

REPORTS OF PLANT PATHOLOGY DEPARTMENT  
OF AGRICULTURAL RESEARCH CENTRE  
TIKKURILA, FINLAND

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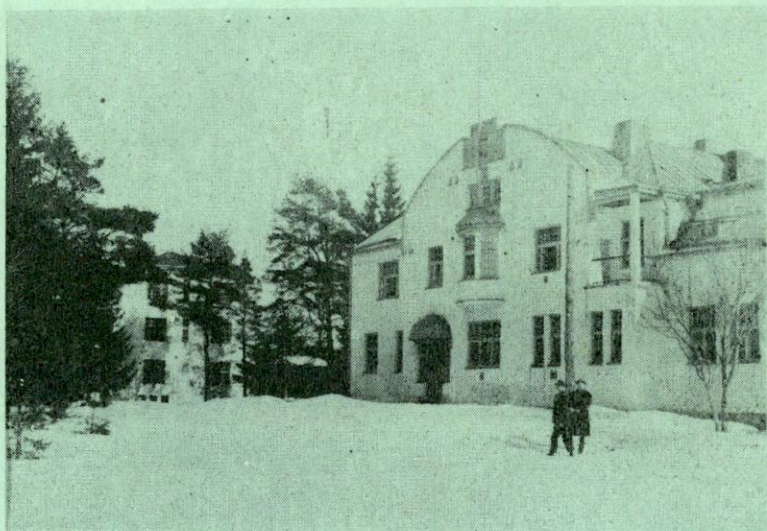
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THE PLANT PATHOLOGY DEPARTMENT OF THE  
AGRICULTURAL RESEARCH CENTRE  
THE MOST IMPORTANT DISEASES OF CROP PLANTS  
IN FINLAND AND THEIR CONTROL

*E. A. Jamalainen*

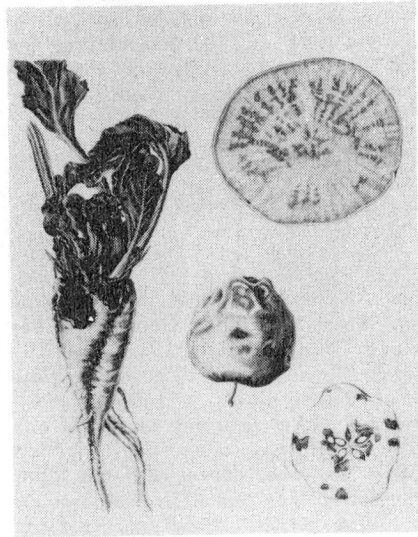


TIKKURILA 1956

## THE PLANT PATHOLOGY DEPARTMENT OF THE AGRICULTURAL RESEARCH CENTRE

The present Plant Pathology Department of the Agricultural Research Centre began its activity in 1911 at Tikkurila, near Helsinki, as a Department of Plant Pathology of the Institute of Agricultural and Economical Research. In addition to being a Research Institute of the State the Institute was, as an experimental station, subordinated to the Faculty of the University. In 1924 the Institute with its Departments was made a separate Agricultural Research Centre of the State.

The most important earlier achievements of the Department were researches on the smut diseases in Finland (17, 18, 19), and researches on the potato wart disease and its control (2), which were carried out under the direction of the renowned mycologist Professor J.L.Liro, who held the directorship of the Department of Plant Pathology until 1937, in addition to his professorship at the University. After him the directorship was held by Professor A.J.Rainio until his death in 1944. The most important of his investigations were research on the *Fusarium* mould of oats (*Fusarium roseum*) (26), research on the bacteria diseases of Gladioli (27) and a report on the potato late blight and its significance in Finland (28). Since 1925, when the Plant Protection Act became valid, the Department has been responsible for the statutes of the control of plant diseases being observed. The Act has been widely applied in order to prevent the spreading of potato wart disease. Instruction in the field of plant protection has continuously been an important part of the activities;



Boron deficiency diseases: (left) heart rot of sugar beet, (above right) brown heart of swede, (below right) internal cork of apples.

for example in the middle of the 1930's instruction for controlling grain diseases was arranged in cooperation with the instructional organizations throughout the country.

