapter VII) and I already pointed out before, that the number of obligatory salt-plants is comparatively small. Only for the last-mentioned plants sodium-chloride is an essential component part in the complex of factors, which determines the occurrence of the plant, with which the restriction should be made yet: under the climatic conditions of this area. For the other plants, the presence of sodium-chloride is only essential under certain external conditions and it loses its limiting effect for the occurrence of the plant when the conditions change. Lippia nodiflora is not a plant pointing to the presence of salt, yet, in the examination on Djarangan, described above, it was exclusively confined to the halophytic-communities. On non-saline spots, where the Polanisia Chelidonii-community arose, it could only have occurred, if the soil had been much damper (see chapter V, 7). Many more instances of this might be given. [1]

B. The calciphilous flora.

As I have said before, the investigation into the calciphilous flora had to take place chiefly on the hilly area between the areas D 3—5 to I 3—5. This area is widely different from the rest of my field of experiment and is very interesting in many respects. The soil consists for

[1] I remark that in our case the salt may not be substituted "for drought" (R ü b e l 1922 p. 164). Lippia nodiflora indeed, always germinates on non-saline soils at a *higher* amount of moisture than at which Polanisia Chelidonii germinates.

the greater part of very heavy, impermeable, black to blackish-grey clay with calcium-carbonate-concretions, for a small part of similar, but less heavy, more permeable clay containing less calcium-carbonate, and finally for a very small part of calcareous sand. The soil-layer is mostly very deep, only on a few spots the calcareous tuff lies near to the surface. The area is somewhat undulating, the level parts vary with lower and higher parts within a short distance. From the fish-ponds the area rises southwards to a height of about 70 M. Only in some parts native cultivation is met with. Especially in the east monsoon, maize, water-melon, cucumber, some peanuts are grown, for the area is not irrigated. In the west monsoon, the rainwater sinks slowly down into the impermeable clay and the lower spots are partly under water. In the east monsoon, however, the soil dries up, showing wide cracks of a depth of over 1 M. These edaphic factors in connection with the climatic ones (less than 2 M. of rain and a dry period of 4—6 months, Warming—Graebner 1918) give to this area a savannah-like character. On the non-cultivated parts, trees and shrubs grow — at a fairly great distance from each other — among which Gramineae and Cyperaceae characterize the flora. Neither is this area undisturbed, owing to the fact that it is used here and there for pasture-land and that fire-wood is sometimes cut there. At the height of the west monsoon a tall growth of grass is found there; in the middle of the east monsoon the area is dry and arid. To some typical parts the description of Warming-Graebner 1918 in chapter 107 of the Brazil Campos may be applied; here the "Obstgarten-ähnliche Character" is striking too. The trees are low in stature, 5 M. on an average, a few higher only; several are armed with thorns. A few shed a great part of their foliage in the middle of the dry season and sprout again before the setting- in of the rains, just like the djati-culture wood (Tectona grandis), which occupies a small part of the area. Typical are Borassus flabelliformis, Odina Wodier (deciduous), Protium javanicum (thorny twigs), Feronia elephantum (thorny), Feronia lucida (thorny twigs), Erioglossum edule (deciduous), Azadirachta indica, Bauhinia malabarica, Cassia Fistula, Morinda tinctoria, Gossampinus heptaphylla (syn. Bombax malabaricum). Greater is the number of bushes or bush-like trees; most of them bear vigorous thorns. The important ones are: Zizyphus Jujuba and Zizyphus Oenoplea, Vangueria spinosa, Capparis sepiaria, Flacourtia indica, Dichrostachys cinerea, Acacia tomentosa, Acacia farnesiana, Streblus asper and Azima sarmentosum; all of them are thorny. Also Allophylus Cobbe, Jasminum pubescens, Jasminum didymum, Brucea amarissima, Bridelia stipularis, Mezoneurum pubescens, Acacia leucophloea, Phyllanthus reticulatus and Jatropha Curcas. None of these shrubs or trees is limited to calcareous soil. They are plants of a dry area, some of which prefer heavy soils, others, on the other hand also occur on light, dry soils. Numbers of climbing plants are formed in the trees and shrubs.

The Gramineae and Cyperaceae have the leading part in the flora, the latter especially in depressions of the soil-level.

The principal Gramineae are: Andropogon pertusus, Andropogon caricosus and rarer Andropogon contortus. Further Ischaemum aristatum, Ischaemum timorense, Rottboellia exaltata, Sclerachne punctata, Polytrias amaura, Themeda arguens and Apluda mutica, among which the Andropogon- and Ischaemum-species are most predominating; most of them are perennial plants. The Cyperaceae are for the greater part Fimbristylis-species, especially Fimbristylis glomerata, -ferruginea and -monostachya occur much, less numerous are Fimbristylis miliacea. Among the dicolytedonous herbs which take up far less important position than the Gramineae and Cyperaceae, Indigofera glandulosa is met with and likewise Indigofera trita and-trifoliata; Tephrosia pumila and -spinosa, Neptunia javanica, Polygala javana, Stylosanthes sundaica, Vitis trifolia, Euphorbia reniformis, Ipomoea obscura, Corchorus acutangulus and -trilocularis, Striga lutea, Goodenia Koningsbergeri, Flemingia lineata and less numerous Flemingia strobilifera.

In the height of the west monsoon among the tall green plots, lower parts, made striking by their brown colour, are seen. Communities are found here in which Fimbristylis-species, especially Fimbristylis ferruginea and -glomerata are dominant and which form a fairly open vegetation. The bottom of these depressions is very marshy and covered with a layer of algae which dry into a thin film in the east monsoon ("meteor-paper"). When the Fimbristylis-species have come to a resting-period in the east monsoon, drought-resistant grasses often develop in these depressions of the area, especially Andropogon-species, owing to which the difference between west and east monsoon-aspect is very great and drought-resistant and moisture-loving plants are met with in one community (see Saxton 1924 "mixed formations in time").

On the higher parts of the area especially Andropogon contortus and-pertusus and the shrubby Flemingia lineata are social.

For the study of the calciphilous plants, the cultivated area of this district has to be considered in the first place. The fact is that the few obligatory calciphilous plants occurring in the field of study, appeared to be weak competitors, which, as soon as the vegetation grows older, are entirely expelled by plants with a wider ecological amplitude. The calciphilous Goodenia Koningsbergeri for instance, forms, in the more or less stationary vegetation, described above, only rarely a pure community, because there is generally no space left for the feeble competitor. Goodenia — it is true — often penetrates into various communities for a short time, dependent on the density of the vegetation already growing there. The plant is dominating in the *Goodenia Koningsbergeri-community*. This community I found exclusively on heavy clay, containing calcium-carbonate-concretions, and which is moist but has not been under water recently. It is therefore not found immediately after sawah or in low depressions lying under water every west monsoon. Both on the hilly area of Bangil and in the area of the cane-cultivation, the community is therefore seldom met with; in this cane-district mostly on high parts, plantation-paths, sawah-ditches etc. only. Below are four inspections giving an idea of the constitution of the community.

	I	II	III	IV
Acacia tomentosa	x	x	—	—
Alysicarpus bupleurifolius	1	—	—	—
„ nummularifolius	x	x	x	x
Andropogon contortus	—	—	x	x
„ pertusus	x	—	—	—
Borreria setidens	x	x	x	x
Eriochloa ramosa	x	—	—	—
Euphorbia reniformis	1	x	x	x
Fimbristylis ferruginea	—	x	—	—
„ glomerata	x	x	x	x
„ monostachya	x	x	1	x
Flemingia lineata	x	—	—	x
Goodenia Koningsbergeri	$3^1/_2$	3	3	3
Indigofera glandulosa	x	—	—	—
Lippia nodiflora	—	x	—	—
Panicum eruciforme	x	—	—	—
„ muticum	—	—	—	x
„ repens	—	—	x	—

Phaseolus trilobus	3	x	2	$3^1/_2$
Phyllanthus maderaspatensis	x	—	—	—
„ Urinaria	1	x	x	x
„ virgatus	x	1	x	x
Sclerachne punctata	x	—	—	—
Senecio sonchifolius	—	—	x	—
Sporobolus tremulus	—	x	—	—
Striga lutea	—	—	x	x
Zoysia Matrella	—	—	—	x

I. March 15 1924. Balepandjang (G. 3).
Moist, heavy, old-quaternary clay with much calcium-carbonate; fallow,

II. April 23 1924. Wrati, the Wonoredjo-plantation. (G. 9).
Moist, heavy, old-quaternary clay with calcium-carbonate; fallow.

III. March 22 1923. Blimbing, the Alkmaar-plantation on ± 300 M. sea-level (B. 13).
Old-quaternary, calcareous clay with moist subsoil; fallow.

IV. February 17 1923. Ratji (H. 3).
Heavy, old-quaternary, calcareous clay.
Moist, shallow, basin-shaped spot; fallow.

Inspection III is especially remarkable. At that height no calcareous soil was yet known in these parts. This area, which has only slight dimensions, struck me, owing to its very differing flora.

Of the plants, constituting this community, Goodenia Koningsbergeri and Panicum eruciforme occur almost exclusively on calcareous soils [1]). Indigofera glandulosa was, up till now, only met with on periodically severely drying-up,

[1]) At the end of March 1926 I met with Goodenia Koningsbergeri on heavy, brown clay, close to the factory Wonoredjo. The soil did, however, not react on calcium-carbonate.

calcareous soils, also elsewhere in the island of Java on these soils only.

Exclusively on unirrigable area, immediately after the soil is ploughed up and for the most part in the west monsoon only, the *Panicum eruciforme-Goodenia Koningsbergeri*-community sometimes occurs (table XVI). I took this vegetation to be a hygrophilous variant of the Panicum eruciforme-community, which community is also a pioneer-community, but with a much wider ecological amplitude. In the list of the inspections of this community, this Goodenia-variant will be found among the numbers 11-16. As soon as the soil gets less heavy, Goodenia Koningsbergeri disappears entirely or for the greater part, even through the soil is sufficiently moist.

It has been observed already that the plants pointing to calcium-carbonate are feeble competitors, in particular they can hardly withstand much shade [1]; by the successions the calcareous character of the soil is not any longer to be recognized.

Below inspection No. 11 is compared with the vegetation on the same place, a year later.

	March 10 1923	March 21 1924
Alysicarpus bupleurifolius. . .	—	$1^1/_2$
„ nummularifolius .	—	x
Andropogon pertusus	x	2
Borreria setidens	1	x
Desmodium triflorum	—	1

[1]) So in this respect they form a contrast with for instance the Mid-European lime-plants, which are strong competitors on calcareous soils. The calcium-carbonate-concretions containing soils, with which we are concerned here, are in many ways not to be compared with the calcareous soils there; it is likely that this accounts for their different behaviour.

	March 10 1923	March 21 1924
Digera alternifolia.	x	—
Euphorbia reniformis.	x	1
Fimbristylis ferruginea	x	—
„ glomerata	x	x
Flemingia lineata	x	4
Goodenia Koningsbergeri. . .	$3^1/_2$	2
Indigofera glandulosa	$^1/_2$	—
Merremia emarginata	x	1
Panicum colonum	x	—
„ eruciforme	4	1
Phaseolus trilobus.	3	x
Phyllanthus maderaspatensis. .	3	2
„ Urinaria	2	x
„ virgatus	2	1
Polygala javana.	—	x
Polytrias amaura	—	2
Rhynchosia minima	—	x
Sclerachne punctata	1	3
Typhonium flagelliforme . . .	x	1
Vitis trifolia	x	—

Owing to the locally dense growth of the shrubby Flemingia Lineata and the attending intensive shading, the calciphilous plants Goodenia Koningsbergeri and Panicum eruciforme appeared to have largely decreased in number.

Variant A of the *Panicum eruciforme-community* (table XVI) occurs on calcareous soils, which do not retain the water very long on the surface, so old-quaternary soils, which lie higher or are intermixed with lighter material (the last possibility occurs most frequently). It does not occur after a sawah any more than the Goodenia-variant (variant B). In that case we meet with, for instance: the Polanisia Chelidonii-community or the Panicum reptans-

Gymnopetalum-community, which, as I have mentioned before, do not react on calcium-carbonate at all. Inspections Nos 1—8 give some idea about the composition of this variant.

Remarkable are the inspections 9 and 10, which are both from very light, old-quaternary sand with much calcium-carbonate, on the hilly area. I included them in the table, even though they could not be classed among this community owing to their widely different floristic composition. They only serve to point out the fact that Panicum eruciforme reacts on calcium-carbonate, independent of the texture of the soil. In this respect the plant forms a contrast with Goodenia Koningsbergeri, which is limited to heavy, calcareous soils.

If we exclude the inspections 9 and 10, it appears that over the whole amplitude of the Panicum eruciforme-community, the seven following plants are constant: Borreria setidens [1]) Euphorbia reniformis, Merremia emarginata, Panicum eruciforme, Phyllanthus maderaspatensis, Phyllanthus Urinaria and Vitis trifolia; only *Panicum eruciforme is an obligatory* calciphilous plant.

Borreria setidens should probably looked upon as a facultative calciphilous plant. In places where there is no calcium-carbonate, it only occurs when the soil is heavy and impermeable (see for instance p. 65). On light soils the plant grows only if the soils are calcareous, as in inspections Nos. 9 and 10. This proved to be so for instance in the squares laid out on Tongas (V 9) (which will not be further discussed), where on the fairly light soil, containing calcium-carbonate-concretions, Borreria setidens occurred side by side with Panicum eruciforme, in the Panicum reptans-Polanisia viscosa-Merremia emarginata-community.

[1]) In inspection No. 7 on the low volcano of Semongkrong. I did not meet with Borreria setidens.

IX. THE WEED-FLORA IN THE WEST MONSOON.

a. The aim of the west monsoon experimental-squares.

In the east monsoon the weed-communities were studied on irrigated second-crop-fields. which occurred in a sufficient number, although a very great part was not suited for an investigation for reasons spoken of before. In the west monsoon the irrigated fields are for the greater part taken up by sawahs in addition to sugar-cane. The other important west monsoon-cultures, such as maize and cassave, are chiefly grown in the wet season on the tegallans (non-irrigated areas) which in this district are chiefly found on the fairly light soils along the foot of the Tengger. In the description of the methods of cultivation, I pointed out that these tegallans are only exceptionally adapted for a study of the communities. Where the communities occur in a pure condition, the west monsoon-aspect is somewhat different owing to relative changes in the abundancies of the species and owing to the occurrence of a number of west monsoon-plants. (see p. 61 and 114). On sloping areas where the rain-water runs off quickly, these differences are hardly noticed and most inspections were made there, which were added to the east monsoon-inspections owing to their almost equal floristic composition.

To explain the view which was aimed at, with the laying-out of the west monsoon-squares, I return for a while to the communities dealt with in chapter V. These communities appeared to have a definite ecological amplitude, within which the group of constants maintained itself as one whole. Except in cases with obvious variants, it was not possible to associate the fluctuations in the floristic composition of the community with the varying conditions within the ecological amplitude, on which the sugar-cane reacts very strongly, however. We discuss as an example the Polanisia viscosa-community. This community occurs for instance on the light Tengger-soils round the Lake of Grati (Q 9), near Wankal-wetan (J 10) and near Karangtengah (L 11). The cane-variety E K 28, so sensitive to differences of soil, does not behave in the same way in these places (although under normal conditions no root-rot occurs). The Wangkal-soils possess a higher productivity than those of Karangtengah and these are better again than a part of the soils round the Lake of Grati. Therefore I have tried to find another method in order to bring out these differences in conditions, with a view to applying this method to the Polanisia-community.

In the pioneer-communities on young second-crop-fields mutual competition was out of the question. In the description of the successions we saw that the Polanisia viscosa-community and a number of related communities, always had the Polytrias amaura-Vernonia chinensis-Tridax procumbens-community, respectively the Polytrias amaura-Tridax procumbens-community for a preliminary final succession. It goes without saying, however, that the way and the rapidity with which these successions will be arrived at, will differ and will be dependent on the degree of resistance, which the weaker elements offer to those which are finally victorious and which form the succession. The degree of resistance will depend on the more or less luxuriant growth of the plants which in its turn is determined by the adaptation to the external conditions.

In a west monsoon with a normal course, the moisture can never occur as minimum-factor, owing to the fairly heavy rainfall, likewise on non-irrigated spots; and owing to the very rapid growth, the mutual competition is strongly manifested, For this reason the squares were laid out in the west monsoon to test the hypotheses mentioned above. The regular attention to the development of the vegetation in a great number of squares, gave additional opportunity to obtain a closer insight into the behaviour of the plants and into the ways in which they compete with one another.

In order to obtain a good amount of material for comparing purposes, some squares were also laid out on soils outside the ecological amplitude of the Polanisia viscosa-community, for instance where the Panicum reptans-Polanisia viscosa-community, the Panicum reptans-Polanisia viscosa-Merremia emarginata-community and the Panicum-reptans-Polanisia viscosa-Portulaca oleracea-community developed. Squares were also laid out on heavy soils for special purposes in order to study the influence of the preceding sawah conditions. The principal results of the latter squares were already discussed with the Eragrostis japonica-community.

b. Description of a few west monsoon experimental-squares.

The squares were originally 15 × 15 M. each and were laid out at practically regular distances, along the foot of the Tengger, beginning at Kepoeh-kidoel, the Pleret-plantation (I 10) and ending at Wotgalih, the Winongan-plantation (T 10), 30 squares in all. A great part of these squares lay in the area of the Kedawoeng-plantation; many thanks are due for the great care given to them, to the manager of the factory, Mr. K. L. Smith. A great drawback of this method of squares is that in most places the native will cut grass in these squares. For this reason squares had to be given up again and again, because the results were no longer trustworthy.

I am not going to deal with all these squares in detail. I shall only describe the development of some, in order to give a fuller explanation of the results of this method.

The area of the surveyed flora is not quite 225 M^2. as a rule. The often diverging borders were always left out. The remaining parts were in any case large enough to typify the flora on this spot, while the same spot in one square was always used for the various inspections. When laying out these squares, the preceding flora was destroyed by frequent ploughing and further tillage, so that the whole surface was clean at the beginning of the experiments; the subterranean organs to be found deeply under the surface, remained undisturbed of course. The squares were surrounded by a fence, consisting of bamboo-latts at such a mutual distance that the sunlight could fully penetrate on all sides. A small change was made in the way of notating the abundancies.

In the inspections of the pioneer-communities all plants were so small, that differences in covering capacity were practically out of the question. Even the total degree of covering capacity of one species — save the species with an abundancy of 5 and 4 — generally remained below 1, that is to say, it covered less than $^1/_{16}$ of the total area. In the squares, however, the degree of covering capacity of plants differ more when the flora grows older. An abundancy of 3 of the grass Digitaria sanguinalis or of the sometimes bushy Vernonia chinensis, is not the same with regard to the mutual competitive-proportions. It should be borne in mind that the example quoted represents an extreme case. Vernonia chinensis was in my squares bushy in some places only. Where both the method of the degree of covering capacity and the method of genuine abundancy were not suited for my purpose, a combination of the two was applied. As Furrer has it (Furrer 1923, p. 58): "In diesem Fall ist zwischen dem Betrag der Raumverdrängung (der Deckung oder Dominanz) und der Individuenzahl (oder Abundanz) ein Ausgleich herzustellen." I endeavoured to attain to that "Ausgleich" by estimating the number of abundancy of a plant having a somewhat larger degree of covering capacity, in compliance with the number, a non-covering plant would obtain, if it took up the total area of the covering plant. When applying this method, fairly important inaccuracies may be made, but it seems to me the best method, in any case the simplest, to approximate the purpose in view. Where this method was applied, the number of abundancy was underlined, thus: 5.

I shall begin to deal with the following typical squares:

1. Wangkal-wetan, square A, the Pleret-plantation (J 10). Pale brown Tengger-soil, being light both in a dry and in a wet condition, so not caking on the surface, not cracking and not practically getting plastic. On p. the mechanic analysis, the percentage of P_2O_5 etc. of this soil and of the two next is mentioned. This soil is typified by the Polanisia-viscosa-community (see table II, No. 16, 23 and on the similar soil of Sindopati Nos. 12, 14, etc.).
2. Karangtengah, square B, the Gayam-plantation (M 11). Ruddy-brown Tengger-soil; little caking when dry and slightly subject to cracking and getting little plastic in a moist condition. The Polanisia-viscosa-community likewise occurs here (see in table II, Nos. 1, 2, 24).
3. Menangas, the Kedawoeng-plantation (F 10), red-brown Tengger-soil, which is fairly light when dry and heavy when wet, that is to say, it is friable when dry and it cracks superficially and becomes very plastic in a moist condition. The Panicum reptans-Polanisia viscosa-Merremia emarginata-community occurs here (see in table V, No. 7, on the same soil-type).

In the tables of these squares the abundancies of the plants have been noted down at every inspection; at the head of each column the date of the inspection has been mentioned.

In the first week of January 1924 the germination in these squares had set in. The dates of the monthly inspections of the three squares differ so little with respect to each other that the inspections may mutually be compared.

The inspection for Menangas at the end of September, is wanting. Although Wangkal-wetan and Karangtengah have both a kind of soil which is typified by the Polanisia viscosa-community, the first effects of mutual competition are very different, as appears clearly from table XVII. After one month there was still no great difference and on both, the Polanisia viscosa-community had developed well. Six weeks afterwards on Wangkal-wetan, Amarantus spinosus was dominating, with Cynodon Dactylon as a dominant grass and it kept that position, while little fundamental change in the square took place; the succession of Polytrias-Vernonia-Tridax was not reached until the next west monsoon (the rains set in in early October 1924), Polytrias amaura and Vernonia chinensis, the dominant constants of the succession, only occurred sporadically.

On Karangtengah, Digitaria sanguinalis was already dominant on March 27. It decided the fate of Amarantus spinosus which was already deteriorating. Six weeks later the constants of the succession had become more predominant. During the next months these constants dominate ever more. Digitaria sanguinalis had to give up the competitive struggle against Polytrias and finally the latter became dominant; all the other constants of the succession were to be found as well.

On Menangas, the Panicum-reptans-Polanisia viscosa-Merremia emarginata-community germinated. All constants were to be found, except Polanisia viscosa, to which we shall refer presently. Digitaria sanguinalis could not develop vigorously here, through which fact Amarantus spinosus could maintain itself a little longer. In early June, Polytrias amaura and Vernonia chinensis (bushy here) already took up a much more important position than was the case on Karangtengah at that time. Amarantus and Digitaria quickly disappeared. Tridax procumbens was also present and before the end of the west monsoon (in the middle of

July the drought set in) the struggle was over and the succession was formed. The succession formed here a Merremia emarginata-variant in which Desmodium triflorum always occurs in great numbers.

By the above-mentioned the experience of the cultivation of cane about the agricultural value of these soils is corroborated by the process of succession. On Menangas — the worst soil-type — the succession occurred soonest, on Karangtengah it appeared somewhat later and on Wangkal-wetan — the best soil — the succession was not formed until the west monsoon.

The discussed examples of the ways in which the succession is formed, will be met with on all light and fairly light soils, varying according to the quality of the soil. Before proving this with more instances, I shall first give a more detailed description of the general results of the squares.

c. *The influence of accident.*

On discussing the floristic composition of the squares the question is obvious as to what extent „accident" influences it. In order to examine this, a number of squares were laid out in several places at a small or a larger distance from each other under equal soil-conditions as far as this was possible.

A few examples will be given only.

A sound judgment of the equality in soil-conditions, of spots lying near each other (at least on level areas on which the precipitation was the same) will be obtained by comparing the percentages of moisture on these spots in the east monsoon (compare also H. L. Shantz 1911, p. 30). On Wangkal-wetan I laid out three squares, 20 M. from each other, in this way: $\begin{matrix} B & A \\ & C \end{matrix}$

On August 2 1924 the measurements of moisture (moisture, expressed in percentages of the soil dried at 105 ° C) give the following result:

	Square A	B	C
at a depth of 11—14 c.M.	36 %	31 %	35 %
„ „ „ „ 20—28 „	37	35	33
„ „ „ „ 34—39 „	35	33	33
„ „ „ „ 54—58 „	36	38	34

Considering the mistakes arising when taking samples and measuring, these differences are small and it may be surely assumed that the flora does not react on this with systematic differences. On June 8 1924 the vegetation was composed as follows:

	A	B	C
Ageratum conyzoides	x (1)	x (1)	x
Alternanthera sessilis	x (2)	x (2)	x
Amarantus spinosus	4 ($3^1/_2$)	3 ($2^1/_2$)	3
Commelina benghalensis	x (x)	- (-)	x
Corchorus olitorius	- (-)	x (-)	-
Cynodon Dactylon	5 (5)	5 (5)	5
Cyperus Iria	x (-)	- (-)	-
„ rotundus	x (x)	x (x)	x
Dactyloctenium aegyptium	x (x)	x (x)	x
Digitaria sanguinalis	2 (1)	3 (x)	2
Eclipta alba	x (x)	x (x)	x
Eleusine indica	2 (3)	2 (3)	3
Eragrostis amabilis	2 (3)	1 (3)	1
Euphorbia hirta	x (x)	x (x)	x
Heliotropium indicum	x (x)	x (x)	-
Ilysanthes veronicifolia	3 (-)	x (-)	x
Ischaemum rugosum	1 (-)	x (-)	-
Leptochloa filiformis	x (-)	- (-)	-
Leucas aspera	x (-)	- (-)	-
Lindernia crustacea	x (-)	x (-)	x
Oldenlandia diffusa	x (-)	x (-)	x
Phyllanthus Niruri	3 (x)	1 (-)	1

	A	B	C
Physalis angulata	x (-)	- (-)	x
„ minima	- (-)	x (-)	-
Polanisia viscosa	x (-)	x (-)	x
Polytrias amaura	x (1)	2 (2)	1
Portulaca oleracea	x (x)	- (-)	x
Synedrella nodiflora	- (-)	- (-)	x
Vernonia chinensis	x (x)	x (x)	x

The difference in floristic composition between these squares is but slight i. e. if we except a dying-off west monsoon-plant such as Ilysanthes veronicifolia.

The bracketed numbers of abundancy indicate the condition on September 29 1924 for squares A and B. From the comparison with June 8 it appears that the accidental differences are gradually levelled. On September 29 square C had been cut off for some time previously by the natives. The other squares afforded the same result.

If the distance between the squares becomes greater, the accidental differences increase. It is not easy to judge then, whether the ecological conditions are the same for the two squares, so that the expression "*accidental* differences" is not quite justified therefore. If the pioneer-vegetation on both spots is destroyed, it appears, however, that the *same* floristic differences do not return in the new vegetation of the two squares, which may point to the fact that the differences meant by me are certainly of an accidental nature. Whatever view may be held in this respect, the way in which the succession is formed, hardly appeared to be influenced by similar differences.

d. Mutual competition and a few conceptions about this in literature.

Before passing to a general discussion of the mutual competition, a few observations on a phenomenon which cannot be classed with this, may precede. In the west monsoon a few species germinate in greater numbers, other in smaller ones than is normal in the east monsoon. On the soil-type of Menangas this fluctuation in abundancy is most obvious,. on Karangtengah it is less so and on Wangkal the germination is practically normal; the same may be observed in the other squares. The heavy rains may cause a change in the soil qualities for the plants. The type of soil of Wangkal is both dry-light and wet-light; no differences are seen to arise here. The soil of Menangas is on the other hand fairly light when dry and heavy in a wet condition. That soil is very plastic when wet, fairly impermeable and approaches the character of a soil which may be called dry-heavy in the east monsoon. The soil of Karangtengah lies between the two, but, in this respect it is more like the Wangkal-type. Polanisia viscosa especially appears to be very sensitive to this; on Wangkal the germination is normal, on Karangtengah moderate, on Menangas there is no germination at all. In all places where — as on Menangas — the Panicum reptans-Polanisia viscosa-Merremia emarginata-community or the Panicum reptans-Polanisia viscosa-Portulaca oleracea-community variant B occurs in the east monsoon, Polanisia viscosa germinates badly or not at all in the west monsoon (squares on Soemberandoeng I, Soemberandoeng II, Sindopati B, Kepoeh B, etc.) The fact that Panicum reptans has the same phenomenon (for instance on Menangas) and that Polytrias amaura germinates at once there (whereas the latter seldom appears in this community in the east monsoon), should — in my opinion — likewise be attributed to the heavy quality of the soil in the wet season.

During the formation of the successions described here, the change in the structure of the soil (for instance owing to increase of humus, a factor so important in non-tropical countries) may be entirely left out of consideration. In the west monsoon we need only consider the immediate influence of the plants upon one another, owing to which the light for instance becomes a minimum factor. In the east monsoon the decrease of the moisture-content should also be taken into account.

It has already been discussed before that:

1. the possibility of germination is determined by the local ecological factors.
2. the *accidental* differences of abundancy, that is to say, not those determined by ecological conditions, do not materially influence the course of mutual competition. The facts already dealt with in this chapter and those yet to be discussed, show that:
3. the adaptation to the external conditions gives to certain plants the rapidity and luxuriance of development to maintain themselves in the mutual struggle for "space" at the cost of less adapted plants.

From this it follows that the process of competition is from the first beginning determined by the local ecological conditions, dependent on the plants to be found in the area of spreading. I could therefore give a more detailed typification of the soil-factors within the ecological amplitude of the Polanisia-community which I took as an example, aided by the way in which the floristic composition was modified, under the influence of mutual competition. In my opinion insufficient attention is paid in literature to the facts compiled above. The pioneer-communities with their special composition and sharp demarcations confirm what has been said in (1) (see p. 92).

Clements clearly explains in his "laws of competition" (Clements, 1917, p. 284) several principles concerning competition. For the rest few opinions about this are found in literature which are based on experiments (see also p.p. 95 and following). Competition is often looked upon as a factor practically independent of the conditions. Jaccard says: (1922, p. 85) "Mais *à côté* (the italics are mine) des exigences physico-chimiques de chaque espèce et des conditions écologiques capables de les satisfaire et d'assurer l'adoptation de la plante à sa station, *un autre facteur encore intervient,* le plus important au point de vue sociologique, c'est la concurrence qui s'établit entre toutes les espèces capables d'occuper une station donnée."

In a very interesting article of Pickworth Farrow "Observations relating to competition between plants" (on the ecology of Breckland, Part V, Journal of Ecology, 1917), based on experiments, this investigator appears to realize clearly "the very great importance of tall and luxuriant growth of the aerial portions of plants from the point of view of ultimately successful competition and the extermination of competitors" and he adds "the very great importance and significance of this is often insufficiently realised." Farrow points to the connection between the way of competition and the conditions of the soil, because these chiefly determine the growth in the beginning.

"In affecting the absolute rates of growth of the aerial portions, however, the effects of different soil conditions and the effects of root competition (which — as we see — he considers separately) thereby greatly affect the relative rates of growth of, or the race between, the aerial portions, and the resulting smothering very frequently results in the death of the competitors." Du Rietz has a quite different opinion (Du Rietz, 1921, p. 201): „Der Ausgang der Konkurrenz hängt wesentlich von der Menge der Verbreitungseinheiten oder Spross-systeme ab, die jede Art in den Kampf einsetzen kann, und weit weniger von den Voraussetzungen, die die eine oder die andere dafür hat, um sich auf dem Boden, die sie sich erworben hat, wirklich optimal wohlfühlen zu können oder von der Eignung des Bodens für die eine oder die andere." Du Rietz does not say what factors are decisive for "die Menge der Spross-systeme" and as it will seem, he does not realise that this very "Eignung des Bodens für die eine oder die andere", is the decisive factor here. Du Rietz thinks a comparison with the competition of nations in this respect "recht gut am Platze." Wether the Germans or the French rule Alsace—Lorraine, depends but little on the greater or smaller fitness of the nation in question to inhabit the country, but far more on the size of the army which every nation can mobilize at a certain point of time. And finally he asks: Warum sollte dies alles nicht auch für die Pflanzen und Pflanzen-gesellschaften gelten." In my opinion, because a comparison between plant-communities and communities of nations cannot be made in that respect. Even though the plants occur in a certain district, the possibility of establishing themselves is determined by the way they react on the ecological conditions, which then determine the size of the "army" at their disposal. The knowledge of the phenomena is only obtained by experiments and not by analogies.

Over against the conception of Du Rietz there is for instance that of Raunkiair (Raunkiair, 1918, "Introduction") ".... on verra dominer les espèces les mieux faites pour vivre dans les conditions d'existence que leur offre le terrain considéré, les espèces moins aptes se trouvant ou refoulées ou entièrement supprimées."

Cajander (1910) only gives generalities. After asserting on p. 11 „Jede Pflanzenart findet anfangs auf dem nackten Ackerboden Raum genug und allerlei finden sich ein," he says on p. 12 „Ueberall, wo dieselben Bedingungen vorhanden sind d. h. an biologisch gleichwertigen Standorten, muss das Resultat dieses allseitigen Kampfes dasselbe werden d. h. derselbe Pflanzenverein entstehen-innerhalb des Verbreitungsgebietes der fraglichen Pflanzen." The latter assertion which I think is right in general, seem to me difficult to explain, when the first phases of the originating of the vegetation are not determined ecologically, but depend more or less on accident, as he seems to think, according to the quotations on p. 11. In the other conceptions about mutual competition too, Cajander is rather vague, in my opinion.

e. *A closer description of the way in which mutual competition modifies the floristic composition of the west monsoon squares.*

Let us first of all have a closer look at the development of the vegetation on Wangkal-wetan, Karangtengah and Menangas. In the first two squares, the constants Cyperus rotundus, Polanisia viscosa and Portulaca oleracea appear to be weak competitors; they develop too slowly and none of the three are shade-proof; this is true for all squares. In the Menangas-square it appears that of the constants of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community, Euphorbia reniformis, Panicum colonum and Phyllanthus Urinaria as well, are little resistant. So my thesis that the strength with which a plant can compete is determined by its degree of accommodation to the external conditions, is not revertible. Not every plant adapted to its surroundings is a strong competitor, no more than every constant of a community reacts on the conditions with the same abundancy.

On Wangkal-wetan Amarantus spinosus rose quickly. On Karangtengah the number of specimens of this plant was indeed great at first, but they developed slowly and remained small with a few exceptions. *As a consequence* Digitaria sanguinalis deteriorates rapidly, it was shaded by Amarantus, whereas at Karangtengah it was less exposed to that competitor. There Digitaria grew very quickly, reached to an abundancy of 5 and finally rose more than 1 M. above Amarantus, owing to which the latter was quite stunted in its growth and died off. One or two specimens, which had risen high in the Digitaria-field, remained alive. On Wangkal, Cynodon Dactylon could maintain itself entirely. This plant resists shade very well and there was no rival rooting in the same soil-layer which might expel it. On Karangtengah, on the other hand, Digitaria sanguinalis is this root-competitor, so that Cynodon Dactylon could not develop there and died off partly. The above conclusions may be proved by cutting off the competitors. Many similar experiments were made (even though a part of a square had repeatedly to be given up for that purpose) in order to control the given explanation of the phenomena.

On Sindopati A (J 9) with the same soil-type the course of development was the same as that on Wangkal. Here the natives made a similar experiment for me by cutting off the whole square for fodder. The composition of this square was some time before and about two months after the cutting off, as follows:

Sindopati A.

	May 4 1924	July 31 1924
Ageratum conyzoides . . .	2	2
Alternanthera sessilis. . . .	—	1
Amarantus spinosus	$3^1/_2$	2
Aneilema nudiflorum. . . .	x	—
Celosia argentea	—	x
Commelina benghalensis . .	x	—
Corchorus olitorius	x	x
Cynodon Dactylon	5	1
Cyperus Iria	1	—
„ pumilus	x	—
„ rotundus	1	2

Sindopati A.

	May 4 1924	July 31 1924
Dactyloctenium aegyptium .	1	x
Digitaria sanguinalis	1	5
Eclipta alba	1	x
Eleusine indica	3	3
Eragrostis amabilis	2	3
„ pilosa	x	—
Euphorbia hirta	x	x
Heliotropium indicum . . .	x	x
Ilysanthes veronicifolia . . .	3	—
Leptochloa filiformis	x	—
Lindernia crustacea	x	—
Oldenlandia diffusa	x	—
Panicum colonum	x	—
Phyllanthus Niruri	2	2
Physalis angulata	x	—
Polanisia viscosa	x	—
Polytrias amaura	—	1
Portulaca oleracea	x	x
Vernonia chinensis	—	2

Amarantus spinosus had been cut down to the ground and for a part slowly sprouted again. Its competitive capacity had however entirely been lost in the new vegetation. On Sindopati too, Digitaria sanguinalis became dominant now as it did on Karangtengah owing to natural causes, in consequence of which Cynodon Dactylon could hardly maintain itself.

On Menangas neither Amarantus, nor Digitaria could sustain the struggle. The Amarantus-plants remained small. Digitaria suddenly came into the foreground in early April and rose above Amarantus. This revival only lasted for a short time, however. When Vernonia chinensis grew quickly and reached an abundancy of 4 in the beginning of May, both these competitors disappeared, to which Polytrias amaura contributed likewise.

In a part where Vernonia was cut off, Digitaria maintained itself somewhat longer, but there too it finally disappeared as a consequence of the competition for space with Polytrias amaura; Cynodon Dactylon fell a victim here to Polytrias, as it did to Digitaria on Karangtengah. Later on we shall return to the question of the increase of Cynodon Dactylon, a phenomenon which is found in nearly all squares in the latter part of the east monsoon and which is likewise the case with Portulaca oleracea and Cyperus rotundus. The constant Panicum reptans was in the long run not equal to Polytrias amaura, which has a quick covering capacity and roots in the same soil-layer. Cynodon Dactylon, Panicum reptans and Polytrias amaura are examples of plants which only compete with their equals. (grasses like Digitaria and Polytrias amaura). Digitaria sanguinalis, however, is a typical light-demanding plant, just as Cyperus rotundus; they also experience the competition of tall-growing Dicotyls such as Amarantus and Vernonia. With quickly covering grasses, such as Polytrias amaura and Digitaria sanguinalis, both root-competition and the struggle for space of the aerial parts will be of great significance. The behaviour of the grasses with respect to each other, is very remarkable. The superficially rooting Eragrostis amabilis suffers by the strong competition of Polytrias amaura, likewise rooting superficially; it disappeared on Karangtengah and Menangas as soon as this plant got the upper-hand. It, indeed, tries to come to the fore again every west monsoon, but is successful for a time only; it never becomes constant in the Polytrias amaura-Vernonia chinensis-Tridax procumbens-community. (see Table XII). Eragrostis amabilis is not obstructed by Cynodon Dactylon, Digitaria sanguinalis and Eleusine indica (all of them rooting deeper, though not lower than about 12 cm.). With respect to the first-mentioned plant this is evident on Wangkal, where Eragrostis amabilis could gradually penetrate; it is shade-enduring. A fine illustration of the struggle for space is the competition between Eleusine indica and Digitaria sanguinalis. When both are still young, the shoots of Digitaria, at first prostrate and often creeping, prevent a vigorous development of Eleusine. If Eleusine has once established itself, it can mostly withstand the competition of Digitaria, although its growth is influenced by it. On Wangkal it spread most, when Digitaria was suppressed by Amarantus. On Karangtengah the soil was probably too dry for its development when Digitaria had been expelled by competing plants. For in a fallow field, lying next to the square of Karangtengah, where Digitaria had already been cut away at an early date, it strongly developed at first.

Before confirming and enlarging on the facts stated here by a discussion of other squares, it will be interesting to trace the development of the three squares in the west monsoon of 1924—'25. The square on Karangtengah was destroyed by the natives in early October and cannot therefore be taken into account. In the middle of October 1924 the rains set in, followed in December by a dry period of a few weeks, which had a very bad influence on the vegetation. After December the rainfall was normal, till the east monsoon already began in April 1925. The development of the vegetation in these two squares will be found in table XVIII; the last inspection in the preceding east monsoon was likewise included and bracketed.

After the rains in October Amarantus, had already deteriorated on Wangkal, although not seriously [1]) after

[1]) Although Amarantus spinosus and Vernonia chinensis are both monocyclic, they can live longer than a year with a regular and sufficient moisture-content. A sharp line between annual and perennial plants, as is done in temperate zones, cannot often be drawn here.

the rainfall in November was followed by the dry period in December, however, Amarantus on Wankal and Vernonia in both squares had for the greater part died off in the beginning of January 1925; also the young plants, germinated in November, were very poor. Let us first have a look at the development on *Wangkal.* When the competitor Amarantus spinosus was disappearing, Digitaria sanguinalis at once came to the fore again and reached its highest abundancy towards the end of March; Amarantus had practically disappeared at that time, also through the latter's influence. And now for the first time in this square, we see that Cynodon Dactylon which up till now could maintain its high abundancy, owing to the absence of competitors, strongly decreases in number at the appearance of Digitaria. During a period of more than one month and a half, its abundancy falls from 5 to 3; its leaves got yellow and were shed. In the beginning of March 1925 a few constants of the Polytrias-Vernonia-Tridax-succession begin to come to the fore for the first time. Polytrias Amaura increases rapidly, so does Vernonia, among which stout specimens occur; in consequence the entire aspect of the square changes. The result is that the situation is seen to appear, which began about a year before on Karangtengah. Polytrias amaura suppresses Eragrostis amabilis and is at the same time the cause, together with Vernonia, that the increase of Digitaria is arrested; Eleusine indica gets yellow and decays. After the setting- in of the east monsoon, in the middle of April 1925, the development was much slowlier. In the middle of July this square too was cut down by the natives, so that the further process could not be observed. A few parts were cut off several times and on these spots only Tridax procumbens appeared numerous and also several specimens of Lourea reniformis occurred (the 6th and 7th constant of the succession), Alysicarpus nummularifolius had already appeared as early as July 6th. It therefore seems to be a question of competition as well, that Tridax procumbens and Lourea reniformis did not predominate before. It is diffucult, however, to account for the late *germination* of Polytrias amaura, Vernonia chinensis, Tridax procumbens Alysicarpus nummularifolius and Lourea reniformis. This happened first on Menangas, then on Karangtengah and at a much later date on Wangkal. It is very likely that a certain condition of the soil is necessary for the germination, which condition is attained sooner or later under the influence of the vegetation itself, dependent on the quality of the soil.

It is not necessary to give a detailed description of the further course of the vegetation on *Menangas*. In early January 1925 the older Vernonia chinensis plants appeared to have died off for the greater part, whereas the germinated specimens remained small, partly owing to the dense bed of Polytrias amaura. In places where I cut it off round Vernonia, the specimens became somewhat bigger, yet they remained much smaller than in the west monsoon of 1923—'24. So Vernonia too, seemed to have suffered from the drought in December, although in a less degree than Amarantus spinosus, for instance. Tridax procumbens with its firm, creeping shoots was less stinted in growth by Polytrias. Cynodon Dactylon had a short but keen revival, which already set in before the rains. I shall refer to this later on. Digitaria sanguinalis and Eragrostis amabilis showed the same phenomenon, although it was far less obvious now too, none of the three last-mentioned plants could maintain the struggle.

Thus we find at the end of the east monsoon, the preliminary final succession, the Polytrias amaura-Tridax procumbens-community. In other squares, to be described later on, it will be seen that this community is much more stable than the Polytrias-Vernonia-Tridax-community.

In early July 1924, just before the setting-in of the drought, half of each west monsoon square of 1923—'24 was cut off, ploughed up again and cleaned. The new vegetation, developing here in the east monsoon, was very thin. Later on when discussing the east monsoon-squares I shall refer to it. The slight number of specimens which had remained, had no influence on the aspect of the west monsoon-vegetation, which developed there, during the first rains in the second half of October 1924. This west monsoon-flora of 1923—'24 I shall call the "new west monsoon-flora", as opposed to the "old west monsoon-flora" of 1923—'24, half of which remained in these squares and the further development of which was discussed before. Although the surface of vegetation was in this way reduced to half of its original size, I did not object to it, at least not for the questions, discussed here.

Just now it was said that after the rainfall in October and November 1924, a dry period of about a fortnight followed in December 1924. In the tables of the total rainfall which were given in the discussion of the climatic, this drought and the local rainfall in October on the foot of the Tengger, where my squares were, is hardly brought out. As was said before, this drought had a bad influence on the young vegetation which up till now had grown up with much rain. A tropical weed-vegetation — especially a young one, — can hardly withstand such quick changes in moisture. The flora on the new west monsoon-square of Wangkal-wetan which was in an excellent condition in the middle of November 1924, had hardly grown in the middle of January 1925. The condition of Amarantus spinosus could not even be compared with that in the equally old vegetation of 1923—'24. Like Polanisia viscosa, it had partly shed its leaves, it had few sprouts and was of a yellow colour. It could be already expected then that it would be unable to hold its own this year against a keen competitor. The rest of the plants, too, had grown less vigorously in all squares. The vegetation never recovered from the influence of the dry period, the plants remained less firm all through the west monsoon.