The research work carried out during the last two decades has extended to comprise besides diseases caused by parasitic fungi also non-parasitic (physiogenic) plant diseases and virus diseases. Of minor elements, boron was the first object of research at the Plant Pathology Department in Finland, and it was proved that the brown heart of swede is caused

by a deficiency of boron (5); also other plant diseases caused by a deficiency of boron were found to occur in Finland, such as the heart rot of sugar beet and the internal cork disease of apple. Continued research on boron has shown that in wide areas in this country this element is a necessary nutrient for many plant species (9). Other publications describing the activity of the Plant Pathology Department have been re-

ported in detail in the periodical *Nordisk Jordbruksforskning* (11). The following objects of research may deserve mentioning in this connection: the resistance of different varieties of wheat to the stinking smut (6), the *Fusarium* fungi in Finland (7), the significance of potato virus diseases in this country (8), and the fungus *Sclerotinia borealis* causing damage in winter cereals and grasses (10).

## PRESENT ACTIVITIES AT THE PLANT PATHOLOGY DEPARTMENT

At present (1956) the work of the Plant Pathology Department includes the following activities: 1) research on plant diseases injurious to cultivated plants, and their control methods, 2) experiments on the effectiveness of fungicides, 3) inspection duties in accordance with the Plant Protection Act and 4) instruction.

The present Head of the Plant Pathology Department is Professor, Dr. E.A. Jamalainen; the Senior Research Assistants are Miss., Dr. Annikki Linnasalmi and Mr. Jaakko Mukula, Lic. Agr & Forest.; the Junior Research Assist-

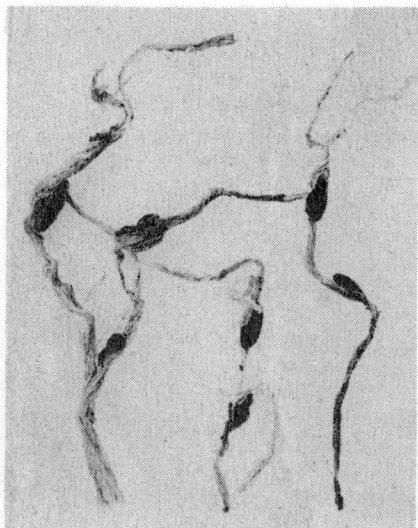
ants are Mr. Matti Haavisto, B. Agr. & Forest. and Mrs. Eeva Tapio, B. Agr. & Forest.; the Plant Protection Inspector is Mr. Aarre Ylimäki, B. Agr. & Forest.; the Plant Protectants Inspector is Aulis Tinnilä B.Sc. (together with the Department of Pest Investigation of the Agr. Res. Centre). In addition the staff of the Department consists of a junior research worker, temporary research workers, an office clerk, two laboratory assistants, two field assistants, and practising undergraduates.

### Investigations and experiments

**OVERWINTERING OF CEREALS, GRASSES, CLOVER, AND RAPE.** Though most of the cultivated fields in Finland are given to overwintering plants - winter rye and wheat, grasses, clover, and winter turnip rape (*Brassica campestris* v. *oleifera* f. *biennis*) - knowledge about the reasons for poor overwintering has earlier in many cases been very insufficient. In the investigations carried out during the last ten years by the Plant Pathology Department,

special attention has been paid to parasitic fungi damaging young crops of cereals, grass, clover, and rape during winter (15, 25, 29). As there is much snow in winter in Finland, these fungi often play a very important part in poor overwintering. In winter cereals and grasses, damage is caused by snow mould (*Fusarium nivale*), in many cases by the fungi of *Typhula* spp. and in central and northern parts of the country by *Sclerotinia borealis* (10). In clover,





Sclerotia of *Sclerotinia borealis* on winter rye.

damage is often caused by clover rot (*Sclerotinia tricolorum*) and in winter turnip rape by *Typhula* sp. and *Sclerotinia sclerotiorum*. Different varieties of winter cereals and different strains of grasses and clover, show great differences with regard to their resistance to damage caused by fungi. At the Plant Pathology Department the object of the investigations has been: to define overwintering fungi; to find out their



The effect of PCNB dusting on red clover, left untreated, right treated in previous autumn.

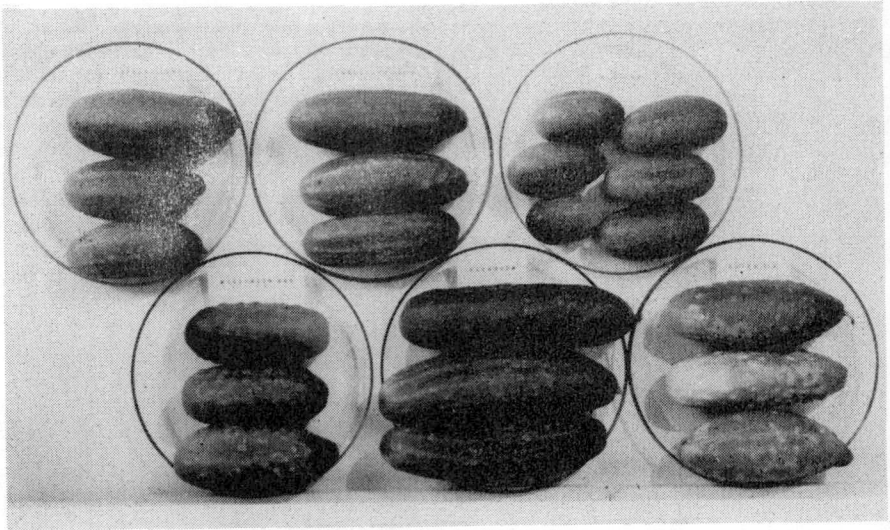
occurrence in different parts of the country and the damage caused by them; to discover the resistance of different strains of grasses and clover and that of the different varieties of winter cereals to winter damage; to examine the importance of seed treatment with chemicals in the control of snow mould; to find out the effect of chemicals in the treatment of overwintering plants (25).

Last time tests were made with the PCNB-(pentachloronitrobenzene-) preparations used as dust in the autumn, very good results were obtained in the controlling of snow mould in winter cereals (25), clover rot (25, 29) and the fungi in winter turnip rape (25).

**FOOT ROT DISEASES OF SPRING CEREALS.** In a wide area in the western part of Finland, spring wheat thrives poorly because the kernels are scabbed (shrivelheads disease of wheat). Investigations have shown (3) that one reason for this is fungi, in the first place *Cercospora herpotrichoides* (causing eye spot disease) as well as some species of *Fusarium* which cause foot rot disease. In addition to this it has been established that also a species of insects, *Amblymerus graminum* Hårdh, can be a cause of the shrivelheads of spring wheat damaging the foot of plants. Foot rot diseases of spring cereals caused by parasitic fungi are also common in other parts of Finland.

**DISEASES OF POTATO.** Attention has chiefly been paid to the control of potato late blight (*Phytophthora infestans*) with chemicals and to the study of the control of storage losses (cf. investigations in storage, p. 0).

**DISEASES OF VEGETABLES AND ROOT CROPS.** In Finland vegetable and root crops suffer during the period of growth from several injurious diseases whose control is difficult. Of these diseases the Department has investigated the following: onion virus disease (*Allium virus 1*) (12), downy



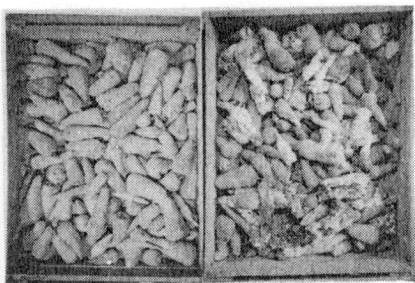
Cucumber varieties resistant against anthracnose (*Cladosporium cucumerinum*). Above (left) Superb OE 48, Cavallius Orig., Muromsk (susceptible); below (left) Wisconsin SR 6, Highmoor, Maine n:o 2. Photo Ingervo.

mildew of onion (*Peronospora destructor*) (12), anthracnose of cucumber (*Cladosporium cucumerinum*), leaf mould of tomato (*C. fulvum*), steak of tomato (Phytophthora infestans), club root of crucifers (*Plasmodiophora brassicae*), Sclerotinia disease (*Sclerotinia sclerotiorum*), and damping-off (caused by *Pythium* and *Rhizoctonia* fungi); the last mentioned disease systematically as well as biologically (21).