Therefore the development of the vegetation in these squares cannot be directly compared with that of the young flora in the west monsoon of 1923—'24. In order to clearly bring out the influence of the soil-conditions on the mutual competition, the first condition is that the squares are under equal climatic conditions. The *mutual* comparison of the squares in 1924—'25 gives, however, the same result with regard to the valuation of the soil as that of 1923—'24, as all the new west monsoon-squares underwent the influence of the dry period. Owing to the fact, however, that the squares did not grow under optimal conditions, the differences were not so striking either. In table XIX will be found the process of this vegetation on Wangkal and Menangas till the setting-in of the east monsoon in April 1925, which continued up till the middle of December 1925; for purposes of comparison a few east monsoon-inspections have been included. The abundancy of the equally old flora in the west monsoon of 1923—24 has been added in brackets. If on Wangkal the abundancies of the plants during the two west monsoons are compared, the far less vigorous growth of Amarantus spinosus strikes one first of all. As a consequence of this its rival Digitaria sanguinalis (which, being besides a more drought-resistant plant, had not suffered nearly so much in December) preponderated more and more and attained an abundancy of 4, whereas in March 1924 it took up a very subordinate position. Cynodon Dactylon which could play a leading part, owing to the lack of a rival finds its opponent in Digitaria and disappears now. Digitaria rose more and more vigorously as its competitors disappeared; in the middle of March it had reached an average height of

1.25 M. In the middle of February, Vernonia chinensis germinated at about the same age of the vegetation as in 1924. The number of specimens increased at a quicker rate, however, than at that time. Tridax procumbens too developed (when the square was about 5 months old). This may also be a result of the altered ratios of competition with respect to 1923—'24 (see pag. 161).

On Menangas the bad growth of Vernonia chinensis gave quite a different aspect to the square than in 1923-'24. Even though the number of specimens was not less great at first, the plants remained smaller, forming a sharp contrast with the stout specimens in the preceding west monsoon. In this way Amarantus spinosus could maintain itself somewhat longer (although in 1923-'24 it had at first developed more strongly), as it was not shaded by Vernonia. For the same reason its competitor Digitaria could also develop more vigoriously now. The struggle between these plants lasted a short time only, because both, together with Vernonia chinensis, were superseded by newly arisen competitors. Owing to the strong growth of a number of trees, standing by the side of it, part of the square was still more in the shade in the beginning of 1925. From this part developed Teramnus labialis, Paederia foetida and Rhynchosia minima, all creeping plants of which especially the first-mentioned, covered the square with a carpet of shoots, getting denser and denser. Presently the fate of the square had been decided and it lost its value as an object of comparison. If we compare the development of Menangas and Wangkal before this catastrophe, it appears that the relative process was the same as in 1923-'24, which confirms our conclusion with regard to the relative soil-qualities.

In order to trace the course of development of the vegetation, if it had not suffered from the drought in December 1924, a square was laid out on Getah with practically the same soil-conditions as that of Karangtengah. The vegetation germinated in early February 1925, so fully in the rainy season. Table XX indicates the condition of the square before the setting-in of the east monsoon, when the vegetation was one month, and two and a half months old. For purposes of comparison, the abundancies in the square of Karangtengah 1923-'24, at equal ages, were indicated in brackets. From this it appears that, but for the dry period, the development of the vegetation in 1924-'25 would not have differed from that in 1923-'24.

The instances now discussed give us an idea of the way in which mutual competition acts and what are its consequences. The great quantity of moisture in the west monsoon, and the high temperature enables the plants to grow very rapidly within a short time. Every plant strives to obtain as much space as possible; dependent on its force of competition, it tries to suppress its inmates. A number of plants under favourable conditions, have a large production of seed, a quick germination and such a covering of the soil or development of its roots, that there is lack of space for other plants. If the plants root in the same soil-layer, the "root-competition" often seems to be most important; in other cases the aerial parts come into conflict with one another. Some plants germinate in a much smaller number, but are able, however, to grow into stout specimens under favourable conditions and to cast their shade over other plants. We have seen that the mere fact of being adopted — in other words, the absolute constancy in a pioneer-community — not always agrees with competitive force. Reversely the degree of adaptation, indeed, determines whether a plant *can* be a keen or a less keen competitor.

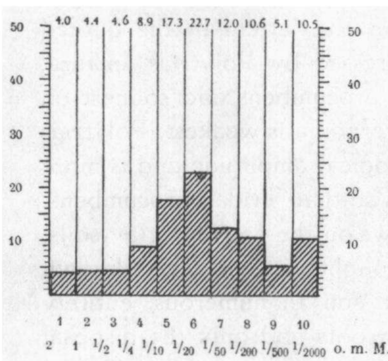
The number of leading plants in the struggles discussed before, and which on these fairly light soils will sooner or later conclude in the Polytrias-Vernonia-Tridax-community, is comparatively small; Amarantus spinosus, Digitaria sanguinalis, Polytrias amaura, Tridax procumbens and Vernonia chinensis are indeed the principal ones. Amarantus spinosus has the smallest ecological amplitude and is at the same time least drought-resistant, as will appear later on in the study of the east monsoon-flora. It has its greatest competitive force on the best soils; and on these soils only Eleusine indica and Cynodon Dactylon can maintain themselves. Digitaria sanguinalis has a wider ecological amplitude and is much more drought-resistant; on the less good soils where Amarantus spinosus could not develop so strongly, it is a keener competitor than the latter. In the quoted examples, it was always suppressed by Polytrias amaura, Vernonia chinensis and Tridax procumbens and soonest on inferior soils. Of these three, Vernonia is weakest, Polytrias amaura has a much wider ecological amplitude and is more drought-resistant, although less so than Tridax procumbens. The latter plant which still grows on the heaviest clay-soils, is at the same time the most drought-resistant weed, known to me. I found it on a light soil in numerous, entirely turgescent specimens, while its roots had only the disposal of 3 % of moisture. We shall now pass on to discuss some squares in which the development of the vegetation is somewhat different. For sake of brevity only the typical phases in the development of these squares will be treated.

Trewoeng, the Kedawoeng-plantation (P 10), experimental squares 1924 and 1925. In a wet condition the soil is much lighter than the one of Menangas and somewhat lighter than the soil of Karangtengah. When dry it is very hard at a depth of more than 20 cm. The tenacity of the dry soil is so great that the drill with a firm steel point can hardly be driven in deeper than 35 cm.; after drying, the soil cracks fairly heavily. The sugar-cane quickly deteriorates on this soil-type after the setting-in of the east monsoon.

Rebelas I, the Kedawoeng-plantation (Q 10) experimental square 1925. When wet, the soil is somewhat lighter than that on Trewoeng; in a dry condition, however, it is less hard. Sugar-cane was not yet grown here (tegallan).

Rebelas II, the Kedawoeng-plantation (Q 10), experimental squares 1924 and 1925. When wet, the soil is somewhat heavier than that on Rebelas I; in a dry condition it is somewhat lighter. Here too no cane was yet grown (tegallan).

Below follow the mechanical analyses of these soils.



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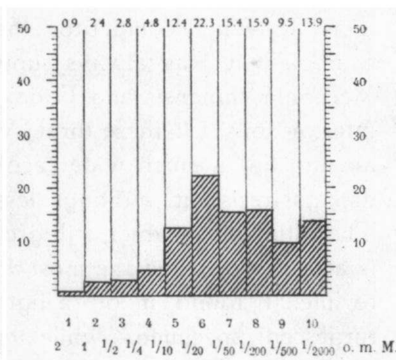

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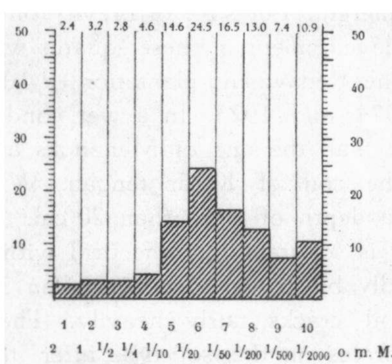

No. 3687

Number of the sample	Square	Gravel bigger than 2 mm.	CO_2	P_2O_5 in		Moi-sture
				22.9 % H Cl	2 % citric acid	
3686	Trewoeng	7.8 %	absent	0.135 %	0.062 %	3.3 %
4039	Rebelas I	0.6	„	0.174	0.092	4.4
3687	Rebelas II	5.9	„	0.153	0.070	3.5

First we shall discuss the squares of Trewoeng and Rebelas II. Neither the mechanical analysis, nor the percentage of P_2 O_5 or the "moisture", exhibits a typical difference between the two soils. In spite of this it will appear that the way in which the vegetation develops, is quite different in the two squares.

Table XXI gives the constitution of the vegetation in 1924 in the squares of Trewoeng and Rebelas II, to which the square of Karangtengah has been added for purposes of comparison.

Trewoeng. The vegetation germinated in the early days of January 1924. Polytrias amaura became at once dominant on Trewoeng. Also we find Vernonia chinensis in a great number of specimens, all of which remained small, however. Just like Digitaria sanguinalis, which likewise strongly increased at first, Vernonia chinensis already died off in the middle of June. The numerous occurrence of Dactyloctenium aegyptium and of Boerhavia later on, is rather remarkable for all these light soils, which on drying becomes so hard and caked. Dactyloctenium has sometimes a keen struggle with Digitaria sanguinalis in this square both died off too soon for this. [1])

[1]) A fine example occurred on Plososari I (R 10), an experimental square which will not be described in detail. In the west monsoon of 1924 Amarantus spinosus and Digitaria sanguinalis at first, had divided the area between them. In one strip Amarantus conquered and Digitaria disappeared; in the other half Digitaria emerged victorious from its struggle. Similar cases will occur if the conditions keep the two competitors nearly in balance; then it seems to be due to accident which of

The development of Amarantus spinosus was very poor. The plants remained small and 3 months after germination, most individuals had disappeared, suppressed by their rivals. Tridax procumbens, however, germinated and grew quickly, so that at the end of the west monsoon the Polytrias amaura-Tridax procumbens-succession had practically established itself. [1]) Menangas too, was typified by the quick development of Polytrias amaura and Tridax procumbens; the vigorous growth of Vernonia chinensis, however, gave at first quite a different aspect to this square; on Trewoeng on the other hand, the Polytrias-Vernonia-Tridax-succession could maintain itself for a short time only. The course of the succession shows that both soils were entirely unsuited for the cultivation of sensitive cane-varieties.

In table XXII the further development of this vegetation in the west monsoon of 1924—'25 may be seen. Digitaria sanguinalis regenerated for a time, The specimens of Vernonia chinensis were still smaller than in 1923—'24 and flowered very soon.

If the dry period of December 1924 is taken into account,

them gains the mastery over the other. In the Digitaria strip Dactyloctenium succeeded in getting the upper hand in the beginning of the east monsoon. The process of abundancy of these plants was on Plososari as follows:

1924	July 10	July 15	August 7	September 4
Digitaria sanguinalis . . .	5	5	$3^1/_2$	x
Dactyloctenium aegyptium	2	$3^1/_2$	5	5
Portulaca oleracea. . . .	1	2	3	$3^1/_2$

In five days, between July 10 and 15, the struggle had been decided in favour of Dactyloctenium. As both root in the same soil-layer, this is a fine illustration of root-competition. Below I placed the development of Portulaca oleracea. When the shading Digitaria was replaced by the low-growing Dactyloctenium, this gave an opportunity to the heliophilous Portulaca to regenerate entirely (see p. 175 and 176).

[1]) On Trewoeng and Rebelas I and II, for instance, a few Hepaticae occurred, which died off soon and which could therefore not be determined; no other Thallophyta occur in any vegetation dealt with here.

it appears that the development of the "new west monsoon"—vegetation in 1925 does not differ essentially from that in 1924, so that a description is superfluous (see table XXIII).

Rebelas II. This square was not put out until the middle of March 1924. The vegetation strongly differs from the one on Trewoeng, first of all owing to the more important place which Amarantus spinosus occupies (see table XXI). In this respect the square is not unlike Wangkal-wetan, but the plants are not so stout, the covering capacity was much slighter and hence the competitive force was not so strong. Digitaria sanguinalis was very numerous, as it was on Karangtengah; however, the plants remained much smaller than on Karangtengah. The entire physiognomy suggested that Amarantus spinosus and Digitaria sanguinalis checked one another in their growth and in a way balanced each other. It indeed turned out to be so. In places where Amarantus was cut away Digitaria developed quite as vigorously as on Karangtengah and reversely just so. The fact that Cyperus rotundus is absent and Cynodon Dactylon but rare, is not a result of mutual competition. Over a comparatively great distance of the square Cyperus rotundus and Cynodon Dactylon occur on these tegallans, but only scattered here and there, in very young vegetation too. I could not find a satisfactory explanation for this local divergence. The Polytrias-Vernonia-Tridax-succession developed much more slowly than on Karangtengah, but far quicker than on Wangkal. The whole process points to a better quality of this soil. It is superior to Karangtengah-soil but far inferior to Wangkal-wetan-soil; the east monsoon-aspect will confirm this later on.

In the west monsoon of 1925 changes are seen to occur in this vegetation, which are similar to those already described for Wangkal-wetan. The young plants of Amarantus and Vernonia, which arose there, remained small and Digitaria sanguinalis took up an important place at first, till

Polytrias became predominating. Owing to the competition between Digitaria and Polytrias, Dactyloctenium and Eleusine could not develop, in contrast with 1924 (see table XXII).

Rebelas II 1925, "new west monsoon", likewise showed the influence of the December-drought, so that Digitaria sanguinalis had full play (see table XXIII). It rose up vigorously and here too it checked the growth of Dactyloctenium and Eleusine. In order to prove more fully that the dry period in December is the cause of this difference in growth with regard to 1924, I draw the attention to square *Rebelas I* [1]) in table XXIII. The vegetation on this square germinated in the last week of December 1924 and was not influenced anymore by the dry period. It may be compared with the square of Getah; (see table XX) which also developed in the height of rainy season and the squares of 1924. Square Rebelas I (Q 10) lies between Trewoeng and Rebelas II. Amarantus spinosus developed in a similar way as it did on Getah; but there was a great difference in the mutual size of the plants. Where Amarantus was vigorous, Digitaria sanguinalis was less predominating. Therefore the aspect of the square was at first not the same everywhere. Soon, hower, the differences were smoothed down. Polytrias amaura very soon occupied an important position; also Vernonia chinensis developed strongly and maintained itself much better than it did on Trewoeng. These two chiefly determined the process of mutual competition. Dactyloctenium aegyptium which obtained some space at the time that the growth of Amarantus checked that of Digitaria, could no more keep up the competition with the overbearing Polytrias and Vernonia. It appears from a mutual comparison of the tables that Rebelas I has a lower agricultural value than Rebelas II, but that it is much better than Trewoeng where plants died off much sooner.

[1]) For the texture-diagram and the soil-analyses, see p. 168.

In all the other squares similar phenomena more or less varied occurred, so that they did not present any new general points of view.

The squares of 1924—'25 proved that if the climatic conditions change (in this case the occurrence of the dry period in December 1924) the effects of mutual competition change too. So long as only squares are compared which develop under the same climatic conditions, the typical differences — occurring on soils of a different agricultural value under optimal conditions —, can also be proved, if they are modified. For the rest the mutual differences appeared to be more striking so long as the climatic conditions remained optimal.

The prolonged period of great precipitation, together with the high temperature, cause that rate and vigour of growth, through which — probably only in a tropical country, — this method of determining the agricultural value of the soils of one type may be applied. In a temperate climate, with a slower growth and especially with greater fluctuations of rainfall and temperature, an analysis of the phenomena will turn out to be much more difficult, if not impossible.

X. THE BEHAVIOUR OF THE WEST MONSOON-FLORA IN THE EAST MONSOON.

At the end of the west monsoon the great changes in the composition of the young vegetation have practically come to an end, as it appears from the tables XVII—XXIII; under the influence of mutual competition a state of equilibrium has been attained.

In 1924 the last rains were in the middle of July or thereabouts, at least at the foot of the Tengger where my squares lay; (farther north the dry season had already set in at the end of May, see under "climate") and about three months later the west monsoon set in again at the Tengger-foot. In 1925, however, the dry season lasted for about 8 months, from the middle of April to the middle of December.

At the end of the west monsoon, in particular in 1925, the vegetation on light soils was chiefly composed of drought-resistant species as, grasses, Vernonia chinensis and Tridax procumbens.

In the east monsoon of 1924 the slight changes, appearing in the squares, were chiefly caused by continued mutual competition. Besides in the east monsoon of 1925, on the other hand, the prolonged drought made itself felt. In the west monsoon the difference in floristic composition and the different effects of the mutual competition, is determined by one factor only, the quality of the soil; in the east monsoon, however two factors are decisive, viz. the quality and the moisture-content of the soil.

In the square of *Wangkal-wetan A*, in the east monsoon-aspect too, the position of Amarantus spinosus remained so predominant that few changes occurred (see table XVII). The moisture-content of the soil [1], was on:

	July 13 1924	September 30 1924
Depth below the surface	Moisture-content	Moisture-content
10 c.M.. . .	39 %	22 %
20 „ . . .	37	26
30 „ . . .	34	27

I shall prove later on that these percentages of moisture lie far above the wilting-points of the plants present. Amarantus spinosus somewhat decreased its abundancy towards the end of the east monsoon, because a few of the bigger plants died off after flowering. Besides most plants had entirely dead tops. A few seemed to be quite

[1]) The moisture-content was calculated as the percentage on the basis of the weight of the soil, dried at a temperature of 105° C.

dead for a time; later on new sprouts were seen to appear again near the basis of the shoots, but the leaves of these new sprouts were much smaller than the original ones. Similar phenomena, often occurring in the east monsoon, will be fully dealt with in the next chapter. In early August 1924, Cynodon Dactylon suddenly increased in abundancy again; Cyperus rotundus and Portulaca oleracea reappeared too. This periodicity in the lives of several tropical weeds is in this case influenced by mutual competition. In the square of Wangkal-wetan, where Cynodon Dactylon maintained itself, it is hardly to be noticed and it is entirely lacking if the competing plants in the neighbourhood are directly cut away. In the square of Menangas, on the other hand, where Cynodon Dactylon was not equal to its competitors, this periodicity is still more striking (see table XVII). In the middle of April 1924, these plants shed their leaves there and at the same time the creeping shoots often shrivelled entirely. Such shrivelled plants I did not count with the inspection of the vegetation, so that the figure of abundancy in the tables decreased. In the middle of the east monsoon, long before the setting- in of the rains many plants (also in the shade) produced new shoots again with normal leaves, others got young leaves to the seemingly dried up shoots, in consequence the figure of abundancy in the table increased. If the figures of abundancy of this plant in March 1924 are compared with those in September 1924 it appears that a part only regenerated after all. The increase of specimens, during the succeeding west monsoon is not connected with it, this was caused by new germination. The regeneration of this plant after the resting period begun in the west monsoon, was observed in most squares [1]) Cyperus

[1]) In the next chapter will be discussed the resting period as shown by a number of plants in the east monsoon under the influence of drought.

rotundus and Portulaca oleracea likewise shed their leaves under the influence of competition and in most cases much sooner than Cynodon Dactylon did; both can seemingly disappear entirely, because they often totally die off above the ground. This heliophilous plants only regenerate with a sufficient amount of light, therefore along the borders of the squares or in places where the vegetation happens to be thinner. The sprouting may generally be forced in those places where the vegetation is cut away in the beginning of the east monsoon. In 1924 this regeneration was more general than in 1925, when it was probably already too dry in August—September.

With other plants the resting period is shorter or far less pronounced. Dactyloctenium aegyptium and Digitaria sanguinalis for instance, have a short, if pronounced resting period, which commences however, at the end of the west monsoon or in the beginning of the east monsoon. The general and typical feature in the phenomenon of regeneration of these weeds is the formation of new shoots and leaves long before the setting-in of the rainy season, just as has often been described for trees and shrubs in the tropics.

In the square of *Karangtengah* 1924, Digitaria sanguinalis nearly disappeared owing to the struggle with its rivals which had already begun in the west monsoon. Several Vernonia-plants died off after flowering; this appeared to be partly induced by competition with Tridax procumbens, which had much increased. Where these plants had been cut off in the beginning, Vernonia growed better.

On September 20, specimens of Digitaria which seemed entirely died off, sprouted again. Cynodon Dactylon regenerated too in the middle of August and Polytrias amaura formed some new leaves. Boerhavia repens and Tridax procumbens, both very drought-resistant plants, increased in number. A few seedlings of Tridax were still found on September 20 with roots of 3 cm., in a soil-layer with 3 % moisture; nevertheless these seedlings maintained themselves. The moisture-content of the soil appeared to be on

	July 22 1924	September 30 1924
Depth below the surface	Moisture-content	Moisture-content
17 cm. . . .	25 %	17 %
35 „ . . .	38	31

This moisture-content was far above the wilting-point of most plants. That for the rest competitive influences were exclusively responsible for the lack of Polanisia viscosa, Amarantus spinosus, Mollugo pentaphylla, Dactyloctenium aegyptium etc. is, for instance, proved by a fallow field which was ploughed up at the end of the west monsoon, and in which many specimens of the above plants were still in a very good condition at the end of September, by lack of struggle among plants in the open vegetation.

Neither did the square of *Menangas* change much in the east monsoon of 1924. In early August a few of the old Vernonia-shrubs died off. Most of these plants however, succeeded in maintaining themselves. The older foliage was shed, often preceded by the dying-off of the ends of the shoots, after which the plants sprouted again.

Cynodon Dactylon regenerated in the beginning of August, whereas Portulaca oleracea and Cyperus rotundus only did so in places where more light could penetrate.

The moisture-content was on September 4 1924:

Depth below the surface	Moisture-content
5 cm.	18 %
20 „	30
30 „	33

In the square of *Trewoeng*, in the beginning of the east monsoon 1924 only a few plants were still alive (see table XXI). In the beginning of August 1924 Vernonia chinensis had quite shrivelled up; and it did not sprout anymore. All its leaves had gradually dried up and the plants died off without any previous signs of wilting. The moisture-content of the soil was as follows:

July 16 1924		September 4 1924	
Depth below the surface	Moisture-content	Depth below the surface	Moisture-content
10 cm.	16 %	5 cm.	8 %
20 „	23	15 „	19
30 „	23	30 „	21

In the east monsoon of 1925 the prolonged drought affected still more the vegetation of Trewoeng. A short discussion of the square which germinated in October 1924 (see table XXIII), should be sufficient. Boerhavia repens shed its leaves about the middle of August, the long, creeping shoots shrivelled and broke off. Few individuals only withstood the drought. Euphorbia hirta also died. Lourea reniformis which remained fresh in 1924 till the rains set in, now likewise shed its leaves in early August and disappeared rather suddenly. Crotalaria stricta, Teramnus labialis and Tridax procumbens successfully withstood the drought, the latter even sprouted still in August. Polytrias amaura shed many leaves (the figure of abundancy was added in brackets, as I could not fix the percentage which had actually died off) and no regeneration followed. Cynodon Dactylon did not sprout anymore (except a few specimens in the thin east monsoon-half, where the drought brought about the resting period, see Chapter XI). A few moisture-determinations follow below [1]):

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[1]) While in 1924 a sample was dug from the side-wall of a deeply bored hole exactly at the indicated depth, in early 1925 a sample of 10 cm. was directly bored so that the average moisture-content over this 10 cm. is given.

Aug. 30 1925		Nov. 3 1925	
Depth below the surface	Moisture-content	Depth below the surface	Moisture-content
		0—10 cm.	4,5 %
10—20 cm.	17 %	10—20 „	17
30—40 „	17	20—30 „	19

In the course of two months, in the height of the east monsoon, the moisture-content, from a depth of 10—20 cm. remained constant; nevertheless the vegetation died off.

In square *Rebelas* I in the east monsoon of 1925, the moisture-content of the soil changed as follows:

July 13 1925		November 3 1925	
Depth below the surface	Moisture-content	Depth below the surface	Moisture-content
		0—10 cm.	4,4 %
10—20 cm.	14 %	10—20 „	11
30—40 „	21	20—30 „	18

The vegetation withstood the drought better than on Trewoeng. It should be borne in mind, however, that it was younger and was not affected by the drought in December 1924.

Euphorbia hirta gradually assumed a dark red colour however, it did not die. Also Boerhavia repens, which germinated late could maintain itself very well. In the beginning of August nearly all the leaves of Vernonia chinensis had been shed and those still left had shrivelled. The upper part of the shoots was entirely dry and it broke off. At the end of August, however, a part of these plants revived; at the bases of the shoots new sprouts with small leaves developed, which remained green and turgescent till my last inspection on November 3; then the drought had continued already for seven months. The longest roots of those plants had a length of 20—30 cm. below the surface and in that soil-layer the moisture-content was decidedly above the wilting-point. In early

November also Polytrias amaura had so dried out that one might think that the plant had quite died off. However, part of the specimens sprouted again in the beginning of November, which no doubt happened to more plants at a later date. Cynodon Dactylon formed new leaves, even from the middle of August.

Rebelas II.

In the east monsoon of 1924 the moisture-content was on:

July 16 1924		September 4 1924	
Depth below the surface	Moisture-content	Depth below the surface	Moisture-content
10 cm.	12 %	5 cm.	6 %
20 „	16	20 „	11
35 „	20	35 „	19

The vegetation changed very little after July. Vernonia chinensis which gradually dried up, sprouted again later on. Cynodon Dactylon too regenerated in early August; the same thing happened to some specimens of Portulaca oleracea on spots where there was still a sufficient quantity of light. The comparatively slight age of the flora, which was only $5^1/_2$ months old in early September, was evidently the cause of the smaller influence of the drought here; no comparison may therefore be drawn with the much older vegetation, for instance, of Trewoeng or Menangas. In the east monsoon of 1925, on the contrary, this comparison was allowed and then the better quality of the soil with respect to Trewoeng was evident because the plants were dying off less quickly.

The moisture-content was on:

November 3 1925	
Depth below the surface	Moisture-content
0—10 cm.	4 % (4,5 %)
10—20 „	13 (17)
20—30 „	16 (19)

The numbers in brackets bear on Trewoeng.

In early November 1925 several Vernonia chinensis-plants had still green leaves on newly-formed sprouts, also Lourea reniformis, Boerhavia diffusa and Boerhavia repens partly maintained themselves. Polytrias amaura had not yet quite shrivelled up, although most leaves had assumed a dark-red colour.

The remaining squares displayed the same phenomena essentially, so that I refrain from discussing them.

From what has been said before, it follows that in the east monsoon of 1924 and even during the severe drought of 1925, the soil lost very little moisture lower down than 20 cm.. below the surface. The upper layer drying up, sufficiently explains the slow deterioration of the plants rooting superficially, such as grasses. They partly have a capacity of regenerating by forming new shoots and leaves, with which I shall deal more fully in the next chapter.

It appeared that the phenomena of desiccation which Vernonia chinensis, Lourea reniformis, Boerhavia diffusa, Boerhavia repens etc. displayed in the east monsoon cannot be explained as happening through the loss of water in soil, for the decrease of the moisture-content of deeper layers, in which these plants root, was only very slight. During the hottest part of the day the plants often lose their turgidity for a time. The moisture-supply cannot compensate quickly enough for the loss of moisture owing to the strong transpiration.

This phenomenon which returns daily is perhaps evoking the desiccation of the plants, which is ultimately seen to appear.

XI. THE EAST MONSOON-VEGETATION ON NON-IRRIGATED AREA.

In the two preceding chapters it turned out that the vegetation of the west monsoon-squares, having practically reached a state of equilibrium in the beginning of the east monsoon, then chiefly consists of drought-resistant species. Although in the east monsoon the influence of the prolonged drought on this vegetation was clearly to be seen, there was no question of wilting in the proper sense of the word. If this should have been so, the wilting-points of a certain plant would have contributed to a mutual comparison of the qualities of the soil. To this purpose the east monsoon-squares were made. These squares were meant to be laid out at the end of the west monsoon, when the rains decreased, but when the soil was still moist, enough for a proper germination. The right choice of this point of time gives, however, a great difficulty. If the square is laid out too early, so that the rains continue for a long time after, the vegetation gets too dense. Mutual competition appears and the species most sensitive to drought, which are most suitable for determining the wilting-point, disappear. In 1924, for instance, it turned out that the squares of Rebelas II and Plososari II had been laid out at too early a date; Amarantus spinosus, Polanisia viscosa etc. disappeared, or were soon in a poor condition. At the foot of the Tengger the rains continued and at the end of June 1924 a second series of squares was laid out. A fortnight after this the dry season happened to set in and several squares remained entirely fallow, either because there was no germination at all or the seedlings prematurely dried up. As a precautionary measure the squares in 1925 were already laid out in early April. Then, however, the germination was insufficient too, as a fortnight afterwards a continuous drought of about eight months set in. So both in 1924 and in 1925, the east monsoon began at an abnormal point of time owing to which the intended purpose of my squares was a failure. On the other hand the sharp contrast of the two years (the one with a comparatively short, the other with a very prolonged east monsoon) gave me an insight into many phenomena. Although the number of successful east monsoon-squares was too slight to carry out my working-scheme, it nevertheless provided me with many data worth mentioning about behaviour of the weed-flora.

a. The Germination.

In the squares preceded by a sawah and where the moisture-content was still very great, a normal germination took place, that is to say: a complete community arose. Under these conditions a complete Polanisia viscosa-community developed in the square of Ngawoedjasem (J 9); the moisture-content was:

Depth below the surface	Moisture-content
13 cm.	44 %
24 „	47 „
43 „	44 „

The same thing happened on Sindopati; here the moisture-content was:

Depth below the surface	Moisture-content
15 cm.	40 %
25 „	37 „
35 „	39 „

The distribution of moisture in the latter square was very irregular. In one part it was:

Depth below the surface	Moisture-content
15 cm.	26 %
25 „	22 „
35 „	24 „

The germination was no longer complete there. On both spots I counted the seedlings on 1 M^2., with the following result:

	The dampest spot:	The driest spot:
Ageratum conyzoides . .	3 individuals	0 individuals
Amarantus spinosus . .	35 ,,	33 ,,
Cynodon Dactylon . . .	22 ,,	12 ,,
Cyperus rotundus . . .	20 ,,	10 ,,
Digitaria sanguinalis . .	13 ,,	0 ,,
Eclipta alba	3 ,,	1 ,,
Eleusine indica	3 ,,	0 ,,
Eragrostis amabilis . . .	8 ,,	0 ,,
,, pilosa	2 ,,	0 ,,
Euphorbia hirta	3 ,,	3 ,,
Kyllingia monocephala .	1 ,,	0 ,,
Oldenlandia diffusa . . .	1 ,,	0 ,,
Phyllanthus Niruri . . .	3 ,,	7 ,,
Polanisia viscosa	16 ,,	8 ,,
Portulaca oleracea . . .	29 ,,	9 ,,
In total . . .	162 individuals	83 individuals

So on the driest spot only 50 %, of the total number of plants on the dampest spot, germinated. This instance also gives an idea of the general proportions. Amarantus spinosus, Cynodon Dactylon, Cyperus rotundus, Polanisia viscosa and Portulaca oleracea germinate easiest. Cyperus rotundus for the greater part, gives off shoots from resting buds, although the plant likewise germinates from seed. In general there is no connection between the drought-resistance of the species and the minimum percentage of moisture for germination. Digitaria sanguinalis and Eragrostis amabilis, both more drought-resistant than any of the others, only germinate at a high moisture-content. When the latter had decreased to 18 % at a depth of 5 cm. only Amarantus spinosus and Portulaca oleracea germinated.

Wangkal-wetan, with the same type of soil, was an exception to the rule. Although the ground-water is found here at a depth of 9 M., the moisture-content was at 10 cm.

under the surface 39 %, at a depth of 20 cm. 37 % (July 13 1924), while no sawah preceded. The Polanisia viscosa-community developed completely here. At a moisture-content of 21 %, 5 cm. deep, only Portulaca oleracea, Amarantus spinosus and a few Polanisia viscosa-specimens had germinated. Occasionally germination takes place at a much lower moisture-content, although in a slight degree only; in this respect too, the plants reveal rather great fluctuations under natural conditions. A few individuals of Portulaca oleracea, and Euphorbia hirta on Ngawoedjasem, for instance, germinated, at a moisture-content of 7 %, of Amarantus spinosus on Wangkal-wetan at 12 % and of Portulaca oleracea at 9 % on non-shaded spots among the west monsoon-vegetation on Plososari (R 10); no germination occurred, however, at a moisture-content of 5 % on the east monsoon-square in that place which bore no vegetation. The minimum moisture-content for germination largely depends upon the type of soil. On Menangas (Panicum reptans-Polanisia viscosa-Merremia emarginata-community) germination stopped, when the moisture-content had fallen to 18 % at a depth of 5 cm. On Karangtengah (Polanisia viscosa-community), on the other hand, Tridax procumbens germinated in a fairly large number even at 3.3 %, on Plososari at a moisture-content of 4.4 %. This drought-resistant plant can therefore even germinate at a very low moisture-content; we have the same case with Vernonia chinensis and Boerhavia repens.

For the rest the germination on Karangtengah, Trewoeng, Menangas, Rebelas I and II etc. was quite insufficient both in 1924 and in 1925.

b. The root-system of the east monsoon-vegetation.

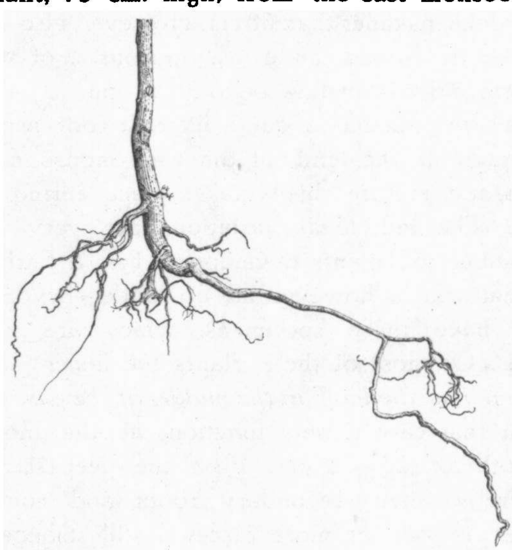
The root-systems of the plants germinating at the end of the west monsoon, display in their development typical deviations from the normal root-system of the west monsoon-flora.

Excellent investigations into the root-system of plants in districts with a prolonged dry period have been carried out for instance by W. A. Cannon and in particular by J. E. Weaver. However, they almost exclusively bear on perennial plants of the prairie-associations. I hardly found anything mentioned about the root-system of short-lived plants, resisting a very dry period. Fitting (1911) remarks that annual desert-plants form no deep roots and refers to Marloth (1908) who says, that in the district of Karroo he saw annuals on dust-dry soils in a fresh condition, while the fibrous root-system had not strongly developed.

After a preliminary orientation, for the study of the root-system a deep trench was dug at a proper distance round about the plant, from which the earth was gradually removed. After the plant was entirely bare, the soil deeper down was always closely examined and the ends of the roots inspected with a magnifying glass, to see if something had unespectedly broken off; doubtful cases were rejected (see alsoo Weaver 1920). Although hundreds of specimens were examined in this way, only a more special study would give a complete insight. The examination was chiefly limited to Amarantus spinosus, Polanisia viscosa, Vernonia chinensis, Tridax procumbens and the grasses. I shall not enter into details about the grasses, because they showed no special features. In the east as well as in the west monsoon, the root-system is fairly superficial. Except Eleusine indica and Cynodon Dactylon, a few roots of which sometimes penetrate down to 40 cm. respectively 35 cm., the root-system is limited to the first 25 cm., while the average active depth lies lower than 10 cm. The short roots which some grasses develop on the lower nodes of the prostate shoots and sometimes on the long creeping sprouts, die off in the east monsoon.

Polanisia viscosa. The depth and branching of the root-system of these as well as of the other examined plants, appeared to be more or less dependent on the nature of the soil. The more impermeable the soil, the slighter the number of strongly developed secondary roots and the smaller the lateral spreading. On heavier soils, where a few Polanisia viscosa-specimens occurred side by side with Polanisia Chelodonii, belonging to that type of soil, the former had entirely assumed the character of primary root of the latter. On the fine soil of Wangkal-wetan the strongest main roots sometimes descend to a depth of 1.10 M. in the west monsoon. The secondary roots have strongly developed in the wet season. Then most rootlets are found between 30 and 40 cm., whereas they are practically wanting between 0 and 15 cm. The lateral spreading extends to 30 cm., at the greatest 40 cm., radial distance from the beginning of the main shoot. This is true for specimens taller than 60 cm. However, also specimens are found, developed quite as vigorously, of which the root-system did not extend beyond 50 cm.

Polanisia viscosa has a quite different root- aspect when it germinates at the end of ,the west monsoon and its development therefore chiefly takes place during the east monsoon. The individual variations are very great. A small number of plants develops at first a fairly normal root-system which, however, has no rootlets beyond 40 cm., no more have those specimens, which are very stout afterwards. Of most of these plants *the lower part of the root-system has died off in the middle of the east monsoon,* so that in that case it only functions at the most down to a depth of 20—25 cm. First the deepest roots dry up, whereby their secondary roots and rootlets get lost. Then in one or more places a still stronger drying up occurs; in consequence the roots sometimes break off there. If later on the plant is carefully dug out, this part is still found in its original state, often separated from the functioning roots. As the deeper-lying roots die off, new secondary roots develop nearer to the surface. These secondary roots are very limited in length and in number and often have few rootlets. As the drought continues, small tubercles, clear as glass, of a size of 0.5 to 1 mm. develop on the new, superficial secondary roots. They are formed especially in places where there are fewest rootlets; and one gets the impression that these tubercles should be looked upon as hypertrophic rootlets. They seem water-storing in a high degree and brought outside the soil they dry into very small brown knobs, in a few minutes. If finally the soil-layer gets very dry, the tubercles shrivel up, first at the end of the small secondary roots, after which the plants are often seen to wilt. The figure below represents a picture of the root-system of a Polanisia viscosa-plant, 75 cm. high, from the east monsoon-square



Root-system of Polanisia viscosa (75 cm. high) of the east monsoon experimental square at Wangkal-wetan: dug out November 3, 1925. ($^1/_4$ natural size).

of Wangkal-wetan. The plant germinated about the middle of April 1925 and it was at the time when it was dug out nearly 7 months old. The plants had small east monsoon leaves and had not wilted. [1])

The main root only reached a depth of 20 cm. below the surface; the part lying deeper had dried up and got loose. The extreme end of the primary root had also dried up and had become brownish-black. The deepest rootlets with living root-hairs were to be found at a depth of 13 cm. Most hypertrophic tubercles occurred between 0 and 10 cm.; they are not to be seen on the figure; at the quick drying-up in the open air they disappeared almost entirely (see the figure on pag. 220).

However, most east monsoon-specimens of Polanisia vicosa, especially the plants growing more slowly, do not root deeply at first. Yet these plants too, show an inclination to ignore the function of its older secondary roots and form as the drought continues more superficial new secondary roots, which always are developing the typical tubercles. On all east monsoon-squares where Polanisia viscosa germinated these phenomena were found; in November 1925, when the entirely rainless east monsoon lasted for more than seven months, it might be observed that the deeper-lying rootsystem of even still smaller plants began to die off.

On Wangkal-wetan for instance, a turgescent Polanisia viscosa-plant with a length of 28 cm., had roots to a depth of 22 cm. To a depth of 10 cm. functioning secondary roots were to be found, closely covered with the clear tubercles.

[1]) On November 18 1925 the moisture-content of the soil in this square was at a depth under the surface of:

0—10 cm.	8 %
5—15 „	13
10—20 „	17
20—30 „	23

The main root had a distorted, dry aspect to a depth of 17 cm. The part of the root at 20—22 cm. depth was dark-brown and entirely dried up. The west monsoon specimens too showed the reduced root-system in the east monsoon. The number of examined cases was too small, however, to form an opinion about this; most Polanisia viscosa-specimens had entirely disappeared already at the end of the west monsoon. When dealing with the box-experiments, we shall see that west monsoon-plants, examined under those conditions, always reduced their roots in the east monsoon.

Finally one more example which gives an idea of the individual variation in the development of the root-system of Polanisia viscosa. On September 29 1924 on Wangkalwetan east monsoon-square B, nine Polanisia viscosa plants were dug out, which had all germinated about the beginning of July 1925. The result was the following:

Length of the plant	Depth of the longest root
30 cm.	15 cm.
36 „	18 „
43 „	11½ „
45 „	17 „
46 „	22 „
50 „	10 „
52 „	42 „
58 „	25 „
70 „	26 „

The formation of a superficial root-system does not occur in the case that east monsoon-plants are growing on sufficiently irrigated second-crop-fields; there, the depth of the root-system is normal. Only if the superficial soil-layer dries up, a few small secondary roots with the hypertrophic tubercles are likewise formed; in a very much slighter degree, however, than on non-irrigated areas.

Amarantus spinosus is displaying the same phenomena in a somewhat modified way. The larger Amarantus-plants too, often reduce their main roots. Just as is the case with Polanisia viscosa, the depth of the root-system in the east monsoon is limited to 40 cm. at the highest, whereas in the west monsoon a depth of 80 cm. is quite normal on good soils. The extreme depth of the roots is not subject to such great fluctuations as with Polanisia viscosa. On September 27—30 1924, on Wangkal-wetan, experimental squares A—C, for instance, nine Amarantus-plants were dug out (see above for Polanisia viscosa) with the following result:

Length of the plant	Depth of the longest root
12 cm.	16 cm.
23 „	24 „
25 „	36 „
34 „	34 „
42 „	25 „
43 „	30 „
45 „	35 „
48 „	32 „
65 „	35 „

Here too, superficial secondary roots were formed and mostly in a very peculiar way. Exclusively on the main root, many small secondary roots, for the greater part in small bundles, 1 to $1^1/_2$ mm. thick and 3 to 5 mm. long, are seen to arise in a soil-layer down to about 10 to 15 cm. under the surface. These small secondary roots have no root-hairs and are of the same bright colour and quite as water-storing as those of Polanisia viscosa, although they do not dry up so quickly.

Among these secondary roots a few rootlets are scattered, which are 10 to 15 c.M. at the most and which have living roothairs. Sometimes Amarantus spinosus has rootlets at a larger depth. Besides, superficial longer secondary roots occur, which are, however, often wanting. These longer secondary roots too, have a limited number of rootlets and they are concentrated in the superficial soil-layer. What has been said above is true for normal specimens of Amarantus spinosus. Comparatively few specimens, however, develop normally, because on dry soils 80 % is sure to be affected by the larva of a beetle. Mr. Leefmans, entomologist of the Institute for Plant-diseases at Buitenzorg, kindly determined this insect for me; its name is Lixus pica F. I did not find it on irrigated soils, the affection is at all events less frequent there. The beetle penetrates from the shoots into the main root and sometimes into a few of the thicker secondary roots. It pupates in the hypocotyl, which had already strongly swollen. A number of plants perish; most of them, remained alive, however, in spite of the great destruction of the tissue. The specimens affected by Lixus pica display the above-mentioned phenomena, such as the formation of a great number of small, thick secondary roots, sometimes in a higher degree. The root-system of Amarantus spinosus on irrigated fields in the east monsoon is quite normal.

Vernonia chinensis. Vernonia chinensis shows often a pronounced contrast between the root-aspect in the east and in the west monsoon. In the west monsoon the plant roots down to 1.20 M. and deeper, with stout secondary roots and regularly distributed rootlets. A picture of the root-system in the east monsoon, as it is often found, is shown by the figure on the next page, of a plant in the square of Getah on August 14 1925.

It was 59 c.M. in height. All roots at a depth of 15 to 20 c.M. had dried up and showed dead root-ends. On the other hand, the superficial root-system had developed strongly. Vernonia chinensis too has a much varying root-aspect. The vigorous development of functioning superficial roots in the east monsoon is, however, always found.