So far the experiments with chemicals on the control anthracnose of cucumber (20) and leaf mould of tomato have not yielded satisfactory results. A great number of experiments have been made with varieties resistant to these diseases, and seed material from different countries has been imported for the purpose. Some of these varieties have, indeed, been found to have a resistance against the diseases in question, and have been found suitable for this country.

- In the control of club root good results have been obtained by treating the planting holes of the seedlings with calomel preparation.

**DISEASES OF FRUIT-TREES AND BERRIES.** Of the diseases occurring in fruit-trees and berries, the Department has investigated the control of apple scab (*Venturia inaequalis*), brown root (*Sclerotinia fructigena*) American mildew (*Sphaerotheca mors uvae*), and spur blight of raspberry (*Didymella applanata*). In the control of apple scab experiments using the timing spray method have given reliable results (4). A great number of these experiments have been carried out in various parts of the country since 1954 and 1955. The effectiveness of new substances against apple scab has been tried out, and of these particularly the Captan preparations have been found to be effective in conditions prevailing in Finland.



The effect of chemicals on stored carrots. Right untreated ; left, treated with TCNB preparation.

#### INVESTIGATIONS OF STORAGE

During the last few years the Department has investigated the effects that the fungi damaging plant products in storage and other injurious factors have on the stored plants. Most experiments were made with potato (24), carrot (23), onion (12) and apple (14). In addition, swede, cabbage, and some other vegetable crops have been used for experiments. In the storage of carrots good results were obtained with the conserving Fusarex- (tetrachloronitrobenzene-) preparation. Storage of onion has been an important problem, because especially the set onion (*Allium cepa aggregatum*) grown in Finland has shown a tendency to decay during storage due to neck rot of onion (*Botrytis allii*). The experiments have thrown light on the effect of some chemicals preventing the sprouting of potato tubers, on the different ways of storage, and on other facts concerning the stored plants, and on the storage resistance of different varieties and strains. At the same time, some of the fungi found in the stored plants have been defined, and biological experiments have been made with them.

**RESISTANCE OF CROP PLANTS TO DISEASES.** The Department has made continuous experiments on the

resistance of new varieties of wheat to stinking smut and on the resistance of new varieties of potato to wart disease. The results of these tests have been reported to plant breeding stations. It has already been mentioned that in the investigations of the overwintering of plants, attention was paid to the resistance of different varieties of winter cereals as well as different strains of grasses and clover to fungi. In addition experiments have been carried out with varieties of cucumber and tomato (cf. p. and with different varieties of raspberry resistant to spur blight (*Didymella applanata*).

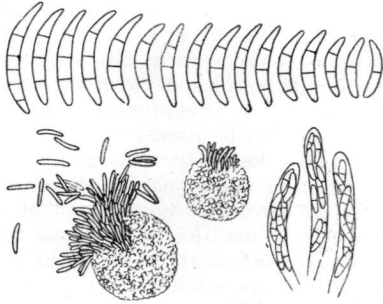
**OTHER INVESTIGATIONS.** As previously mentioned, the Department has earlier investigated the significance of boron on plant cultivation in Finland to find out to what extent it improves the quality of yields and increases them. At present the Department has continued the observations of deficiency diseases of minor elements and their occurrence in field and garden plants.

The Department has investigated the injurious effect on plants of such chemical substances that are used for the conserving of the wooden parts of greenhouses.

In order to control the fungus diseases of coniferous trees experiments have been conducted concerning the effectiveness of chemical substances against the *Lophodermium pinastri* (Schrad.) Chev. and the *Herpotrichia nigra* Hartig. In the control of the latter fungus, which causes damage in the nurseries during overwintering, good results have been obtained with the PCNB compound (25).

Virus investigation have been begun on potato, tomato, raspberry, and other plants mainly in order to define the species of virus appearing in them.

Of the diseases affecting ornamental plants investigations have been



conducted on mildew of begonia (*Oidium begoniae*) and on carnation wilts (*Verticillium* sp.), and the effects of chemical substances on these diseases have been examined.

The Department has continued its research on the *Fusarium-fungi* appearing in Finland (cf. oo).

*Fusarium nivale* (above) - *Calonectria graminicola* below.

### Testing the effectiveness of plant protectants

In 1951 the Finnish Parliament passed on Act and a additional Statute for the Examination of Plant Protectants. These came into force at the beginning of 1952. According to this Act only such chemical preparations as have been biologically examined are allowed to be sold. The preparations that have gone through a thorough examination have their salepackages stamped accordingly. Lists containing the names of the examined substances with corresponding explanations are published at two-, three- yearly intervals.

Tests to find out the effectiveness of plant protectants have lately given the Department much work, because several new chemicals have been sent and are being sent to the shops for sale, and their suitability for use in this country has to be examined. It may be mentioned that in 1955 the Plant Pathology Department examined the following substances and compounds in connection with various experiments: seed treatment chemicals 14, sprays for potato, vegetable crops, fruit-

trees, berries, and ornamental plants 29, dusts for vegetable crops 2, chemicals against fungi injurious to overwintering plants 8, soil disinfectant chemicals 6, conserving substances for plant products (incl. preparations for preventing the sprouting of potato tubers) 7, other preparations 5. Examining the effectiveness of plant protectants does not only mean that preparations of different names are compared with one another and compounds suitable for use are recommended. In this work the Department has also deliberately searched among new preparations for such protectants as are necessary in Finland for preventing damage caused by injurious diseases whose control is difficult.

Acts and Statutes passed on Plant Protectants:

The Act on Plant Protectants, April, 27, 1951, No. 261;

The Statute on the Plant Protectants Act, June, 29, 1951, No. 399;

The Statute on Poisons, July, 12, 1946, No. 555.



Testing the effectiveness of fungicides in the control of soil-borne fungi by desinfectans. Soil desinfected by steam, infested using pure culture of fungus, after that treated by different fungicides.

#### Supervision of plant protection

According to the Plant Protection Act passed in 1925 and the statutes and decisions connected with it, the Plant Pathology Department must attend to measures controlling dangerous plant diseases. In this work attention has chiefly been paid, as mentioned above, to the potato wart disease and its control (30). The inspection of plants to be imported or exported is done by the Plant Pathology and Pest Investigation Departments of the Agr. Res. Centre. The Plant Path. Department examines the exported plants and the imported potato and gives the required certificates. Inspections of garden nurseries, their cultivations and stores, also form a

part of this activity and are conducted by the Plant Pathology and Pest Investigation Departments.

The most important provisions concerning Plant Protection are as follows:

The Plant Protection Act, June 5 1925, No. 202;

The Decision of the Cabinet on the application of the Plant Protection Act, June 5, 1925, No. 204;

The Statute on Plant Destroyers, April 11, 1947, No. 309;

The Decision of the Ministry of Agriculture concerning the conditions of the importation and transit of potato, Printing;

The Decision of the Ministry of Agriculture concerning the conditions of the importation and transit of plants and parts of plants from Belgium and the Netherlands, May 13, 1947, No. 395;

The Decision of the Ministry of Agriculture concerning the conditions of the importation and transit of living plants and parts of plants, May 13, 1947, No. 396.

#### Instructional activities in the control of plant diseases

Because of the numerous plant diseases and the methods of controlling them the Department must devote much time to purely instructional work. The Department answers annually about a thousand questions about plant diseases sent by growers. Agricultural and horticultural organizations have greatly increased their instructional activities with regard to plant protection, and the Department issues directions concerning plant diseases. Firms preparing, importing, and selling fungicides and plant protection equipment continuously apply to the Department for information concerning the possibilities of using these fungicides and equipment in Finland. In cooperation with instructional organizations a campaign



for promoting plant protection in gardens has been going on throughout the country since 1950. For this purpose a Plant Protection Inspector is working under the supervision of the Plant Pathology and Pest Investi-

gation Departments of the Centre. For example the booklets containing advice and information on the current activities in the field of plant protection was a result of this work.