Tridax procumbens. This plant is indeed an extreme case with respect to the differences discussed here. The plant is perennial. Germinated in the middle of the west monsoon, it develops big roots descending deeply. I could trace the roots of plants on Trewoeng, which were nearly one year old, down to 1.10 M. and they evidently penetrated

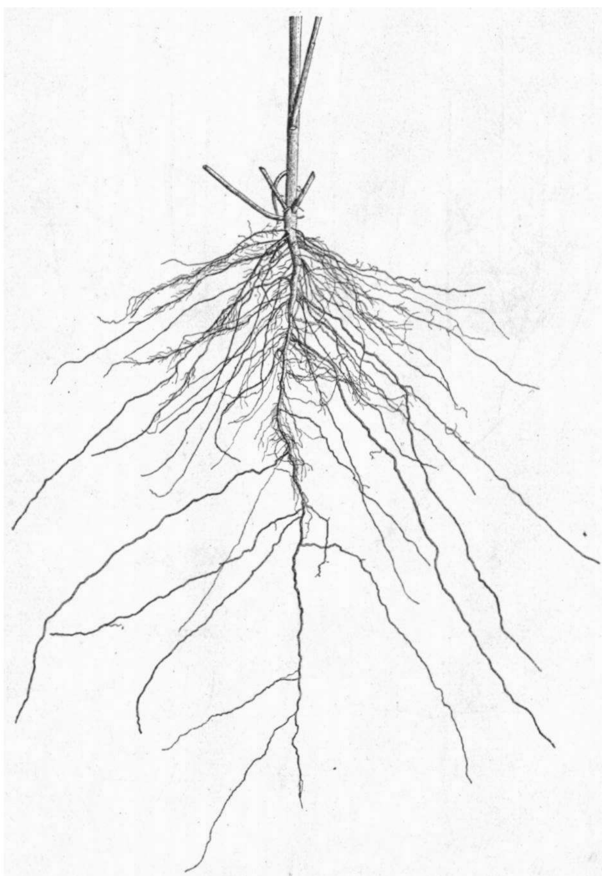


Fig. II. Root-system of Vernonia chinensis (59 cm. high) of the east monsoon experimental square at Getah; dug out August 14, 1925. ($^1/_4$ natural size)

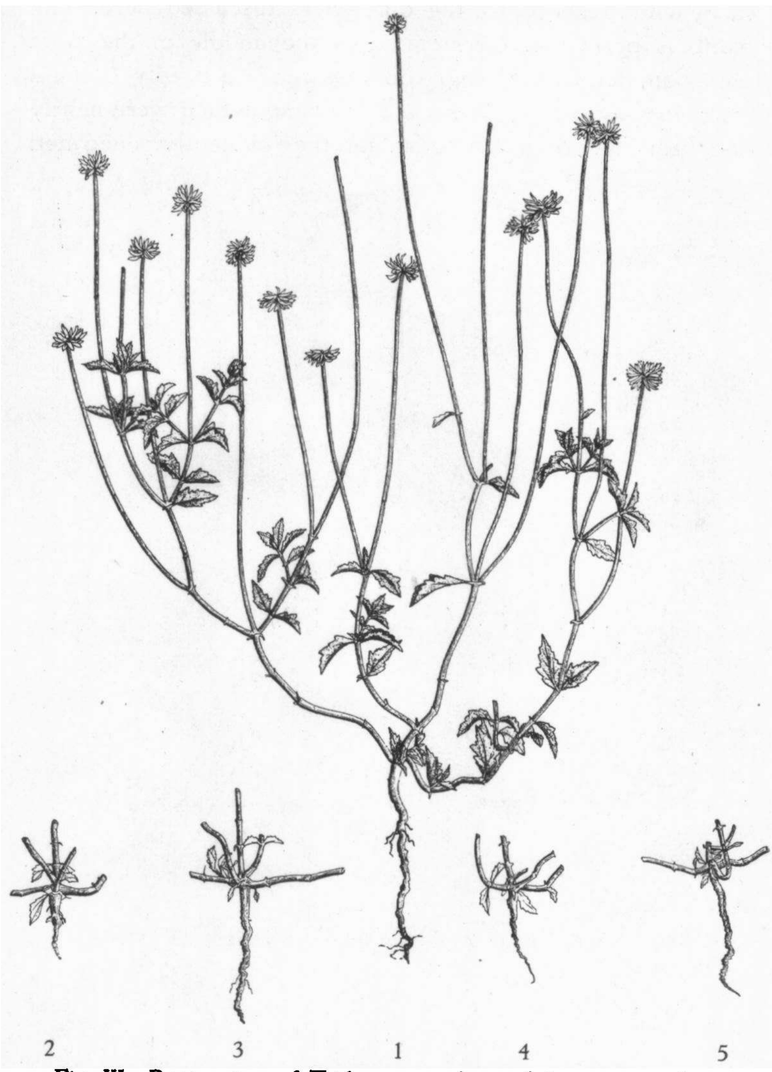


Fig. III. Root-system of Tridax procumbens of the east monsoon experimental square at Trewoeng, dug out November 3, 1925. ($^1/_4$ natural size).

even deeper. No reduction of this root-system formed in the west monsoon was observed.

Quite a different aspect affords the root-system of plants which developed in the east monsoon. Some figures are given here of Tridax-plants which had germinated on Trewoeng about the middle of April 1925 and which were dug up on Nov. 3 1925 (figure III). The plants were in excellent condition, they only had no creeping sprouts like west monsoon-plants. The root-system consisted of a primary root with rough surface, only descending to a depth of 3 to 7 cm. under the surface. The end of the main root had entirely dried up and stopped rather abruptly. The number of rootlets with living root-hairs was very small; they were entirely wanting to numbers 4 and 5. The cell-layers under the superficial cortex-layer contained much water, so that by a slight pressure of the nail a little moisture oozed through. On November 19 1925 Tridax-plants with a root of 6 to 7 cm. in length were still turgescent at a moisture-content of the soil of 3.3 %—4.0 %. It is evident therefore that Tridax procumbens is a strongly drought-resistant plant. The small tubercles, which Polanisia viscosa and Amarantus spinosus formed, were neither found with Vernonia, nor with Tridax. Whether other plants in the east monsoon on dry soils gave evidence of similar peculiarities in their root-system was not sufficiently investigated. In my experimental fields only the Dicotyls dealt with above, germinated in a sufficient number. In a special investigation the factors should be studied, which evoke these root-reductions; before this has been done, hypotheses about the cause of these phenomena have little value.

c. *The physiognomy of the east monsoon-plants.*

The typical differences between the east and the west monsoon aspect was already pointed out in a few words (see for instance p. 175).

In the beginning of the east monsoon, a number of specimens both of Amarantus and of Polanisia, do not differ much from young west monsoon-plants. Their leaves are often somewhat darker-tinted and have often shorter petioles. On growing up, which happens at a much slower rate than in the west monsoon, the secondary shoots remain short and the older leaves are soon shed. The new leaves are smaller, have, very short petioles and those of Polanisia are more hairy. Both with Amarantus spinosus and with Polanisia viscosa, the end of the shoot often dies off, while the lower part remains alive and goes on forming very small leaflets with small petioles, the secondary shoots sometimes remain entirely leafless and dry up. Occasionally Polanisia viscosa-plants are entirely leafless for a time. It sometimes happens, however, that the plant shoots again at the top and this takes place gradually, without being entirely leafless for a moment. In this case too, the individual differences — even on one and the same type of soil — are very great. Many plants of both species grow very slowly, form small east monsoon-leaves from the beginning and remain sometimes entirely unbranched. All those phenomena take place if the moisture-content still lies far above the wilting-point. In places with a regular irrigation, however, the differences from the west monsoon-aspect are far less typical or do not occur at all. On Wangkal-wetan in the neighbourhood of the squares there were a few irrigated, low-growing Phaseolus lunatus-fields; the Polanisia viscosa-and Amarantus spinosus-plants, growing there, showed none of the above-mentioned phenomena of reduction of leaves and shoots. In the east monsoon Vernonia chinensis too sheds its older leaves, which have faded into yellow a long time before. This plant especially may remain leafless for a long time and then seems to be died off. A number of specimens do not shoot anymore and dry up (which will also happen sometimes to the other discussed species). But many of them form at the bases of the seemingly dead shoots new sprouts and leaves which are much smaller than the original ones. The upper part of the main shoot dries up gradually then, if it had not died off before. These leaf- and shoot-reductions will probably decrease the transpiration of the plant.

Tridax procumbens displays few differences in east and west monsoon-aspect. The east monsoon-plants are mostly erect, because they do not form any creeping shoots; the leaves are somewhat smaller. In contrast with the other plants mentioned, I never saw it change its foliage.

If the soil was very damp during germination and dried up very soon after that, the phenomena described revealed themselves at a much quicker rate.

The above-discussed reduction of the leaf-surface by developing new shoots with smaller leaves, forms a transition to the typical resting-period occurring with some plants. Attention was already called to the fact that under the affect of mutual competition, various grasses, Cyperus rotundus, and Portulaca oleracea shed their leaves either entirely or partly in the west monsoon, in order to sprout afresh in the height of east monsoon (see p. 175). When describing these phenomena, it was already remarked that the same happens in the east monsoon-squares and now induced by the drought (there is no mutual competition at all in most of the squares, where only few plants germinated). After a few months of intense drought such plants as Cynodon Dactylon, Dactyloctenium aegyptium, Digitaria sanguinalis, Cyperus rotundus, Portulaca oleracea, partly or entirely shed their leaves. Before the rains, at the end of the east monsoon, these plants sprout again; Cyperus rotundus and in most cases Portulaca oleracea too, only are forming new leaves when the rains have already set in. It is a peculiar thing therefore, that these plants — except the two latter ones — regenerate at a much smaller moisture-content of soil, than that at which they entered upon their resting-period. As the plants beginning their period of rest in west monsoon, practically sprout again at the same time as the plants mentioned above, so the rest lasts much shorter for the latter.

d. The wilting of the plants of the east monsoon-experimental squares.

In special experimental boxes in my garden, the moisture-content of soil was measured, with a number of plants at the time of wilting; in the next chapter these experiments will be fully discussed. If the results obtained there, may be taken as a basis — though the conditions in my boxes were not entirely natural — the moisture-content of soil remained in 1924 far above the wilting-point of full-grown plants (see determinations of soil-moisture on page 174 and following). Even during the dry period of 8 months in 1925 this will have been so, at least for plants rooting deeper than 20 cm under the surface.

In this connection I just want to draw the attention to Tridax procumbens. On page 197 already, this strongly resistant plant was said to keep its leaves in spite of the intensest drought. On Trewoeng it was still entirely fresh on November 3 and 19 1925, at a moisture-content of the soil of 3.3 % (see page 167). It may be assumed as a fact that this plant never wilts on that type of soil. For the moisture-content of air-dry soil, determined by drying at 105° C also amounted to 3.3 %; a lower moisture-percentage cannot occur therefore under natural conditions. I do not think it very likely that dew is of any importance as a source of moisture. Contrary to Warming-Graebner (1918, p. 42), "Die Taubildung ist in den Tropen viel stärker als unter höheren Breiten", no noticeable deposition of dew was ever observed by me in the plain of Pasuruan in the height of east monsoon; the strong dropping of many plants might lead to a confusion. If, however, during the night, the relative air-moisture approaches the saturation-point, the superficial soil-layer may absorb aqueous vapour and the moisture-content of soil may rise conformable. To this purpose on November 19, 1925 at six o'clock in the morning, 5 samples of the upper 7 cm soil-layer were taken in the square of Trewoeng, within an area of a few square meters. The moisture-content was measured and compared with that of 5 samples lying in between, which were dug $5^1/_2$ hours after. The result was the following:

6 a.m.		11.40 a.m.	
sample	moisture-content	sample	moisture-content
1	4.4 %	1a	3.4 %
2	4.2 „	2a	3.4 „
3	5.1 „	3a	3.9 „
4	4.4 „	4a	3.3 „
5	4.3 „	5a	4.0 „
on an average	4.5 %		3.6 %

It is possible that the 0.9 % higher moisture-content of the soil-layer, in which Tridax roots, may partly be absorbed by this plant; besides the water containing tissue of the root may perhaps serve as a water-reservoir (see p. 195).

Even though the moisture-content of soil should have reached the wilting-point of various plants, a determination in the open would have been practically impossible. The fact is that under the circumstances, as they presented themselves here, no *typical* wilting phenomena occur, at least not of older plants. The wilting of these older plants, displaying phenomena of reduction of shoots and leaves, was exclusively studied in experimental boxes in my garden, because a daily supervision was possible there. Later on I shall deal with this more fully. Only with seedlings or very small plants, rooting in a more superficial soil-layer, drying up *very quickly*, typical wilting phenomena can be seen. Determinations of the wilting-point of very young plants in the open on different squares, lying wide apart, are practically too troublesome, because the phenomenon cannot be sufficiently watched, owing to the quick drying-process of the superficial soil-layer. Occasionally I was successful in it; the number of cases is too slight, however, to be mentioned especially,

I have not come across facts in literature, which may directly be compared with the phenomena of reduction in root, shoot and leaves, dealt with in this chapter. When describing the associations in the dry area of the Tooele Valley, Kearny, Briggs c.s. (1914) always make mention of the manner of adaptation to the physical conditions; the plants discussed there are, however, of quite a different nature from those studied bij me. In the Tooele Valley, with only 400 mm. rain a year, perennial plants with a very deep-lying root-system predominate. The "drought-escaping" character of many of these plants (l. c. page 383) revealing itself in the shedding of leaves and shoots, cannot be compared with similar phenomena of the comparatively short-lived weeds discussed here.

Besides, the plants of the Tooele Valey only shoot again, when it rains sufficiently. In the quoted publication, I find one case of root-reduction mentioned, i. e. of Kochia vestita, limited to saline soils. The reduction of those deeper roots, no doubt formed during a period of heavy rainfall, would take place when the salts rise during the dry periods Other studies in similar areas give no new insights either, into the phenomena described.

XII. THE WILTING-POINT.

Determinations of the wilting-point in the open are generally very troublesome, especially in the conditions occurring here (cf. page 196 f. f.). According to Briggs and Shantz (1912) "it is practically impossible to measure the wilting coefficient by means of field samples." So, should an idea be formed of the moisture-content of soil at the time of permanent wilting, we are bound to make culture-experiments.

Investigations about the wilting-point are already of an early date. For a survey of the literature concerning it, I may refer for instance to Caldwell (1913), Clements (1920) etc. I only want to bring to mind the fact that Sachs (1859) was the first to show that young tobacco-plants wilted at a different moisture-content, dependent on the soil-type.

Wilting may be represented as being a reaction of the plant resulting from the fact that the loss of moisture by transpiration is insufficiently compensated by the supply of it through root-absorption. So wilting is an intricate physiological process, affected by all the factors which may alter the transpiring power or the rate of absorption. Crump (1913), Caldwell (1913) and Blackmann (1914) were the first to emphasize this. The nature of the soil and the quantity of moisture at its disposal are only a few factors of the total complex of factors affecting the phenomenon. The transpiring power is dependent on the nature of the plant, on the temperature, the saturation-deficit of the air, the force of the wind, on shading or on sunshine. The rate of absorption is likewise affected by the nature of the plant, the development of the root-system, the water-content, the temperature and the rest of the qualities of the soil. If we want to compare the wilting-points of one single plant in different soil-types, the other conditions should be as similar as possible. The conditions in the area of investigation are very favourable in this respect, at least during the east monsoon, the time of experimenting. The temperature hardly changes, the relative moisture of the air indicates nearly the same period every day, the sky is almost constantly cloudless, while the wind varies but slightly in force.

For studying the properties of soil and for getting an insight into the live of plants as well, it is in the first place necessary that the conditions in which the experiments are performed, should agree as much as possible with those in the open.

Experiments with potted plants is the most usual method. However, the root-system of the plant especially, deviates strongly from that in natural conditions in this case. A much greater number of secondary roots and rootlets are formed than in the field, at least in my experiments, and they fill almost the whole pot. Besides, the development of the root-system is limited by the depth of the pot which has an equalizing effect on plants with different root developments.

Pot-cultures cannot give an insight into the drought-resistance of the plant in natural conditions. By drought-resistance is meant the resistance of the plant against drought *in the open*, which need not be attended by a low wilting-point. Plants with a high wilting-point, but with deeplydescending roots may be more drought-resistant than those with a low wilting-point, but a superficial root-system.

In case the potted plants are moreover under external conditions strongly deviating from the normal ones, there is even a greater chance that the conclusions drawn from such experiments, cannot be applied to the behaviour of the plant in the open. The experiments of Briggs and Shantz (1911, 1912) clearly illustrate this.

The results of Gain, Heinrich, Hedgcock, Clements etc. showing that different plants in one single soil-type wilted at a very different water-residue in the soil, entirely agreeing with the general physiological insight, are not correct according to Briggs and Shantz (1912 c).

The wilting-points of hydrophytes to xerophytes showed mutually but slight variations, according to their researches, so long as the type of soil did not change; they are of the opinion that their results could also be applied to plants living under natural conditions (l.c.p. 61). They finally meant that the wilting-point might be calculated, with a very slight error only, from the data of the mechanical analysis of the soil-particles, *independent of the plant itself*. Caldwell (1913) in particular has proved that the abnormal external circumstances under which the experiments were made — "a glass damp chamber" a "dry greenhouse" — were the causes of these strongly diverging results. He finds that plants in Tucson wilt in the open air at a moisture-content of the soil which is 30 %—40 % higher than the wilting-point, obtained in a damp chamber. Crump (1912) also points to the fact that the impenetrable glass pots in which the plants grew and the layer of wax on the surface of the pot give quite unnatural conditions of development.

Most investigators exclusively experimented with seedlings or with very young plants. As soil-indicators such wilting-point-measurings may be of some value, but for an insight into the life of the plant it is necessary, in my opinion, to examine older specimens as well.

Besides with potted plants, I also experimented with plants growing in bottomless zinc boxes, having measurements of 1 × 1 × 0.80 M., totally buried in the soil. In such boxes the development is much more natural, especially when the external conditions, in other respects too, agree with those in the open.

Experiments with potted plants are very simple and furnish easy orientation. For, if a plant wilts in a pot, the moisture-content in the centre of the pot may also be taken to be the average for the total soil-layer, in which the plants are rooting. In deep boxes, on the other hand, the root-system runs through soil-layers of different degrees of moisture, in which the absorbing surface of the roots greatly differs as a rule. What share a certain soil-layer has in the total supply of water for the plant, is hard to find out. So if a plant wilts, it remains a question what should be assumed to be the wilting-point; in other words, what the moisture-content would be, at the time of wilting, if the soil was everywhere equally moist in various depths. Little attention has been paid in literature to this problem, which is so fundamental for a proper insight into the behaviour of plants in dry regions.

Briggs and Shantz, who measured the "wilting-point" from the mechanical analysis of the size of soil-particles independent of the plant, can in this way indicate for every soil-layer, what the relation is, between the moisture-content and this "wilting-point." We have seen, however, that their "wilting-point" is rather a soil-constant and is accordingly not immediately connected with the vital phenomena of the plant.

In my opinion the problem in question cannot be properly solved for the present; we shall have to content ourselves with an estimation.

Taking into account that, as a rule, the quantity of absorbing roots decreases, as the depth increases, whereas the moisture-content rises, I determined to take as a basis, the average moisture-content within the whole soil-layer in which living roots are still found; this soil-layer was named by me: "absorption-sphere of the roots".

Let us finally discuss the term "wilting-point", that no misconceptions concerning my ideas should arise.

By the middle of the day, when the saturation-deficit of the air is greatest, wilting often takes place. This phenomenon is of a temporary nature and arises, because the loss of moisture by excessive transpiration cannot be compensated rapidly enough by root-absorption. When during the night, the relative moisture approaches the saturation-point and the transpiration decreases, the balance is redressed and the plant recovers its turgidity. Covering it with a glass globe or shading, makes the plant regain its turgescent state within a short time, even in the middle of the day. Consequently we cannot take as a basis this "temporary wilting", dependent on the daily fluctuations in the external conditions.

At the point of "permanent wilting" on the other hand, the moisture-content of the soil determines the "wilting-coefficient" synonym „wilting-point" (Briggs and Shantz, 1912: "non available water" = "echard" of Clements).

In this way we arrive at the following definition of the wilting-point. The wilting-point is the average moisture-content of the soil, calculated as the percentage on the basis of the weight of soil dried at 105° C., within the sphere of water-absorbing roots of an entirely wilted plant, which does not recover its turgidity in an atmosphere nearly saturated with aqueous vapour, without the addition of water. The supplement "within the sphere of water-absorbing roots", is connected with what was remarked above concerning plants with a normally developed root-system (consequently not in pots). Stress was laid on the *entirely* wilted state of the plant, as all the leaves do not lose their turgidity at the same time and it is not allowed to speak of a minimal moisture-degree of the soil before all the leaves have wilted. Of my plants, grown in pots, the oldest, consequently the lowest, leaves *unexceptionally* wilted first; the younger and youngest leaves were then still quite turgescent. The phenomenon had its gradual course to the top, although several days often elapsed before the youngest leaves also maintained their wilted state in the early morning. In the east monsoon of 1924 as well as in that of 1925 this phenomenon had an entirely similar course. Caldwell (1913), however, says for instance in paragraph 2: "Plants beginning to lose turgor in the youngest leaves etc." and paragraph 3: „Temporary wilting of the younger foliage etc." From this should be concluded, that the manner of wilting depends upon the nature of the plants and probably upon the climate as well.

In his conclusions Caldwell (l. c.) says "Permanent wilting appears to be a condition of general plasmolysis but not of death, in all the tissues of the plant, with accompanying cessation of certain of the protoplasmic activities." Livingstone (1910) too speaks of plasmolysis of the cells, when the plant wilts. I did not observe that permanent wilting is accompanied by „general plasmolysis in all the tissues of the plant". The cell-wall follows the collapsing vacuol, but the protoplast is not detached from the cell-wall. My studies confirm the results of Holle (1915), who did not observe plasmolysis either in intact cells after wilting and who points out that this is only found in the neighbourhood of injured tissue. Steinbrinck (1899) too asserted that the protoplast does not get loose from the cell-wall even in case of a very heavy loss of moisture. If the plants remain in a wilted condition, plasmolysis will finally occur, which in my opinion, however, should be looked upon as the beginning of death.

Before starting the investigation proper, preliminary experiments on wilting were undertaken by me. Table XXIV gives an example of it; the Polanisia viscosa plants were at the moment of observation at an age of about $3^1/_2$ weeks. The pots were filled with the light Tengger-soil of Wangkal-wetan.

This preliminary investigation gave for the four plants, on which I experimented, (see below) the following results a.o.:

1. In the state of temporary as well as permanent wilting

the leaf-cells are not plasmolysed. This refers to younger as well as to older plants (length up to 60 cm.).

2. If no water is added after permanent wilting, plasmolysis occurs after some time in the leaf-cells, beginning in the oldest leaves. The time at which it happens, depends upon the species, but besides, it may rather vary in different specimens of the same species.

3. Permanent wilting weakens the drought-resistance. For, if a plant which has permanently wilted, is watered again, it wilts sooner, after being kept dry, than a specimen that had not yet wilted permanently before. A plant, which had permanently wilted two or more times successively, finally can recover its turgidity only partly or not at all, even if it is watered abundantly for several times.

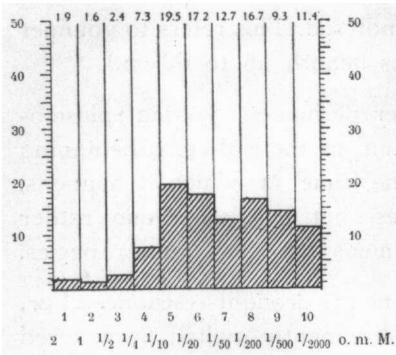
Experiments with potted plants. The investigations were performed in the east monsoon-months of 1924 and 1925. Four plants were tested: Amarantus spinosus, Leucas aspera, Polanisia viscosa and Vernonia chinensis. These plants were studied in three soil-types.

a. Soil of Sindopati square A (Pleret-plantation). This is the same soil-type as of Wangkal-wetan. Typified by the Polanisia viscosa-community.

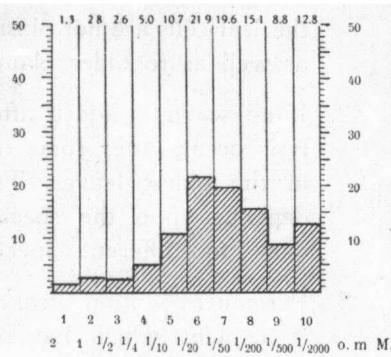
b. Soil of Karangtengah square A (Gayam-plantation). Typified by the Polanisia viscosa-community.

c. Soil of Menangas, (Kedawoeng-plantation). Typified by the Panicum reptans-Polanisia viscosa-Merremia emarginata-community.

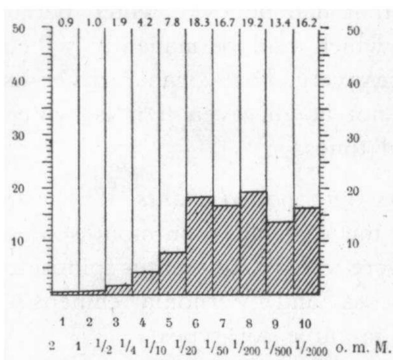
Below the texture-diagrams and analyses of these three soils:



No. 3688



No. 3689



No. 3685

Number	Sample.	Gravel bigger than 2 mm.	CO_2	P_2O_5 in		Moi-sture
				22.9 % H Cl.	2 % citric acid	
3688	Sindopati	4.7 %	absent	0.061 %	0.025 %	5.1 %
3689	Karangtengah	5.2	„	0.124	0.048	4.9
3685	Menangas	1.5	„	0.115	0.052	6.8

From the occurrence of the Panicum reptans-Polanisia viscosa-Merremia emarginata-community and from the way in which the succession was formed, it appeared that the soil of Menangas has the lowest agricultural value; the cane-variety E K 28 is affected by root-rot here and dies off prematurely. The soil of Sindopati and of Karangtengah is typed by the Polanisia viscosa-community. The development of the successions proved, however, that to Karangtengah a lower agricultural value should be assigned than to Sindopati. (Wangkal-wetan), which agrees with the experiences in the cultivation of cane. For the remaining qualities of these soils, I refer to p. 147 and following).

The pots (ordinary flower-pots of red brick with a thin, porous wall) had a diameter of 19 cm. and a depth of 10 cm. They were buried up to the edge, in earth similar to that in the pots. The earth was beaten fine, sieved and equably moistened before being done into and round the pots. During the growth of the plants, the pots as well as the earth round them, were equably and prudently watered, three times a day, until they were left dry. In this way the conditions within and without the pot remained the same, in so far as this was possible.

Nine strips were laid out in an alternate succession, each with about twenty pots; there were three strips of each soil-type. The tested plants had the full benifit of the sunlight from $\pm$ 8 a.m. till $\pm$ 4 p.m. In 1924 as well as in 1925, only very little shading by clouding occurred during the time of experimenting. The circumstances under which the plants were growing were, for the rest, very equable. In 1924 the plants wilted from September 29 till October 9, in 1925 from June 12 till June 26. [1])

In 1924 there were a few slight showers after October 9, wherefore I put an end to my experiments, though most plants had not yet wilted. Only of Amarantus spinosus the number of tested specimens in each soil-type was sufficient for obtaining a reliable result. In the following table *n* means the number of observations, w % the wilting-point and m.e. the mean error of the average.

[1]) For the relative humidity of the air, the saturation-deficit, the temperature of the air and the percentage of sunshine during these periods, see Table XXV.

Plant	Sindopati n	w %	m.e.	Karangtengah n	w %	m.e.	Menangas n	w %	m.e.
Amarantus spinosus	13	13.3	± 0.4	15	15.8	± 0.2	27	19.6	± 0.5
Polanisia viscosa ..		—		(5	13.2	± 0.8)		—	
Leucas aspera		—		(5	12.8	± 0.7)		—	

In 1925 one hundred and twenty-one pots were tested, with three plants in each pot on an average. At the beginning of this series of observations, I fell ill. Dr. P. J. van Breemen, botanist of the Experimental Station at Pasuruan, kindly performed the determinations with great care in my stead, for which in this place I want to express my best thanks. The results for 1925 agreed very well with my results for 1924, so that there was not much difference between us as to the critical state of wilting. The result was the following:

Plant	Sindopati n	w %	m.e.	Karangtengah n	w %	m.e.	Menangas n	w %	m.e.
Amarantus spinosus	11	13.7	± 0.4	10	15.2	± 0.5	11	19.2	± 0.5
Polanisia viscosa ..	9	12.8	± 0.5	10	12.6	± 0.4	9	18.1	± 0.5
Leucas aspera	9	14.5	± 0.4	11	14.1	± 0.1	9	18.2	± 0.3
Vernonia chinensis	9	12.4	± 0.7	14	13.5	± 0.2	9	18.7	± 0.6

With reference to these results we may observe the following:

1. *Amarantus spinosus.* In both years this plant had the highest wilting-point in the Menangas-soil, which is agreeing with the results obtained before, that this soil has the lowest agricultural value of the three. The difference of agricultural value between the soils of Sindopati and of Karangtengah is reliably represented also by the wilting-point.
2. *Polanisia viscosa.* Has a slightly lower wilting-point than Amarantus spinosus. Expressed in the "m.e.", the deviations — Amarantus minus Polanisia — amount to:

	Sindopati	Karangtengah	Menangas
1924 . . .	—	+ 3 m.e.	—
1925 . . .	+ 1½ m.e.	+ 4½ „	+ 1½ m.e.

Although only a deviation of three times the "m.e." may be called reliable, yet the course of the figures gives sufficient security that the deviations are not accidental. The difference between the soil-types of Karangtengah and Sindopati was clearly shown by the wilting-point of Amarantus spinosus, but Polanisia viscosa reacts in the same way in the two types of soil; the wilting-point of this plant is also highest in the Menangas-soil though.

3. *Leucas aspera*. In the soil-types of Sindopati and Karangtengah this plant has a reliable higher wilting-point than Polanisia viscosa. Within the limits of the error it has the same wilting-point as Amarantus spinosus. No more than Polanisia does Leucas aspera react upon the difference in soil-nature between Sindopati and Karangtengah.

4. *Vernonia chinensis* has the same wilting-point as Polanisia viscosa. The moisture-content at the time of wilting is reliably lower than that of Amarantus in Karangtengah-soil and of Leucas aspera in Sindopati- and Karangtengah-soil, for the rest the deviations keep within the limits of the errors.

When taken the wilting-point of Polanisia viscosa in each soil-type as the unity, we obtain the following results for the determinations during 1925.

	Sindopati	Karangtengah	Menangas
Amarantus spinosus	1.07 ± 0.03	1.21 ± 0.04	1.06 ± 0.03
Polanisia viscosa	1.00 ± 0.04	1.00 ± 0.03	1.00 ± 0.03
Leucas aspera	1.13 ± 0.03	1.12 ± 0.01	1.01 ± 0.02
Vernonia chinensis	0.97 ± 0.05	1.07 ± 0.02	1.03 ± 0.03

When taken the wilting-points in Sindopati-soil as the unity we obtain:

	Sindopati	Karangtengah	Menangas
Amarantus spinosus	1.00 ± 0.03	1.11 ± 0.04	1.40 ± 0.04
Polanisia viscosa	1.00 ± 0.04	0.98 ± 0.03	1.41 ± 0.04
Leucas aspera	1.00 ± 0.03	0.97 ± 0.01	1.26 ± 0.02
Vernonia chinensis	1.00 ± 0.06	1.09 ± 0.02	1.51 ± 0.05

From the first table, once more it appears clearly that the variations in wilting-point of the tested plants are not great in one single soil-type. This result does not confirm the investigations of Briggs and Shantz of course. Their point-of-view is interpreted by Kearny and Shantz (1912 p. 352) as follows: "Wilting in all cases taking place at practically the same limit of moisture-content in a given soil. This is true not only of crop-plants but of such extreme forms as the cacti of the deserts and the ferns of moist tropical forests." The four plants, however, which were examined here, are all mesophytes. It is true that from the second table it appears, that, in case of potted plants, the variations in wilting-point are much greater, with regard to the extreme types of soil — Sindopati and Menangas — than those of the plants if compared mutually. When dealing with the box-cultures, we shall see that, under more natural conditions, these variations with respect to the soil-types are less pronounced for some plants.

As several specimens were examined in each pot, it appeared that equally large, vigorous plants may behave very unequally, and that the time of permanent wilting may show a difference of days. From the mutual comparison of these plants in one single pot, it was also evident that seedlings and small plants wilt sooner than medium-sized specimens (25—40 cm.); in the determinations of the wilting-point, these deviations cannot be indicated; they appear to lie within the limits of the error. The m.e. of 10 determinations amounts to $\pm$ 0.5 %, doubtless partly owing to the mutual differences actually existing. In the observations of Briggs and Shantz the error is about ten times smaller (see for instance Briggs and Shantz 1912 a); however, on account of the way in which they made their experiments, the differences of individuality were less clearly shown. When later on the box-experiments will be dealt with, the individuality of the plant, to which in my opinion more attention should be paid in ecological studies, will be clearly evident.

Experiments with plants cultivated in boxes. The same plants and types of soil as the above-mentioned, were examined in boxes as well; of each soil-type there were three boxes. The zinc boxes (1 M. long and wide and 0.80 M. deep) were buried in the ground and bottomless. In the east monsoon of 1924 the boxes were filled with earth which was beaten fine and sieved; after that the seed was scattered in them. In order to attain a distribution of moisture, as regular and natural as possible, the boxes were left to themselves during the whole rainy season of 1924—'25 and the experiments were only begun in the east monsoon of 1925. Nevertheless it appeared that a perfectly regular distribution of moisture is not achieved in such large boxes; spots lying near each other in one box, may vary more than 2 % in degree of moisture. As the three boxes of one soil-type showed mutual varying differences of the same order, the moisture-content of the three boxes might be assumed as being equal, by which the accidental differences were better eliminated too. Only box 2 was not combined with box 6 and 8 (soil-type of Sindopati), because the first-mentioned box had at first a 2 % lower degree of moisture in all depths than the boxes 6 and 8.

With the sampling-drill, mentioned before, samples of 10 cm. were taken every fortnight to a maximum depth of 60 cm.; these samples were regularly distributed over the surface of the boxes in the course of the months.

Apart from the accidental fluctuations, mentioned before, over the whole depth of the boxes, the moisture-content decreased fairly slowly and regularly during the four months of observation. The average moisture-content of the boxes 3, 5 and 7 (soil-type of Menangas) was for instance:

At a depth of:	0—10 cm.	10—20 cm.	20—30 cm.
on July 1 1925 . . .	18 %	22 %	23 %
„ September 23 . .	9 %	12 %	13 %

For box 1, 4 and 9 (soil-type of Karangtengah).

on July 1 1925 . . .	13 %	16 %	17 %
„ September 23 . .	7 %	10 %	11 %

For box 2 (soil-type of Sindopati).

on July 1 1925 . . .	13 %	15 %	16 %
„ September 23 . .	5 %	9 %	10 %

For box 6 and 8 (soil-type of Sindopati).

on July 1 1925 . . .	15 %	18 %	18 %
„ September 23 . .	6 %	10 %	11 %

In connection with the local fluctuations in the moisture-content of the boxes and the great variations in the wilting-point among the individuals of one kind of plant, it is no use seeking to attain a great degree of accuracy in the determinations of moisture. For that reason we need not scruple to interpolate the moisture-content between the fortnightly samplings.

From the east monsoon of 1924, the superfluous specimens were regularly removed as the plants appeared above the ground. The plants, however, showed such a great difference in their rate of growth, as regards the species as well as the individuals, that when the plants were left dry in the beginning of July 1925, there were both small and larger specimens in each box.

During the four months in which the investigation took place, the climatic conditions were so regular again, that a statement of the relative humidity of the air may suffice.

Relative humidity of the air at Pasuruan.

1925	7 a. m.	Noon	5 p. m.
July	79 %	51 %	56 %
August	71 %	52 %	50 %
September.	68 %	49 %	53 %
October	65 %	46 %	52 %

The behaviour of the plants with regard to the wilting was in many respects different from that of the potted plants. In the boxes more than three months elapsed between the moment of wilting of the first plant and that of the last one, in the pots only a fortnight; in the case of potted plants eight days at most elapsed, between the moment when the first wilting phenomena in one plant became visible till the moment of permanent wilting; in the case of box-cultures, on the other hand two or three months often went by. On the whole, the phenomena which the plants showed in the boxes, agreed more with those which were observed in the open and which were described in chapter XI.

The wilting-point of 260 plants was examined and the root-systems of more than 300 plants were studied. Although the number of plants was fairly large, it was far too small to solve all questions presenting themselves, which would in fact require a separate study of several years. It was clearly evident to me, that as yet we know hardly anything of the wilting of full-grown plants under natural conditions, a problem so fundamental from an ecological point- of-view. I hope that this study which only stresses a few main features of the problem, may be sufficient to show that determinations of the wilting point of seedlings growing in pots, give us but a very slight insight into the behaviour of plants in the open.

In the beginning of July the first specimens began to wilt, which phenomenon regularly continued till the month of October. From the end of September till the end of October the boxes were opened, although at that time all the plants had not yet wilted; Polanisia viscosa especially had many specimens still which had not wilted. Opening the boxes was necessary, however, because otherwise the root-system of those plants that had wilted as far back as July and August, would perhaps be unfit for being studied.

As no determinations of moisture were performed after September 23 1925, the degree of moisture for the plants that had wilted in October was extrapolated, which does not cause an error worth mentioning.

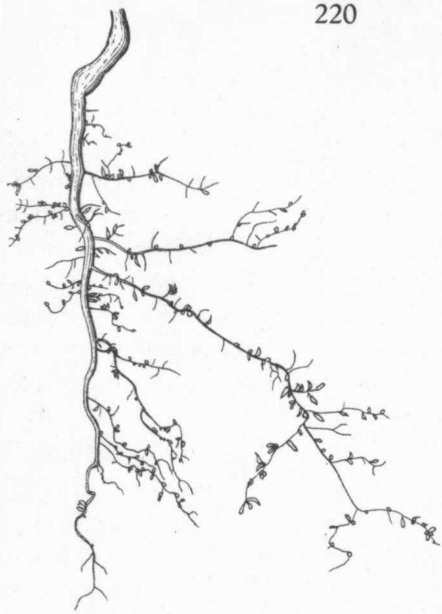
The tables XXVI a, b and c give a full survey of the tested plants. The plants were continually numbered for each type of soil according to the moment of wilting (nr). Column 2 indicates the date of wilting (date). Column 3 contains the average moisture-content of the soil-layer in which active roots were found (moisture $^0/_0$). Column 4 indicates the depth of the soil-layer in centimeters, which area I have denoted before by the name of "absorption-sphere" (a.s.). Column 5 gives the length of the aerial part of the plant in centimeters(l.). Column 6 the length in centimeters of the root penetrating most deeply(l.r.). The plants that had not yet wilted, when the boxes were opened; were also included in the tables. For these the degree of moisture was recorded on the day that the plant was dug up (this date was put in parentheses in the table) and by the sign $<$ it was indicated that the wilting-point is lower than the moisture-content mentioned. Besides some plants were included in the tables that dit not wilt, but that shrivelled and died off, a phenomenon that will presently be discussed in detail. They were put in parentheses and "shrivelled" was entered in the column of "moisture $^0/_0$".

Before discussing the average results in the tables, I shall first of all consider more fully the phenomena during wilting and the properties of the root-system.

A very striking result of this investigation is the high degree of variability (even of plants of equal size), both in the manner and in the moment of wilting and in the development of the root-system. A single glance at the table shows that this is the case in a higher or smaller degree with all plants in each of the three soil-types. For instance in Sindopati-soil the P_1, with a length of 20 cm. and which has an absorption-sphere of 16 cm., wilts on July 16 at 13 % of soil-moisture; the P_4 (length 26 cm.) which has an absorption-sphere of 15 cm., wilts on August 13 at 11 % of soil-moisture; the P_{14} (length 28 cm.), on the other hand, with an absorption-sphere of only 10 cm., wilted on October 6 at 5 % of soil-moisture. In the same type of soil, L 6 wilts on July 19 at 15 % of soil-moisture with a height of 24 cm. and an absorption-sphere of 15 cm. The L 9 of nearly the same height, with an absorption-sphere of only 10 cm. held its own, however, till September 1 and only wilted at 9 % of soil-moisture; the greatest depth to which the roots penetrated was the same for both plants. Numbers of such instances from the tables may be given and they show that, with these plants, there is *on the whole* no connection in the individuals of one single species, between the size of a plant, the absorption-sphere, the deepest root and the wilting-point. In other words it is evident that in this case, there is no connection between the morphological features and the physiological reaction. From the investigation it appeared that the variation in the wilting-point of individuals of one species of plant, is closely related to their property to lower the wilting-point connected with a decrease of the transpiring-surface. Although transpiration-measurements could only furnish an absolute proof, we may yet presume that this is effected by the shedding of the large leaves and the forming of very small ones, while the secondary shoots are often put out of function. Only those plants which attained this new physiognomy at an early date, withstood the drought longest and finally showed the lowest wilting-point. The plants with a high wilting-point were invariably specimens, which wilted when the original leaves were either entirely or for the greater part still in function. The rate at which the plant, incited by intense drought, acquires this new physiognomy, often seems to be connected with a more or less vigorous development, although not always so; undoubtedly its physiological constitution also plays a leading part in this. Thus we have arrived at the conclusion that these plants possess, not one, but several wilting-points under external conditions which are, for the rest, similar. The following instances will illustrate this more fully.

Polanisia viscosa. In the boxes with *Menangas-soil,* the mutual differences between the wilting-points were greatest. The plants showing a high wilting-point (13 %—16 %) had all retained more or less their west monsoon-aspect. P_1, 46 cm. in length (a. s. 16, l. r. 25) had normal secondary roots which were distributed almost regularly over a depth of 16 cm.; the hypertrophic organs ("the tubercles") were entirely lacking. The plant had leaves, with long petioles, of a normal size. Only in its main root it showed the first symptoms of the east monsoon-aspect — for the extreme end had dried up and had been already partly shed. On July 20 (when the plant had been left dry for about one month) the oldest leaves began to wilt. Gradually the younger leaves lost their turgidity, the oldest, already wilted, were shed etc., till on August 3, at six o'clock in the morning, the youngest leaves remained limp. The wilting developed in the same way as it did in potted plants, it only took some more time (13 days as against 8 days maximally in potted plants); the wilting-point amounted to 16 % (potted-plants 18 % on an average). P_2 and P_4 showed the same physiognomy and way of wilting. P_3 had already a stronger reduction of its main root. It had already shed many leaves, which had dried up without wilting. Hypertrophic tubercles on the secondary roots were, however, entirely lacking. P_5 was a very small plant, which had not grown anymore after it had been left dry; it entirely had the west monsoon-aspect, the lower part of the main root had been shed, however; here too, the secondary roots had no "tubercles". P_6, P_7 and P_{10} were transition cases, both in the physiognomy of the aerial parts and in that of the roots; similar cases are rare, however. All the other plants assumed the east monsoon-physiognomy. P_{12} was a peculiar plant and only 13 cm. in size. It had germinated at the moment that the boxes had been left dry. The plant grew up with small, short-petioled east monsoon-leaves. For such a small plant it had a large absorption-sphere (16 cm.); over the entire depth there were small secondary roots with a fair number of tubercles. The plant wilted only $2^1/_2$ months later (September 30) in a normal way, at a moisture-content of 9 %. A similar plant (21 cm. in size) grown up under the same conditions, was dug up on September 3, before the wilting, when it was still quite fresh. The root-system has been drawn, on the next page, in its natural size. In the schematic figure, next to it, the situation of the rootlets has been indicated.

Of the bigger plants which had gradually assumed a strongly pronounced east monsoon-physiognomy, I draw attention to P_9 (60 cm. long). On September 12 the first small leaves at the basis of the shoot began to wilt. On September 19 the process had already come to an end and the whole plant had wilted at a moisture-content of 9 %. The main root, 11 cm. in length, appeared, for the greater part, to have dried up for a long time. The plant had lived on only 5 small secondary roots which were



Root-system of Polanisia viscosa (21 cm. high). Turgescent specimen of an experimental box with Menangas-soil. ($^{2}/_{3}$ natural size).

Schematic figure of the same root-system with the rootlets indicated. ($^{2}/_{3}$ natural size).

between o and 5 cm. below the surface. The many "tubercles" attached to these secondary roots and studied immediately after the wilting, appeared to be entirely dried up and to have faded to yellow. This would point to the fact that they serve as water-storing organs, which are only made use of, immediately before wilting. A few plants wilted at 8 %, such as P_{17}, which had germinated just before the cessation of watering the boxes. P_{16} had shed all its west monsoon-leaves at the end of August. In the middle of September the plant displayed many young sprouts and small leaves. On September 29 the basis-most leaves began to curl up, which phenomenon gradually reached the top. On October 9 only the top-most leaves had remained turgescent. On October 15 all leaves had wilted at a moisture-content of 7 %. The plant was immediately dug up. All hypertrophic tubercles (with which the very small secondary roots were all thickly set) appeared to have dried up and were of a yellow colour. The deepest secondary roots penetrated to 8 cm., the main root was only 10 cm. long and entirely wasted at its end; most secondary roots were found between o and 5 cm. below the surface. Many plants were still fresh when the boxes were opened, so that their wilting-point lies below a moisture-content of 7 %. P_{19}, a stout plant, 97 cm. in length, regenerated twice. After it had shed all its west monsoon-leaves in early August, it had formed in the meantime young, small leaves. These leaves began to lose colour on August 30. The leaves did not wilt, but dried up; on Oct. 9 it had already shed a part of these dry leaves. Gradually a few buds at the basis of the shoot began to swell. On October 26 the plant was dug up. Then it had two young, fresh, vigorous sprouts of about 8 cm. in length, on a level of 10 to 16 cm. above the ground; the rest of the plant was leafless and had dried up. The big, contorted main root was only

15 cm. long; in the soil lay loose from the rest of the root-system, a dried piece of the main root, which had so died off and got detached before. The greater part of the secondary roots, densely covered with fresh tubercles, clear as glass, was to be found between o and 5 cm. under the surface. The deepest secondary root was 8 cm. in length and reached to a depth of 10 cm. P_{20}, with a length of one M., behaved itself in a similar way. Only a small part of the uppermost small top-leaves, remained intact, in contrast with P_{19}. For the rest, this plant too, formed a new sprout (between the end of September and October 14), which was entirely turgescent when the box was broken up on October 26. The extreme half of the big primary root (15 cm. in length) was yellow, twisty and had dried up. The plant had only small secondary roots between o and 5 cm., which were thickly set with the small hypertrophic organs. P_{22} likewise regenerated twice. P_{18}, P_{14}, P_{18}, P_{21}, did not do so and were still fresh, with their first east monsoon-foliage, when the boxes were broken up.

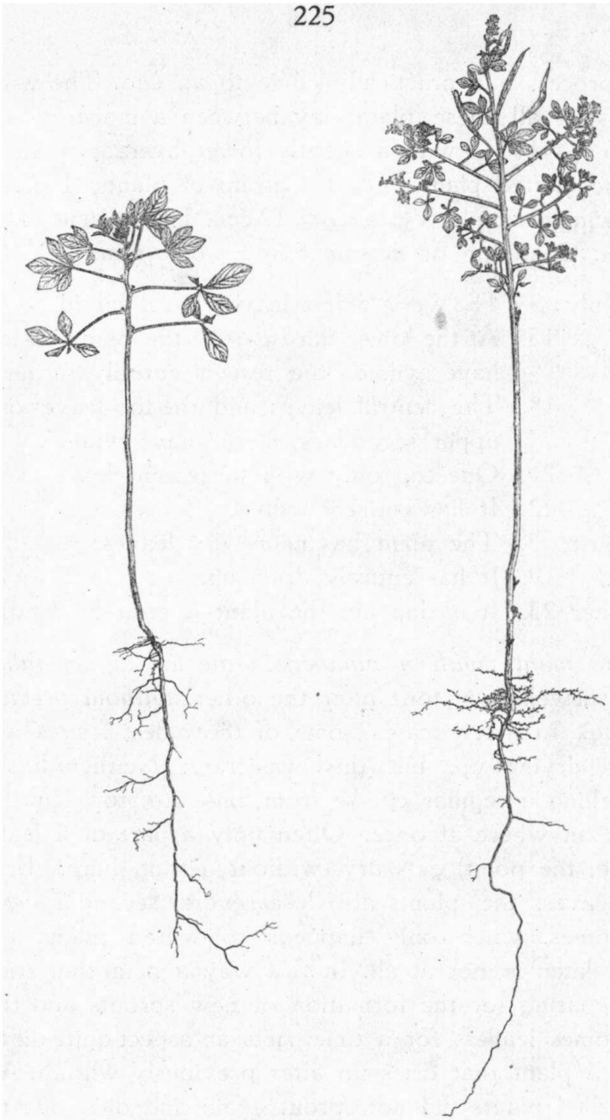
In the boxes with *Karangtengah*-soil the mutual differences of Polanisia-specimens were not so great as in the Menangas-boxes. The plants held out longer and wilted on an average at a lower moisture-content, as it also appeared in the potted plants. Nevertheless in Menangas-soil also several plants had a wilting-point below 7 %. Only on August 30 the first plants wilted, 27 days later than on Menangas-soil as we see, while all boxes had been left dry at the same time. The root-system of P_3, for instance, (which wilted at a moisture-content of soil of 9 % on September 1), had not entirely lost its west monsoon-character. The secondary roots had spread rather regularly between o and 10 cm. and there were a few hypertrophic tubercles only. The end of the primary root was, however, inactive already and a part had probably been already shed. This plant, just like P_1, P_2 and P_4 and in a less degree P_5—P_8, had partly kept its west monsoon-foliage, which began to lose its colour, however, some time before wilting. Of the other plants, all with very small east monsoon-leaves, a few wilted in October at a moisture-content of 6 % to 8 %; others were still fresh at the breaking-up of the boxes at a moisture-content lower than 7 % to 8 %. A description of those plants may be omitted, as the wilting-phenomena entirely agreed with those in the Menangas-boxes. I only wish to point to P_{10}, where the entire west monsoon primary root was still present (51 cm. in length), although inactive below 20 cm. without any secondary roots. The functioning secondary roots were mainly to be found between o and 7 cm. under the surface, with one secondary root at 11 cm. and one at 20 cm. depth, besides. The most superficial ones were thickly covered with hypertrophic tubercles which had already lost their moisture entirely and faded to yellow, when the plant was dug up. In the *Sindopati-boxes* the process of the wilting phenomena was not different from that in the two other soil-types, a detailed description is therefore unnecessary. P_1—P_5 and P_8 all had nearly exclusively, the larger, longer-petioled west monsoon-leaves; the tubercles on the secondary roots were lacking. They wilted at the highest moisture-content of soil, agreeing about with that of the potted plants. P_6 and P_7 had east monsoon-leaves for a part only; the rest of the plants gradually assumed the east monsoon-physiognomy. A great part of the latter plants had not yet wilted when the boxes were broken up. P_{18} renewed its leaves in the middle of September for the second time and displayed a new fresh, vigorous sprout, when the plant was dug out on October 19. From September 25 till the beginning of October this plant was practically leafless. In these Sindopati-boxes too there appears to be no direct relation between the depth of the absorption-sphere, the size of the plant and the moisture-content of soil at the time of wilting. The fluctuations in the wilting-point appear to be chiefly connected with the degree of regeneration. On the next page a figure of the plants P_1 and P_{17} in Sindopati-soil.

Amarantus spinosus. The variations in the wilting-point appeared to be much slighter than in the case of Polanisia viscosa. Contrary to its conduct in the open, the plants in the boxes lacked nearly entirely their capacity of regeneration.

I ascribe this wholly to the severe affection by the larva of the beetle Lixus Pica F., from which nearly all plants suffered. As has been discussed before, Amarantus spinosus is also affected by this beetle on non-irrigated soils in the open; in that case the plants do not seem to suffer so much from it. In the boxes many specimens died off, without wilting. Only very occasionally a plant substituted its west monsoon-leaves partly for small east monsoon-leaves; therefore these plants remained fresh for a longer period of time (A_{10} and A_{11} in the Sindopati-, A_{20} and A_{21} in the Karangtengah-, A_{34} in theMenangas-boxes). The root-system was superficial indeed, but lacked the small hypertrophic secondary roots, so typical in the east monsoon under natural conditions (cf p. 191). A further description is superfluous here. Most plants wilted in quick succession, sometimes in large groups at a time, which reminded one very much of the conduct of potted plants.

Vernonia chinensis. This plant displayed very clearly the regenerative phenomena of leaves and shoots and the effect of this on the wilting-point. *In the Menangas-boxes* a great number of plants wilted normally, that is to say the wilting was not preceded by any regeneration (Nos. 1—18).

Wilting began in the oldest leaves; at the end of July a



b

Figure V.

a. Polanisia viscosa of an experimental box with Sindopati-soil. Specimen (P_1) with west monsoon aspect and a wilting-point of 13 %.

b. Polanisia viscosa of the same box. Specimen (P_{17}) with east monsoon-aspect and a wilting-point $<$ 6 %. ($^1/_4$ natural size).

this process had practically come to an end. The wilting-points of all these plants lay between a moisture-degree of 16 %—19 %, with a slightly lower average than that of the potted plants. Of this group of plants I give the following example. V_{10} a.s. = 12 cm., l. = 41 cm., l. r. = 17 cm. Condition of the plant at ± 6.30 a.m.

July	8.	The very oldest leaves have wilted.
„	15.	At the lower third part of the plant all leaves have wilted, the rest is entirely turgescent.
„	18.	The central leaves and the top-leaves of two upper secondary shoots have wilted.
„	21.	One top only with turgescent leaves.
„	22.	It has entirely wilted.
August	3.	The plant has many dry leaves.
„	19.	It has entirely dried up.
October	23.	It is dug up, the plant is entirely dead.

The plants with a number in the list higher than 18 had shrivelled up one after the other, *without previously wilting*. In a few cases some of the oldest leaves wilted before drying up, but this was rare. Neither has the shrivelling a regular course from base to top, but may begin anywhere at once. Often only a part of a leaf (as a rule, the point) gets dry, without getting limp. Besides the leaves, the plants also lose several secondary shoots sometimes, which only happens to wilted plants either much later or not at all. In this way a plant that dries up in preparing for the formation of new sprouts and that is sometimes leafless for a time, gets an aspect quite different from a plant that dries up after previously wilting. A few shrivelled plants did not sprout again and died off; these are, however, exceptions. I included a few of such plants in the table; they were put in parentheses. V_{19}, for instance, had entirely dried up at a moisture-content of ± 16 %, practically equal to the wilting-point; the plant did not shoot forth any more new leaves. The same took place at V_{22} and V_{24}, which had shrivelled up at a moisture-content of $\pm 13\,\%$.

The regenerating plants wilted at a moisture-content lower than $6\,\%$ to $9\,\%$, because they still had turgescent, young sprouts, when the boxes were broken up in October. As an illustration of this group I mention V_{20}.

July 8. The tops of a number of leaves gèt brown, especially towards the basis of the plant.
„ 14. Many of the basis-leaves have entirely shrivelled up, towards the top too, there are dead leaves.
„ 28. The plant has shed many shrivelled leaves,
August 3. The plant is practically leafless; at the top there are still a few green or partly green leaves.
„ 15. The plant has also dried up at the top, a few secondary shoots were shed.
„ 18. The plant looks dead.
„ 24. There are swollen buds near the basis of the plant.
September 16. Three vigorous sprouts have formed with young, small leaves. The top of the plant is dead.
October 14. The plant has sprouts with still entirely turgescent leaves. When dug up, it appears to have fairly regularly distributed secondary roots, down to a depth of 30 cm. The main-root has died off at a depth of 30 cm. The wilting-point of this plant lies below $9\,\%$.

In the *Sindopati-boxes*, Vernonia showed similar phenomena. A group of plants wilted in the normal way with their original foliage at a moisture-content of soil of $12\,\%$—$15\,\%$ (V_1—V_{15}). A few shrivelled up without wilting, and did not sprout any more (V_{19}—V_{21}). Others shrivelled up before wilting, but afterwards they sprouted again and were still turgescent at the breaking-up of the boxes in October (V_{16}—V_{18}, V_{22}—V_{31}). The wilting-coefficient of these last few plants lies below 6—9 % of moisture. Transitions between the first and the second group, as we observed with Polanisia viscosa, do not occur at Vernonia chinensis. The plants either wilt with their original leaves or they shrivel up and die off, but mostly are forming new sprouts. A double regeneration, as I came across a few times with Polanisia viscosa, does not occur here. In the *Karangtengah-boxes* the number of Vernonia-plants was small; they all happened to wilt in the normal way.

Leucas aspera. This plant does not show any typical regenerative phenomena. Sometimes however the various sprouts wilt, but not at the same time. When most of them already stand leafless, a few sprouts have fresh top-leaves still, which remain turgescent for a very long time. In this way the transpiring surface is greatly reduced, even though the adaptation to the drought could not prevent most of them from wilting already before October. In the *Menangas-boxes* the plants L_1 to L_{12} wilted regularly between July 7 and 28. The second group, L_{13} to L_{19} only wilted between August 3 and October 14. In the *Sindopati-boxes* only L_9 belonged to the second group; all the other plants wilted regularly. *In the Karangtengah-boxes* all plants wilted normally, except L_{17} to L_{23}. L_{23} was the only Leucas-specimen that still bore turgescent leaves on October 14. This plant had the largest absorption-sphere of all the tested Leucas-specimens (30 cm.).

Table XXVII gives a survey of the wilting-points of box-plants and of potted plants. The wilting-point of the "non-regenerated plants" (that is to say with exclusively west monsoon-leaves) was generally lower than that of the potted plants although the differences are not great. I called those plants "partly regenerated", which partly substituted [1]) their west monsoon-leaves for east-monsoon-leaves; they had a far lower wilting-point than the plants of the first group. The majority of the "entirely regenerated" specimens (i. e. with east monsoon-leaves only) had not yet wilted when the boxes were broken up. For those plants the moisture-content, below which the wilting-point is sure to lie, was put down under "moisture $^0/_0$". It was indicated in this way, for instance $< 7\,^0/_0$; the date in brackets points out the last day on which the non-wilted plants were dug out. A further discussion of the table may be omitted after what has preceded. The result is that potted plants do not give an insight into the phenomena which the plant displays under natural conditions. The capacity of Polanisia viscosa and Vernonia chinensis, of being able to strongly reduce their wilting-point by regeneration, makes them highly drought-resistant plants, which does not come out at all in the pot-cultures.

The great influence of this regeneration on the wilting-point is still more evident, if at the same time we consider the reduction of the root-system. For as the east monsoon continues, these plants keep forming superficial roots and their deeper descending roots gradually die off.

The entirely regenerated plants, which are the last to wilt as we have seen, proportionately root most superficially, nevertheless they appear to be most drought-resistant. For the "entirely regenerated plants" I calculated the average proportion of the length of the plant to the absorption-sphere, likewise for the "non-regenerated plants" and for plants in my boxes in the middle of the west monsoon (February 1926). The result was as follows:

[1]) In this list were also included the Leucas-plants which wilted irregularly, and which in this way resisted the drought, although no "regeneration" took place; cf. p. 228.

The average proportion of the length of the plant to the absorption-sphere of the roots.

	west monsoon	east monsoon non-regenerated	east monsoon entirely-regenerated
Polanisia viscosa.			
Sindopati . . .	0.9	1.8 (41 cm.)	2.6 (62 cm.)
Karangtengah .	1.3	—	3.7
Menangas . .	1.7	2.9 (32 cm.)	7.7 (34 cm.)
Vernonia chinensis.			
Sindopati . . .	1.3	3.8 (62 cm.)	4.7 (75 cm.)
Karangtengah .	1.2	2.6	—
Menangas. . .	1.1	3.3 (39 cm.)	4.4 (65 cm.)

From this table it clearly appears that the reduction of the root-system is very important in these plants. The west monsoon-plants were selected in such a way that the average length agreed with that of the "entirely regenerated" plants. The average length of the non-regenerated plants is slightly smaller, as it appears from the figures in parentheses. The ratio: length to absorption-sphere, will therefore be relatively a little too high for the non-regenerated plants. For Polanisia viscosa the figures clearly indicate, that the plant will feel most at home in Sindopati-soil, less in that of Karangtengah and least of all in Menangas-soil.

Finally, I wish to emphasize once more, that these studies on wilting phenomena had a preliminary character only. Many questions must remain unsolved. My experiments, however, seems to justify the conclusion that our knowledge on the subject of wilting and drought-resistance of plants is still very meagre. To this fact I will draw the attention of investigators, especially in the tropics, where the conditions for similar researches are so favourable.

Summary.

1. The plain of Pasuruan (the island of Java), bearing on my investigation, is a young volcanic formation of the Quaternary period. (Chapter I and II B, a.)

   As the region is geologically young and the rivers continually supply large quantities of silt, as an ingredient of the irrigation-water, all food-material for plants is generally present in a sufficient amount. (Chapter II B, *b.*)

   A natural, undisturbed flora is to be found anywhere in this district, which is exclusively agricultural (rice, sugar-cane, maize etc.). The qualities of the crop, and its influence on the soil and weed-vegetation were described, together with the methods of cultivating. (Chapter II C).

   The climate of the district may be typified as a monsoon-climate with a fairly keen separation between a nearly rainless period of 4—5 months and a wet period with a total of about 1300 mm. of rain in about 100 rainy days. The monthly average of temperature is high and very equal (25,4°—27,1° C.); the sunshine-percentage, with an average of 75 %, is very high. (Chapter II A).

2. In the weed-vegetation on culture-fields of the district, a number of communities, with a definite floristic constitution and physiognomy, could be determined.

   The weed-communities on sufficiently irrigated second-crop-fields, not older than four to six weeks, give indications, in the examined area, about the agricultural

value of the soils, agreeing with the views obtained in the cultivation of sugar-cane.

The *Polanisia-viscosa*-community typifies the good light E K 28-soils, in which this variety is not affected by root-rot, when treated normally.

The *Panicum reptans-Polanisia viscosa*-community occurs on light soils, on which E K 28 does not give its best produce, but on which root-rot is rare. They are very good soils for D I 52, if there is an ample water-supply.

The *Panicum reptans-Polanisia viscosa-Merremia emarginata*-community typifies light and fairly light, less good soils, which soon dry up. E K 28 often goes wrong here, owing to root-rot. D I 52 can yield a sufficient produce, provided the soil is kept sufficiently moist.

The *Panicum reptans-Polanisia viscosa-Portulaca oleracea*-community typifies light and fairly light soils, which do not dry up quickly, The *variant A* of this community occurs on soils very suitable for D I 52. E K 28 gives very changeable results, a real failure from a cultural point of view is exceptional, however. The *variant B* typifies soils, unsuitable for E K 28; D I 52 and S W 3 often deteriorate quickly and show signs of dying-off at the setting-in of the east-monsoon in the year of reaping; the P. O. J.-varieties are best suited for these soils.

The *Panicum reptans-Gymnopetalum leucostictum*-community grows on medium-heavy to heavy soils.

The *variant A* is typical of soils, which are most suitable for strongly-rooting cane-varieties.

Where the *variant B* occurs, only the hardiest cane-varieties will grow; at the setting-in of the east monsoon, the condition generally quickly deteriorates.

The *variant C* typifies soils which are yet suited for S W 3, for the rest, on these soils too, the strong P. O. J.-varieties are preferable, because they are less subject to risk.

The *Polanisia Chelidonii*-community occurs only on fairly heavy clay with a high level of ground-water. The presence of the variants A, B or C is dependent on the higher or lower level of the ground-water and the greater or smaller permeability of the clay; on soils with the variant B, S W 3 and D I 52 may be planted, for the rest the strong P. O. J.-varieties yield the best produce on this heavy clay.

The *Dentella repens-Lippia nodiflora*-community grows on heavy soils which, also superficially, dry up but slowly; they are only suited for strong P.O.J.-varieties.

The *Moschosma Polystachyum-Sphaeranthus africanus*-community is met with on damp, medium-heavy and fairly heavy soils, which have not sufficiently dried up and are therefore poor in oxygen.

The *Lippia nodiflora-Phaseolus trilobus*-community is typical of heavy soils of inferior quality, which are damp at first, but dry up quickly. Even the strongest P.O.J.-varieties yield but moderately here, for in the year of reaping drying-up of the cane soon begins. (Chapter V).

3. The weed-communities described, which are studied statistically at so early an age that mutual competition was excluded, are typified by a great number of "constants" and are, generally, sharply delimited. The constitution-diagram of these communities shows the typical curve of homogeneity (Nordhagen). It was concluded that germination of definite plants only takes place within a definite ecological amplitude. Some sowing-experiments in experimental squares and other discussed observations confirmed this view.

With a gradual course of ecological conditions too, the transition-zones between these pioneer-communities are very narrow; a possible explanation of this fact was given.

I emphasized the fact, that later on the habitat and the communities are often mutually unrelated, even though, the vegetation was determined ecologically; it was pointed out that the dissimilar conditions during the arising of the communities should be taken into account to explain this.

The corresponding qualities of my "communities" and the "associations" were discussed (Chapter VI).

4. A few succession-communities were described. It appeared that the ecological amplitude of the succession-communities is wider than that of the communities preceding them (Chapter VII).

5. A number of communities on fallow rice-fields, after reaping the rice, were studied. The poverty in oxygen of the substratum is the chief determining factor for these communities. It appeared that on light and medium-light soils the occurrence of definite communities does not depend only on the quality of the soil, but also on the duration and the intensity of the irrigation of the preceding rice-fields (Chapter IV).

6. On saline soils a number of communities sharply delimited occur, depending among other things on the salt-amount of the soil; on soils, containing calcium-carbonate-concretions, a few communities were found which pointed to calcium-carbonate.

   On germinating the halophytic communities are already determined as such; in other words, the common view that the exclusive occurrence of halophilous plants depends only upon competitors, is not confirmed here.

In special, bare experimental squares on saline soils, the germination was experienced of halophytic communities, in whose immediate neighbourhood non-saline vegetation was abundant. Nevertheless not a single plant, typically confined to a halophobous community, germinated in the open saline vegetation, to be superceded later on by victorious halophilous competitors, as it is usually believed; the reverse too, was investigated, and with the same result. When the flora grows older and competition sets in, the struggles are fought between the halophilous plants or between the non-saline ones; an intermingling of these opponents, however, followed by a selective competition, leading to the conquest of halopholous or halophilous plants, dependent on soil conditions, was never observed by me. The condition of sugar-cane and maize is correlatively connected with the occurrence of definite salt-indicating communities.

Besides with the chemical character of soils, the occurrence of halophilous as well as calciphilous plants is connected with a definite combination of external conditions.

The obligatory calciphilous plants are weak competitors in this district, in consequence the calcareous character of a soil is no more to be recognized from the successions.

7. The sugar-cane appears to react on the differences of the soil within the amplitude of a community, as was spoken of under 2.

The Polanisia viscosa-community was closer examined in this respect. The rate at which and the way in which, the Polanisia viscosa-community attains the first succession, in different experimental squares, under equal climatic conditions, appears to be a basis for a closer division of the soils within the ecological amplitude of this community, agreeing with the experiences of the cultivation of sugar-cane with regard to the agricultural value of these soils.

8. The rains in the west-monsoon, combined with the high temperature in the tropics, enables plants to grow very rapidly. For that reason, the west monsoon-squares gave an opportunity to study the way in which plants compete with one another. The chief results may be summarized in the following "competition-rules", which were experimentally composed.

   a. The way in which plants mutually compete and the results of this struggle, in an area of a definite floristic composition, are determined, beforehand by the local ecological conditions. *Accidentally* floristic fluctuations, not determined ecologically, are unable to influence the course of the struggle essentially.

   b. Plants, having a quick and luxuriant growth of their superterranean parts in conditions favourable to them, are the keenest competitors. They cast their shade over weaker competitors or supersede the others in the struggle for space.

   Root-competition too occurs, more especially in the east monsoon.

   c. The vigorous competitors, which finally form the succession, appear to be at the same time drought-resistant plants; inversion of the rule is not allowed, however.

   d. The keenest competitors within the communities, preceding the successions, are always constants at the same time. Reversely, constancy in itself, is not a condition for a strong competitor, even if the plant is drought-resistant (Polanisia viscosa).

e. As an effect of mutual competition some plants are entering upon a resting-period in the west monsoon; their leaves are shed and sometimes their superterranean parts die off totally. These plants are capable of regeneration in the height of the east monsoon; for some plants, however, a sufficient amount of light is an essential condition. (Chapter IX).

9. In the beginning of the east monsoon the vegetation in most west monsoon-squares appears to be chiefly constituted of drought-resistant plants and to have attained a relative equilibrium, only disturbed for a short time during the successive west monsoons (Chapters IX and X).

10. In experimental squares, laid out towards the end of west monsoon, the east monsoon-vegetation was studied, with the following results:

a. Practically, the soil on non-irrigated area at a depth of more than 20 cm. below the surface, does not decrease in moisture-content, even not during the very prolonged, entirely rainless east monsoon of 1925.

b. The top-layer of the soil, however, after the setting-in of the drought dries up so quickly, that after a short time not a single plant germinates any more; the vegetation maintaining itself in the east monsoon, almost exclusively originated during the west monsoon.

c. There is generally no correlation between the minimal value of moisture-content for germinating and the drought-resistance. The strongly drought-resistant of the plants Tridax procumbens, however, still germinates, with a very low moisture-percentage of soil.

d. In the east monsoon several plants shed their leaves and often their secondary shoots, in connection with the shooting forth of new, very small leaves; apparently, this is a way to diminish their transpiring surface.

e. A number of plants have a resting-period in the east monsoon, displaying itself by the shedding or shrivelling of leaves and shoots and their reviving, a long time before the rainy season sets in again, without any obvious change in the external conditions.

f. As the east monsoon continues, a number of plants reduce their deeper-lying root-system, which dries up and often dies off; they form at the same time more and more superficial secondary roots.

Polanisia viscosa develops on the superficial secondary roots, which were formed later on, small hypertrophic tubercles, which seem to serve as water-storing organs.

g. As a rule the moisture-content of soil does not fall below the wilting-point of plants, rooting deeper than 20—30 cm. below the surface. (Chapter XI).

11. Of four plants (Mesophytes) the wilting-point was determined in two soil-types, typified by the Polanisia viscosa-community and in another one, typified by the Panicum reptans-Polanisia viscosa-Merremia emarginata-community.

a. Results of experiments obtained with potted plants of a length of 20 cm. on an average:

1. The wilting-points of the four plants in soil, typified by the Panicum reptans-Polanisia viscosa-Merremia emarginata-community, were about 4 % higher than the wilting-points in the two other soils, typified by the Polanisia viscosa-community. On the mutual difference of these latter two soil-types, the four plants reacted differently. The greatest mutual difference of wilting-point of the four plants in one single soil-type,

was about 20 $^0/_0$; and of the wilting-points of one single plant in the three soil-types about 50$^0/_0$.

2. It appeared that, at the time of permanent wilting, the cells of leaves and shoots are not plasmolysed. If no water is supplied again, plasmolysis is observed; this should be considered, however, as a dying- off-phenomenon.

Permanent wilting weakens the drought-resistance of a plant. This appears from the fact that a plant, watered again after permanent wilting, under similar external conditions, wilts quicker now than a plant, which had not permanently wilted before. A plant, which had permanently wilted two or more times successively, can finally recover its turgidity only partly or not at all, even if it is watered abundantly several times.

3. Potted plants do not generally admit of conclusions concerning the degree of their drought-resistance under natural conditions. (See sub. 11 *b*, 2).

b. Results of experiments obtained with more or less full-grown plants in bottomless boxes of one meter by one meter by 0,80 meter, totally dug in the soil.

1. The plants displayed in a more or less degree similar phenomena of reducing their transpiring surface and their deeper-lying roots, as observed under natural conditions (see sub 10 f.) and most pronounced with Polanisia viscosa and Vernonia chinensis.

2. The individuals of one single species, under similar external conditions, wilt at a totally different moisture-content of soil, dependent upon their degree of adaptation to the drought and induced by it.

Specimens of Polanisia viscosa and Vernonia chinensis, which obtained the typical east monsoon-physiognomy, showed a wilting-point. more than 50 $^0/_0$ lower than specimens wilting with their west monsoon-aspect.

A few specimens of Polanisia viscosa renewed twice their foliage in a period of three months.

Whether different individuals of one single species are fitted to assume the typical east monsoon-aspect, seems chiefly determined by mutual, internal, structural differences.

The great significance of the diminishing of the transpiring surface lies in the fact that it is connected with a decrease of the wilting-point.

3. There is, generally, no correlation between the size of the plant, its absortion-sphere (the depth of soil-layer with roots still functioning), the length of the deepest root and the wilting-point. It appears, however, that plants with the typical east monsoon-aspect and which are the last to wilt (sub I1 b 2) proportionately root most superficially; nevertheless they are the most drought-resistant individuals. The proportion of the length of the plant to the absorption-sphere of the roots, changes with Vernonia chinensis from 1,2 on an average, for west monsoon-specimens, to 4.5 on an average for plants with typical east monsoon-aspect; for Polanisia viscosa these values are 1,3 and 4,7.

From this it appeared that the decrease of the value of the wilting-point is far more significant in the struggle against drought, than the damage by the reduction of deeper descending roots.

4. The differences in the qualities of soil within the amplitude of a community can better be typified by analysing the course of competition (sub 7) than by determining witing-points. (Chapter XII).

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List of plant-names.

	FAMILY
Abutilon crispum Sw.	Malvaceae
„ indicum Sw.	„
Acacia farnesiana Willd.	Leguminosae
„ leucophloea Willd.	„
„ tomentosa Willd.	„
Acalypha boehmerioides Miq.	Euphorbiaceae
„ indica L.	„
Acanthus ilicifolius L.	Acanthaceae
Achyranthes aspera L.	Amarantaceae
Acrostichum aureum L.	Polypodiaceae
Aegle Marmelos L.	Rutaceae
Aeschynomene indica L.	Leguminosae
Ageratum conyzoides L.	Compositae
Agyneia bacciformis Juss.	Euphorbiaceae
Allophylus cobbe Bl.	Sapindaceae
Alternanthera sessilis R. Br.	Amarantaceae
Alysicarpus bupleurifolius DC.	Leguminosae
„ nummularifolius DC.	„
„ rugosus DC.	„
Amarantus gracilis Desf.	Amarantaceae
„ lividus L.	„
„ spinosus L.	„
„ tricolor L.	„
Ammania baccifera L.	Lythraceae
„ octandra Roxb.	„
Andropogon aciculatus Retz.	Gramineae
„ caricosus L.	„
„ contortus L.	„
„ pertusus Willd.	„
„ sorghum Brot.	„
Aneilema nudiflorum R. Br.	Commelinaceae
Apluda mutica L.	Gramineae
Arachis hypogaea L.	Leguminosae
Athroisma laciniatum DC.	Compositae
Atylosia scarabaeoides Bth.	Leguminosae
Azadirachta indica Juss.	Meliaceae
Azima sarmentosum Bth. et Hook.	Salvadoraceae
Bacopa Monnieria Wettst.	Scrophulariaceae
Bauhinia malabarica L.f.	Leguminosae
Bergia oryzetorum Fenzl.	Elatinaceae
Blepharis exigua Valet. ms.	Acanthaceae

	FAMILY
Blumea humifusa Boerl.	Compositae
" lacera DC.	"
Boerhavia diffusa L.	Nyctaginaceae
" erecta L.	"
" repens L.	"
Borassus flabelliformis L.	Palmae
Borreria hispida Schum.	Rubiaceae
" ocimoides DC.	"
" setidens Bold.	"
Bridelia stipularis Bl.	Euphorbiaceae
Bruoea amarissima Merr.	Simarubaceae
Buchnera tomentosa Bl.	Scrophulariaceae
Cajanus Cajan Millspaugh	Leguminosae
Capparis sepiaria L.	Capparidaceae
Capsicum annuum L.	Solanaceae
Cassia alata L.	Leguminosae
" fistula L.	"
" occidentalis L.	"
Celosia argentea L.	Amarantaceae
Centella asiatica Urb.	Umbelliferae
Centipeda minima O.K.	Compositae
Centranthera hispida R. Br.	Scrophulariaceae
Chloris barbata Sw.	Gramineae
Citrullus vulgaris Schrad.	Cucurbitaceae
Cleome aspera	Capparidaceae
Clitorea ternatea L.	Leguminosae
Commelina benghalensis L.	Commelinaceae
" nudiflora L.	"
Convolvulus paniculatus L.	Convolvulaceae
Conyza japonica Les.	Compositae
Corchorus acutangulus L.	Tiliaceae
" olitorius L.	"
" trilocularis L.	"
Crotalaria retusa L.	Leguminosae
" striata DC.	"
Cucumis melo L.	Cucurbitaceae
" sativus L.	"
Cynodon Dactylon Pers.	Gramineae
Cyperus compressus L.	Cyperaceae
" difformis L.	"
" distans L	"
" Eragrostis Vahl.	"
" Iria L.	"
" pulcherrimus Kth.	"
" pumilus L.	"
" rotundus L.	"
Dactyloctenium aegyptium Willd.	Gramineae
Datura fastuosa L.	Solanaceae
Dentella repens Forst.	Rubiaceae
Desmodium gangeticum DC.	Leguminosae

	FAMILY
Desmodium triflorum DC.	Leguminosae
Dichrostachys cinerea W. et A.	„
Digera alternifolia Asch.	Amarantaceae
Digitaria sanguinalis Scop	Gramineae
Diplachne polystachya Back.	„
Dolichos Lablab L.	Leguminosae
Dopatrium junceum Ham.	Scrophulariaceae
Drymaria hirsuta Bartl.	Caryophyllaceae
Eclipta alba Hassk.	Compositae
Eleusine indica Gärtn.	Gramineae
Eragrostis amabilis O.K.	„
„ cilianensis Vignolo Lutati	„
„ japonica	„
„ pilosa P.B.	„
Erigeron linifolius Willd.	Compositae
Eriocaulon cinereum R. Br.	Eriocaulaceae
Eriochloa decumbens Bailey.	Gramineae
„ ramosa O.K.	„
Erioglossum edule Bl.	Sapindaceae
Euphorbia hirta L.	Euphorbiaceae
„ parviflora L.	„
„ reniformis Bl.	„
Feronia elephantum Corr.	Rutaceae
„ lucida Scheff.	„
Fimbristylis annua R. et Sch.	Cyperaceae
„ barbata Bth.	„
, complanata Link.	„
„ ferruginea Vahl.	„
„ glomerata Ness.	„
„ miliacea Vahl.	„
„ monostachya Hassk.	„
Flacourtia indica Merr.	Flacourtiaceae
Flemingia lineata Roxb.	Leguminosae
„ strobilifera R. Br.	„
Galinsoga parviflora Cav.	Compositae
Glinus lotoides L.	Aizoaceae
„ Spergula Pax.	„
Glycine Max. Merr.	Leguminosae
Goodenia Koningsbergeri Back.	Goodeniaceae
Gossampinus heptaphylla Bakh.	Bombacaceae
Grangea maderaspatama Poir.	Compositae
Gymnopetalum leucostictum Cogn.	Cucurbitaceae
„ quinquelobum Miq.	„
Gynandropsis gynandra Briquet.	Capparidaceae
Heliotropium indicum L.	Borraginaceae
Hepateceae Spec.	Hepateceae
Hibiscus surattensis L.	Malvaceae
Hydrolea zeylanica Cahl.	Hydrophyllaceae
Hyptis suaveolens Poit.	Labiatae
Ilysanthes serrata Urb.	Scrophulariaceae

	FAMILY
Ilysanthes veronicifolia Urb.	Scrophulariaceae
Imperata cylindrica P.B.	Gramineae
Indigofera enneaphylla L.	Leguminosae
„ glandulosa Willd.	„
„ hirsuta L.	„
„ linifolia Retz.	„
„ trifoliata L.	„
„ trita L. f.	„
„ viscosa Lam.	„
Ipomoea aquatica Forst.	Convolvulaceae
„ Batatas Lam.	„
„ obscura Ker.	„
„ Pes tigridis L.	„
„ triloba L.	„
„ verrucosa Bl.	„
Ischaemum aristatum L.	Gramineae
„ rugosum Salisb.	„
„ timorense Kth.	„
Jacquemontia paniculata Hall.	Convolvulaceae
Jasminum didymum Forst.	Oleaceae
„ pubescens Willd.	„
Jatropha Curcas L.	Euphorbiaceae
„ gossypifolia L.	„
Jussieua linifolia Vahl.	Onagraceae
Kyllingia brevifolia Rottb.	Cyperaceae
„ monocephala Rottb.	„
Lantana camara L.	Verbenaceae
Leptochloa chinensis Nees.	Gramineae
„ filiformis R. et Sch.	„
Leucas aspera Spr.	Labiatae
„ javanica Bth.	„
„ lavendulifolia Sm.	„
Leucophloea glauca Bth.	Leguminosae
Limnocharis flava Buch.	Butomaceae
, crustacea F.M.	Scrophulariaceae
Lindernia glandulifera (Bl) Kooper	„
Lippia nodiflora Rich.	Verbenaceae
Lourea reniformis DC.	Leguminosae
Ludwigia parviflora Roxb.	Onagraceae
Manihot utilissima Pohl.	Euphorbiaceae
Marsilia crenata Pr.	Marsiliaceae
Melochia corchorifolia L.	Sterculiaceae
Melothria maderaspatana Cogn.	Cucurbitaceae
Merremia emarginata Hall. f.	Convolvulaceae
„ gemella Hall.	„
Mezoneurum pubescens Desf.	Leguminosae
Mollugo pentaphylla L.	Aizoaceae
Momordica charantia L.	Cucurbitaceae
Monochoria vaginalis Presl.	Pontederiaceae
Morinda tinctoria Roxb.	Rubiaceae

	FAMILY
Moschosma polystachyum Bth.	Labiatae
Nasturtium indicum DC.	Cruciferae
Neptunia javanica Miq.	Leguminosae
Nicandra physaloides Gaertn.	Solanaceae
Ocimum canum Sims.	Labiatae
„ sanctum L.	„
Odina Wodier Roxb.	Anacardiaceae
Oldenlandia corymbosa L.	Rubiaceae
„ diffusa Roxb.	„
Oryza sativa L.	Gramineae
Paederia foetida L.	Rubiaceae
Panicum caudiglume Hack.	Gramineae
„ colonum L.	„
„ Crus galli L.	„
„ eruciforme Sibth. et Smith.	„
„ muticum Forst	„
„ ramosum L.	„
„ repens L.	„
„ reptans L.	„
„ trypheron Schultes.	„
Paspalum conjugatum Berg.	„
„ scrobiculatum L.	„
„ vaginatum Boerl.	„
Passiflora foetida L.	Passifloraceae
Pentapetes phoenicea L.	Sterculiaceae
Phaseolus lunatus L.	Leguminosae
„ radiatus L.	„
„ trilobus Ait.	„
Phyllanthus maderaspatensis L.	Euphorbiaceae
„ Niruri L.	„
„ reticulatus Poir.	„
„ Urinaria L.	„
„ virgatus Forst.	„
Physalis angulata L.	Solanaceae
„ minima L.	„
Polanisia Chelidonii DC.	Capparidaceae
„ viscosa DC.	„
Polygala javana DC.	Polygalaceae
Polytrias amaura OK.	Gramineae
Portulaca oleracea L.	Portulacaceae
„ quadrifida L.	„
Protium javanicum Burm.	Burseraceae
Psophocarpus tetragonolobus DC.	Leguminosae
Quamoclit coccinea Moench.	Convolvulaceae
Rhynchosia minima DC.	Leguminosae
Rotala indica Koehne.	Lythraceae
Rottboellia exaltata L. f.	Gramineae
Salvia occidentalis Sw.	Labiatae
Scirpus setaceus L.	Cyperaceae
„ supinus L.	„

	FAMILY
Sclerachne punctata R. Br.	Gramineae
Senecio sonchifolius Moench.	Compositae
Sesbania grandiflora Pers.	Leguminosae
„ sericea Back.	„
Sesuvium Portulacastrum L.	Aizoaceae
Sida acuta Burm.	Malvaceae
„ retusa L.	„
„ rhombifolia L.	„
„ veronicifolia Lam.	„
Sphaeranthus africanus Willd.	Compositae
„ indicus L.	„
Spilanthes Acmella Murr.	„
Sporobolus tremulus Kth.	Gramineae
„ virginicus Kth.	„
Stachytarpheta jamaicensis Vahl.	Verbenaceae
Staurogyne spathulata Kds.	Acanthaceae
Streblus asper Lour.	Moraceae
Striga lutea Lour.	Scrophulariaceae
Stylosanthes sundaica Taub.	Leguminosae
Suaeda maritima Dum.	Chenopadiaceae
Synedrella nodiflora Gaertn.	Compositae
Tectona grandis L.	Verbenaceae
Tephrosia pumila Pers.	Leguminosae
„ spinosa Pers.	„
Teramnus labialis Spr.	„
Themeda arguens Hack.	Graminae
Trianthema crystallinum Vahl.	Aizoaceae
„ Portulacastrum L.	„
Tridax procumbens L.	Compositae
Torenia peduncularis Bth.	Scrophulariaceae
Typhonium flagelliforme Bl.	Araceae
Uraria lagopoides DC.	Leguminosae
Urena lobata L.	Malvaceae
Vangueria spinosa Roxb.	Rubiaceae
Vernonia chinensis Less.	Compositae
Vigna sinensis Endl.	Leguminosae
Vitis trifolia L.	Vitaceae
Xerochloa imberbis R. Br.	Graminae
Zea mays L.	„
Zizyphus Jujuba Lam.	Rhamnaceae
„ Oenoplia Mill.	„
Zornia diphylla Pers.	Leguminosae
Zoysia Matrella Merr.	Graminae

CONTENTS.

TABLE I.

THE ERAGROSTIS JAPONICA—COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	K%	A
Alternanthera sessilis	3	—	—	—	—	—	—	—	x	—	—	—	25	—
Ammania baccifera	1	4	3	2	2½	3	x	1	3	2	2	2	100	2
„ *octandra*	x	1	—	—	x	x	x	1	x	x	1	x	83	½
Athroisma laciniatum	2	—	—	—	—	—	—	—	—	—	—	—	8	—
Bergia oryzetorum	4	3	3	3	2½	2	2	2	2	3	3½	2	100	2½
Blumea humifusa	2	—	—	—	—	—	—	—	—	—	—	—	8	—
„ lacera	—	—	—	—	—	—	—	—	—	—	x	—	8	—
Commelina benghalensis	—	—	—	x	—	—	—	—	—	—	—	—	8	—
Cynodon Dactylon	1½	x	—	2	2	x	—	1	x	—	—	2	67	—
Cyperus Iria	—	2	—	—	—	—	—	—	—	—	—	—	8	—
Cyperus pulcherrimus	—	—	—	—	x	—	—	—	—	—	—	x	17	—
Dopatrium junceum	—	—	—	—	x	—	—	—	—	—	—	—	8	—
Eclipta alba	—	1	—	x	x	x	—	—	x	—	—	x	50	—
Eragrostis japonica	4½	4½	4	5	4	4	4	5	3½	4½	5	3	100	4½
Eriocaulon cinereum	—	x	—	—	—	—	—	—	—	—	—	—	8	—
Euphorbia hirta	—	1	—	—	—	—	—	—	—	—	—	—	8	—
„ parviflora	—	—	—	—	—	—	—	—	—	—	—	x	8	—
„ reniformis	—	—	2	x	—	—	—	—	—	1	x	—	33	—
Fimbristylis miliacea	3	4	3	4	3	4	2	4	3	3	3	3	100	3½
Fimbristylis ferruginea	—	—	—	—	—	—	—	—	—	x	—	—	8	—
Heliotropium indicum	—	1	—	—	—	—	—	—	—	—	—	—	8	—
Hydrolea zeylanica	—	2	—	—	—	—	—	—	—	x	—	—	17	—
Ilysanthes veronicifolia	—	—	—	3	1	1	1	x	1	—	—	x	58	—
Lippia nodiflora	—	—	x	—	—	—	—	—	—	—	—	—	8	—
Ludwigia parviflora	—	—	—	—	—	—	2½	—	—	—	—	—	8	—
Marsilia crenata	1	—	—	—	—	—	—	—	—	—	—	—	8	—
Merremia emarginata	—	—	1	—	—	—	—	—	—	—	—	—	8	—
„ gemella	—	—	—	—	x	—	—	—	—	—	—	—	8	—
Moschosma polystachyum	—	—	—	—	—	—	—	1	—	—	—	—	8	—
Oldenlandia corymbosa	—	—	—	—	—	—	—	—	—	—	—	x	8	—
Oldenlandia diffusa	—	—	—	—	—	—	—	—	—	x	—	—	8	—
Panicum colonum	—	—	—	—	—	—	—	—	—	—	—	x	8	—
„ repens	—	2	—	—	—	—	—	—	—	—	—	—	8	—
Passiflora foetida	—	—	—	—	—	—	—	—	—	—	—	x	8	—
Pentapetes phoenicea	1	—	—	—	—	—	—	—	—	—	—	—	8	—
Phaseolus trilobus	—	—	x	—	—	—	—	—	—	—	—	—	8	—
Phyllanthus Niruri	—	—	—	—	—	—	—	—	—	—	—	x	8	—
Polytrias amaura	—	—	—	x	x	—	—	—	—	—	—	2	25	—
Rotala indica	—	—	—	—	—	—	—	—	—	—	—	2	8	—
Sphaeranthus africanus	—	1	—	2	—	—	—	—	—	—	x	—	25	—
Sphaeranthus indicus	3	4	2	3½	3	4	3	3	3	x	3	2½	100	3
Staurogyne spathulata	—	—	—	—	x	1	x	x	1	—	—	—	42	—
Vitis trifolia	—	—	—	—	—	—	—	—	—	—	x	—	8	—
	12	15	9	12	14	11	9	10	11	10	10	17	—	—

THE ERAGROSTIS JAPONICA—COMMUNITY.

1. September 9 1923. Dawoehan, the Gayam-plantation. L. 10. Old-quaternary, slightly calcareous clay. Fallow after reaping west monsoon-rice.
2. September 11 1923. Karangdjati, the Alkmaar-plantation. F. 10. Heavy, red, lateritically weathered mountain-clay. Fallow after reaping west monsoon-rice.
3. September 13 1923. Soemberbanteng, the Pleret-plantation. I. 8. Old-quaternary, calcareous clay, cracking deeply. Fallow after reaping west monsoon-rice.
4. November 13 1923. Areng-areng, the Wonoredjo-plantation. N. 10. Fairly light, brown soil. Fallow after reaping east monsoon-rice.
5. August 1 1924. Kemirahan, the Pleret-plantation. J. 9. Fairly light soil, not very plastic when wet; after getting dry, subject to fairly deeply cracking. Fallow after reaping west monsoon-rice.
6. August 31 1923. Tjengkrong, the Gayam-plantation. K. 11. Fairly light, cracking Tengger-soil. Fallow after reaping west monsoon-rice.
7. August 31 1924. Winong, the Gayam-plantation. K. 10. Light, friable, brown, slightly cracking soil. A low-lying part; fallow after reaping west monsoon-rice.
8. August 31 1924. Bener [2], the Pleret-plantation. J. 11. Fairly light, brown, cracking soil. Fallow after reaping west monsoon-rice.
9. August 31 1924. Kebontjandi, the Gayam-plantation. M 9. Fairly light, brown, cracking soil. Fallow after reaping west monsoon-rice.
10. September 13 1924. Assemdjadjar, the Pleret-plantation. I. 9. Old-quaternary, non-calcareous, deeply cracking clay. Fallow after reaping west monsoon-rice.
11. September 20 1924. Tembero, the Pleret-plantation. J. 8. Heavy, red-brown, deeply cracking clay. Fallow after reaping west monsoon-rice.
12. July 9 1924. Klotok, the Pleret-plantation. J. 9. Fairly light brownish-grey, cracking soil. Fallow after reaping west monsoon-rice.

TABLE II.

THE POLANISIA VISCOSA—COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	% K	A	
Acalypha boehmerioides	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	1	—	—	—	—	—	11	—	Acalypha boehmerioides
Aeschynomene indica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	x	—	—	—	7	—	Aeschynomene indica
Ageratum conyzoides	—	—	2	—	—	—	—	x	x	x	—	—	—	—	—	—	x	x	x	—	—	x	—	—	—	—	—	30	—	Ageratum conyzoides
Alternanthera sessilis	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Alternanthera sessilis
Alysicarpus nummularifolius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	4	—	Alysicarpus nummularifolius
Amarantus gracilis	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	7	—	Amarantus gracilis
Amarantus spinosus	2	3	3½	3	3½	2½	3½	2	2½	2	2½	3	2½	2	3	3	3	3	2	3	2½	x	2	4	3½	2½	3	100	2½	*Amarantus spinosus*
Blumea lacera	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Blumea lacera
Boerhavia repens	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Boerhavia repens
Cassia alata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	4	—	Cassia alata
Celosia argentea	—	x	—	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	15	—	Celosia argentea
Commelina benghalensis	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Commelina benghalensis
Corchorus olitorius	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Corchorus olitorius
Cynodon Dactylon	4	3	4½	5	4	5	5	3	4	4	5	5	3	4	4½	4	4	5	4	5	5	5	4	5	5	5	4	100	4½	*Cynodon Dactylon*
Cyperus compressus	1	x	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	Cyperus compressus
Cyperus Iria	1	2½	x	—	—	—	—	—	x	—	—	1	x	1	1	x	—	x	—	—	—	—	—	—	—	—	—	37	—	Cyperus Iria
„ pumilus	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	„ pumilus
Cyperus rotundus	4	3	4	4	4½	4	5	2	3½	3	4	4½	5	4	4	4	4	4	4	4	4	4	4	4	4	4	3	100	4	*Cyperus rotundus*
Dactyloctenium aegyptium	—	1	—	x	—	—	1	3	2	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	22	—	Dactyloctenium aegyptium
Dentella repens	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Dentella repens
Digera alternifolia	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Digera alternifolia
Digitaria sanguinalis	3	4	2	3	3	1	2	3½	2	3	1	2	4	2½	2	2	2½	2	2	2	2½	2	2	2	2	x	3	100	2½	*Digitaria sanguinalis*
Drymaria hirsuta	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	7	—	Drymaria hirsuta
Eclipta alba	—	—	—	—	—	—	1	—	x	—	—	—	—	—	x	—	—	x	x	—	—	—	—	—	—	—	—	18	—	Eclipta alba
Eleusine indica	2	1	x	2	2	x	2	x	1	x	x	1	2½	2	1	2	1	x	x	x	x	x	1	x	x	x	1	100	1	*Eleusine indica*
Eragrostis amabilis	—	1	—	2	3	—	1	4	3	x	—	x	3	1	1	—	—	—	x	—	—	—	—	—	—	—	—	44	—	Eragrostis amabilis
„ cilianensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	4	—	„ cilianensis
„ pilosa	2	1	1	—	—	x	—	x	x	—	x	x	1½	1	—	—	1	x	x	x	—	—	x	x	—	x	—	63	—	„ pilosa
Erigeron linifolius	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Erigeron linifolius
Euphorbia hirta	x	x	1	1	2	x	1	1	x	1	x	x	2	1	2	1	1½	x	x	x	1	x	x	x	1	2	1	100	½	*Euphorbia hirta*
Euphorbia parviflora	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Euphorbia parviflora
Fimbristylis barbata	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Fimbristylis barbata
Galinsoga parviflora	—	—	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	1	1	—	—	—	—	—	18	—	Galinsoga parviflora
Glinus lotoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	4	—	Glinus lotoides
Gynandropsis gynandra	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	x	—	—	—	11	—	Gynandropsis gynandra
Heliotropium indicum	—	—	—	x	—	x	x	—	x	—	—	x	x	—	—	x	—	x	x	x	—	x	—	—	—	x	1	48	—	Heliotropium indicum
Ilysanthes serrata	x	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Ilysanthes serrata
„ veronicifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	4	—	„ veronicifolia
Ipomoea Pes tigridis	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Ipomoea Pes tigridis
„ triloba	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	4	—	„ triloba
Leucas aspera	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	4	—	Leucas aspera
Leptochloa filiformis	—	—	—	—	—	x	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	x	x	—	18	—	Leptochloa filiformis
Lindernia crustacea	x	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	11	—	Lindernia crustacea
„ glandulifera	x	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	„ glandulifera
Mollugo pentaphylla	2	x	—	—	—	—	—	—	—	—	—	x	x	1	—	—	—	—	—	—	—	x	—	—	—	—	—	22	—	Mollugo pentaphylla
Momordica Charantia	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Momordica Charantia
Nasturtium indicum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	4	—	Nasturtium indicum
Panicum caudiglume	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Panicum caudiglume
„ colonum	—	—	—	—	—	3½	—	—	—	—	—	—	x	x	1	1½	—	—	x	x	x	3	—	x	x	—	—	41	—	„ colonum
Phyllanthus Niruri	2	1	2	3	2½	2	3	x	1	1	2	2	2	1	1	2	1	3	1	x	2	x	1	3	2	2	2	100	1½	*Phyllanthus Niruri*
Phyllanthus reticulatus	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Phyllanthus reticulatus
Physalis angulata	—	—	—	1½	3	x	x	—	—	x	x	—	—	1	1	—	—	—	—	—	—	x	—	—	—	—	1	37	—	Physalis angulata
„ minima	—	—	—	—	—	—	x	—	x	—	—	—	x	x	—	—	—	x	—	x	—	—	—	—	x	x	1½	33	—	„ minima
Polanisia viscosa	2	2	3	3	3	3	4	x	2½	1½	3	2	2½	2	2½	2	2	2	2	2	2	2	3	3½	3½	3	3	100	2½	*Polanisia viscosa*
Polytrias amaura	x	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	Polytrias amaura
Portulaca oleracea	2	2	3	3	3	3½	3	3	3	2½	3½	4	2½	3	3	3	2½	4	3	3	3	3	3	3	3	2½	3	100	3	*Portulaca oleracea*
Salvia occidentalis	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Salvia occidentalis
Senecio sonchifolius	—	—	1	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Senecio sonchifolius
Spilanthes Acmella	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	4	—	Spilanthes Acmella
Synedrella nodiflora	—	—	—	1	2½	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	Synedrella nodiflora
Torenia peduncularis	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Torenia peduncularis
Trianthema Portulacastrum	—	—	—	—	—	3	x	—	—	—	—	—	x	1	—	—	—	—	—	x	3	—	—	—	—	—	—	22	—	Trianthema Portulacastrum
Tridax procumbens	—	—	—	2	1	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	Tridax procumbens
Urena lobata	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Urena lobata
Vernonia chinensis	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Vernonia chinensis
Vitis trifolia	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	Vitis trifolia
	19	18	16	18	16	19	20	16	19	21	12	14	19	21	15	13	12	19	18	14	13	16	10	16	13	15	14			

THE POLANISIA VISCOSA—COMMUNITY.

1. March 18 1923. Karangmodjo South, the Gayam-plantation. M. 11. Light, reddish Tengger-soil, caking on the surface on drying and slightly cracking. A young plantation of Arachis hypogaea.
2. May 27 1923. Karangtengah, the Gayam-plantation. M. 10. Light, reddish Tengger-soil, caking on the surface on drying and slightly cracking; unirrigable. A plantation of Zea May and Glycine Max.
3. August 1 1923. Sentoel, southern section of the Alkmaar-plantation. B. 15. Good, light mountain-soil at a sea-level of ± 360 M. A young plantation of Arachis hypogaea.
4. September 9 1923. Getah[2], the Gayam-plantation. L. 11. Good, light Tengger-soil. A young plantation of Arachis hypogae; a a fairly dry plot of ground.
5. September 9 1923. Getah[3], the Gayam-plantation. L. 11. Good, light Tengger-soil. A young plantation of Phaseolus lunatus.
6. October 6 1923. Sambisirah, the Wonoredjo-plantation. G. 8. Light, brownish, friable soil, transported by water, slightly cracking, and plastic when wet; a damp part. A young plantation of Arachis hypogaea.
7. October 9 1923. Close to the factory Menang, Kediri, Light, sandy, ashes-containing Kloet-soil. A young plantation of Arachis hypogaea.
8. October 9 1923. Minggir the Menang-plantation, Kediri, Light Kloet-soil, caking on the surface, unirrigable. A young plantation of Arachis hypogaea.
9. October 9 1923. Watoegede, Kediri. Fairly dry, light Kloet-soil. A young plantation of Arachis hypogaea.
10. October 10 1923. Near the factory Kawarassan, Kediri. Good, light Kloet-soil, with a good deal of transported, coarse material and a moist subsoil. A young plantation of Glycine Max.
11. November 15 1923. Sambisirah, the Wonoredjo-plantation. G. 9. Light, brownish, friable soil, non-cracking and transported by water. A young plantation of Zea Mays.
12. January 11 1924. Sindopati, the Pleret-plantation. J. 9. Light Tengger-soil, transported by water. Fallow after tobacco-harvest.
13. February 9 1924. Kletak, the Pleret-plantation. K. 9. Light, ruddy Tengger-soil, transported by water. Fallow after tobacco-harvest.
14. March 15 1924. Kemirahan, the Pleret-plantation. J. 9. Light Tengger-soil, transported by water. Fallow after reaping of Zea Mays.
15. June 10 1924. Some way south of Bentjoeloek, the Pleret-plantation. J. 10. Light Tengger-soil, transported by water. A young plantation of Zea Mays.
16. June 20 1924. Wangkal-wetan, the Pleret-plantation. J. 10. Light Tengger-soil, transported by water; a fairly moist plot of ground. A young plantation of Ipomoea Batatas.
17. August 8 1924. Lebaksari, the Pandaan-plantation. A. 6. Light, friable, brown Welirang-soil, at an elevation of ± 200 M. A young plantation of Zea Mays.
18. August 22 1924. Simping, the Alkmaar-plantation. B. 14. Light, reddish Ardjoeno-soil, at an elevation of ± 345 M. A young plantation of Zea Mays.
19. August 30 1924. Kersikan, the Gayam-plantation. L. 9. Light, brownish Tengger-soil. A young plantation of Arachis hypogaea.
20. August 30 1924. Winong, the Gayam-plantation. K 10. Light, brownish Tengger-soil, very occasionally irrigated. A young plantation of Zea Mays.
21. August 31 1924. Trate, between Kersikan and Winong, the Gayam-plantation. K. 9. Light Tengger-soil, not frequently irrigated. A young plantation of Zea Mays.
22. August 31 1924. Some way south of Winong, the Gayam-plantation. K. 10. Light, moist Tengger-soil, caking on the surface when drying up, slightly cracking, on a subsoil of old-quaternary clay. A young plantation of Zea Mays.
23. September 29 1924. Wangkal wetan, the Pleret-plantation. J 10. Light Tengger-soil, transported by water. A young plantation of Ipomoea Batatas.
24. November 5 1924. 2 K.M. south of Karangmodjo, the Gayam-plantation. M. 11. Light Tengger-soil. A young plantation of Glycine Max.
25. November 5 1924. Sibon, south of Getah[3], the Gayam-plantation. L. 12. Light Tengger-soil. A young plantation of Arachis hypogaea.
26. November 5 1924. Getah[3], the Gayam-plantation. L 11. Light Tengger-soil. A young plantation of Arachis hypogaea.
27. June 8 1925. Bedji-Makan, the Kedawoeng-plantation. O. 9. Light, friable soil, non-cracking, very slightly plastic in a moist condition. A young plantation of Zea Mays.

TABLE III.

THE PANICUM REPTANS — GYMNOPETALUM LEUCOSTICTUM — COMMUNITY

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Community 1—39		Variant A. 1—18		Variant B. 19—31		
																																								K%	A	K%	A	K%	A	
Abutilon indicum	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	3	—	—	3	—	—	—	—	—	—	—	—	—	x	—	—	13	—	6	—	23	—	Abutilon indicum
Acacia tomentosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Acacia tomentosa
Aeschynomene indica	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	5	—	6	—	—	—	Aeschynomene indica
Ageratum conyzoides	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	5	—	6	—	—	—	Ageratum conyzoides
Alternanthera sessilis	1	—	2	—	—	—	—	1	—	2½	3	—	1	x	2½	1	—	—	2	—	x	—	1½	—	—	x	—	x	—	—	2	—	x	—	—	—	—	—	—	41	—	50	—	46	—	Alternanthera sessilis
Amarantus spinosus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	x	—	—	—	x	—	x	x	13	—	—	—	8	—	Amarantus spinosus
Bergia oryzetorum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	5	—	—	—	15	—	Bergia oryzetorum
Blepharis exigua	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	6	—	8	—	Blepharis exigua
Borreria setidens	—	—	—	—	2	1	x	—	—	—	—	—	x	x	x	—	—	—	x	1	x	x	x	1	x	x	x	x	x	x	x	2	—	—	—	—	—	—	—	51	—	33	—	100	x	Borreria setidens
Celosia argentea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	3	—	—	—	—	—	Celosia argentea
Clitorea ternatea	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Clitorea ternatea
Commelina benghalensis	—	—	—	—	1	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	11	—	—	—	Commelina benghalensis
„ nudiflora	—	—	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	11	—	8	—	„ nudiflora
Corchorus acutangulus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	5	—	—	—	—	—	Corchorus acutangulus
„ olitorius	—	—	—	—	—	x	—	—	—	x	—	x	—	x	—	—	—	—	—	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	x	x	—	—	21	—	22	—	15	—	„ olitorius
Crotalaria striata	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Crotalaria striata
Cynodon Dactylon	1	1	3	3	3	4	4	3	4	x	1	3½	3	1	3	1½	1	1	3	3	4	4	3	4	4	4	4	3	4	3	2	—	1½	1	2	—	—	2	—	90	2½	100	2	100	3½	Cynodon Dactylon
Cyperus pulcherrimus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Cyperus pulcherrimus
„ rotundus	2	—	—	—	—	—	—	3	1	—	—	x	—	2	1	x	2½	1	—	—	—	—	—	x	—	1	—	3	—	—	3	3	1	2	1	1½	1	1½	2	54	—	50	—	31	—	„ rotundus
Dentella repens	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	—	—	x	2	13	—	6	—	—	—	Dentella repens
Desmodium gangeticum	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Desmodium gangeticum
„ triflorum	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	11	—	—	—	„ triflorum
Digera alternifolia	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	11	—	—	—	Digera alternifolia
Digitaria sanguinalis	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Digitaria sanguinalis
Eclipta alba	—	x	x	—	—	x	x	x	—	x	—	—	—	—	—	—	—	x	—	x	1	—	2	x	—	—	—	—	—	x	x	x	—	—	x	—	x	x	—	46	—	39	—	54	—	Eclipta alba
Eragrostis japonica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Eragrostis japonica
„ pilosa	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	5	—	6	—	—	—	„ pilosa
Euphorbia hirta	—	—	1	—	—	—	—	—	—	x	—	x	—	x	—	—	x	1	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	x	—	x	—	23	—	33	—	8	—	Euphorbia hirta
Euphorbia reniformis	2½	2	2	2	1	3	2	1	3	3	3	1	1	2	1	2½	3	2	2	2	2	3	3	3	3	3	2	2	2	3	3	3	2½	3	3	3	3	1	2	100	2½	100	2	100	3	*Euphorbia reniformis*
Fimbristylis miliacea	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	1½	—	—	—	x	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	15	—	11	—	31	—	Fimbristylis miliacea
Gymnopetalum leucostictum	3	3	2	2	—	x	1	x	x	1	2	x	1	2	x	1	x	1	1	1	1	1	x	3	x	x	3	1	x	x	x	3	1	1	x	x	—	1	1	95	1	94	1	100	1	*Gymnopetalum leucostictum*
Gymnopetalum quinquelobum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	x	—	1	—	—	13	—	6	—	15	—	Gymnopetalum quinquelobum
Heliotropium indicum	—	x	x	x	—	—	—	x	—	1	x	—	x	x	—	—	—	2	x	x	x	x	x	x	x	x	x	x	—	x	1	x	—	—	—	—	x	x	x	64	—	50	—	92	x	Heliotropium indicum
Ilysanthes veronicifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	5	—	—	—	15	—	Ilysanthes veronicifolia
Ipomoea aquatica	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	5	—	6	—	—	—	Ipomoea aquatica
Ipomoea Pes tigridis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Ipomoea Pes tigridis
„ triloba	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—	—	x	—	—	—	—	10	—	6	—	15	—	„ triloba
Kyllingia brevifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	15	—	Kyllingia brevifolia
Leptochloa filiformis	—	—	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—	—	—	—	—	x	—	—	x	—	—	—	—	x	—	—	—	—	—	x	—	x	18	—	11	—	23	—	Leptochloa filiformis
Leucas aspera	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Leucas aspera
Leucas javanica	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	17	—	8	—	Leucas javanica
Lindernia glandulifera	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Lindernia glandulifera
Lippia nodiflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Lippia nodiflora
Lourea reniformis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Lourea reniformis
Marsilia crenata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	x	2	—	—	—	—	1	10	—	—	—	8	—	Marsilia crenata
Melochia corchorifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	8	—	6	—	8	—	Melochia corchorifolia
Melothria maderaspatana	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	x	—	—	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	15	—	22	—	15	—	Melothria maderaspatana
Merremia emarginata	3½	3	3½	3	3	4	4	4	4	4	4	3	3½	4	3	3	2½	2	3	3	3	4	3½	4	4	4	3	2	3	4	2	4	3	4	2	3	3½	3	3	100	3½	100	3½	100	3½	*Merremia emarginata*
Merremia gemella	—	—	—	—	—	—	—	x	x	—	—	—	—	—	x	—	—	1	3	2	4	2	1½	1	2½	2	2	4	2½	2½	1½	—	x	—	—	—	—	—	—	46	—	22	—	100	2½	Merremia gemella
Mollugo pentaphylla	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Mollugo pentaphylla
Monochoria vaginalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Monochoria vaginalis
Moschosma polystachyum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	6	—	15	—	Moschosma polystachyum
Nasturtium indicum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Nasturtium indicum
Oldenlandia corymbosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	8	—	Oldenlandia corymbosa
„ diffusa	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	„ diffusa
Panicum colonum	—	—	1	1	—	—	—	1	—	—	—	1	—	x	x	x	—	1	—	—	—	—	2	—	x	3	x	x	—	—	2½	2	2	2	4	3½	1½	3	2	56	—	44	—	46	—	Panicum colonum
„ repens	—	—	2	—	2	—	—	x	—	—	—	—	—	—	—	—	—	—	1	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	—	17	—	15	—	„ repens
Panicum reptans	2	3½	4	4	3	3	2½	3½	2	3½	3	5	3	3	4	4	4	3	4	3	3½	3	5	4	4½	5	5	5	2	5	4	3	3	2	2½	5	4	4	3½	100	3½	100	3½	100	4	*Panicum reptans*
Paspalum scrobiculatum	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Paspalum scrobiculatum
Pentapetes phoenicea	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	x	—	—	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	13	—	11	—	23	—	Pentapetes phoenicea
Phaseolus trilobus	—	—	—	—	2	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	17	—	—	—	Phaseolus trilobus
Phyllanthus Niruri	—	—	—	—	—	x	—	x	x	x	—	2	—	—	—	—	1	x	—	1	—	—	1	1	1	1	1	—	—	—	1	—	—	—	x	2	2	x	—	48	—	39	—	54	—	Phyllanthus Niruri
Phyllanthus Urinaria	1½	2	2	2	1½	1	x	x	2	3	1	x	x	1	1	2½	2	3	2	2	1	x	2	2½	2	2	3	2	x	2	2	3	2	2	x	x	1	2	2	100	1½	100	1½	100	1½	*Phyllanthus Urinaria*
Physalis angulata	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	1	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	10	—	11	—	8	—	Physalis angulata
„ minima	—	x	—	—	—	—	—	x	—	x	x	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	15	—	28	—	8	—	„ minima
Polanisia Chelidonii	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	x	—	—	x	x	—	—	—	—	—	—	—	13	—	11	—	15	—	Polanisia Chelidonii
„ viscosa	x	—	—	—	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	x	—	x	15	—	17	—	8	—	„ viscosa
Polytrias amaura	—	—	—	1½	—	2	2	—	—	—	x	—	—	4	2	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	21	—	33	—	15	—	Polytrias amaura
Portulaca oleracea	x	—	—	—	x	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	2	1	2	3	1	1	2	2	31	—	17	—	8	—	Portulaca oleracea
„ quadrifida	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	3	—	—	—	—	—	„ quadrifida
Rhynchosia minima	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Rhynchosia minima
Senecio sonchifolius	—	—	2	—	1	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	11	—	—	—	Senecio sonchifolius
Sida veronicifolia	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Sida veronicifolia
Sphaeranthus africanus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	8	—	—	—	23	—	Sphaeranthus africanus
„ indicus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	15	—	„ indicus
Trianthema Portulacastrum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	3	1	—	—	—	—	8	—	—	—	—	—	Trianthema Portulacastrum
Tridax procumbens	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	10	—	17	—	—	—	Tridax procumbens
Uraria lagopoides	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	—	—	Uraria lagopoides
Vitis trifolia	—	x	x	—	—	—	x	—	—	—	—	—	x	—	—	—	—	1	—	—	—	—	—	—	—	—	—	x	x	—	—	—	x	1	—	—	—	—	—	23	—	28	—	15	—	Vitis trifolia
	12	11	15	10	14	11	13	21	18	17	12	18	12	16	16	11	10	22	18	11	13	11	23	20	11	23	14	18	10	11	23	14	15	15	16	14	16	16	16	—	—	—	—	—	—	

THE PANICUM REPTANS-GYMNOPETALUM LEUCOSTICTUM-COMMUNITY.

1. January 21 1924. Gondang Koelon, the Pengkol-plantation. K 7. Medium-heavy, brown clay, easily subject to crumbling, in a wet condition very plastic. A young plantation of Zea Mays.
2. January 21 1924. Ledoeg, the Pleret-plantation. J 6. Medium-heavy, brownish-black clay; a high plot of land. A young plantation of Zea Mays.
3 February 20 1924. Koeripan, the Willem II-plantation. Modjokerto. Medium-heavy, brownish-red mountain-clay, at a sea-level of 400 M. A young plantation of Zea Mays.
4. March 10 1924. Lebaksarie, the Wonoredjo-plantation. G 8. Medium-heavy, blackish-brown clay, deeply cracking.
5. March 28 1924. Kertosarie, the Alkmaar-plantation. G 12. Brownish-red, medium-heavy mountain-clay, at a sea-level of 280 M.
6. April 7 1924. Lebaksarie[2], the Wonoredjo-plantation. G 8. Medium-heavy, brownish-black, cracking clay.
7. April 27 1924. Blembem[2], the Wonoredjo-plantation. G 7. Medium-heavy, brownish-black, cracking clay, very plastic in a moist condition. A young plantation of Vigna sinensis.
8. May 27 1924. Klodjen, the Alkmaar-plantation. E 12. Medium-heavy, red clay, with much sand; at a sea-level of 240 M. A young plantation of Zea Mays.
9. June 10 1924. Krandon, the Kedawoeng-plantation. M 7. Medium-heavy, brownish, moist clay. A young plantation of Zea Mays.
10. November 3 1924. Djambangan, the Pleret-plantation. K 8. Brownish-red, medium-heavy, cracking soil, very plastic in a wet condition; after tillage it easily crumbles. A young plantation of Arachis hypogaea.
11. November 3 1924. Patebon, the Pleret-plantation. J 8. Medium-heavy, brownish-red, cracking soil, after tillage easily crumbling, and very plastic when moist. A young plantation of Glycine Max.
12. November 4 1924. Moelioredjo, the Pleret-plantation. J 7. Medium-heavy, brownish-grey soil, fairly deeply cracking, after tillage it easily crumbles, damp afflux-side of the field. A young plantation of Glycine Max.
13. February 9 1925. Klotok near Sindopati, the Pleret-plantation. K 9. Medium-heavy, brown, cracking soil. Fallow after reaping Zea Mays.
14. February 17 1925. Dermo-Goenoenggangsir, the Soemberredjo-plantation. B 1. Medium-heavy, greyish-brown clay. A plantation of Zea Mays.
15. February 19 1925. Between Moelioredjo and Djoegorasmi, the Pleret-plantation. J 7. Medium-heavy, greyish-black clay. A plantation of Zea Mays.
16. August 25 1925. Doropajoeng, the Pengkol-plantation. L 6. Brownish-grey, medium-heavy clay; afflux-side of the field. A young plantation of Glycine Max.
17. August 25 1925. Manik, the Gayam-plantation. M 7. Fairly light, brown, cracking clay, with much sand; a dry part. A young plantation of Glycine Max.
18. September 2 1925. Between Ploengen and Moelioredjo, the Pleret-plantation. J 7. Medium-heavy, greyish-black, deeply cracking clay, when drying it falls into hard clods; it is mixed with some sand. A thin plantation of Zea Mays.
19. September 24 1923. Soemberredjo, in the southern section of the Winongan-plantation. P 11. Heavy, black clay, cracking deeply. A young plantation of Zea Mays.
20. April 26 1924. Genengan, the Winongan-plantation. J 6. Fairly heavy, blackish-brown, old-quaternary clay; cracking deeply. A plantation of Zea Mays.
21. August 30 1924. Pedjagan, the Gayam-plantation. K 10. Old-quaternary clay, mixed with sand. A young plantation of Zea Mays.
22. October 8 1924. Soembersoeko, the Woneredjo-plantation. G 9. Brownish-black, medium-heavy, cracking, old-quaternary clay. A plantation of Zea Mays.
23. November 5 1924. Between Pekadjangan and Menjarik, the Gayam-plantation. M 10. Fairly heavy, black, old-quaternary, non-calcareous clay. A very moist area. Fallow after reaping Zea Mays.
24. November 5 1924. Minggir, the Gayam-plantation. L 10. Fairly heavy, old-quaternary, non-calcareous clay, mixed with some sand. A young plantation of Zea Mays.
25. November 5 1924. Between Pedjagan and Tjengkrong, the Gayam-plantation. L 10. Heavy, black, old-quaternary, non-calcareous clay. A young plantation of Glycine Max.
26. November 5 1924. Mindi, the Gayam-plantation. L 10. Heavy, black, old quaternary, non-calcareous clay. Fallow after plantation of Zea Mays.
27. November 5 1924. Dawoehan, the Gayam-plantation. L 10. Heavy, calcareous, old-quaternary clay. A young plantation of Glycine Max.
28. November 25 1924. Djarangan, the Kedawoeng-plantation. N 6. Medium-heavy, dark-brown, deeply cracking clay. A young plantation of Zea Mays.
29. January 13 1925. Menangas, the Kedawoeng-plantation. F 10. Fairly heavy, black clay. Fallow.
30. January 16 1925. Pekejongan, the Pandaan-plantation. M 10. Old-quaternary clay. A young plantation of Zea Mays.
31. August 25 1925. Petoeng, the Gayam-plantation. M 6. Fairly heavy, damp, brownish-black clay. A thin plantation of Arachis hypogaea and Glycine Max.
32. January 21 1924. Soengi Wetan, the Pleret-plantation. J 5. Heavy, brownish-black, damp clay. Fallow after reaping Zea Mays.
33. February 28 1924. Botohan, the Pleret-plantation. J 3. Heavy, old-quaternary clay, a little calcareous, a fairly damp plot of soil. A young plantation of Zea Mays.
34. February 28 1924. Randoesari, the Pleret-plantation. J 4. Medium-heavy, old-quaternary, greyish-black clay, mixed with sand; and with few calcium-carbonate-concretions; a fairly damp part. Fallow after reaping Zea Mays.
35. September 17 1924. Plososari, the Kedawoeng-plantation. R 11. Dark-brown, deeply-cracking, medium-heavy clay, not easily crumbling and very plastic in a moist condition; a fairly low-lying part. A young plantation of Arachis hypogaea.
36. September 30 1924. Slambrit, the Ngempit-Winongan-plantation. G 7. Medium-heavy, greyish-brown, plastic soil, slightly cracking; a fairly damp part.
37. November 4 1924. Kemlokan, the Pleret-plantation. I 7. Medium-heavy, fairly moist, greyish-brown soil, with much sand.
38. February 12 1925. Bantek near Ngoeling, the Winongan-plantation. K 9. Medium-heavy, brownish-black clay; a low-lying part. A young plantation of Zea Mays.
39. August 30 1925. Kebroegan, south of factory Kedawoeng. P. 8. Fairly light, brownish soil; on drying it gets hard, falling to clods, and plastic when moist; a damp plot of soil. A young plantation of Zea Mays.

TABLE IV.

THE PANICUM REPTANS — POLANISIA VISCOSA — COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	K%	A
Abutilon indicum	—	—	—	—	—	—	—	—	—	x	—	x	—	—	—	—	—	—	11	—
Acalypha boehmerioides	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1½	—	x	17	—
„ indica	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	6	—
Achyranthes aspera	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	11	—
Ageratum conyzoides	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	x	x	17	—
Alternanthera sessilis	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—
Amarantus gracilis	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	1½	—	—	17	—
Amarantus spinosus	3	3	3	4	3	2	3	1	1½	2	3	2	2	2½	2	3	2	3½	100	2½
Celosia argentea	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—
Cleome aspera	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	6	—
Commelina benghalensis	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	x	x	17	—
Corchorus olitorius	—	—	—	—	—	—	—	—	—	—	—	x	x	—	x	—	—	—	17	—
Cynodon Dactylon	3	2	3	2	2½	4	3	4	x	4	2½	4	4	2½	2	1½	3	4	100	3
Cyperus Iria	x	2	x	x	x	x	—	—	x	3	x	x	x	—	x	x	x	x	83	½
Cyperus rotundus	2	2	1	2	2½	3	3	3	4	3	3½	4	3½	3	3½	3	4	3	100	3
Dactyloctenium aegyptium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	6	—
Dentella repens	—	—	—	—	x	x	—	—	x	—	—	—	—	—	—	—	—	x	22	—
Desmodium triflorum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	6	—
Digera alternifloia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	6	—
Digitaria sanguinalis	1	3	1	x	2	1	1	1	1	x	x	1	1	2½	x	1	1	1	100	1
Eclipta alba	—	—	—	—	x	x	—	—	x	x	x	—	—	—	—	—	x	—	33	—
Eleusine indica	x	x	x	1	x	1	x	x	x	x	x	x	x	—	x	2	3	3	94	½
Eragrostis amabilis	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	x	x	x	22	—
Eragrostis pilosa	1	1	3	x	x	x	3	x	—	x	2	x	x	x	x	—	x	x	88	½
Euphorbia hirta	x	x	x	x	1	x	x	—	x	2	x	2	1	x	1	2	x	1	94	½
Euphorbia parviflora	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	x	x	22	—
„ reniformis	—	1	—	—	—	x	—	—	—	x	x	x	x	—	2	1	2	x	55	—
Galinsoga parviflora	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	6	—
Gymnopetalum leucostictum	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	6	—
Gynandropsis gynandra	1	1	2	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	22	—
Heliotropium indicum	—	x	—	—	—	—	—	x	x	x	—	x	—	—	—	2	x	x	44	—
Ipomoea Pes tigridis	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—
„ triloba	—	—	—	—	—	—	—	—	2	—	—	—	—	—	x	—	x	x	22	—
Leptochloa filiformis	—	—	—	—	—	—	—	—	x	x	x	—	—	x	—	—	—	x	28	—
Leucas aspera	—	—	—	—	x	x	—	—	1	—	x	—	—	x	—	—	—	—	28	—
Leucas javanica	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—
Lindernia crustacea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	6	—
Merremia emarginata	—	—	—	x	—	—	—	—	—	—	x	x	—	—	—	—	—	—	17	—
Mollugo pentaphylla	—	—	—	2	x	x	—	—	—	—	2	x	—	1	x	1½	x	—	50	—
Oldenlandia diffusa	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—
Panicum colonum	3	4	3½	x	x	—	3	2	x	3	x	x	x	x	2	x	x	—	88	1½
Panicum reptans	3½	3	4	5	5	3	4	3	5	3	5	1	1	4	4½	4	3	2	100	3½
Phyllanthus Niruri	1½	3	3	3	3	1	3	1	3	2	2	1	1	—	3	2	4	4	94	2½
Physalis angulata	1	4	2	—	1	—	—	1	x	—	x	—	—	—	x	x	x	x	61	—
„ minima	—	x	1	x	—	x	—	x	x	—	—	x	—	—	—	x	2	x	55	—
Polanisia viscosa	3	1	1	3½	3	2	3	2	3	1	1	2½	3	1	2	3	3	3½	100	2½
Polytrias amaura	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	6	—
Portulaca oleracea	3	3	3	4	3	1	5	3½	3½	4	3½	3	3	2	2½	2	2	3	100	3
Salvia occidentalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	6	—
Senecio sonchifolius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	6	—
Sida rhombifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	6	—
Trianthema Portulacastrum	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	6	—
Tridax procumbens	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	x	11	—
Typhonium flagelliforme	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	6	—
Vitis trifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	6	—
	17	19	18	20	20	18	14	15	24	20	20	21	17	16	19	23	26	27		

THE PANICUM REPTANS-POLANISIA VISCOSA-MERREMIA EMARGINATA-COMMUNITY.

1. August 25 1923. Djatigoenting, the Wonoredjo-plantation. F 9. Light, brownish soil, non-cracking but caking superficially. A plantation of Zea Mays.

2. August 25 1923. Kendangdoekoeh, the Wonoredjo-plantation. F 8. Friable, light, non-cracking soil, getting somewhat plastic in a wet condition; a fairly moist part. A young plantation of Glycine Max.

3. August 25 1923. Djatigoenting, the Wonoredjo-plantation. E 9. Light, brownish, non-cracking soil, caking on the surface. A plantation of Zea Mays.

4. January 11 1924. Some way north of Assemdjadjar, the Pleret-plantation. I 9. Light, brownish soil, caking somewhat and but slightly cracking. Fallow after Zea Mays-harvest.

5. January 11 1924. Kepoeh kidoel, the Pleret-plantation. I 10. Light, brown soil, not easily caking and non-cracking. A young plantation of Arachis hypogaea.

6. January 11 1924. Kedoengpengaron[2], the Pleret-plantation. H 11. A brown, non-cracking, non-plastic soil, somewhat caking. A young plantation of Zea Mays.

7. August 2 1924. Kendang, the Wonoredjo-plantation. E 8. Light, friable, brown soil, but slightly cracking and somewhat caking on the surface. A young plantation of Arachis hypogaea.

8. August 31 1924. A little north of Winong, the Gayam-plantation. K 10. Friable, moist, brownish soil, somewhat caking and a little plastic in a moist condition. A thin plantation of Zea Mays.

9. September 21 1924. Kebondjero, the Kedawoeng-plantation. P 10. Fairly light, brownish soil, somewhat caking on the surface and slightly cracking; afflux-side of the field. A young plantation of Zea Mays.

10. November 10 1924. Patebon, the Pandaan-plantation. A 5. Fairly light, damp, greyish-brown soil; afflux-side of the field. A young plantation of Zea Mays.

11. November 17 1924. Kepoeh kidoel, the Pleret-plantation; I 10. Friable, ruddy, light soil, somewhat plastic when moist; non-cracking. A young plantation of Zea Mays.

12. November 24 1924. Ngamploeng, the Pleret-plantation. I 8. Light, friable, brownish soil. A young plantation of Zea Mays.

13. November 24 1924. Poekoel, the Pleret-plantation. H 8. Fairly light, friable, brownish soil. A young plantation of Zea Mays.

14. February 10 1925. Kili, the Gayam-plantation. L 9. Fairly light, brown Tengger-soil, a little plastic. A young plantation of Zea Mays.

15. September 2 1925. Tampoeng, the Winongan-plantation. F 6. Light, brownish, sandy soil. A young plantation of Zea Mays and Arachis hypogaea.

16. October 11 1925. Djatigandjeng, the Pleret-plantation. I 11. Friable, ruddy-brown soil, only slightly cracking and a little plastic in a moist condition. A thin plantation of Zea Mays.

17. October 12 1925. Leles, the Pengkol-plantation. K 7. A damp, fairly light, non-cracking soil, mixed with some river-silt. A young plantation of Zea Mays.

18. October 12 1925. Rangeh, the Pengkol-plantation. K 8. Light, non-cracking soil, mixed with much river-silt. Afflux-side of the field. A young plantation of Arachis hypogaea.

TABLE V.

THE PANICUM REPTANS — POLANISIA VISCOSA — MERREMIA EMARGINATA — COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	K%	A
Abutilon indicum	—	x	—	—	—	—	—	x	—	x	—	—	—	—	21	—
Acalypha boehmerioides	—	—	—	—	—	—	x	—	—	—	—	—	—	—	7	—
„ indica	—	—	—	—	—	—	1	—	—	—	—	—	—	—	7	—
Aeschynomene indica	—	—	—	—	—	—	—	—	—	x	—	—	—	—	7	—
Ageratum conyzoides	—	—	—	—	—	—	—	—	—	—	—	1	—	—	7	—
Alternanthera sessilis	—	x	3	—	1	—	—	1	2	x	—	1	2	2	64	—
Amarantus gracilis	—	—	—	—	—	—	x	—	—	—	—	—	2	—	14	—
Amarantus spinosus	x	1	1	1	1	1½	1	3	1	x	2	2	2	1	100	1½
Blumea humifusa	—	—	—	—	—	—	—	—	—	—	x	—	—	—	7	—
Cassia occidentalis	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—
Celosia argentea	—	—	—	—	—	—	—	—	—	—	—	—	x	—	7	—
Commelina benghalensis	—	—	—	—	—	—	—	—	—	—	—	x	—	—	7	—
„ nudiflora	—	—	—	—	—	—	—	—	x	—	—	—	—	—	7	—
Corchorus olitorius	—	x	—	—	—	—	x	—	x	x	—	x	1	—	43	—
Crotalaria striata	—	—	—	—	—	—	—	x	—	—	—	—	—	—	7	—
Cynodon Dactylon	x	x	2	3	3	x	x	2	2	x	2	3	3	4	100	1½
Cyperus Iria	x	—	x	—	—	—	—	x	—	—	x	—	2	1	43	—
Cyperus rotundus	3	3	x	4	5	x	4	1	x	x	2	3	3	4	100	2½
Dentella repens	—	3	—	—	—	—	—	—	—	—	1½	—	2	2	36	—
Desmodium triflorum	—	—	—	—	—	—	—	—	—	—	—	x	—	—	7	—
Digera alternifolia	—	—	—	—	—	—	—	x	—	—	—	—	—	—	7	—
Digitaria sanguinalis	1	x	x	x	1	1½	2	x	x	—	1	1½	2	1	93	1
Eclipta alba	x	—	x	x	x	x	x	x	x	x	x	—	2	x	86	x
Eleusine indica	—	x	—	—	x	—	x	x	x	—	x	x	1½	—	57	—
Eragrostis pilosa	x	—	—	—	x	—	—	—	x	x	1	—	—	x	43	—
Euphorbia hirta	—	x	x	x	x	1	x	x	x	x	1	2	1½	x	93	½
Euphorbia parviflora	—	—	—	—	—	—	—	—	x	x	—	—	—	—	14	—
Euphorbia reniformis	1½	1	1½	2	1	2	2	2	2½	2	2	1	2½	2	100	2
Fimbristylis miliacea	—	—	—	—	—	—	—	—	—	—	x	—	—	—	14	—
Gymnopetalum leucostictum	—	—	1	—	—	—	—	x	—	—	—	x	—	—	21	—
Heliotropium indicum	—	x	x	x	—	—	—	x	x	x	—	1	2	1	64	—
Ilysanthes veronicifolia	—	—	—	—	—	—	—	—	—	—	1	—	—	—	7	—
Ipomoea aquatica	—	—	—	—	—	—	—	—	—	—	x	—	—	—	7	—
„ Pes tigridis	x	x	—	—	—	—	—	—	—	—	—	—	—	x	21	—
„ triloba	—	—	x	—	—	—	2	x	—	—	—	—	—	—	21	—
Leptochloa filiformis	—	—	—	—	x	1	2	x	—	—	x	x	2½	—	50	—
Leucas aspera	—	—	—	x	x	—	1	—	—	—	—	—	—	—	21	—
„ javanica	—	—	—	—	—	—	—	x	—	—	—	—	—	—	7	—
Lindernia crustacea	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—
Lourea reniformis	—	—	—	—	—	—	x	—	x	—	—	—	—	—	14	—
Melochia corchorifolia	—	—	—	—	—	—	—	x	x	1	—	—	1½	—	29	—
Merremia emarginata	3	1	2½	1½	3	2	1	3	4	4	1½	2	1	2	100	2½
Merremia gemella	—	—	—	—	—	—	—	—	—	—	—	x	—	—	7	—
Mollugo pentaphylla	—	—	—	x	—	—	—	—	—	—	—	x	—	x	21	—
Moschosma polystachyum	—	—	—	—	—	—	—	—	—	—	1	—	—	—	7	—
Nasturtium indicum	—	—	—	—	—	—	—	—	—	—	x	—	2½	—	14	—
Oldenlandia corymbosa	—	—	—	—	—	1	—	—	—	—	1½	—	—	—	14	—
Panicum colonum	2	x	x	x	x	1½	x	x	1	x	1	—	2	x	93	½
„ *reptans*	4	4	4	4	4	4	5	5	5	4	4	3½	4	3	100	4
Phyllanthus maderaspatensis	—	—	—	—	—	—	—	x	—	—	—	—	—	—	7	—
Phyllanthus Niruri	x	x	x	2	2½	3	3	3	1	1	2	2	2½	1	100	1½
„ *Urinaria*	x	1	x	x	—	1	1	x	1	1	x	1½	2	x	93	½
Physalis angulata	—	x	x	—	x	x	—	—	x	—	x	—	—	x	50	—
„ minima	x	x	x	—	—	—	—	x	x	—	x	—	3	—	50	—
Polanisia viscosa	x	1	1	1	2	2½	2	1	1	x	2½	2	2½	2	100	1½
Polytrias amaura	3	—	—	—	—	—	x	—	—	—	x	—	—	x	29	—
Portulaca oleracea	2½	2	2	3	3	3	4	2	1	1	2	2½	2	2½	100	2½
Senecio sonchifolius	—	—	—	x	x	—	x	—	—	—	—	—	—	—	21	—
Sida rhombifolia	—	—	—	—	—	—	—	x	—	—	—	—	—	—	7	—
Sphaeranthus africanus	—	—	—	—	—	—	—	—	—	—	—	—	x	—	7	—
Tridax procumbens	—	—	—	—	—	—	x	—	x	—	—	—	—	—	14	—
Vernonia chinensis	—	—	—	—	—	—	x	—	—	—	—	—	—	x	14	—
	18	23	21	18	21	19	27	29	26	21	29	23	27	24		

THE PANICUM REPTANS-POLANISIA VISCOSA-MERREMIA EMARGINATA — COMMUNITY.

1. October 20 1923. Karangassem[2], the Wonoredjo-plantation. F 8. A fairly light, ruddy, soil quickly drying up and cracking, getting very hard on the surface and very plastic when wet. A young plantation of Arachis hypogaea.
2. October 25 1923. Wonodjati, the Gayam-plantation. M 9. Fairly light, brown soil, somewhat cracking, with a moist, plastic subsoil. Fallow.
3. November 5 1923. Kemirahan, the Pleret-plantation. J 9. Medium-heavy, dark-brown soil, cracking widely; after tillage friable, however, and easily falling to pieces. Deflux-side of the field. A young plantation of Arachis hypogaea.
4. July 18 1924. Djatisari, the Alkmaar-plantation. D 11. Fairly light, friable, slightly cracking, residuary, brown soil. A young plantation of Zea Mays.
5. July 18 1924. Pakem, the Alkmaar-plantation. D 12. Fairly light, slightly cracking soil, plastic when wet. A young plantation of Zea Mays.
6. August 20 1924. Tambakjoedo, the Pleret-plantation. K 5. Fairly light, cracking, brown soil, plastic when wet. A young plantation of Arachis hypogaea.
7. September 21 1924. Kebondjero, the Kedawoeng-plantation. P 10. A fairly light, ruddy soil, getting hard and somewhat cracking. Deflux-side of the field. A young plantation of Arachis hypogaea.
8. November 4 1924. Gambiran, the Pleret-plantation. J 7. A fairly light, slightly cracking, brownish soil. A young plantation of Zea Mays.
9. November 4 1924. North of Ngamploeng and west of Gambiran, the Pleret-plantation. J 7. A light, brown soil, slightly cracking when drying up. A young plantation of Zea Mays.
10. November 4 1924. Sekarpoetih, north-west of Gambiran, the Pleret-plantation. J 7. A light, greyish-brown, slightly cracking soil.
11. July 29 1924. Poetjangan, the Pleret-plantation. K 5. A fairly light, brown, slightly cracking soil, very plastic when moist; a damp part. A young plantation of Arachis hypogaea.
12. August 26 1925. Sroewi kidoel, the Winongan-plantation. N 11. A light, brown, slightly cracking soil, drying up quickly and then getting hard. A young plantation of Zea Mays.
13. August 26 1925. Mendalan, the Gayam-plantation. N 9. A light, sandy, somewhat cracking soil, plastic when wet; a damp plot of ground. A young plantation of Ipomoea Batatas.
14. January 11 1926. Kepoeh kidoel, the Pleret-plantation. J 10 A fairly light, cracking soil with a hard top-layer, plastic when moist. Deflux-side of the field. A young plantation of Zea Mays.

TABLE VI.

THE PANICUM REPTANS — POLANISIA VISCOSA — PORTULACA OLERACEA — COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Community 1—24		Variant A 1—11		Variant B 12—24		
																									K%	A	K%	A	K%	A	
Abutilon indicum	—	—	—	x	—	—	x	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	—	27	—	—	—	Abutilon indicum
Acalypha boehmerioides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	4	—	—	—	8	—	Acalypha boehmerioides
Ageratum conyzoides	x	—	—	—	—	—	—	1½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	—	18	—	—	—	Ageratum conyzoides
Alternanthera sessilis	—	—	—	—	—	—	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	8	—	9	—	8	—	Alternanthera sessilis
Amarantus gracilis	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Amarantus gracilis
Amarantus spinosus	x	x	x	—	x	1	2	x	x	1	x	1	—	—	—	—	x	—	x	—	1	x	x	x	71	—	91	½	54	—	Amarantus spinosus
Bergia oryzetorum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	4	—	—	—	8	—	Bergia oryzetorum
Cassia occidentalis	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Cassia occidentalis
Celosia argentea	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Celosia argentea
Conyza japonica	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Conyza japonica
Corchorus olitorius	—	—	—	—	—	x	—	—	1½	—	—	x	—	—	—	—	—	—	—	—	—	x	—	—	17	—	18	—	15	—	Corchorus olitorius
Cynodon Dactylon	4	1	2	5	1	1	1½	3	4	2	1½	1	x	1	1	1	x	x	x	x	1	1	x	1	100	1½	100	2½	100	½	*Cynodon Dactylon*
Cyperus Iria	—	—	—	1	x	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	x	—	—	17	—	18	—	15	—	Cyperus Iria
Cyperus rotundus	2	x	3½	4	x	x	2	2	3	2	1½	1	1	x	2	2	x	4	3	x	2	2	3	2	100	2	100	2	100	1½	*Cyperus rotundus*
Dentella repens	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	13	—	18	—	8	—	Dentella repens
Digera alternifolia	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	x	—	1	—	—	13	—	—	—	23	—	Digera alternifolia
Digitaria sanguinalis	—	1	1	—	x	1	—	—	—	2	—	x	1	—	—	—	—	—	—	—	2	—	—	—	33	—	45	—	23	—	Digitaria sanguinalis
Eclipta alba	—	—	—	x	—	—	x	x	—	x	x	x	—	—	—	—	—	—	—	—	—	x	—	—	29	—	45	—	15	—	Eclipta alba
Eleusine indica	—	—	x	x	x	—	x	—	—	x	—	x	—	—	—	x	—	—	—	—	—	—	—	—	29	—	45	—	15	—	Eleusine indica
Eragrostis pilosa	—	1½	—	x	x	x	x	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	29	—	45	—	15	—	Eragrostis pilosa
Euphorbia hirta	x	x	x	2	x	x	x	1	1	1	x	1	1	—	—	—	—	—	—	—	1	1½	x	1½	71	—	100	½	46	—	Euphorbia hirta
Euphorbia reniformis	2	2	2½	2	2	1	1½	2	2	2½	2	2	1	3	3	2½	x	2	3	2	2	1½	2	2½	100	2	100	2	100	2	*Euphorbia reniformis*
Fimbristylis miliacea	—	—	—	—	—	—	x	—	—	—	—	2	—	—	—	—	—	—	—	—	—	x	—	—	13	—	9	—	15	—	Fimbristylis miliacea
Galinsoga parviflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	4	—	—	—	8	—	Galinsoga parviflora
Glinus lotoides	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Glinus lotoides
Gymnopetalum leucostictum	—	—	—	—	—	x	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	8	—	9	—	8	—	Gymnopetalum leucostictum
Heliotropium indicum	—	—	—	x	—	—	x	x	—	—	—	x	—	x	—	—	x	—	—	—	—	x	—	—	29	—	27	—	31	—	Heliotropium indicum
Ilysanthes veronicifolia	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	8	—	Ilysanthes veronicifolia
Ipomoea Pes tigridis	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	8	—	—	—	15	—	Ipomoea Pes tigridis
„ triloba	—	—	x	—	—	—	—	—	—	1	x	—	—	—	—	—	—	—	—	—	x	x	2	2	29	—	27	—	31	—	„ triloba
Leptochloa filiformis	—	—	—	x	—	1	—	—	—	—	—	2	—	—	—	—	—	x	—	—	x	x	—	—	25	—	18	—	31	—	Leptochloa filiformis
Leucas aspera	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Leucas aspera
Lindernia crustacea	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	8	—	Lindernia crustacea
Marsilia crenata	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—	8	—	9	—	8	—	Marsilia crenata
Melochia corchorifolia	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Melochia corchorifolia
Merremia emarginata	—	—	—	—	—	—	—	—	x	—	—	3	2	2	2	2	2	2	2	2	1½	1½	3	2	58	—	9	—	100	2	Merremia emarginata
„ gemella	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	4	—	—	—	8	—	„ gemella
Mollugo pentaphylla	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	8	—	Mollugo pentaphylla
Moschosma polystachyum	x	—	—	—	—	—	—	—	—	—	1	—	—	—	x	x	—	—	—	—	—	—	—	x	21	—	18	—	23	—	Moschosma polystachyum
Nasturtium indicum	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Nasturtium indicum
Oldenlandia corymbosa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—	—	—	8	—	—	—	15	—	Oldenlandia corymbosa
„ diffusa	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	8	—	„ diffusa
Panicum colonum	3	4	2	3½	3	3	3½	3	3	3	2	3	3	3	4	4	4	3	2	4	2	3	3½	2	100	3	100	3	100	3	*Panicum colonum*
„ *reptans*	4½	5	5	3	4	4½	4½	4	3	4½	4	4	3	5	5	5	3	3	3	5	4	4	4	4½	100	4	100	4	100	4	„ *reptans*
Passiflora foetida	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	8	—	9	—	8	—	Passiflora foetida
Phyllanthus Niruri	2	2	3	2½	2	2	2	3	2½	2	3	1	1	3	3	2	2	x	1	1	1	2½	2	2½	100	2	100	2½	100	1½	*Phyllanthus Niruri*
Phyllanthus Urinaria	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	—	x	x	—	x	x	—	x	29	—	18	—	38	—	Phyllanthus Urinaria
Physalis angulata	—	—	—	—	x	1	—	—	x	2	x	—	—	x	—	—	—	—	1	x	x	x	—	x	46	—	45	—	46	—	Physalis angulata
„ minima	—	—	—	—	—	x	x	2	—	x	—	x	—	x	—	—	—	—	—	—	—	x	—	—	29	—	36	—	23	—	„ minima
Polanisia viscosa	1	3	1	1	1	3	2	2	3	3	3	2½	2½	2½	4	3	3	4	4	3	3	2	2½	2½	100	2½	100	2	100	3	*Polanisia viscosa*
Polytrias amaura	—	—	—	—	—	1	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	8	—	9	—	8	—	Polytrias amaura
Portulaca oleracea	2	2	2	3	2	3½	2½	3	3½	3½	2½	2	3	3	3½	3	4	2	2	2	3	2½	2½	2	100	2½	100	2½	100	2½	*Portulaca oleracea*
Rhynchosia minima	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	4	—	—	—	8	—	Rhynchosia minima
Sida rhombifolia	—	—	—	—	—	x	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	8	—	9	—	8	—	Sida rhombifolia
„ veronicifolia	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	„ veronicifolia
Trianthema Portulacastrum	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Trianthema Portulacastrum
Tridax procumbens	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	9	—	—	—	Tridax procumbens
	13	12	15	16	15	23	18	19	15	18	16	28	16	13	10	11	12	12	13	11	17	24	12	18							

THE PANICUM REPTANS-POLANISIA VISCOSA-PORTULACA OLERACEA-COMMUNITY.

1. August 31 1924. Karangsentoel, the Pengkol-plantation. K 8. A greyish-brown, light soil, caking superficially on drying up, hardly cracking, however; when moist it is fairly plastic. A thin plantation of Arachis hypogaea.
2. October 6 1924. Tjobensari, the Wonoredjo-plantation. F 9. A fairly light, friable soil, somewhet cracking, but hardly plastic when moist. A young plantation of Arachis hypogaea.
3. November 5 1924. Brambang, the Pengkol plantation. L 9. A light, friable, brown soil, hardly cracking; slightly plastic when moist. A plantation of Arachis hypogaea.
4. November 10 1924. Patebon, the Pandaan-plantation. A 5. Fairly light, grey, superficially cracking soil, fairly plastic when wet. Deflux-side of the field.
5. November 24 1924. Babadan, the Wonoredjo-plantation. E 10. A fairly light, friable, brown, slightly plastic, water-retaining soil; little cracking when getting dry. A young plantation of Zea Mays.
6. November 24 1924. Between Sambisirah-wetan and Areng-Areng, the Wonoredjo-plantation. G 8. A fairly light, brownish-grey, somewhat plastic, slight cracking soil. Fallow after Zea Mays-harvest.
7. July 29 1925. Genengwaroe, west of Ngempit; the Winongan-plantation. G 6. Fairly light, brownish-grey, easily crumbling, slight cracking soil, a little plastic when moist. A fairly moist part. A young, thin plantation of Arachis hypogaea.
8. August 25 1925. Wonosari, the Gayam-plantation. L 8. A light, friable, brown, little cracking soil, somewhat plastic when moist. A young plantation of Arachis hypogaea.
9. August 26 1925. Djolodaran, the Pleret-plantation. I 6. A light, brown, sandy soil, very superficially wide cracking and somewhat plastic when moist. A young plantation of Zea Mays.
10. August 27 1925. Between Sambisirah wetan and Kloewoet, the Wonoredjo-plantation. G 8. A light, friable soil, cracking very slight and fairly plastic when moist. A young plantation of Arachis hypogaea.
11. September 29 1925. Manik, the Gayam-plantation. M 7. A light, slight cracking, brownish-grey clay with much sand; retaining its moisture a long time. Afflux-side of the field. A young plantation of Zea Mays.
12. February 9 1924. Soemberwoeni, the Pleret-plantation. I 10. Fairly light, brown soil forming a hard, cracking top-layer on drying, and getting somewhat plastic when moist.
13. April 27 1924. Kandangdoekoeh[2], the Wonoredjo-plantation. F 8. A fairly light, brown soil, forming a hard cracking top-layer on drying. A young plantation of Zea Mays.
14. August 31 1924. Ranggeh, the Gayam-plantation. K 8. A fairly light, superficially cracking, caking, greyish-brown soil. Deflux-side of the field.
15. August 31 1924. Tjenkrong S, the Gayam-plantation. K 11. A caking, superficially cracking, brown soil, very plastic when moist. A young plantation of Arachis hypogaea.
16. August 31 1924. Lemahabang; the Gayam-plantation. L 11. A fairly light, brown soil with a easily cracking, hard top-layer and plastic when moist. A plantation of Zea Mays.
17. August 31 1924. Boedeng, the Gayam-plantation. L 10. A fairly light, brown, superficially cracking soil, with a hard top-layer, fairly plastic when wet and retaining the moisture a very long time. A plantation of Zea Mays.
18. September 13 1924. Waroengdowo, the Pleret-plantation. J 7. Moist, light, brownish soil, hard on the surface and cracking; when moist it is plastic. A young plantation of Zea Mays.
19. September 13 1924. Sladi, the Pleret-plantation. J 7. A fairly light, brown soil, hard and cracking on the surface, and plastic when wet. A fairly moist part. A plantation of Ipomoea Batatas.
20. October 3 1924. Pagoeboekan near Areng-Areng, the Wonoredjo-plantation. G 7. A medium-heavy, dark-brown clay with much sand, getting hard and cracking on drying. A young plantation of Zea Mays.
21. August 1 1925. Klodjen near Sladi, the Pleret-plantation. J 8. Medium-heavy, brownish, damp soil, cracking and getting hard on drying; very plastic when moist. A young open plantation of Zea Mays.
22. September 2 1925. Plingissan, the Winongan-plantation. I 6. A fairly light, greyish-brown soil, getting hard and cracking on drying; plastic when moist. Deflux-side of the field. A young plantation of Glycine Max.
23. November 17 1925. Djombang near Logowo, the Pleret-plantation. J 6. A light, greyish-brown, sandy soil, getting very hard on drying. A thin plantation of Vigna sinensis.
24. November 20 1925. Between Gojoran and Bandjangan, the Pleret-plantation. K 7. A fairly light, cracking, brownish soil; plastic in a moist condition. A young plantation of Arachis hypogaea.

TABLE VII.

NAME OF THE PLANT	The Polanisia viscosa-community	The Panicum reptans-Polanisia viscosa-community	The Panicum reptans-Polanisia viscosa-Merremia emarginata-community	The Panicum reptans-Polanisia viscosa-Portulaca oleracea-community		The Panicum reptans-Gymnopetalum leucostictum-community.		NAME OF THE PLANT
				var. A	var. B	var. A	var. B	
Amarantus spinosus	2½	2½	1½	½	54%	—	8%	Amarantus spinosus
Borreria setidens	—	—	—	—	—	33%	x	Borreria setidens
Cynodon Dactylon	4½	3	1½	2½	½	2	3½	Cynodon Dactylon
Cyperus Iria	37%	½	43%	18%	15%	—	—	Cyperus Iria
„ rotundus	4	3	2½	2	1½	50%	31%	„ rotundus
Digitaria sanguinalis	2½	1	1	45%	23%	6%	—	Digitaria sanguinalis
Eclipta alba	18%	33%	x	45%	15%	39%	54%	Eclipta alba
Eleusine indica	1	½	57%	45%	15%	—	—	Eleusine indica
Eragrostis pilosa	63%	½	43%	45%	15%	6%	—	Eragrostis pilosa
Euphorbia hirta	½	½	½	½	46%	33%	8%	Euphorbia hirta
Euphorbia reniformis	—	55%	2	2	2	2	3	Euphorbia reniformis
Gymnopetalum leucostictum	—	6%	21%	9%	8%	1	1	Gymnopetalum leucostictum
Heliotropium indicum	48%	44%	64%	27%	31%	50%	x	Heliotropium indicum
Merremia emarginata	—	17%	2½	9%	2	3½	3½	Merremia emarginata
„ gemella	—	—	7%	—	8%	22%	2½	„ gemella
Panicum colonum	41%	1½	½	3	3	44%	46%	Panicum colonum
„ reptans	—	3½	4	4	4	3½	4	„ reptans
Phyllanthus Niruri	1½	2½	1½	2½	1½	39%	54%	Phyllanthus Niruri
„ Urinaria	—	—	½	18%	38%	1½	1½	„ Urinaria
Polanisia viscosa	2½	2½	1½	2	3	17%	8%	Polanisia viscosa
Portulaca oleracea	3	3	2½	2½	2½	17%	8%	Portulaca oleracea
	when dry the soil is not hard and it does not crack; when moist it is not plastic.	when dry the soil cakes superficially and is slightly cracking; when wet it is plastic.	when dry the soil tightly cakes on the surface, and slightly cracks; it rapidly loses water; when moist it is very plastic.	the soil has a fairly great retentive power for water; when dry it is not hard and it slightly cracks; when moist it is fairly plastic.	the soil has a great retentive power for water; when dry it is hard and widely cracking on the surface; when moist it is very plastic.	a medium-heavy soil; when dry it cracks widely and deeply; when moist it is very plastic.	a very heavy soil; on drying it rapidly loses its moisture; it cracks deeply and widely; when moist it is very plastic.	

TABLE VIII

THE POLANISIA CHELIDONII-COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Community 1—30		Variant C. 15—30		
																															K%	A	K%	A	
Abutilon indicum	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	x	—	—	—	—	—	4	—	—	1	—	—	x	2	20	—	31	—	Abutilon indicum
Alternanthera sessilis	—	x	—	3	2	2	—	—	—	—	—	—	—	—	—	—	—	—	x	—	1	—	—	1	x	1	1	—	—	—	33	—	38	—	Alternanthera sessilis
Amarantus gracilis	—	x	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	10	—	6	—	Amarantus gracilis
,, spinosus	—	—	—	—	—	—	—	—	x	x	x	1	1	x	—	—	—	—	x	—	—	—	x	—	x	—	—	—	—	—	30	—	19	—	,, spinosus
,, tricolor	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	,, tricolor
Ammania baccifera	—	x	—	—	x	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	Ammania baccifera
Aneilema nudiflorum	—	—	—	x	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	—	Aneilema nudiflorum
Athroisma laciniatum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2	1½	1	2	1	x	x	1½	1	2	1½	2	1	1	53	—	100	1½	Athroisma laciniatum
Bergia oryzetorum	—	x	—	1	x	—	—	—	—	—	—	—	1	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	20	—	6	—	Bergia oryzetorum
Blepharis exigua	—	—	—	—	—	—	—	—	—	—	—	x	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	—	Blepharis exigua
Blumea humifusa	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Blumea humifusa
,, lacera	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	,, lacera
Borreria setidens	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Borreria setidens
Cassia occidentalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	Cassia occidentalis
Celosia argentea	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Celosia argentea
Centipeda minima	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Centipeda minima
Commelina nudiflora	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Commelina nudiflora
Corchorus acutangulus	—	—	x	—	—	—	—	x	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1½	17	—	13	—	Corchorus acutangulus
Cynodon Dactylon	—	—	—	1	—	x	—	—	—	—	—	—	—	2	—	x	—	x	—	—	—	—	1	—	—	—	—	—	—	3	23	—	25	—	Cynodon Dactylon
Cyperus distans	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Cyperus distans
Cyperus Iria	—	x	—	—	—	—	—	—	x	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	Cyperus Iria
,, pulcherrimus	—	—	—	—	—	—	—	—	—	—	—	—	1½	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—	6	—	,, pulcherrimus
,, rotundus	1	x	x	2	2½	1½	3	x	x	—	—	—	—	1½	—	—	—	—	x	x	2	—	2	—	2	1	—	1	4	x	63	—	56	—	,, rotundus
Dentella repens	3½	1	2	2	2	3	3	2	1	2	x	x	3	1½	3	2	3	3	2	3	3½	1½	3	4	3	2	4	2½	3½	4	100	2½	100	3	*Dentella repens*
Desmodium gangeticum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	Desmodium gangeticum
Digera alternifolia	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Digera alternifolia
Eclipta alba	x	x	x	2	1	2	2	x	x	x	x	x	x	x	x	x	x	x	x	1	x	x	2	x	x	x	x	x	1	1½	100	½	100	½	*Eclipta alba*
Eleusine indica	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Eleusine indica
Eriochloa ramosa	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	7	—	6	—	Eriochloa ramosa
Euphorbia hirta	—	—	—	—	—	x	—	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	Euphorbia hirta
Euphorbia parviflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	x	—	1	—	—	—	—	—	—	—	—	—	—	10	—	19	—	Euphorbia parviflora
Euphorbia reniformis	1½	3	3	2	2	1½	1½	3	1½	2	x	3	2½	2	2	1½	2	2	1	2	2	1	1	2	1	2	2	3	2	2½	100	2	100	2	*Euphorbia reniformis*
Fimbristylis miliacea	3	4	2	3	2½	3½	2½	1	3½	x	1	1	3	2	3	3	3	3	3	3	3	4	3	4	3	2	4	2	2	2	100	2½	100	3	*Fimbristylis miliacea*
Glinus lotoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	Glinus lotoides
Grangea maderaspatana	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	3	—	3	x	—	13	—	25	—	Grangea maderaspatana
Gymnopetalum leucostictum	1	x	x	x	x	x	1	1½	x	1	x	x	x	x	1	x	1	1	3	x	x	x	x	3	2½	x	3	x	—	1	97	½	94	1	*Gymnopetalum leucostictum*
Gymnopetalum quinquelobum	—	—	—	—	—	—	x	2	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	Gymnopetalum quinquelobum
Heliotropium indicum	x	x	x	1½	2	2½	x	3	x	2	1	x	1	2	1	x	x	1	x	2	1	x	x	2	2½	2	2	1	x	2	100	1	100	1	*Heliotropium indicum*
Hydrolea zeylanica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	3	—	6	—	Hydrolea zeylanica
Ilysanthes veronicifolia	1½	x	3	x	2	2	x	x	—	—	—	—	—	x	—	—	—	—	—	x	1½	—	—	—	—	—	—	—	—	—	37	—	13	—	Ilysanthes veronicifolia
Ipomoea aquatica	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	x	x	—	—	x	—	—	—	x	—	—	—	x	20	—	31	—	Ipomoea aquatica
,, obscura	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	7	—	6	—	,, obscura
,, triloba	—	—	—	x	—	—	x	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	,, triloba
Jussieua linifolia	—	—	—	—	x	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	13	—	6	—	Jussieua linifolia
Leptochloa filiformis	—	x	—	—	1½	3	—	x	x	—	—	x	2	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	2½	33	—	13	—	Leptochloa filiformis
Leucas javanica	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Leucas javanica
Lindernia crustacea	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Lindernia crustacea
Lippia nodiflora	—	—	—	—	—	—	—	1	—	—	—	—	—	—	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1	2	57	—	100	x	Lippia nodiflora
Ludwigia parviflora	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Ludwigia parviflora
Marsilia crenata	1	—	x	—	2	—	x	—	x	—	—	—	2½	1	—	—	—	2	—	x	1	1	3	—	x	—	—	—	—	—	43	—	38	—	Marsilia crenata
Melochia corchorifolia	—	—	—	—	1	—	—	—	x	1	—	—	—	—	—	x	1	—	—	—	—	—	x	x	—	—	—	—	—	—	23	—	25	—	Melochia corchorifolia
Melothria maderaspatana	—	—	—	—	—	—	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	—	Melothria maderaspatana
Merremia emarginata	—	x	2	—	—	—	—	—	1	3	1	1½	2	2½	—	2½	2	3	—	—	—	2½	—	—	2	—	2	—	—	—	47	—	38	—	Merremia emarginata
,, gemella	—	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	1	—	—	—	x	—	—	—	—	—	—	—	—	13	—	13	—	,, gemella
Monochoria vaginalis	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Monochoria vaginalis
Moschosma polystachyum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	x	—	7	—	13	—	Moschosma polystachyum
Nasturtium indicum	—	—	—	2	x	3	2	—	—	—	—	—	—	1	2½	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23	—	13	—	Nasturtium indicum
Panicum colonum	2	1	2	1	2	2	1	2	4	2	1	x	3	1	1	x	1	2½	2	2	1	2	4	2	1	1	2	2	2½	x	100	1½	100	1½	*Panicum colonum*
Panicum repens	—	—	—	—	—	—	—	1	—	—	—	—	—	2	—	—	—	2	—	—	2	—	—	—	—	—	—	x	—	—	17	—	19	—	Panicum repens
,, reptans	—	x	4	—	x	—	—	—	1	1	4	4	2	3	—	—	—	—	—	x	—	—	—	—	—	1	—	—	3	—	40	—	19	—	,, reptans
Paspalum scrobiculatum	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	x	—	—	—	10	—	13	—	Paspalum scrobiculatum
Pentapetes phoenicea	—	—	—	—	—	—	—	2	—	x	—	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	13	—	6	—	Pentapetes phoenicea
Phaseolus trilobus	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Phaseolus trilobus
Phyllanthus Niruri	—	x	—	—	1	—	1	x	2½	3	2½	2½	2½	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	40	—	13	—	Phyllanthus Niruri
Phyllanthus Urinaria	1	2	3	2	1	x	2	2	1	3	1	1	1½	2½	2	1	2	1	4	x	x	x	1	2	3	x	2	x	1	1	100	1½	100	1½	*Phyllanthus Urinaria*
Physalis angulata	—	—	—	x	—	—	—	x	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	—	—	—	Physalis angulata
,, minima	—	—	—	—	—	—	1	x	—	x	x	—	1	—	x	—	—	—	—	—	—	—	x	—	—	—	—	—	1	2	30	—	25	—	,, minima
Polanisia Chelidonii	3	4	2½	3½	3	3	1½	1½	4	2½	3	2½	3	3	3	3	3	3	4	3	3	3	4	4	3½	3½	4	3½	2½	2½	100	3	100	3½	*Polanisia Chelidonii*
Polanisia viscosa	—	—	—	—	—	—	—	—	—	—	x	1½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	—	—	Polanisia viscosa
Portulaca oleracea	—	x	—	—	—	—	x	x	x	x	x	1	1½	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30	—	—	—	Portulaca oleracea
Scirpus setaceus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	3	—	6	—	Scirpus setaceus
Sphaeranthus africanus	—	x	—	1	1	2	—	—	x	—	—	—	x	—	—	—	x	—	—	—	—	x	—	—	—	—	—	—	1	—	30	—	19	—	Sphaeranthus africanus
,, indicus	x	x	—	—	x	—	—	—	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	23	—	23	—	,, indicus
Sporobolus tremulus	1	1	x	2	1½	2	x	x	1	—	—	—	—	—	—	—	—	—	x	—	—	—	—	x	—	x	—	4	—	—	43	—	25	—	Sporobolus tremulus
Tridax procumbens	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	Tridax procumbens
Vitis trifolia	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	1	10	—	13	—	Vitis trifolia
Zoysia Matrella	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	3	—	6	—	Zoysia Matrella
	17	26	19	21	26	19	22	27	21	23	19	23	22	27	15	18	16	20	20	16	18	16	18	15	16	19	15	16	19	23	—	—	—	—	

THE POLANISIA CHELIDONII-COMMUNITY

1. May 28 1924. Sidogiri, the Winongan-Ngempit-plantation. H 6. Heavy, black, moist clay. A young plantation of Arachis hypogaea.
2. April 24 1924. Kramjangan, the Pengkol-plantation. L 5. Fairly heavy, black, moist clay; deflux-side of the field. A young plantation of Arachis hypogaea.
3. November 10 1924. Baoedjeng, the Pandaan-plantation. B 4. Heavy, black, old-quaternary clay with little calcium-carbonate; a low-lying part. Fallow after Zea Mays-harvest.
4. August 25 1925. Doropajoeng, the Pengkol-plantation. L 6. Fairly heavy, brownish-grey clay; deflux-side of the field. A young plantation of Glycine Max.
5. August 25 1925. Boegoel kidoel, the Pengkol-plantation. M 5. Heavy, brownish-black clay, mixed with a little sand. A young plantation of Zea Mays.
6. August 25 1925. Between Tegaldjagoeng and Boegoel lor, the Pengkol-plantation. M 4. Heavy, black, damp clay. A young plantation of Arachis hypogaea.
7. September 17 1925. Babadan, the Kedawoeng-plantation. N 6. Fairly heavy, greyish-brown, moist clay. A young plantation of Glycine Max.
8. November 17 1925. Genengwaroe, the Winongan-Ngempit-plantation. G 6. A heavy, greyish-black, old-quaternary, moist clay. Fallow after reaping the cane.
9. August 24 1924. Boeloe, the Pengkol-plantation. L 6. Fairly heavy, black clay with much sand. A young plantation of Glycine Max.
10. November 25 1924. Kedoengbakoe, the Kedawoeng-plantation. N 7. A fairly heavy, black, moist clay, containing sand and ashes, crumbling fairly easily. Fallow after the cane has been cut off.
11. July 29 1925. Pekoentjen I. 5. Blackish-brown, medium-heavy clay, with much sand, crumbling fairly easily; afflux-side of the field. A young plantation of Arachis hypogaea.
12. August 27 1925. Bloesoek, the Pleret-plantation. J 6. Medium-heavy, brownish-grey clay; afflux-side of the field. A young plantation of Zea Mays.
13. August 27 1925. Temenggoengan, the Pleret-plantation. K 6. Fairly heavy, greyish-brown clay with sand, not cracking deeply on drying; afflux-side of the field. A young plantation of Arachis hypogaea.
14. September 28 1925. Gading, the Pleret-plantation. L 4. A fairly heavy, blackish-brown clay with much sand. A young plantation of Arachis hypogaea.
15. March 16 1923. Ketoek, the Pleret-plantation. K 4. Plastic, heavy, black, moist clay. A young plantation of Zea Mays.
16. August 1923. Gempeng, the Soemberredjo-plantation. F 2. Heavy, black, moist clay. Fallow after reaping the cane.
17. September 13 1923. Karangpandan, the Gayam-plantation. L 6. Heavy, black, moist clay. Fallow after a plantation of Zea Mays.
18. November 9 1923. Masangan, the Soemberredjo-plantation. G 2. Old-quaternary, very moist clay with very little calcium-carbonate. Fallow after reaping the cane.
19. January 3 1924. Manaroei, the Soemberredjo-plantation. F 2. Heavy, black clay, very moist and containing ashes. Ploughed up a month before, now fallow.
20. June 18 1924. Tjangkringmalang, the Soemberredjo-plantation. C 2. Blackish, non-calcareous, moist clay.
21. Juny 20 1924. Tjankringmalang, the Soemberredjo-plantation. C 1. Fairly heavy, non-calcareous, black, moist clay. A young plantation of Zea Mays.
22. July 5 1924. Kaligoenting, the Soemberredjo-plantation. E 1. Heavy, black, moist clay, containing little calcium-carbonate. A young plantation of Zea Mays.
23. July 30 1924. Segoropoero, the Kedawoeng-plantation. P 6. Heavy, moist, calcareous clay. Fallow after reaping Zea Mays.
24. July 30 1924. Petagoeran, the Kedawoeng-plantation. O 6. Heavy, brownish-black, moist clay. Fallow after reaping the cane.
25. November 7 1924. Sekarpandan, the Kedawoeng-plantation. O 6. Heavy, moist, blackish-brown clay. Fallow after reaping the cane.
26. November 7 1924. Padekan, the Kedawoeng-plantation. N 5. A heavy, brownish-black clay; a low-lying area.
27. November 7 1924. Petoegoeran, the Kedawoeng-plantation. O 6. Heavy, brownish-black, non-calcareous clay. Fallow after reaping the Zea Mays.
28. November 7 1924. Petoegoeran, the Kedawoeng-plantation. O 6. Heavy, black, non-calcareous clay; a low-lying spot of the area. Fallow after reaping the Zea Mays.
29. September 17 1925. Krandong, the Kedawoeng-plantation. M 7. Heavy, black clay. A young plantation of Arachis hypogaea.
30. September 17 1925. Boedoe, the Kedawoeng-plantation. M 6. Heavy, greyish-brown clay. A young plantation of Arachis hypogaea.

TABLE IX.

THE DENTELLA REPENS — LIPPIA NODIFLORA — COMMUNITY.

	1	2	3	4	5	6	7	8	9
Alternanthera sessilis	—	x	—	—	—	x	—	—	—
Athroisma laciniatum	—	—	x	x	2	—	x	—	1
Bergia oryzetorum	—	—	x	x	—	—	—	—	—
Blumea humifusa	x	—	—	—	—	—	x	—	—
„ lacera	—	—	—	—	—	—	x	—	—
Corchorus acutangulus	x	—	—	—	—	—	—	—	—
Cynodon Dactylon	2½	5	2	4	3	3	4	3	2
Cyperus rotundus	1	x	3	x	x	2	1	1	—
Dentella repens	4	2½	4½	4	3	4	3	2½	3
Eclipta alba	3	1	x	x	1	x	x	x	x
Eragrostis japonica	—	—	—	2	—	—	2	—	—
Eriochloa ramosa	—	—	—	—	—	x	—	—	—
Euphorbia reniformis	1	2	2	1	x	x	1	1	1
Fimbristylis miliacea	3	—	x	—	—	—	—	—	2
Grangea maderaspatana	—	—	x	x	—	—	—	—	—
Gymnopetalum leucostictum	—	x	—	—	—	—	—	x	—
„ quinquelobum	—	1	—	—	—	—	—	—	—
Heliotropium indicum	—	—	2	x	x	x	x	—	—
Ilysanthes veronicifolia	—	x	—	—	—	—	x	—	—
Ipomoea aquatica	1	—	—	—	2	—	—	—	1
Ipomoea obscura	—	—	—	—	—	—	x	—	—
Leptochloa filiformis	x	—	—	—	—	—	—	—	—
Lindernia crustacea	x	—	—	—	—	—	—	—	—
Lippia nodiflora	3½	3	3½	3	2½	3½	3	3	2½
Marsilia crenata	1	—	—	—	—	—	—	—	—
Merremia emarginata	—	x	—	—	x	x	—	3	—
Moschosma polystachyum	—	—	—	—	—	—	—	—	1
Nasturtium indicum	—	—	2	—	—	—	—	—	—
Panicum colonum	2	2	1	—	2	1	x	x	2
„ *repens*	2	x	1	x	2	3	2	x	x
Panicum reptans	—	—	—	—	—	—	—	x	—
Paspalum scrobiculatum	—	—	x	—	—	x	—	—	—
Phyllanthus Urinaria	1	x	2	1	1	2	x	1	1
Physalis minima	—	—	x	—	—	x	—	—	—
Polanisia Chelidonii	—	x	—	—	—	1	—	—	x
Polytrias amaura	—	3	—	—	—	—	—	1	—
Portulaca oleracea	—	—	—	—	—	x	—	—	—
Sphaeranthus africanus	—	—	—	—	—	—	1	—	—
„ indicus	—	—	—	x	—	—	x	—	—
Sporobolus tremulus	—	—	x	—	—	—	—	—	x
Typhonium flagelliforme	—	—	—	—	—	—	—	x	—
Vitis trifolia	—	—	—	—	x	—	—	—	—
	16	16	18	14	14	17	18	14	14

THE DENTELLA REPENS-LIPPIA NODIFLORA-COMMUNITY.

1. August 9 1924. Pogar, the Soemberredjo-plantation. D 2. Old-quaternary clay, fairly heavy; a very moist area. A plantation of Zea Mays.
2. September 15 1924. Kasoeran, the Kedawoeng-plantation. N 6. Fairly heavy, brownish-grey, very moist clay.
3. October 15 1924. Petoegoeran, the Kedawoeng-plantation. O 6. Very moist, fairly heavy, brownish-black clay, mixed with sand.
4. November 7 1924. Petoegoeran, the Kedawoeng-plantation. O 6. Heavy, greyish-brown clay, cracking on the surface; a low-lying, very moist plot of ground. An experimental square.
5. November 8 1924. Glogoh, the Winongan-plantation. H 6. A fairly heavy, brownish-black, very moist clay, mixed with calcium-carbonate; a very moist part.
6. November 25 1924. Djarangan, the Kedawoeng-plantation. N 6. A medium-heavy, brownish, very moist clay; a depression in the area. Fallow after reaping the cane.
7. November 25 1924. Redjoso lor, the Kedawoeng-plantation. N 7. A very moist, brownish-black, fairly heavy clay. A plantation of Zea Mays.
8. June 11 1925. Sedaroem, the Winongan-plantation. T 9. Fairly heavy, black clay; a wet depression in the area. A young plantation of Glycine Max.
9. October 13 1925. Ketoeg, the Pleret-plantation. K 4. Fairly heavy, brownish-black, very moist clay. A young plantation of Zea Mays.

TABLE X.

THE MOSCHOSMA POLYSTACHYUM — SPHAERANTHUS AFRICANUS — COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	K%	A
Abutilon indicum	—	—	—	—	—	—	—	x	—	—	—	9	—
Aeschynomene indica	—	—	—	—	—	—	—	—	—	—	x	9	—
Ageratum conyzoides	—	2	—	—	—	—	—	—	—	—	—	9	—
Alternanthera sessilis	—	—	x	—	—	—	—	x	x	—	—	27	—
Ammania octandra	—	—	—	—	—	—	x	—	—	x	—	18	—
Athroisma laciniatum	—	—	—	—	—	—	—	1	—	—	—	9	—
Bergia oryzetorum	—	—	—	—	x	—	x	—	—	—	—	18	—
Blumea humifusa	—	—	—	x	—	—	—	—	—	—	—	9	—
„ lacera	—	—	—	x	—	—	—	—	—	—	x	18	—
Borreria setidens	—	—	—	—	—	—	—	—	x	—	—	9	—
Centipeda minima	—	—	—	—	—	—	—	x	—	—	1	18	—
Cynodon Dactylon	3	4	4	4½	2	x	4	2	3	3	2	100	3
Cyperus difformis	—	—	—	—	—	—	—	—	x	—	—	9	—
„ pulcherrimus	—	—	—	—	—	—	—	—	x	x	—	18	—
Cyperus rotundus	2	1	1½	x	2	1	2	1	2	x	x	100	1
Dentella repens	2	2	3	3½	2	2	4	3	2½	3	2	100	2½
Eclipta alba	x	1	x	x	1	x	x	1	x	x	x	100	½
Eragrostis japonica	1½	3	1	1	—	1	1	—	—	—	—	55	—
Euphorbia hirta	1	1	—	—	—	—	—	—	—	—	—	18	—
„ parviflora	—	—	—	—	x	—	—	—	—	—	—	9	—
Euphorbia reniformis	1	x	2	x	x	1	1	1	1	2	x	100	1
Fimbristylis miliacea	—	1	—	—	x	2	—	—	x	1½	1½	55	—
Grangea maderaspatana	—	—	1	—	—	—	—	—	—	—	—	9	—
Heliotropium indicum	—	x	—	—	x	—	—	—	x	x	x	45	—
Hydrolea zeylanica	—	—	x	—	—	—	—	—	—	x	x	27	—
Ilysanthes veronicifolia	—	—	x	1	—	—	—	—	—	—	—	18	—
Leptochloa filiformis	—	—	—	—	x	—	—	—	—	—	—	9	—
Lindernia crustacea	—	—	—	x	—	—	—	—	—	—	—	9	—
Lippia nodiflora	—	—	—	—	x	—	—	—	—	—	—	9	—
Marsilia crenata	—	—	—	—	—	—	—	—	—	x	—	9	—
Melochia corchorifolia	—	—	—	—	—	—	—	x	—	x	—	18	—
Merremia emarginata	2	2	—	1	—	—	x	—	—	2	x	55	—
„ gemella	1½	—	—	—	—	x	—	—	x	—	1	36	—
Moschosma polystachyum	2	2½	3	2½	3	2½	2	3	2	2½	2½	100	2½
Nasturtium indicum	—	—	—	—	x	—	x	—	—	—	—	18	—
Oldenlandia diffusa	1	—	—	—	—	—	—	—	—	—	—	9	—
Panicum colonum	1	2	1	x	2½	2½	x	2	3	3	2	100	1½
Panicum repens	—	—	—	—	x	1	—	—	x	—	x	36	—
„ reptans	1	1	—	—	—	—	1	—	—	—	—	27	—
Pentapetes phoenicea	—	—	—	—	—	—	—	—	x	—	—	9	—
Phyllanthus Niruri	x	1	—	—	—	—	x	—	—	—	—	27	—
Phyllanthus Urinaria	x	x	1	x	1	x	1	1½	1	x	x	100	½
Physalis angulata	—	—	x	—	—	x	—	—	—	—	—	18	—
„ minima	—	—	x	—	—	—	—	x	—	—	—	18	—
Polanisia Chelidonii	—	—	—	—	—	—	x	—	—	—	—	9	—
Polytrias amaura	2	1	—	2	—	—	—	—	—	—	—	27	—
Sphaeranthus africanus	2	2	2	3	2	2½	3	3	3½	3	2½	100	2½
„ *indicus*	x	1	x	2	2½	2	1½	1	2	1	1	100	1½
	18	19	17	17	18	15	18	16	19	18	19		

THE MOSCHOSMA POLYSTACHYUM-SPHAERANTHUS AFRICANUS-COMMUNITY.

1. August 1 1924. Ngawoedjasem, the Pleret-plantation. J 9. A fairly light, brown Tengger-soil. Fallow. Ploughed up after sawah (see p. 50).
2. August 1 1924. Kemirahan, the Pleret-plantation. J 9. Fairly light, cracking, red-brown Tengger-soil. Fallow, ploughed up after sawah. (see p. 51).
3. August 21, 1924, Sedaroem, the Winongan-plantation. T 9. Fairly heavy, old-quaternary clay, mixed with sand, a low-lying, moist plot. A young plantation of Arachis hypogaea; after sawah.
4. August 24 1924. Ladjoek, the Gayam-plantation. L 7. Medium-heavy, moist clay. A plantation of Zea Mays; after sawah.
5. September 2 1924. Padokaton, the Gayam-plantation. M 9. Fairly heavy clay, very moisture-retaining. A young plantation of Glycine Max.
6. September 5 1924. Semoet, the Alkmaar-plantation. E 11. Red clay, medium-heavy, red clay. A plantation of Zea Mays; after sawah.
7. September 15 1924. Manik, the Gayam-plantation. M 7. Medium-heavy, greyish-brown, moist clay. Fallow after west monsoon-sawah.
8. October 16 1924. Gandingan, the Pleret-plantation. L 4. Brownish-black, medium-heavy, moist clay, insufficiently drained. A young plantation of Zea Mays.
9. August 15 1925. Soemberredjo, the Winongan-plantation. P 10. Fairly heavy, black, moist clay, mixed with gravel. A depression of the area. A young plantation of Arachis hypogaea.
10. September 24 1925. Ropoh, the Winongan-plantation. O 10. Medium-heavy, wet, brownish-black clay.
11. October 10 1925. Polleredjo, the Alkmaar-plantation. C 11. Moist, medium-heavy, red clay. A plantation of Zea Mays after sawah.

TABLE XI.

THE LIPPIA NODIFLORA — PHASEOLUS TRILOBUS — COMMUNITY.

	1	2	3	4	5	6	7	8	9
Acacia tomentosa	—	—	x	—	—	—	—	—	—
Ageratum conyzoides	—	—	—	—	—	—	—	—	x
Alternanthera sessilis	1½	—	—	2	2	—	x	—	—
Alysicarpus nummularifolius	—	—	x	—	—	x	—	—	—
„ rugosus	—	—	—	—	—	—	—	x	—
Andropogon pertusus	—	2	—	—	—	—	—	—	—
Athroisma laciniatum	—	—	—	—	x	—	—	—	—
Bacopa Monnieria	—	—	—	—	—	—	x	—	—
Bergia oryzetorum	—	—	—	1½	1	—	—	—	—
Blumea humifusa	—	—	—	—	—	—	—	x	—
Blumea lacera	—	—	—	—	—	—	—	1	—
Borreria setidens	—	—	x	—	—	—	—	—	—
Commelina benghalensis	x	—	—	—	—	—	—	—	—
Corchorus acutangulus	—	—	—	—	—	x	—	—	—
„ trilocularis	—	—	—	—	—	—	—	x	—
Cynodon Dactylon	4	5	2	3	4	3	5	4	3
Cyperus rotundus	1	—	—	1	—	—	—	—	x
Dentella repens	—	—	—	1	—	—	1	—	1
Desmodium triflorum	—	1	2	—	—	—	—	—	—
Digitaria sanguinalis	—	—	—	—	—	—	—	—	1
Eclipta alba	x	x	x	x	x	x	x	x	x
Eragrostis japonica	—	—	—	1	x	—	—	—	x
Euphorbia hirta	—	—	—	—	—	—	—	—	x
Euphorbia reniformis	1	2	1	1	2	1	2½	1	1
Fimbristylis miliacea	—	—	—	—	x	—	—	—	—
Flemingia lineata	—	—	2	—	—	—	—	—	—
Goodenia Koningsbergeri	x	—	—	—	—	—	—	—	—
Gymnopetalum leucostictum	1	—	—	—	—	—	x	—	—
Heliotropium indicum	x	—	—	x	x	—	—	—	x
Imperata cylindrica	—	—	—	—	—	4	—	—	—
Lippia nodiflora	2½	4	3	3	3	4	3½	3	3
Lourea reniformis	—	—	x	—	—	—	—	—	—
Marsilia crenata	—	—	—	—	x	—	—	—	—
Melothria maderaspatana	—	—	—	—	—	—	—	—	x
Merremia emarginata	3	2	3	4	2	2	3	2	2
Merremia gemella	1	1	—	—	—	—	—	—	—
Panicum colonum	1	—	—	—	2	—	—	—	2
Panicum repens	1	x	1	1	1	1	x	1	x
Panicum reptans	1	—	—	—	—	—	—	—	1½
Paspalum scrobiculatum	—	—	—	—	—	—	—	—	x
Pentapetes phoenicea	—	—	—	x	—	—	—	—	—
Phaseolus trilobus	3	3	3	3	2½	4	2	2½	2
Phyllanthus Niruri	—	—	—	—	—	—	1	—	—
Phyllanthus Urinaria	1	x	1	1	1	1	1	x	x
Polanisia Chelidonii	—	—	—	—	x	—	—	—	x
Polytrias amaura	—	—	3	—	—	2	2	2	—
Portulaca oleracea	x	—	—	—	—	—	—	—	—
Sphaeranthus africanus	—	—	—	—	—	x	—	—	—
„ indicus	—	—	—	—	x	—	—	—	—
Sporobolus tremulus	—	—	x	—	—	—	—	—	—
Vitis trifolia	—	—	—	—	—	x	—	—	—
	18	11	16	15	18	14	14	13	20

THE LIPPIA NODIFLORA-PHASEOLUS TRILOBUS-COMMUNITY.

1. February 8 1924. Rembang, the Soemberredjo-plantation. F 5. An elevation of the area with old-quaternary clay. A young plantation of Zea Mays.
2. April 30 1924. Loewoeng, the Soemberredjo-plantation. D 2. Old-quaternary, calcareous clay, mixed with sand; a sloping area. A young plantation of Zea Mays.
3. May 7 1924. Logoran, the Pleret-plantation. H 10. Old-quaternary, dark-brown clay; a gently sloping area. Fallow.
4. June 8 1924. Pekoren, the Soemberredjo-plantation. D 2. Old-quaternary clay with silt; a sloping, fallow area, after west monsoon-sawah.
5. July 31 1924. Latek, the Soemberredjo-plantation. G 2. A fairly moist, old-quaternary clay, mixed with a good deal of sand; superficially dried up and cracking. A young plantation of Arachis hypogaea.
6. September 13 1924. Tembero, the Pleret-plantation. I 8. Old-quaternary clay, mixed with sand and with little calcium-carbonate; fallow after west monsoon-sawah.
7. September 15 1924. Redjoso, the Kedawoeng-plantation. N 7. Fairly heavy, brown clay. A young plantation of Zea Mays, after east monsoon-sawah.
8. September 20 1924. Kepoeh kidoel, the Pleret-plantation. H 10. Old-quaternary clay, mixed with sand, containing very little calcium-carbonate; a well-draining plot. A young plantation of Zea Mays, after west monsoon-sawah.
9. November 10 1924. Kenep, the Soemberredjo-plantation. D 3. Old-quaternary clay, mixed with sand and gravel; a sloping area. A young plantation of Arachis hypogaea, after east monsoon-sawah.

TABLE XII.

THE POLYTRIAS AMAURA-VERNONIA CHINENSIS-TRIDAX PROCUMBENS-COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Abutilon crispum	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
„ indicum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—
Acalypha boehmerioides	—	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—
Alysicarpus nummularifolius	x	x	x	x	1	x	x	x	x	x	x	x	x	x	x	x
Amarantus spinosus	1	—	—	x	—	—	—	—	1	1	—	—	1½	2	x	x
Aneilema nudiflorum	—	—	—	—	—	—	—	—	x	—	—	—	x	—	—	—
Boerhavia diffusa	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—
„ repens	2	—	—	2	—	x	—	1	—	—	x	—	—	x	x	—
Celosia argentea	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—	x
Commelina benghalensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	x
Commelina nudiflora	—	—	—	—	—	—	—	—	—	—	x	—	—	—	x	—
Corchorus olitorius	—	—	—	—	—	—	—	—	—	—	—	—	—	1½	—	—
Cynodon Dactylon	2	1	x	x	x	2	2	2	x	x	x	2	1½	2	1	x
Cyperus compressus	—	—	—	—	—	—	—	—	—	—	—	2	—	x	1	x
„ Iria	—	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—
Cyperus pumilus	—	—	—	—	—	—	—	—	x	—	—	x	—	1	1	—
„ rotundus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x
Dactyloctenium aegyptium	1	x	—	1½	1	—	—	—	2	2	1	x	—	—	—	—
Datura fastuosa	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Desmodium triflorum	—	—	—	—	2	x	3	2	—	x	3	1	—	—	—	3
Digera alternifolia	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—	x
Digitaria sanguinalis	—	—	—	—	—	x	—	—	2	1	2	3	1	3	3	1
Eleusine indica	x	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—
Eragrostis amabilis	1	1	x	1	1	x	—	—	x	2	1	—	x	—	—	—
„ cilianensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—
Eragrostis pilosa	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—
Euphorbia hirta	x	1	1	x	1	2	x	x	1	1	1	2	1	x	x	x
Euphorbia reniformis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Fimbristylis annua	—	—	—	—	—	—	—	—	—	—	—	2½	—	—	—	—
Flemingia lineata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
Gymnopetalum leucostictum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
Ilysanthes serrata	—	—	—	—	—	—	—	—	x	—	x	—	x	—	—	—
Ipomoea Pes tigridis	—	x	—	—	—	—	—	—	1	x	—	x	—	—	—	x
„ triloba	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—
Leucas aspera	x	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2
Lindernia crustacea	—	—	—	—	—	—	—	—	1	x	x	2½	x	—	—	—
„ glandulifera	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—
Lourea reniformis	x	2	2	1	1	2	2½	3	x	x	x	2	1	1	x	1
Merremia emarginata	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	3
Mollugo pentaphylla	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—
Panicum colonum	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
„ reptans	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
Phyllanthus maderaspatensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
„ Niruri	—	—	—	—	—	x	x	—	—	x	—	—	x	x	x	x
„ reticulatus	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
Phyllanthus Urinaria	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	1
Physalis angulata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x
Polanisia viscosa	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polytrias amaura	4	5	5	5	5	5	5	5	5	5	5	5	5	3	5	3
Portulaca oleracea	x	—	—	—	—	—	—	—	x	—	—	—	x	1	2	x
Sida rhombifolia	—	—	—	—	—	—	—	—	—	—	—	x	—	x	—	—
Tridax procumbens	2	3	4	3	3½	3	3	3	2	2	1	x	2	x	x	x
Vernonia chinensis	4	3	3	3	3	3	3½	2	3	3	3	2	2	3	1	2
	18	10	8	12	10	12	10	9	17	15	15	20	19	21	25	29

THE POLYTRIAS AMAURA-VERNONIA CHINENSIS-TRIDAX PROCUMBENS-COMMUNITY.

1. September 9 1923. Sibon, the Gayam-plantation. K 12. Light Tengger-soil.
2. October 31 1923. Karangmodjo, the Gayam-plantation. L 11. Light Tengger-soil.
3. October 31 1923. Tjoerahmalang, the Gayam-plantation. M 11. Light Tengger-soil.
4. October 31 1923. Getah[2], the Gayam-plantation. L 11. Light Tengger-soil.
5. October 31 1923. Kedoengbanger, the Gayam-plantation. M 12. Fairly light, brownish-red Tengger-soil, plastic in a moist condition.
6. August 7 1924. Karangtengah, the Gayam-plantation. M 11. Fairly light Tengger-soil.
7. September 1924. Menangas, the Kedawoeng-plantation. P 10 Dark-brown Tengger-soil, slightly cracking, very plastic in a moist condition.
8. September 21 1924. Kebondjero, the Kedawoeng-plantation. O 10. Fairly light, cracking Tengger-soil, plastic when moist.
9. May 27 1923. Karangtengah, the Gayam-plantation. M 11. Light Tengger-soil.
10. May 27 1923. Sibon, the Gayam-plantation. K 11. Light Tengger-soil
11. May 27 1923. Karangtengah, the Gayam-plantation. M 11. Light Tengger-soil.
12. April 27 1924. Kendangdoekoeh, the Wonoredjo-plantation. F 8. Fairly light, brown soil, somewhat cracking and plastic when wet.
13. May 2 1924. Karangtengah, the Gayam-plantation. M 11. Light Tengger-soil.
14. February 8 1925. Between Plososari and Djatisari, the Kedawoeng-plantation. R 10. Brownish Tengger-soil, slightly plastic.
15. February 8 1925. Djatisari, the Kedawoeng-plantation. S 10. Brownish soil, slightly plastic.
16. February 21 1925. Soembersoeko, the Kedawoeng-plantation. R 11. Very plastic, brown Tengger-soil.

TABLE XIII.

THE POLYTRIAS AMAURA-TRIDAX PROCUMBENS-COMMUNITY.

	1	2	3	4
Alysicarpus nummularifolius	x	—	—	—
Boerhavia diffusa	x	x	1	2
„ repens	—	1	x	2
Celosia argentea	x	—	—	—
Crotalaria striata	—	x	x	—
Cynodon Dactylon	2	x	1	x
Dactyloctenium aegyptium	x	—	—	—
Desmodium triflorum	—	1	—	2
Digitaria sanguinalis	1	x	—	—
Eragrostis amabilis.............	x	—	—	—
Euphorbia hirta	x	x	x	—
Hyptis suaveolens	—	—	x	—
Indigofera hirsuta	—	—	1	—
Lourea reniformis	—	x	3	2
Polytrias amaura	5	5	5	5
Sida rhombifolia	—	—	—	x
Teramnus labialis	—	—	—	x
Tridax procumbens	3	3	4	3
	10	10	10	9

THE POLYTRIAS AMAURA-TRIDAX PROCUMBENS-COMMUNITY.

1. September 21 1924. Soemberredjo, the Winongan-plantation. P. 11. Fairly light, very dry, brown soil, mixed with much gravel.
2. August 1925. Trewoeng, the Kedawoeng-plantation. P. 10. Fairly light soil, very hard when dry.
3. November 1925. Menangas, the Kedawoeng-plantation. P. 10. Brown, cracking Tengger-soil.
4. November 1925. Wotgalih, the Winongan-plantation. T. 9. Light, intensely drying-up soil.

TABLE XIV.

THE POLYTRIAS AMAURA—FLEMINGIA LINEATA—COMMUNITY.

	1	2	3	4	5	6	7	8	9
Acacia tomentosa	x	x	x	x	—	—	—	—	—
Alysicarpus nummularifolius	1	x	x	1	3	1	2	x	x
Andropogon aciculatus	2	—	—	—	—	—	—	—	—
„ caricosus	—	—	—	—	x	—	—	—	—
„ pertusus	—	—	—	—	4	—	—	—	—
Blepharis exigua	1	2	1	1	—	—	—	—	—
Blumea humifusa	2	x	—	x	—	—	1	—	—
„ lacera	—	x	—	—	—	—	—	—	—
Borreria setidens	—	—	—	—	2	—	x	—	—
Convolvulus paniculatus	—	x	x	—	—	—	—	—	—
Crotalaria retusa	—	—	—	—	—	—	—	—	x
Cynodon Dactylon	3	4	3	3	2	3½	3	1	1
Desmodium triflorum	2½	2	2½	2½	5	2	2½	1	3
Digera alternifolia	—	x	—	—	—	—	—	—	—
Euphorbia hirta	—	—	—	—	1	—	—	—	x
Euphorbia reniformis	2	2	2	2	2	2	2	x	1
Flemingia lineata	4	3	3	3	4	4	3	3	3
Gymnopetalum leucostictum	—	—	—	—	—	—	—	x	—
Hibiscus surattensis	—	x	—	x	—	—	—	—	—
Imperata cylindrica	—	—	—	—	—	—	—	—	2
Indigofera enneaphylla	—	—	—	—	—	—	—	—	x
Jatropha gossypifolia	1	x	x	x	—	—	—	—	—
Lantana camara	—	x	x	x	—	—	—	—	—
Leucas aspera	—	1	—	—	—	—	—	—	—
Lourea reniformis	—	—	—	—	3	—	—	—	—
Melochia corchorifolia	1	—	—	—	—	—	—	—	—
Merremia emarginata	2	2	2	3	2	3	3½	2	3
Merremia gemella	—	3	2	2	—	—	—	—	—
Ocimum canum	—	x	—	—	—	—	—	—	—
„ sanctum	—	—	x	x	—	—	—	—	—
Panicum reptans	—	—	—	—	—	x	x	—	—
Phaseolus trilobus	3	—	x	x	—	x	x	—	—
Phyllanthus Urinaria	1	—	—	—	—	—	—	—	—
Polygala javana	—	—	—	—	—	—	—	—	x
Polytrias amaura	4½	3	5	5	2	5	5	5	5
Rhynchosia minima	—	x	1	1	—	—	—	—	—
Rottboellia exaltata	1	—	—	—	—	—	—	—	—
Sida veronicifolia	1	—	—	—	—	—	x	—	—
Tephrosia pumila	—	—	—	—	—	—	—	x	—
Teramnus labialis	1	—	—	—	—	—	—	—	—
Themeda arguens	—	—	—	—	x	—	—	—	—
Vernonia chinensis	—	3	2	2	—	—	—	—	—
	18	21	17	18	13	9	12	9	12

THE POLYTRIAS AMAURA-FLEMINGIA LINEATA-COMMUNITY.

1. August 1 1923. Tanggoelangin, the Pleret-plantation. J. 8. Old-quaternary, calcareous clay, with a fairly moist subsoil.
2. September 9 1923. Dawoehan, the Gayam-plantation. L. 10. Medium-heavy, old-quaternary, calcareous clay.
3. September 9 1923. Minggir, the Gayam-plantation. L. 10. Medium-heavy, old-quaternary, calcareous clay.
4. September 9 1923. Mindi, the Gayam-plantation. L. 10. Fairly heavy, old-quaternary, calcareous clay.
5. April 24 1924. Maoeneng, the Pleret-plantation. I. 4. Old-quaternary, calcareous clay.
6. September 13 1924. Koeroeng, the Pleret-plantation. I. 8. Old-quaternary, non-calcareous clay.
7. September 13 1924. Tembero, the Pleret-plantation. I. 9. Old-quaternay, non-calcareous clay, with a fairly moist subsoil.
8. September 20 1924. Kepoeh lor, the Pleret-plantation. I. 10. Brownish-black, non-calcareous, old-quaternary clay on a sloping area.
9. November 10 1924. Baoedjeng, the Ardjosari-plantation. D. 3. Medium-heavy, old-quaternary clay.

TABLE XV

THE FLEMINGIA LINEATA-THEMEDA ARGUENS-COMMUNITY

	1	2	3	4	5	6	7	8	9
Acacia tomentosa	—	x	—	—	x	—	—	—	—
Alternanthera sessilis	—	—	—	x	—	—	—	—	—
Alysicarpus nummularifolius	x	2	x	1	1	x	x	x	x
Atylosia scarabaeoides	2	x	2	x	x	2	x	2	x
Blumea humifusa	x	2	—	—	x	—	—	—	—
Blumea lacera	—	1	—	—	—	—	—	—	—
Boerhavia diffusa	—	—	—	1½	—	—	—	—	—
Borreria setidens	—	—	—	—	—	—	—	—	x
Buchnera tomentosa	—	1	—	—	—	—	—	—	—
Celosia argentea	—	—	—	x	—	—	—	—	—
Centranthera hispida	—	1	—	—	—	—	—	—	—
Crotalaria striata	3	2	3	x	2	2	3	1	3
Cynodon Dactylon	3	2	3	1	2	4	4	4	4
Desmodium triflorum	1	3½	1	x	3	2	2	2	2
Eriochloa ramosa	—	—	—	—	—	x	—	x	—
Euphorbia hirta	2	—	—	1	—	—	—	—	—
Euphorbia reniformis	2	2½	2	x	2	x	x	x	1
Flacourtia indica	—	x	—	—	x	—	—	—	—
Flemingia lineata	3	3	3	4	3	x	2	x	3
Hyptis suaveolens	3	1	3	x	x	—	x	—	—
Imperata cylindrica	—	—	—	—	—	x	x	x	x
Ipomoea obscura	1	1	x	—	—	—	—	—	x
Leucas aspera	2	—	—	1	—	—	—	—	—
„ javanica	—	—	—	—	—	—	x	—	x
Lindernia crustacea	—	1	—	—	—	—	—	—	—
Lourea reniformis	1	—	1	—	—	—	—	—	—
Merremia emarginata	—	—	—	—	—	x	x	1	—
„ gemella	—	3	—	—	—	—	1	—	1½
Polytrias amaura	4	4	4	5	5	5	5	5	5
Sida rhombifolia	—	1	—	—	x	—	—	—	x
Stachytarpheta jamaicensis	2	1	2	1	x	1	x	x	x
Streblus asper	—	x	—	—	x	—	—	—	—
Themeda arguens	5	4	5	1	4	3	2	3	3
Tridax procumbens	3	—	3	3	—	x	x	x	—
Uraria lagopoides	—	2	—	—	1	x	—	x	—
Vernonia chinensis	2	—	2	x	—	—	—	—	—
	18	23	15	18	17	15	16	15	16

THE FLEMINGIA LINEATA-THEMEDA ARGUENS-COMMUNITY.

1. August 1 1923. Goenoengsari, the Alkmaar-plantation. D. 13. Medium-heavy, red clay; a sloping area.
2. August 1 1923. Babatan, the Alkmaar-plantation. D. 10. Very dry, red mountain-clay, cracking deeply.
3. August 1 1923. Kertosari, the Alkmaar-plantation C. 12. Heavy, red clay.
4. October 20 1923. Kemantren, the Alkmaar-plantation. C. 12. Red clay, mixed with sand, on an area, fallow for only 6½ months.
5. October 20 1923. Wonoanjer, the Alkmaar-plantation. E. 10. Heavy, red, very dry, cracking clay.
6. June 18 1924. Soembersoeko, the Alkmaar-plantation. C. 13. Fairly heavy, red clay.
7. June 18 1924. Pakem, the Alkmaar-plantation. D. 12. Medium-heavy, red clay.
8. July 18 1924. Soemberbendo, the Alkmaar-plantation. C. 13. Heavy, red clay.
9. July 18 1924. Alkmaar, the Alkmaar-plantation. C. 11. Medium-heavy, red clay.

TABLE XVI.

THE PANICUM ERUCIFORME-COMMUNITY.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Inspections 1—8 and 11—16		
																	K%	A	
Acalypha boehmerioides	—	—	x	—	—	x	—	—	—	—	—	—	—	—	—	—	14	—	Acalypha boehmerioides
Aegle Marmalos (seedling)	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—	Aegle Marmalos (seedling)
Alysicarpus bupleurifolius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	7	—	Alysicarpus bupleurifolius
„ nummularifolius	—	x	x	x	—	—	—	—	—	—	—	—	x	—	—	x	36	—	„ nummularifolius
Amarantus gracilis	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Amarantus gracilis
Andropogon pertusus	—	—	—	—	—	—	—	—	—	—	x	—	—	x	—	—	14	—	Andropogon pertusus
Aneilema nudiflorum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	7	—	Aneilema nudiflorum
Blumea humifusa	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Blumea humifusa
„ lacera	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—	„ lacera
Boerhavia erecta	—	—	x	—	—	2	—	—	—	—	—	—	—	—	—	—	14	—	Boerhavia erecta
Boerhavia repens	—	—	—	—	3	—	x	—	x	x	—	—	—	—	—	—	14	—	Boerhavia repens
Borreria hispida	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—	Borreria hispida
Borreria setidens	x	x	1	x	1	x	—	x	x	x	1	1	x	x	x	x	93	½	*Borreria setidens*
Celosia argentea	—	2	x	x	—	—	—	—	—	—	—	—	—	—	x	x	36	—	Celosia argentea
Commelina benghalensis	—	—	—	x	—	x	x	—	—	—	—	—	—	—	x	—	29	—	Commelina benghalensis
Corchorus acutangulus	x	x	x	x	x	x	x	x	x	x	—	—	—	—	—	—	57	—	Corchorus acutangulus
„ trilocularis	—	—	—	x	—	—	x	—	—	—	—	—	—	x	—	—	21	—	„ trilocularis
Cynodon Dactylon	2	2½	x	2	3	3	1	x	—	—	—	3	—	—	—	—	64	—	Cynodon Dactylon
Dactyloctenium aegyptium	—	—	—	—	—	1	—	—	—	x	—	—	—	—	—	—	7	—	Dactyloctenium aegyptium
Desmodium triflorum	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	7	—	Desmodium triflorum
Digera alternifolia	—	—	x	1	2	x	—	x	—	x	x	—	—	x	x	—	57	—	Digera alternifolia
Digitaria sanguinalis	—	—	—	—	—	2	—	—	—	x	—	—	—	—	—	—	7	—	Digitaria sanguinalis
Eragrostis amabilis	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Eragrostis amabilis
„ japonica	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—	„ japonica
Euphorbia hirta	—	—	—	1	x	1	—	x	x	x	—	—	—	—	—	—	29	—	Euphorbia hirta
Euphorbia reniformis	2	x	1	1½	2	x	x	x	—	—	x	2	2	x	1½	x	100	1	*Euphorbia reniformis*
Fimbristylis ferruginea	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	7	—	Fimbristylis ferruginea
„ glomerata	x	—	—	—	—	—	—	—	—	—	x	—	—	x	1	x	36	—	„ glomerata
Flemingia lineata	—	—	—	—	x	—	—	2	—	—	x	2	—	—	—	—	29	—	Flemingia lineata
Goodenia Koningsbergeri	—	—	—	—	—	—	—	—	—	—	3½	2	2½	4	4	3	43	—	Goodenia Koningsbergeri
Indigofera glandulosa	—	—	—	—	—	—	—	x	—	—	1	—	3½	1	—	—	29	—	Indigofera glandulosa
„ linifolia	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	„ linifolia
„ trita	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	x	14	—	„ trita
Ipomoea obscura	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	7	—	Ipomoea obscura
Leptochloa filiformis	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	7	—	Leptochloa filiformis
Leucas aspera	—	—	x	—	x	—	1	—	—	—	—	—	—	—	—	—	21	—	Leucas aspera
Lourea reniformis	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	14	—	Lourea reniformis
Merremia emarginata	3	3	3	3	3	3	1½	2	—	—	x	x	x	x	1	x	100	1½	*Merremia emarginata*
Panicum colonum	1	x	x	x	—	—	—	—	—	—	x	1	x	x	2	x	71	—	Panicum colonum
Panicum eruciforme	4	5	5	4½	4½	4	4	5	4	4	4	4½	5	4	4	4	100	4½	*Panicum eruciforme*
Panicum reptans	—	1	2	—	3½	—	—	3½	—	—	—	3	—	—	—	—	36	—	Panicum reptans
„ trypheron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	7	—	„ trypheron
Pentapetes phoenicea	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	7	—	Pentapetes phoenicea
Phaseolus trilobus	2	1	—	x	—	2	—	x	—	—	3	2	3	3	3½	2	79	—	Phaseolus trilobus
Phyllanthus maderaspatensis	2	2	1	1	3	2	2	3½	1	2½	3	1	1	2½	x	x	100	1½	*Phyllanthus maderaspatensis*
Phyllanthus Niruri	—	—	—	—	x	1	—	—	—	—	—	—	—	—	—	—	14	—	Phyllanthus Niruri
Phyllanthus Urinaria	2	x	x	x	x	x	x	x	—	—	2	x	1	2	1	x	100	½	*Phyllanthus Urinaria*
Phyllanthus virgatus	—	x	—	—	—	—	—	—	2	—	2	2	3	2	2	1	50	—	Phyllanthus virgatus
Polanisia viscosa	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Polanisia viscosa
Polytrias amaura	—	—	—	x	1	2½	1	—	x	x	—	—	—	—	—	—	29	—	Polytrias amaura
Portulaca oleracea	1½	—	—	x	x	—	x	—	—	—	—	—	—	—	—	—	29	—	Portulaca oleracea
„ quadrifida	—	—	x	—	—	—	x	—	—	—	—	—	—	—	—	—	14	—	„ quadrifida
Rhynchosia minima	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	—	Rhynchosia minima
Sclerachne punctata	—	x	—	x	—	—	—	1	—	—	1	—	—	x	—	x	43	—	Sclerachne Punctata
Sida veronicifolia	—	—	x	—	x	—	—	—	—	—	—	—	—	—	—	—	14	—	Sida veronicifolia
Streblus asper (seedling)	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—	Streblus asper (seedling)
Tephrosia spinosa	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	7	—	Tephrosia spinosa
Trianthema Portulacastrum	—	—	—	x	—	2	—	—	—	—	—	—	—	—	—	—	14	—	Trianthema Portulacastrum
Tridax procumbens	2	2	2½	2	x	3	2½	x	3	3	—	—	—	—	—	—	57	—	Tridax procumbens
Typhonium flagelliforme	2	—	x	—	—	—	—	—	—	—	x	x	x	x	1	x	57	—	Typhonium flagelliforme
Vernonia chinensis	—	x	—	x	x	—	—	—	—	—	—	—	—	—	—	—	21	—	Vernonia chinensis
Vitis trifolia	x	x	x	x	x	x	x	1	—	—	x	x	x	x	x	x	100	x	*Vitis trifolia*
	15	19	23	28	22	22	20	18	10	11	19	16	15	19	18	18			

THE PANICUM ERUCIFORME-COMMUNITY.

1. February 26 1923. Tambakbojo. H. 5. Old-quaternary clay, mixed with sand. A unirrigable plot of ground, elevation of the area. A plantation of Arachis hypogaea.
2. April 6 1924. Balongbendo. G. 2. Medium-heavy clay, containing little calcium-carbonate. A young plantation of Zea Mays.
3. June 9 1924. Pandean wetan. F. 3. Medium-heavy, old-quaternary clay, mixed with much sand; slight calcareous. A ploughed up fallow part.
4. April 25 1924. Ngoeling, the Winongan-plantation. U. 8. Medium-heavy, calcareous, old-quaternary clay, mixed with sand and gravel. Experimental square, 6 weeks old.
5. June 9 1924 Tongas, the Winongan-plantation. V. 9. Old-quaternary clay, mixed with much sand. Unirrigable. A young plantation of Phaseolus lunatus.
6. February 22 1925. Ratji. H. 3. Medium-heavy, old-quaternary, calcareous clay, mixed with a great deal of sand. A young plantation of Zea Mays.
7. May 6 1925. Semongkrong. R. 7. Calcareous, medium-heavy clay. A young plantation of Andropogon sorghum.
8. March 21 1925. Between Djati and Tjoerahdjarah. H. 4. Medium-heavy, old-quaternary, calcareous soil. A young plantation of Zea Mays.
9. March 21 1925. Djati. H. 3. Old-quaternary sand with much calcium-carbonate. A young, thin plantation of Zea Mays.
10. March 21 1925. Djati. H. 3. Old-quaternary sand with much calcium-carbonate. A young, plantation of Zea Mays, which has failed.
11. March 10 1923. Bendoengan. H. 4. Old-quaternary clay. Fallow after reaping Zea Mays.
12. February 8 1924. Modjotoenon, the Soemberredjo-plantation. D. 3. Old-quaternary clay. A young plantation of Zea Mays.
13. April 24 1924. Banjoepoetih I. 3. Old-quaternary clay. A young plantation of Zea Mays.
14. April 24 1924. Balongbendo. G. 2. Heavy, old-quaternary clay with much calcium-carbonate. Moist plot. A young plantation of Zea Mays.
15. April 24 1924. Ratji. H. 3. Old-quaternary clay. A young plantation of Zea Mays.
16. April 30 1924. Tjoeroehdjarah. H. 4. Heavy, old-quaternary clay. A young plantation of Zea Mays.

TABLE XVII.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON EXPERIMENTAL-SQUARES.

NAME OF THE PLANT	WANGKAL-WETAN A								KARANGTENGAH B								MENANGAS							NAME OF THE PLANT
	1924								1924								1924							
	9/2	27/3	4/5	8/6	13/7	2/8	26/8	29/9	16/2	27/3	2/5	8/6	3/7	29/7	18/8	20/9	11/2	27/3	6/5	10/6	15/7	7/8	3/9	
Acalypha boehmerioides	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	x	x	x	—	—	—	Acalypha boehmerioides
Ageratum conyzoides	—	—	—	x	2	2	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Ageratum conyzoides
Alternanthera sessilis	—	—	x	x	1	1	1½	2	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	Alternanthera sessilis
Alysicarpus nummularifolius [1]	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	—	x	x	x	x	x	x	*Alysicarpus nummularifolius* [1]
Amarantus spinosus	2	4	5	4	5	4	4	3½	3	2	1	1	x	x	x	—	3	2	2	x	x	—	—	Amarantus spinosus
Amarantus tricolor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	x	x	Amarantus tricolor
Aneilema nudiflorum	—	—	—	—	—	—	—	—	—	—	1	x	—	—	—	—	—	—	—	—	—	—	—	Aneilema nudiflorum
Boerhavia diffusa	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	x	—	1	x	2	x	x	x	Boerhavia diffusa
„ repens	—	—	—	—	—	—	—	—	—	x	x	x	1	1	2	2	x	x	x	2	x	x	x	„ repens
Borreria ocymoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Borreria ocymoides
Borreria setidens	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Borreria setidens
Celosia argentea	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	Celosia argentea
Cleome aspera	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Cleome aspera
Commelina benghalensis	—	—	—	x	x	x	x	x	2	1	1	x	—	—	—	—	—	x	1	x	—	—	—	Commelina benghalensis
Corchorus olitorius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	2	x	—	—	—	Corchorus olitorius
Cynodon Dactylon	4½	4	4	5	4	5	5	5	3	2	2	2	2	2	3	3	4½	5	1	x	x	1	3	*Cynodon Dactylon*
Cyperus compressus	—	—	—	—	—	—	—	—	1	x	x	—	—	—	—	—	—	—	—	—	—	—	—	Cyperus compressus
„ Iria	x	x	x	x	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	„ Iria
„ pumilus	—	x	x	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	„ pumilus
„ rotundus	4	2	1	x	—	—	x	x	2	1	1	—	—	—	—	—	5	5	1½	x	—	1	1	„ rotundus
Dactyloctenium aegyptium	—	—	x	x	x	x	x	x	—	x	2	x	x	x	—	—	—	x	x	x	—	—	—	Dactyloctenium aegyptium
Desmodium triflorum	—	—	—	—	—	—	—	—	x	x	x	x	x	x	x	x	1	3	3	3	3	3	3	Desmodium triflorum
Digera alternifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	Digera alternifolia
Digitaria sanguinalis	1	3	2	2	1	1	1	1	2	4	5	4	4	1	x	x	x	x	2	1	—	—	—	Digitaria sanguinalis
Eclipta alba	—	—	x	x	x	x	x	x	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	Eclipta alba
Eleusine indica	x	2	3	2	2	2½	2½	3	x	x	x	—	—	—	—	—	x	x	x	x	x	—	—	Eleusine indica
Eragrostis amabilis	x	x	x	2	3	3	3	3	x	1	2	1	1	x	x	—	—	x	1	x	—	—	—	Eragrostis amabilis
„ pilosa	x	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	„ pilosa
Euphorbia hirta	x	x	x	x	1	1	x	x	1	1	2	2	2	3	2	3	x	x	x	x	x	x	x	*Euphorbia hirta*
Euphorbia reniformis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	Euphorbia reniformis
Fimbristylis annua	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	Fimbristylis annua
Heliotropium indicum	—	x	x	x	x	x	1	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Heliotropium indicum
Ilysanthes serrata	—	—	—	—	—	—	—	—	—	x	1	—	—	—	—	—	—	—	—	—	—	—	—	Ilysanthes serrata
„ veronicifolia	x	2	2	3	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	„ veronicifolia
Ipomoea Pes tigridis	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	Ipomoea Pes tigridis
Ischaemum rugosum	—	x	x	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Ischaemum rugosum
Leptochloa filiformis	—	x	x	x	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Leptochloa filiformis
Leucas aspera	—	1	1	x	—	—	—	—	x	x	1	1	x	—	—	—	—	—	—	—	—	—	—	Leucas aspera
Lindernia crustacea	—	x	x	x	—	—	—	—	x	x	1	—	—	—	—	—	—	x	x	x	—	—	—	Lindernia crustacea
„ glandulifera	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	„ glandulifera
Lourea reniformis	—	—	—	—	—	—	—	—	—	x	2	2	2	2	2	2	—	x	1	1	1	1	2	*Lourea reniformis*
Merremia emarginata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2	1	x	x	x	Merremia emarginata
Mollugo pentaphylla	x	x	x	—	—	—	—	—	x	x	x	—	—	—	—	—	—	x	—	—	—	—	—	Mollugo pentaphylla
Oldenlandia diffusa	—	x	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Oldenlandia diffusa
Panicum colonum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	Panicum colonum
Panicum reptans	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	3½	2	—	—	—	Panicum reptans
Phyllanthus Niruri	x	2	2	3	3	2	2	x	1	1	2	1	x	x	x	x	3	3	1	x	x	x	x	Phyllanthus Niruri
„ Urinaria	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	—	—	—	„ Urinaria
Physalis angulata	x	x	x	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Physalis angulata
„ minima	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	„ minima
Polanisia viscosa	2½	1	1	x	—	—	—	—	1	x	x	—	—	—	—	—	—	—	—	—	—	—	—	Polanisia viscosa
Polytrias amaura	—	—	—	x	x	1	1	1	2	2	4	4	5	5	5	5	2	2	5	5	5	5	5	*Polytrias amaura*
Portulaca oleracea	3	x	x	x	—	—	—	x	3	x	x	—	—	—	—	—	2	2½	1	x	x	1	1	Portulaca oleracea
Sida veronicifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	Sida veronicifolia
Synedrella nodiflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	Synedrella nodiflora
Tridax procumbens	—	—	—	—	—	—	—	—	—	x	1	1½	2	2½	4	4	x	x	2	2	2	2	3	*Tridax procumbens*
Uraria lagopoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	—	—	Uraria lagopoides
Vernonia chinensis	—	—	x	x	x	x	x	x	x	1	2	2	3	3	2½	1	x	1	4	4	4	3½	3½	*Vernonia chinensis*
Age of the square, expressed in weeks	4	11	16	21	26	29	33	37	5	10	15	21	24	28	31	35	6	12	18	23	28	31	35	

[1] The constants of the Polytrias amaura-Vernonia chinensis-Tridax procumbens-succession are printed in italics in this table and the next.

TABLE XVIII.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARES.

NAME OF THE PLANT	WANGKAL-WETAN						MENANGAS						
	1924		1925				1924			1925			
	29/9	3/11	9/1	28/2	24/3	6/7	3/9	13/1	21/2	15/3	25/4	30/8	3/11
Aeschynomene indica	—	—	x	x	x	—	—	—	—	—	—	—	—
Ageratum conyzoides	(1)	x	x	1	1	1	—	—	—	—	—	—	—
Alternanthera sessilis	(2)	2	2	3	3	3	—	—	—	—	—	—	—
Alysicarpus nummularifolius	—	—	—	—	—	x	(x)	1	1	1	1	1	1
Amarantus spinosus	(3½)	3	1½	1½	x	—	—	x	x	x	—	—	—
Amarantus tricolor	—	—	—	—	—	—	(x)	x	x	x	x	—	—
Aneilema nudiflorum	—	—	x	1	1	—	—	—	—	—	—	—	—
Boerhavia diffusa	—	—	—	—	—	—	(x)	x	1	2	1	x	2
„ repens	—	—	—	—	—	—	(x)	x	x	x	x	2	2
Borreria ocymoides	—	—	—	—	—	—	—	—	x	x	x	—	—
Commelina benghalensis	(x)	x	1	x	x	x	—	x	x	x	x	—	—
Corchorus olitorius	—	—	—	—	—	—	—	—	x	x	x	—	—
Cynodon Dactylon	(5)	5	5	3	3	2	(3)	3	4	4	x	1	2
Cyperus rotundus	(x)	1	2	2	1	x	(1)	1	2½	2	—	—	—
Dactyloctenium aegyptium	(x)	x	x	x	x	x	—	1	1	x	—	—	—
Desmodium triflorum	—	—	—	—	—	—	(3)	2	2½	3	2½	2	2
Digitaria sanguinalis	(1)	1	2½	3½	3½	2	—	1	2	2	1	—	—
Eclipta alba	(x)	x	x	x	x	—	—	—	—	—	—	—	—
Eleusine indica	(3)	3	3	3	2½	2	—	—	—	—	—	—	—
Eragrostis amabilis	(3)	3	3	3	2	x	—	—	x	2	1	—	—
Euphorbia hirta	(x)	—	1	1	x	x	(x)	1	1	1	1	x	x
Heliotropium indicum	(x)	x	x	x	—	—	—	—	—	—	—	—	—
Ipomoea obscura	—	—	—	—	—	—	—	—	x	—	—	—	—
Ischaemum rugosum	—	—	x	1½	2	x	—	—	—	—	—	—	—
Lindernia crustacea	—	—	—	—	—	—	—	—	—	x	—	—	—
Lourea reniformis	—	—	—	—	—	—	(2)	2	2	2	2	2	2
Merremia emarginata	—	—	—	—	—	—	(x)	x	x	x	—	—	—
Oldenlandia corymbosa	—	—	x	x	—	—	—	—	—	—	—	—	—
„ diffusa	—	—	x	x	x	—	—	—	—	—	—	—	—
Paspalum conjugatum	—	—	—	x	x	—	—	—	—	—	—	—	—
Paederia foetida	—	—	—	—	—	—	—	—	—	x	—	—	—
Phyllanthus Niruri	(x)	x	x	1	x	x	(x)	—	—	—	—	—	—
Physalis angulata	—	—	x	1	x	—	—	—	—	—	—	—	—
Polytrias amaura	(1)	1	1	1	3½	4	(5)	5	5	5	5	5	5
Portulaca oleracea	(x)	x	—	—	—	—	(1)	—	—	—	—	—	—
Rhynchosia minima	—	—	—	—	—	—	—	—	x	x	—	—	—
Sesbania sericea	—	—	—	—	—	—	—	x	x	x	x	—	—
Sida rhombifolia	—	—	—	—	—	—	—	—	—	—	x	x	x
„ veronicifolia	—	—	—	—	—	—	(1)	x	x	x	x	—	—
Synedrella nodiflora	—	—	—	x	x	x	(x)	—	x	x	x	—	—
Teramnus labialis	—	—	—	—	—	—	—	x	1	2	2	2	x
Tridax procumbens	—	—	—	—	—	—	(3)	3	3	3	3	3	3½
Uraria lagopoides	—	—	—	—	—	—	—	—	x	x	—	—	—
Urena lobata	—	—	x	x	—	—	—	—	—	—	—	—	—
Vernonia chinensis	(x)	x	x	1	2	2½	(3½)	1	2	1½	1	—	—
Vitis trifolia	—	—	—	—	—	—	—	x	x	x	—	—	—
Age of the square, expressed in weeks	37	42	52	59	63	77	35	54	59	62	68	86	96

TABLE XIX.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARES.

NAME OF THE PLANT	WANGKAL-WETAN					MENANGAS			
	1924	1925				1925			
	3/11	9/1	28/2	24/3	6/7	13/1	21/2	15/3	25/4
Acalypha boehmerioides	—	—	—	—	—	- (x)	x (x)	- (x)	—
„ indicum	—	—	—	—	—	—	x (-)	—	—
Aeschynomene indica	—	—	x (-)	—	—	—	—	—	—
Ageratum conyzoides	—	—	1 (x)	1½ (1)	1½ (1)	—	—	—	—
Alternanthera sessilis	—	x (-)	2 (x)	2 (1)	1½ (2)	—	—	—	—
Alysicarpus nummularifolius	—	—	—	—	—	- (x)	1 (x)	1 (x)	2 (x)
Amarantus spinosus	3	2 (4)	2 (5)	x (5)	- (3½)	2 (2)	2 (1)	1½ (x)	x (x)
„ tricolor	—	—	—	—	—	x (1)	x (1)	- (1)	- (1)
Aneilema nudiflorum	—	—	—	—	—	—	x (-)	x (-)	—
Boerhavia diffusa	—	—	—	—	—	1 (1)	1½ (1)	2 (2)	2 (x)
Boerhavia repens	—	—	—	—	—	- (x)	x (1)	x (2)	x (x)
Borreria ocymoides	—	—	—	—	—	- (x)	x (-)	x (-)	—
„ setidens	—	—	—	—	—	- (x)	1 (-)	x (-)	—
Cleome aspera	—	—	—	—	—	x (x)	x (-)	—	—
Commelina benghalensis	—	—	—	- (x)	- (x)	x (x)	1 (1)	- (x)	—
Corchoris olitorius	—	—	—	—	—	x (1)	2 (1)	1½ (x)	x (-)
Crotalaria striata	—	—	—	—	—	x (-)	x (-)	x (-)	x (-)
Cynodon Dactylon	5	4 (4)	3 (5)	2 (4)	1½ (5)	3 (4)	4 (1)	3 (x)	1 (x)
Cyperus Iria	—	x (x)	- (x)	—	—	—	—	—	—
„ pumilus	—	x (x)	—	—	—	—	—	—	—
Cyperus rotundus	4	4 (1)	2½ (x)	x (-)	x (x)	2 (4)	1½ (1½)	1½ (x)	—
Dactyloctenium aegyptium	—	—	- (x)	- (x)	- (x)	x (x)	x (x)	1½ (x)	1½ (-)
Desmodium triflorum	—	—	—	—	—	2 (3)	3 (3)	3 (3)	2 (3)
Digera alternifolia	—	—	—	—	—	—	- (x)	—	x (-)
Digitaria sanguinalis	1	3 (2)	5 (2)	4 (1)	4 (1)	2 (1)	3 (2)	3 (1)	x (-)
Eclipta alba	—	x (-)	x (x)	x (x)	- (x)	x (-)	x (-)	—	—
Eleusine indica	x	2 (2)	2 (2)	1 (2)	1 (3)	x (x)	x (x)	x (x)	- (x)
Eragrostis amabilis	x	x (x)	2 (1)	2 (3)	2 (3)	x (x)	1 (1)	- (x)	—
Euphorbia hirta	x	x (x)	1 (x)	1 (1)	1 (x)	x (x)	x (x)	x (x)	1 (x)
Euphorbia reniformis	—	—	—	—	—	x (x)	x (x)	x (-)	—
Heliotropium indicum	x	x (x)	x (x)	- (x)	- (x)	—	—	—	—
Ilysanthes veronicifolia	—	1 (2)	- (2)	- (1)	—	—	—	—	—
Ischaemum rugosum	—	x (x)	2 (x)	2 (1)	—	—	—	—	—
Leucas aspera	—	- (1)	x (x)	x (-)	—	—	—	—	—
Lindernia crustacea	—	- (x)	1 (x)	x (-)	—	- (x)	x (x)	x (x)	—
Lourea reniformis	—	—	—	—	—	1 (x)	2 (1)	- (1)	1½ (1)
Merremia emarginata	—	—	—	—	—	2 (1)	2 (2)	2 (1)	2 (x)
Mollugo pentaphylla	—	- (x)	x (-)	—	—	- (x)	—	—	—
Oldenlandia corymbosa	—	—	x (-)	x (-)	—	—	—	—	—
„ diffusa	—	x (x)	x (x)	- (x)	—	—	—	—	—
Panicum colonum	—	—	—	—	—	x (x)	x (-)	—	—
„ reptans	—	—	—	—	—	1 (2)	2½ (3)	1½ (2)	—
Paspalum conjugatum	—	—	—	—	1 (-)	—	—	—	—
Paederia foetida	—	—	—	—	—	—	—	x (-)	1 (-)
Phaseolus trilobus	—	—	—	—	—	x (-)	—	—	—
Phyllanthus Niruri	x	1 (2)	1 (3)	2 (3)	1 (x)	2 (3)	1½ (1)	x (x)	- (x)
„ Urinaria	—	—	—	—	—	x (x)	x (x)	x (x)	—
Physalis angulata	—	1 (x)	1 (x)	1 (x)	x (-)	—	—	—	—
Polanisia viscosa	—	x (1)	x (x)	—	—	—	—	—	—
Polytrias amaura	—	—	—	x (x)	x (1)	3 (3)	4½ (5)	5 (5)	5 (5)
Portulaca oleracea	x	1 (x)	- (x)	—	- (x)	1 (2)	x (1)	x (x)	- (x)
Rhynchosia minima	—	—	—	—	—	—	x (-)	1 (-)	1 (-)
Salvia occidentalis	—	—	—	—	x (-)	—	—	—	—
Sesbania sericea	—	—	—	—	—	—	—	1 (-)	1 (-)
Sida veronicifolia	—	—	—	—	—	x (-)	1 (-)	x (-)	—
Synedrella nodiflora	—	—	—	—	1 (-)	—	—	x (x)	1 (x)
Teramnus labialis	—	—	—	—	—	—	x (-)	2½ (-)	2½ (-)
Tridax procumbens	—	—	—	x (-)	1 (-)	x (1)	2 (2)	2 (2)	2 (2)
Uraria lagopoides	—	—	—	x (-)	—	- (x)	1 (x)	x (x)	- (x)
Urena lobata	—	—	x (-)	—	—	x (-)	—	—	—
Vernonia chinensis	—	—	1 (x)	1 (x)	2 (x)	3 (2)	3½ (4)	3 (4)	x (4)
Age of the square, expressed in weeks	2	11	18	22	37	12	17	21	26

TABLE XX.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARE OF GETAH

NAME OF THE PLANT	1925 3/3	1925 20/4
Alternanthera sessilis	x (–)	x (–)
Amarantus spinosus	4 (3)	2 (2)
Aneilema nudiflorum	x (–)	x (–)
Celosia argentea	—	x (–)
Commelina benghalensis	2 (2)	1 (1)
Cynodon Dactylon	3 (3)	2 (2)
Cyperus compressus	x (1)	1 (x)
„ Eragrostis	—	x (–)
„ Iria	– (x)	1 (x)
„ rotundus	3 (2)	2 (1)
Digera alternifolia	—	x (–)
Digitaria sanguinalis	3 (2)	4½ (4)
Eleusine indica	– (x)	1 (x)
Eragrostis amabilis	– (x)	2 (1)
„ pilosa	– (1)	x (–)
Euphorbia hirta	x (1)	1½ (1)
Fimbristylis annua	—	1 (x)
Ilysanthes serrata	x (x)	1 (x)
Lindernia crustacea	x (x)	x (x)
Mollugo pentaphylla	x (x)	1 (x)
Panicum colonum	—	x (–)
Phyllanthus Niruri	x (1)	1 (1)
Polanisia viscosa	x (1)	x (x)
Polytrias amaura	x (2)	2 (2)
Portulaca oleracea	2 (3)	1 (x)
Tridax procumbens	—	x (x)
Vernonia chinensis	x (x)	2 (1)
Age of the square, expressed in weeks	4 w.	11 w.

TABLE XXI.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARES.

NAME OF THE PLANT	TREWOENG						REBELAS II				KARANGTENGAH B								NAME OF THE PLANT
	1924						1924				1924								
	11/2	27/3	6/5	15/7	7/8	4/9	10/6	6/7	7/8	3/9	16/2	22/3	2/5	8/6	3/7	29/7	18/8	20/9	
Acalypha boehmerioides........	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Acalypha boehmerioides
Alysicarpus nummularifolius	—	x	x	x	x	—	—	—	—	—	—	—	—	—	x	x	x	x	*Alysicarpus nummularifolius*
Amarantus spinosus	3	x	x	—	—	—	4	4	3	2	3	2	1	1	x	x	x	—	Amarantus spinosus
„ tricolor	—	—	—	—	—	—	x	x	x	x	—	—	—	—	—	—	—	—	„ tricolor
Aneilema nudiflorum	—	—	—	—	—	—	—	—	—	—	—	—	1	x	—	—	—	—	Aneilema nudiflorum
Boerhavia diffusa..............	—	x	x	x	x	—	—	—	x	x	—	—	—	x	x	x	x	x	Boerhavia diffusa
„ repens	x	1	1	3	3	3	—	1	1	2	—	x	x	x	1	1	2	2	„ repens
Celosia argentea..............	x	x	x	—	—	—	—	x	—	—	—	—	x	—	—	—	—	—	Celosia argentea
Commelina benghalensis	—	—	—	—	—	—	x	x	x	x	2	1	1	x	—	—	—	—	Commelina benghalensis
Corchorus olitorius	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	Corchorus olitorius
Crotalaria striata	—	x	x	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	Crotalaria striata
Cynodon Dactylon	x	1	x	—	—	x	1	x	x	1	3	2	2	2	2	2	3	3	*Cynodon Dactylon*
Cyperus compressus	x	x	—	—	—	—	x	—	—	—	1	x	x	—	—	—	—	—	Cyperus compressus
„ Iria	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	„ Iria
„ pumilus	x	x	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	„ pumilus
Cyperus rotundus	1	x	x	—	—	—	—	—	—	—	2	1	1	—	—	—	—	—	Cyperus rotundus
Dactyloctenium aegyptium	x	2	4	x	—	x	1	2½	3	3	—	x	2	x	x	x	—	—	Dactyloctenium aegyptium
Desmodium triflorum..........	—	1	1	1	1	1	—	—	—	—	x	x	x	x	x	x	x	x	Desmodium triflorum
Digera alternifolia	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	Digera alternifolia
Digitaria sanguinalis	1	4	4	1	—	—	3	4	3	3	2	4	5	4	4	1	x	x	Digitaria sanguinalis
Eleusine indica	—	—	—	—	—	—	3	2	x	x	x	x	x	—	—	—	—	—	Eleusine indica
Eragrostis amabilis	x	1	2	x	x	x	x	x	x	x	x	1	2	1	1	x	x	—	Eragrostis amabilis
„ pilosa	x	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	„ pilosa
Euphorbia hirta	x	x	x	x	x	x	x	x	x	x	1	1	2	2	2	3	2	3	*Euphorbia hirta*
Fimbristylis annua	—	—	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	Fimbristylis annua
Ilysanthes serrata	—	—	—	—	—	—	—	—	—	—	—	x	1	—	—	—	—	—	Ilysanthes serrata
Ipomoea obscura	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	Ipomoea obscura
„ Pes tigridis	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	„ Pes tigridis
„ triloba	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	„ triloba
Leucas aspera	—	x	x	—	—	—	x	—	—	—	x	x	1	1	x	—	—	—	Leucas aspera
Lindernia crustacea............	x	x	x	—	—	—	—	—	—	—	x	x	1	—	—	—	—	—	Lindernia crustacea
„ glandulifera	—	—	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	„ glandulifera
Lourea reniformis	—	x	x	x	x	x	—	—	x	x	—	x	2	2	2	2	2	2	*Lourea reniformis*
Mollugo pentaphylla	x	x	x	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	Mollugo pentaphylla
Oldenlandia corymbosa	—	—	—	—	—	—	—	x	—	—	—	—	—	—	—	—	—	—	Oldenlandia corymbosa
Panicum reptans	x	x	x	—	—	—	x	—	—	—	—	—	—	—	—	—	—	—	Panicum reptans
Phyllanthus Niruri	2	1	x	—	—	—	1	x	x	x	1	1	2	1	x	x	x	x	Phyllanthus Niruri
Polanisia viscosa	x	x	x	—	—	—	1½	1	x	x	1	x	x	—	—	—	—	—	Polanisia viscosa
Polytrias amaura	5	5	5	5	5	5	x	1	2	2	2	2	4	4	5	5	5	5	*Polytrias amaura*
Portulaca oleracea	3	2	—	—	—	—	2	1	1	1	3	x	x	—	—	—	—	—	Portulaca oleracea
Rhynchosia minima	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—	Rhynchosia minima
Sida acuta....................	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	—	—	—	Sida acuta
„ retusa	—	—	—	—	—	—	x	x	x	x	—	—	—	—	—	—	—	—	„ retusa
Tridax procumbens	x	2	3	3	4	4	1	1	2	2	—	x	1	1½	2	2½	4	4	*Tridax procumbens*
Vernonia chinensis	x	2	4	x	x	—	x	2	2	2	x	1	2	2	3	3	2½	1	*Vernonia chinensis*
Age of the square, expressed in weeks	6	12	18	28	31	35	12	15	20	24	5	10	15	21	24	28	31	35	

TABLE XXII

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARES

NAME OF THE PLANT	TREWOENG 1925								REBELAS II 1925							NAME OF THE PLANT
	13/1	21/2	15/3	25/4	20/5	12/7	30/8	3/11	13/1	21/2	15/3	25/4	20/5	30/8	3/11	
Achyranthes aspera	—	x	x	x	x	—	—	—	—	—	—	—	—	—	—	Achyranthes aspera
Alysicarpus nummularifolius	x	x	x	x	x	x	—	—	1	1	1	x	1	—	—	*Alysicarpus nummularifolius*
Amarantus spinosus	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	Amarantus spinosus
Boerhavia diffusa	—	—	—	—	—	—	—	—	—	1	1	2	2	2	x	Boerhavia diffusa
„ repens	3½	3	3	3	3	3	3	x	2	2	2½	1	1	x	—	„ repens
Borreria hispida	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	Borreria hispida
„ ocymoides	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	„ ocymoides
Commelina benghalensis	x	—	—	—	—	—	—	—	x	x	x	—	—	—	—	Commelina benghalensis
Crotalaria striata	x	1	x	x	x	x	x	x	—	—	—	—	—	—	—	Crotalaria striata
Cynodon Dactylon	x	x	1	x	—	—	—	—	x	1	—	—	—	—	—	*Cynodon Dactylon*
Cyperus compressus	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	Cyperus compressus
Dactyloctenium aegyptium	—	—	x	—	—	—	—	—	1	1	x	—	—	—	—	Dactyloctenium aegyptium
Desmodium triflorum	3	3	3	3	3	2	—	—	—	—	—	—	—	—	—	Desmodium triflorum
Digitaria sanguinalis	2½	2½	3	1	1	—	—	—	4	4	4½	4	3	—	—	Digitaria sanguinalis
Eleusine indica	—	—	—	—	—	—	—	—	—	x	—	x	—	—	—	Eleusine indica
Eragrostis amabilis	—	2½	3	—	—	—	—	—	—	x	1	—	—	—	—	Eragrostis amabilis
„ pilosa	—	—	x	—	—	—	—	—	—	—	—	—	—	—	—	„ pilosa
Euphorbia hirta	—	—	—	—	—	—	—	—	x	x	x	x	x	—	—	*Euphorbia hirta*
Heliotropium indicum	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Heliotropium indicum
Ipomoea obscura	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	Ipomoea obscura
Ipomoea Pes tigridis	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Ipomoea Pes tigridis
„ triloba	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	„ triloba
Leucas aspera	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Leucas aspera
Lindernia crustacea	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	Lindernia crustacea
Lourea reniformis	—	x	1	1	1	1	—	—	—	1	1	1	1½	2	x	*Lourea reniformis*
Phyllanthus Niruri	x	1	x	—	—	—	—	—	x	x	—	—	—	—	—	Phyllanthus Niruri
Polytrias amaura	5	5	4½	5	5	5	5	5	4	4	4	5	5	5	5	*Polytrias amaura*
Sesbania sericea	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	Sesbania sericea
Sida acuta	—	—	—	—	—	—	—	—	—	x	x	x	x	—	—	Sida acuta
Teramnus labialis	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Teramnus labialis
Tridax procumbens	4	4	4	4	4	4	4	4	3	3	3½	3	3½	3	3	*Tridax procumbens*
Vernonia chinensis	x	3	2	1	x	—	—	—	1	2	2	1	x	x	—	*Vernonia chinensis*
Age of the square, expressed in weeks	54	59	63	68	72	80	87	96	43	48	51	57	61	75	85	Age of the square, expressed in weeks

TABLE XXIII.

CONSTITUTION OF THE VEGETATION IN THE WEST MONSOON-EXPERIMENTAL SQUARES.

NAME OF THE PLANT	TREWOENG								REBELAS II							REBELAS I								NAME OF THE PLANT
	1925								1925							1925								
	13/1	21/2	15/3	25/4	20/5	12/7	30/8	3/11	13/1	21/2	15/3	25/4	20/5	30/8	3/11	13/1	21/2	15/3	25/4	20/5	12/7	30/8	3/11	
Abutilon crispum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	x	x	Abutilon crispum
Acalypha boehmerioides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	Acalypha boehmerioides
„ indica	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1½	—	—	—	—	—	—	—	„ indica
Achyranthes aspera	—	x	x	—	—	—	—	—	—	—	x	—	—	—	—	—	x	x	x	x	x	x	—	Achyranthes aspera
Ageratum conyzoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	Ageratum conyzoides
Alysicarpus nummularifolius	—	—	—	—	—	—	—	—	—	—	x	x	x	x	x	—	—	—	—	—	—	—	—	*Alysicarpus nummularifolius*
Amarantus spinosus	x	x	—	—	—	—	—	—	3	1	x	x	—	—	—	3	3	2	x	—	—	—	—	Amarantus spinosus
„ tricolor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	2	1	x	—	„ tricolor
Aneilema nudiflorum	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	x	x	—	—	—	—	—	Aneilema nudiflorum
Boerhavia diffusa	—	—	—	—	—	—	—	—	—	—	x	1	x	x	x	—	—	—	x	x	1	x	—	Boerhavia diffusa
Boerhavia repens	1	3	3	3	2	2	2	—	2	2	2	2	2	x	x	—	—	—	—	—	x	x	x	Boerhavia repens
Borreria ocymoides	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Borreria ocymoides
Commelina benghalensis	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	x	x	1	x	x	x	—	—	Commelina benghalensis
Corchorus acutangulus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	x	—	—	—	Corchorus acutangulus
„ olitorius	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	1	x	x	—	—	„ olitorius
Crotalaria striata	—	x	x	x	x	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Crotalaria striata
Cynodon Dactylon	x	x	x	x	—	—	—	—	x	—	—	—	—	—	—	2	1½	1	x	—	—	1	1	*Cynodon Dactylon*
Cyperus compressus	1	1½	x	—	—	—	—	—	x	x	—	—	—	—	—	x	x	x	—	—	—	—	—	Cyperus compressus
„ Iria	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	„ Iria
„ rotundus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1½	1	—	—	—	—	—	„ rotundus
Dactyloctenium aegyptium	4	3	3	3	3	x	—	—	x	1	1	2	2	—	—	1	3½	3	2	1½	x	—	—	Dactyloctenium aegyptium
Desmodium gangeticum	—	—	—	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Desmodium gangeticum
„ triflorum	—	x	x	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	„ triflorum
Digitaria sanguinalis	5	5	4½	3	3	—	—	—	5	5	5	5	4	x	—	3	5	4	3	2	x	—	—	Digitaria sanguinalis
Eleusine indica	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	1	x	x	x	—	—	—	—	Eleusine indica
Eragrostis amabilis	x	1	x	—	—	—	—	—	—	—	—	—	—	—	—	2	2	2½	2	2	1	—	—	Eragrostis amabilis
„ pilosa	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	x	2	—	—	—	—	—	—	„ pilosa
Euphorbia hirta	x	x	x	x	x	x	—	—	x	x	x	x	x	x	—	x	x	1	x	x	1	x	x	*Euphorbia hirta*
Hepatecae spec.	—	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	Hepatecae spec.
Ipomoea obscura	—	x	x	x	x	x	x	—	x	x	—	—	—	—	—	x	x	x	—	—	—	—	—	Ipomoea obscura
Ipomoea triloba	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	—	x	—	—	—	—	—	Ipomoea triloba
Kyllinga monocephala	—	—	—	—	—	—	—	—	x	x	x	—	—	—	—	—	—	x	—	—	—	—	—	Kyllinga monocephala
Lindernia crustacea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	2½	x	—	—	—	—	Lindernia crustacea
Lourea reniformis	1	2	2	3	3	1	—	—	—	x	x	x	x	x	x	—	x	x	x	x	x	x	—	*Lourea reniformis*
Mollugo pentaphylla	2	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mollugo pentaphylla
Ocimum sanctum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	Ocimum sanctum
Paederia foetida	—	x	x	x	x	x	x	x	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paederia foetida
Panicum reptans	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	Panicum reptans
Phyllanthus Niruri	1	1	x	—	—	—	—	—	x	—	—	—	—	—	—	2	1½	1½	1	x	—	—	—	Phyllanthus Niruri
Polanisia viscosa	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	x	—	—	—	—	—	—	—	Polanisia viscosa
Polytrias amaura	4	4	4	5	5	(5)	(5)	(5)	—	1	1½	3	3	4	(4)	3	3½	4	4½	5	5	5	(5)	*Polytrias amaura*
Portulaca oleracea	x	x	—	—	—	—	—	—	x	1	—	—	—	—	—	2	1½	1	—	—	—	—	—	Portulaca oleracea
Salvia occidentalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	Salvia occidentalis
Sida acuta	—	—	—	—	—	—	—	—	—	x	x	—	—	—	—	—	—	x	x	x	x	—	—	Sida acuta
Sida rhombifolia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	—	—	—	—	—	—	Sida rhombifolia
Synedrella nodiflora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	x	x	x	x	—	—	—	Synedrella nodiflora
Teramnus labialis	—	—	x	x	x	x	—	—	—	x	1	1	x	—	—	—	x	x	x	x	x	x	x	Teramnus labialis
Tridax procumbens	2	2	2½	2½	2½	3	3	3	—	1	2	2	2	2	2	x	x	x	x	x	2	2	2	*Tridax procumbens*
Vernonia chinensis	1	2	2	2	1	—	—	—	x	1	1	1	1	1	x	1½	3	3	2½	2½	2	1	1	*Vernonia chinensis*
Age of the square expressed in weeks	12	17	21	26	30	38	45	54	12	17	21	6	30	45	54	3	8	11	17	21	28	35	45	

TABLE XXIV.

DATE. 1924	POT 1. 3 plants of Polanisia viscosa 12, 11, 12 c.m. length.	POT 2. 1 plant Polanisia viscosa. 16 c.m. length.	POT 3. 1 plant Polanisia viscosa. 20 c.m. length.	POT 4. 1 plant Polanisia viscosa. 12 c.m. length.
9/VI 7 a.m.….	Kept dry.	Kept dry.	Kept dry.	Kept dry.
10/VI 1 p.m.….	1st plant, one basis-leaf wilted, the rest is fresh. 2nd plant, fresh. 3rd plant, one basis-leaf wilted.	Two basis-leaves have wilted; the rest is fresh.	Two basis-leaves have wilted; the rest is fresh.	Entirely fresh.
11/VI 6 a.m.….	Entirely turgescent.	Entirely turgescent.	Entirely turgescent.	Entirely turgescent.
1 p.m.….	1st plant, 2 basis-leaves wilted. 2nd „ 2 „ „ „ 3rd „ 3 „ „ „	2 basis-leaves wilted; one of these removed; no plasmolysis.	3 basis-leaves wilted; one of these removed; no plasmolysis.	One basis-leaf wilted.
12/VI 7 a.m.….	1st and 2nd plant fresh. 3rd plant, one basis-leaf yellow and limp, the rest fresh.	Turgescent.	Turgescent, save one of the oldest leaves; this one removed; no plasmolysis.	Entirely turgescent.
14/VI 1 p.m.….	1st and 3rd plant entirely limp. 2nd plant, upper leaves still fresh.	All leaves, except the four top-ones have wilted.	Wilted, save the six top-leaves.	The four top-leaves still turgescent.
15/VI 6 a.m.….	The three plants have all three shed the oldest, yellow leaves. 1st plant, the three top-leaves fresh; 2nd „ „ four „ „ „ 3rd „ „ five „ „ „	The six youngest leaves are still turgescent, the oldest one has been shed.	The eight top-leaves fresh. 9th and 10th leaf have wilted (no plasmolysis), the 11th leaf dead (plasmolysis), 12th and 14th leaf have been shed.	The oldest leaves have been shed; 6 fresh top-leaves.
16/VI 6 a.m.….	Plant 1 and 2, all leaves wilted. Plant 3, two top-leaves still turgescent. Of plant 1, one fruit-stalk still turgescent. It is watered.	Three leaves still turgescent. The wilted leaves not plasmolysed, except one yellow leaf.	Entirely wilted. Watered.	Two leaves still fresh.
8 a.m.….	All leaves entirely fresh again. Leaf-stalks turgescent.	Two leaves fresh.	Entirely turgescent.	Two leaves fresh.
17/VI 7 a.m.….	The older leaves of all plants have wilted (no plasmolysis); the younger leaves are fresh.	Entirely wilted.	5 top-leaves turgescent, the rest is limp (no plasmolysis).	Entirely wilted.
20/VI 7 a.m.….	Entirely wilted; watered.	Watered.	Entirely wilted; watered.	Watered.
21/VI 6 a.m.….	Of plant 1 only the fruit-stalk is turgescent. The rest does not recover; watered again.	Only the youngest leaves turgescent.	A few of the younger leaves turgescent.	A few of the youngest leaves fresh.
10 a.m.…	Remains limp.	Wilted.	Wilted, no plasmolysis.	Watered.
22/VI 6 a.m.….	Remains limp, leaves plasmolysed.	Wilted, no plasmolysis in the youngest leaves. Watered again.	No plasmolysis.	Wilted, save one top-leaf.
24/VI 6 a.m.….		Limp, leaves plasmolysed.	A few of the younger leaves not yet plasmolysed, the rest has.	All leaves with plasmolysed cells.

TABLE XXV.

1924 Date.	Air-temperature in centigrades. 7 a.m.	noon.	5 p.m.	max.	min.	Relative moisture. 7 a.m.	noon.	5 p.m.	Saturation-deficit. 7 a.m.	noon.	5 p.m.	Number of quarters of an hour between 7 a.m. and 5 p.m. (maximum) 40
Sept. 29	25°.3′	31°.6′	30°.3′	33°.0′	22°.0′	65%′	46%′	51%′	8.4%′	18.6%′	15.7%′	40
„ 30	24°.4′	33°.0′	30°.0′	33°.5′	22°.1′	69	44	54	7.0	20.9	14.5	40
Oct. 1	24°.2′	31°.2′	29°.8′	32°.3′	21°.5′	69	49	55	6.9	17.2	14.0	36
„ 2	26°.0′	32°.6′	31°.4′	34°.5′	22°.5′	63	39	47	9.2	22.3	18.1	35
„ 3	26°.0′	32°.4′	31°.6′	34°.0′	22°.7′	60	43	42	10.0	20.6	20.0	37
„ 4	25°.6′	32°.4′	32°.0′	34°.5′	23°.6′	68	47	44	7.8	19.1	19.8	39
„ 5	26°.9′	31°.3′	29°.4′	32°.5′	24°.4′	65	52	53	9.2	16.3	14.3	32
„ 6	25°.4′	30°.4′	29°.6′	31°.5′	23°.9′	61	52	51	9.4	15.5	15.1	20
„ 7	24°.8′	31°.4′	29°.4′	32°.3′	23°.7′	65	52	52	8.1	16.4	14.6	14
„ 8	25°.8′	31°.8′	29°.0′	32°.5′	22°.0′	73	48	62	6.7	18.1	11.3	34
„ 9	27°.0′	30°.8′	26°.8′	32°.0′	24°.3′	65	58	75	9.3	13.9	6.5	30
1925												
June 12	23°.2′	30°.2′	28°.8′	31°.5′	21°.4′	83	55	66	3.6	14.4	10.0	35
„ 13	23°.8′	31°.2′	29°.2′	32°.5′	21°.6′	78	49	61	4.8	17.2	11.7	36
„ 14	24°.2′	31°.0′	29°.4′	33°.0′	22°.5′	78	50	52	4.9	16.7	14.6	31
„ 15	24°.4′	30°.4′	30°.2′	31°.5′	21°.2′	71	51	50	6.6	15.8	15.9	40
„ 16	22°.0′	30°.0′	29°.2′	31°.5′	20°.5′	84	55	60	3.1	14.2	12.0	40
„ 17	23°.2′	30°.6′	31°.4′	31°.5′	22°.0′	76	56	43	5.1	14.3	19.4	40
„ 18	21°.4′	30°.2′	29°.6′	31°.0′	20°.0′	76	44	51	4.2	17.9	15.1	39
„ 19	23°.8′	28°.9′	29°.2′	30°.5′	22°.4′	63	52	42	8.1	14.2	17.5	40
„ 20	19°.4′	29°.6′	28°.2′	30°.0′	17°.3′	74	41	56	4.3	18.2	12.5	40
„ 21	19°.0′	29°.4′	28°.0′	30°.0′	17°.1′	87	46	61	2.1	16.4	11.0	40
„ 22	20°.5′	29°.8′	28°.4′	31°.0′	18°.5′	83	49	65	3.0	15.9	10.0	27
„ 23	22°.0′	29°.4′	29°.0′	30°.5′	20°.9′	83	58	58	3.3	12.8	12.5	38
„ 24	21°.4′	29°.3′	28°.8′	30°.5′	19°.8′	78	51	59	4.2	14.8	12.1	38
„ 25	21°.6′	29°.2′	28°.4′	30°.2′	20°.7′	78	54	56	4.2	13.8	12.6	33
„ 26	21°.5′	29°.5′	28°.8′	30°.5′	20°.0′	75	53	57	4.7	14.4	12.6	39

TABLE XXVI*a*

SOIL OF MENANGAS. THE KEDAWOENG-PLANTATION

VERNONIA CHINENSIS						LEUCAS ASPERA						AMARANTUS SPINOSUS						POLANISIA VISCOSA					
No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.
V_1	8 July	18½%	12	28	12	L_1	7 July	16 %	8	15	17	A_1	7 July	19 %	14	10	14	P_1	3 Aug.	16 %	16	46	25
V_2	11 ,,	19	14	16	34	L_2	8 ,,	19	15	37	27	A_2	7 ,,	17	7	30	15	P_2	8 ,,	15½	15	32	15
V_3	15 ,,	17	6	20	8	L_3	8 ,,	17½	10	10	11	A_3	7 ,,	17½	10	21	16	P_3	15 ,,	14½	7	27	11
V_4	15 ,,	17	6	16	12	L_4	8 ,,	18	12	28	20	A_4	7 ,,	18	12	32	26	P_4	15 ,,	14	11	41	19
V_5	15 ,,	17	5	22	12	L_5	9 ,,	17½	9	10	12	A_5	7 ,,	19½	20	50	27	P_5	20 ,,	13	6	11	9
V_6	16 ,,	17	9	20	13	L_6	10 ,,	18	15	14	20	A_6	7 ,,	17½	10	12	23	P_6	12 Sept.	10	5	25	8½
V_7	16 ,,	17	8	27	8	L_7	11 ,,	18	14	10	14	A_7	7 ,,	18	12	12	18	P_7	12 ,,	9	5	23	7½
V_8	17 ,,	18	14	33	16	L_8	15 ,,	17	10	18	13	A_8	7 ,,	18	12	15	12	P_8	19 ,,	9	8	58	8
V_9	18 ,,	19	18	35	18	L_9	15 ,,	18	12	30	12	A_9	7 ,,	17½	10	10	25	P_9	19 ,,	9	5	60	11
V_{10}	22 ,,	16½	12	41	17	L_{10}	16 ,,	18	14	11	15	A_{10}	8 ,,	19	16	22	17	P_{10}	24 ,,	9½	9	22	9
V_{11}	23 ,,	17	12	57	21	L_{11}	20 ,,	16½	11	14	11	A_{11}	9 ,,	17½	10	27	18	P_{11}	25 ,,	9½	8	41	14
V_{12}	23 ,,	15	8	58	58	L_{12}	28 ,,	16	16	44	17	A_{12}	9 ,,	18	12	40	27	P_{12}	30 ,,	9	16	13	19
V_{13}	24 ,,	18	18	76	32	L_{13}	23 Aug.	14	16	39	16	A_{13}	9 ,,	17	7	9	7	P_{13}	(12 Oct.)	< 9	14	54	30
V_{14}	24 ,,	19	24	43	24	L_{14}	30 ,,	13	15	38	20	A_{14}	9 ,,	18	13	25	13	P_{14}	(12 ,,)	< 9	12	64	19
V_{15}	1 Aug.	16½	16	55	24	L_{15}	30 ,,	13	14	30	17	A_{15}	9 ,,	17½	10	14	14	P_{15}	14 ,,	8	10	40	26
V_{16}	1 ,,	17	17	47	20	L_{16}	1 Sept.	13½	20	41	30	A_{16}	9 ,,	17½	10	15	18	P_{16}	15 ,,	7	8	43	10
V_{17}	1 ,,	16	14	56	33	L_{17}	5 ,,	12	8	14	12	A_{17}	9 ,,	16	5	23	13	P_{17}	16 ,,	8	10	27	10
V_{18}	2 ,,	17	18	67	22	L_{18}	20 ,,	10½	16	32	20	A_{18}	9 ,,	17½	10	50	21	P_{18}	(26 ,,)	< 7	10	40	10
(V_{19}	shrivelled	—	14	46	14)	L_{19}	14 Oct.	7	8	27	16	A_{19}	9 ,,	19	14	52	21	P_{19}	(26 ,,)	< 7	10	97	15
V_{20}	(14 Oct.)	< 9	30	53	30	L_{20}	—	—	—	—	—	A_{20}	9 ,,	19	14	55	14	P_{20}	(26 ,,)	< 7	5	100	15
V_{21}	(14 ,,)	< 8	12	69	27	L_{21}	—	—	—	—	—	A_{21}	10 ,,	18	12½	38	30	P_{21}	(26 ,,)	< 7	5	62	8
(V_{22}	shrivelled	—	10	48	14)	L_{22}	—	—	—	—	—	A_{22}	10 ,,	17	11	10	11	P_{22}	(26 ,,)	< 7	5	66	8
V_{23}	(12 Oct.)	< 8	16	70	57	L_{23}	—	—	—	—	—	A_{23}	10 ,,	17	11	12	11	—	—	—	—	—	—
(V_{24}	shrivelled	—	12	33	32)	L_{24}	—	—	—	—	—	A_{24}	10 ,,	17	10	23	13	—	—	—	—	—	—
V_{25}	(26 Oct.)	< 7	16	93	31	L_{25}	—	—	—	—	—	A_{25}	10 ,,	18	14	69	15	—	—	—	—	—	—
V_{26}	(26 ,,)	< 7	15	71	30	—	—	—	—	—	—	A_{26}	10 ,,	16	6	57	16	—	—	—	—	—	—
V_{27}	(26 ,,)	< 7	14	53	28	—	—	—	—	—	—	A_{27}	10 ,,	18	14	50	19	—	—	—	—	—	—
V_{28}	(26 ,,)	< 7	14	56	21	—	—	—	—	—	—	A_{28}	15 ,,	18	12	24	11	—	—	—	—	—	—
V_{29}	(26 ,,)	< 6	10	53	16	—	—	—	—	—	—	A_{29}	20 ,,	16	7	12	7	—	—	—	—	—	—
												A_{30}	28 ,,	15	10	15	18	—	—	—	—	—	—
												A_{31}	28 ,,	16	15	30	30	—	—	—	—	—	—
												A_{32}	1 Aug.	16	16	14	16	—	—	—	—	—	—
												A_{33}	3 ,,	14	8	13	10	—	—	—	—	—	—
												A_{34}	5 Sept.	12½	18	64	24	—	—	—	—	—	—

TABLE XXVI*b*.

SOIL OF KARANGTENGAH. THE GAYAM-PLANTATION.

VERNONIA CHINENSIS						LEUCAS ASPERA						AMARANTUS SPINOSUS						POLANISIA VISCOSA					
No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.
V_1	13 July	13 %	18	37	22	L_1	7 July	13½%	14	47	18	A_1	7 July	13 %	12	33	14	P_1	30 Aug.	8 %	8	28	8
V_2	17 „	13	12	50	14	L_2	9 „	13½	14	33	18	A_2	7 „	12½	10	35	13	P_2	30 „	10	16	39	22
V_3	8 Aug.	12	18	32	26	L_3	10 „	13	15	28	15	A_3	8 „	13½	16	41	18	P_3	1 Sept.	9	10	36	21
V_4	8 „	12	18	48	23	L_4	10 „	12	10	12	19	A_4	8 „	13½	14	35	22	P_4	10 „	9	14	22	18
V_5	13 „	10½	12	40	12	L_5	10 „	13	16	34	19	A_5	8 „	13	12	18	17	P_5	15 „	7½	8	26	10
V_6	15 „	12	18	51	20	L_6	11 „	12½	12	25	13	A_6	8 „	12½	10	22	13	P_6	19 „	8	12	60	16
V_7	15 „	10½	14	32	15	L_7	12 „	13	16	30	16	A_7	9 „	10	6	11	8	P_7	3 Oct.	8	16	76	30
V_8	20 „	10	12	17	13	L_8	15 „	10	7	39	7	A_8	9 „	12½	10	26	9	P_8	3 „	7	12	30	11
V_9	26 „	10	14	40	20	L_9	18 „	12	17	19	17	(A_9	10 „	shrivelled	22	50	25)	P_9	5 „	6	6	48	7
—	—	—	—	—	—	L_{10}	28 „	12	16	31	19	A_{10}	10 „	12½	12	14	20	P_{10}	9 „	7½	20	49	51
—	—	—	—	—	—	L_{11}	1 Aug.	12	12	37	18	A_{11}	10 „	13	14	34	17	P_{11}	10 „	7	16	70	23
—	—	—	—	—	—	L_{12}	2 „	12	14	34	19	A_{12}	12 „	12	10	13	22	P_{12}	16 „	6	12	66	20
—	—	—	—	—	—	L_{13}	13 „	11	16	49	18	A_{13}	12 „	11½	8	13	9	P_{13}	(17 „)	< 7	19	29	20
—	—	—	—	—	—	L_{14}	15 „	12	17	39	34	A_{14}	16 „	12	10	37	22	P_{14}	(17 „)	< 7	8	13	18
—	—	—	—	—	—	L_{15}	19 „	12	18	44	31	A_{15}	20 „	12	11	35	16	P_{15}	(17 „)	< 7	10	39	13
—	—	—	—	—	—	L_{16}	19 „	11	14	40	28	A_{16}	21 „	12½	14	30	16	P_{16}	(23 „)	< 7	18	56	33
—	—	—	—	—	—	L_{17}	26 „	10	12	19	19	A_{17}	25 „	12	11	35	16	P_{17}	(23 „)	< 7	14	66	21
—	—	—	—	—	—	L_{18}	27 „	10	15	15	21	A_{18}	28 „	12	12	37	21	—	—	—	—	—	—
—	—	—	—	—	—	L_{19}	5 Sept.	10	14	15	18	A_{19}	1 Aug.	12	14	17	23	—	—	—	—	—	—
—	—	—	—	—	—	L_{20}	23 „	8	16	40	30	A_{20}	6 „	9	6	28	6	—	—	—	—	—	—
—	—	—	—	—	—	L_{21}	24 „	8	14	34	25	A_{21}	7 „	10½	10	21	18	—	—	—	—	—	—
—	—	—	—	—	—	L_{22}	29 „	7	10	20	12												
—	—	—	—	—	—	L_{23}	(14 Oct.)	< 8	30	42	35												

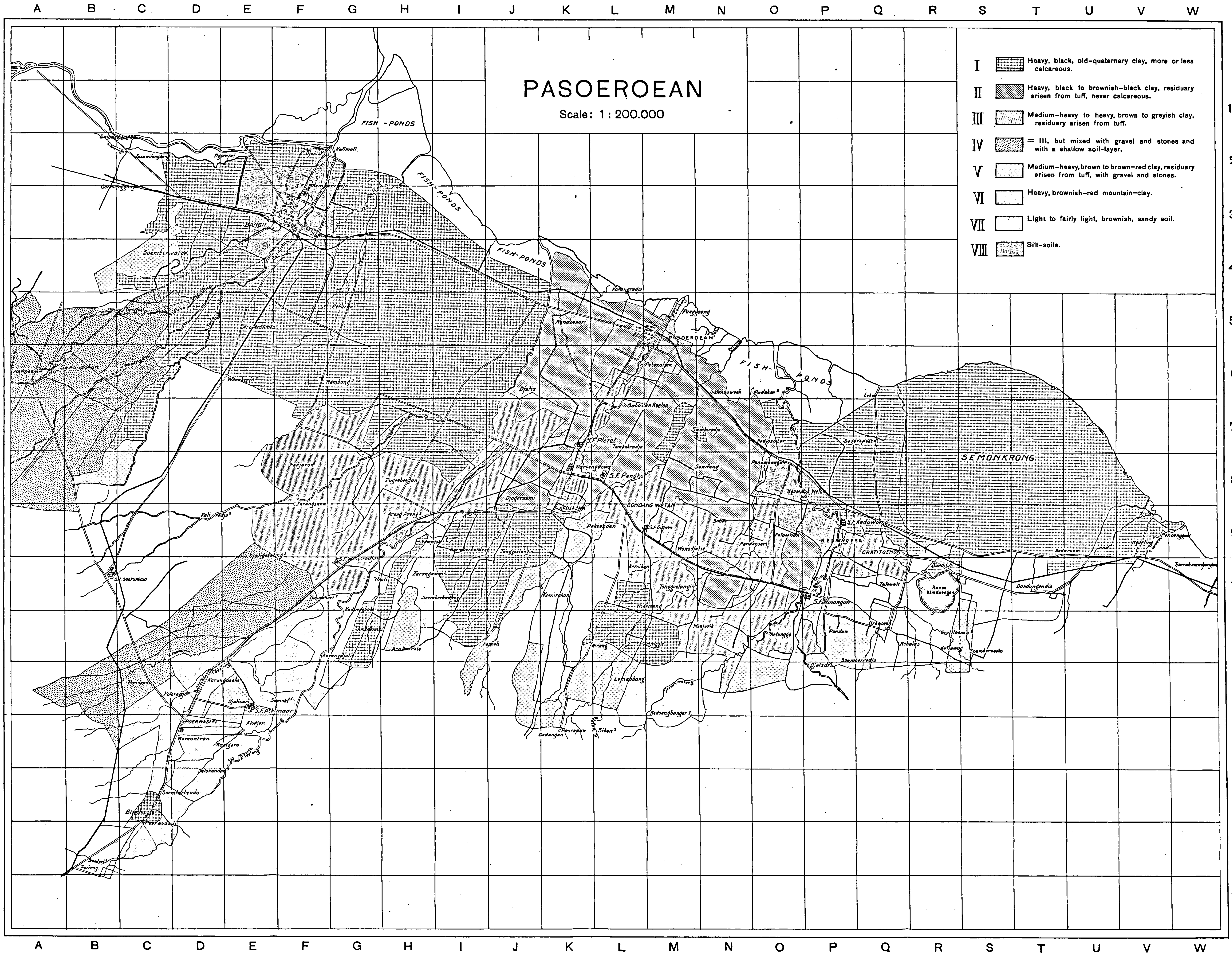
TABLE XXVI*c*.

SOIL OF SINDOPATI. THE PLERET-PLANTATION.

VERNONIA CHINENSIS						LEUCAS ASPERA						AMARANTUS SPINOSUS						POLANISIA VISCOSA					
No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.	No.	Date	Moisture %	a.s.	l.	l.r.
V_1	11 July	13 %	16	54	35	L_1	8 July	12½%	10	24	14	A_1	7 July	13 %	14	40	18	P_1	16 July	13 %	16	20	17
V_2	15 „	12	10	16	14	L_2	9 „	12	8	14	14	A_2	8 „	15	12	26	12	P_2	3 Aug.	11	10	39	15
V_3	15 „	15	14	61	16	L_3	10 „	13	12	31	22	A_3	8 „	16	15	50	24	P_3	5 „	13	25	41	40
V_4	20 „	13½	25	51	26	L_4	10 „	12	10	26	14	A_4	9 „	13	12	22	21	P_4	13 „	11	15	26	20
V_5	28 „	12	18	56	27	L_5	10 „	13	12	17	23	A_5	9 „	14½	10	36	10	P_5	15 „	11	16	11	16
V_6	29 „	13	24	54	30	L_6	19 „	15	15	24	14	A_6	9 „	14½	10	54	13	P_6	19 „	8½	8	9	9
V_7	30 „	13	24	58	43	L_7	24 „	15	14	38	17	A_7	10 „	13	15	40	18	P_7	19 „	8½	8	10	9
V_8	15 Aug.	14	20	88	54	L_8	6 Aug.	12½	10	25	19	A_8	10 „	14	8	65	8	P_8	23 „	10	14	22	22
V_9	16 „	14½	26	94	74	L_9	1 Sept.	9	10	26	13	A_9	10 „	15	12	31	12	P_9	5 Sept.	5½	8	16	12½
V_{10}	17 „	13	13	51	17	—	—	—	—	—	—	A_{10}	8 Aug.	12	16	16	26	P_{10}	8 „	6	10	16	22
V_{11}	17 „	13	13	63	13	—	—	—	—	—	—	A_{11}	13 „	12½	24	25	38	P_{11}	19 „	6	15	22	25
V_{12}	20 „	12	14	78	17	—	—	—	—	—	—	—	—	—	—	—	—	P_{12}	24 „	7	16	46	19
V_{13}	20 „	12	8	69	16	—	—	—	—	—	—	—	—	—	—	—	—	P_{13}	30 „	5½	12	15	15
V_{14}	22 „	12½	18	63	18	—	—	—	—	—	—	—	—	—	—	—	—	P_{14}	6 Oct.	5	10	28	12
V_{15}	23 „	12½	18	76	28	—	—	—	—	—	—	—	—	—	—	—	—	P_{15}	(6 „)	< 6	18	34	25
V_{16}	(6 Oct.)	< 7	24	80	30	—	—	—	—	—	—	—	—	—	—	—	—	P_{16}	(6 „)	< 6	12	48	16
V_{17}	(6 „)	< 6	18	72	20	—	—	—	—	—	—	—	—	—	—	—	—	P_{17}	(6 „)	< 6	12	31	25
V_{18}	(19 „)	< 6	14	62	58	—	—	—	—	—	—	—	—	—	—	—	—	P_{18}	(6 „)	< 7	24	35	37
(V_{19}	shrivelled	—	12	64	21)	—	—	—	—	—	—	—	—	—	—	—	—	P_{19}	(6 „)	< 6	15	77	38
(V_{20}	„	—	18	65	27)	—	—	—	—	—	—	—	—	—	—	—	—	P_{20}	(6 „)	< 5	10	34	15
(V_{21}	„	—	12	42	25)	—	—	—	—	—	—												
V_{22}	(19 Oct.)	< 6	18	68	52	—	—	—	—	—	—												
V_{23}	(19 „)	< 7	16	76	39	—	—	—	—	—	—												
V_{24}	(19 „)	< 7	14	66	34	—	—	—	—	—	—												
V_{25}	(23 „)	< 8	20	80	20	—	—	—	—	—	—												
V_{26}	(23 „)	< 7	15	92	21	—	—	—	—	—	—												
V_{27}	(23 „)	< 9	34	85	35	—	—	—	—	—	—												
V_{28}	(23 „)	< 8	20	77	32	—	—	—	—	—	—												
V_{29}	(23 „)	< 6	10	51	11	—	—	—	—	—	—												
V_{30}	(23 „)	< 6	10	79	67	—	—	—	—	—	—												
V_{31}	(23 „)	< 6	10	81	61	—	—	—	—	—	—												

TABLE XXVII.

DETERMINATIONS in 1925	POT-CULTURES			BOX-CULTURES											
				not regenerated				partly regenerated				entirely regenerated			
	n	moisture %	m. e.	n	moisture %	m. e.	mean date of wilting	n	moisture %	m. e.	mean date of wilting	n	moisture %	m. e.	mean date of wilting
SINDOPATI															
Amarantus spinosus	11	13.7	$\pm$ 0.4	9	14.2	$\pm$ 0.4	8 July	2	12	—	10 Aug.	—	—	—	—
Polanisia viscosa	9	12.8	$\pm$ 0.5	6	11.5	$\pm$ 0.5	7 Aug.	2	8½	—	19 Aug.	12	< 7	—	(19 Oct.)
Leucas aspera	9	14.5	$\pm$ 0.4	8	13.1	$\pm$ 0.4	16 July	1	9	—	1 Sept	—	—	—	—
Vernonia chinensis	9	12.4	$\pm$ 0.7	15	13.0	$\pm$ 0.3	5 Aug.	—	—	—	—	13	< 7	—	(23 Oct.)
KARENGTENGAH															
Amarantus spinosus	10	15.2	$\pm$ 0.5	18	12.3	$\pm$ 0.2	14 July	2	8	—	6 Aug.	—	—	—	—
Polanisia viscosa	10	12.6	$\pm$ 0.4	—	—	—	—	8	8.3	$\pm$ 0.3	13 Sept.	9	< 7	—	(23 Oct.)
Leucas aspera	11	14.1	$\pm$ 0.1	22	12.2	$\pm$ 0.2	8 Aug.	1	< 8	—	(14 Oct.)	—	—	—	—
Vernonia chinensis	14	13.5	$\pm$ 0.2	9	11.4	$\pm$ 0.4	10 Aug.	—	—	—	—	—	—	—	—
MENANGAS															
Amarantus spinosus	11	19.2	$\pm$ 0.5	33	17.7	$\pm$ 0.2	12 July	1	12½	—	5 Sept.	—	—	—	—
Polanisia viscosa	9	18.1	$\pm$ 0.5	5	14.6	$\pm$ 0.5	12 Aug.	3	9½	—	16 Sept.	14	< 9	—	(26 Oct.)
Leucas aspera	9	18.2	$\pm$ 0.3	12	17.4	$\pm$ 0.3	13 July	7	11.9	$\pm$ 0.9	9 Sept.	—	—	—	—
Vernonia chinensis	9	18.7	$\pm$ 0.6	18	17.3	$\pm$ 0.3	21 July	—	—	—	—	8	< 7	—	(26 Oct.)


PASOEROEAN
Scale: 1 : 200.000
I Heavy, black, old-quaternary clay, more or less calcareous.
II Heavy, black to brownish-black clay, residuary arisen from tuff, never calcareous.
III Medium-heavy to heavy, brown to greyish clay, residuary arisen from tuff.
IV = III, but mixed with gravel and stones and with a shallow soil-layer.
V Medium-heavy, brown to brown-red clay, residuary arisen from tuff, with gravel and stones.
VI Heavy, brownish-red mountain-clay.
VII Light to fairly light, brownish, sandy soil.
VIII Silt-soils.
FISH-PONDS
BANGIL
PASOEROEAN
SEMONKRONG
GONDANG WETAN
KESANGGENG
CRATITOENOEH
POERWASARI