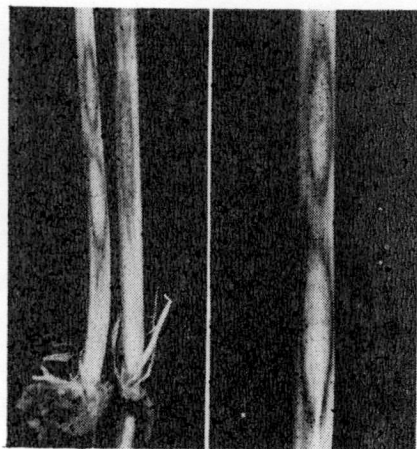
## THE MOST IMPORTANT DISEASES OF CROP PLANTS IN FINLAND AND THEIR CONTROL

During its period of activity the Plant Pathology Department of the Agr. Res. Centre has collected information on some 600 diseases occurring in crops, and about 100 of these diseases must be considered common and injurious.

Of the diseases of cereals, smut fungi are common in Finland as in other countries. The most important of them is the bunt or stinking smut of wheat (*Tilletia caries* (DC.) Tul.) which damages both winter and spring wheat. Other smut fungi to be found in Finland are loose smut of barley (*Ustilago nuda* (Jens.) Rostr.), loose smut of wheat (*U. tritici* (Pers.) Rostr.), covered smut of barley (*U. hordei* (Pers.) Lagerh.), loose smut of oats (*U. avenae* (Pers.) Jens.), and stripe smut of rye (*Tubercinia occulta* (Wallr.) Liro). Increasing the seed treatment with chemicals, and the use of new varieties more resistant to smut diseases, have recently diminished the significance of smut fungi. Leaf stripe of barley (*Helminthosporium gramineum* Rabenh.) is common and injurious in some parts of the country. In Finland considerable damage in winter cereals is often caused by fungi, which were described earlier in this paper. The most important of them is snow mould (*Fusarium nivale* (Fr.) Ces.), and the fungi of *Typhula* spp. (*T. idahoensis* Remsb. and *T. itoana* Imai). *Sclerotinia borealis* Bubák & Vleugel only occurs in central and northern parts of the country, often causing considerable damage. The rust fungi of cereals (*Puccinia graminis*



Test of winter wheat varieties where the plants are damaged by *Typhula* sp. Photo April 17, 1948, Tikkurila.



Eyespots (*Cercospora herpotrichiloides*) in straws of spring wheat.

Pers., *P. glumarum* (Schmidt) Erikss. & Henn., and *P. coronata* Corda, *P. triticina* Erikss., *P. dispersa* Erikss. & Henn., and *P. hordei* Otth.) are relatively common in Finland. Considerable damage, however, is only caused by them in certain years favourable for the occurrence of rust fungi (13). At present, the brown rust of wheat must be considered the most injurious of the rust fungi. Foot rot diseases (caused by *Cercospora herpotrichoides* Fron and *Fusarium* spp.) seem to be common, especially in spring wheat. Ergot (*Claviceps purpurea* (Fr.) Tul.) occurs in winter rye and barley.

One of the most important means of controlling diseases of cereals is seed treatment with organic mercurials, which, however, is not yet so common in Finland as in some other countries. Approximately one third of the seed of all the cereals is annually treated with chemical substances. Judging by the experiments, especially the seed treatment of winter rye has considerably increased yields. In experiments conducted during many years in different parts of the country (1) the increase in the yields of winter rye averages 19 % and of winter wheat 6.5 %. These experiments have also resulted in considerable increases in the yields of spring crops: wheat 7.3 %, barley 7.5-12.5 % and oats 11.6 %.

In the attempts to control overwintering fungi and rust fungi, chief attention has been paid to cultivating varieties resistant to these diseases. Recent results obtained with the PCNB preparations seem to indicate an effective means of controlling injurious winter fungi (25). - In the control of foot rot diseases it is, above all, important to avoid growing spring wheat and barley continuously in the same place.

In grasses, winter injuries are caused by the same fungi as in the winter cereals. Winter injuries of

clover are often due to an important disease, clover rot (*Sclerotinia trifoliorum* Erikss.).

Poor overwintering of winter wheat and clover is sometimes also the result of damage caused by the successive freezing and thawing of the soil, soil-ice needles, and frost, in districts and during winters with little snow.

In the control of diseases in grasses one of the most important measures is to cultivate resistant strains. Timothy has been found to possess a strong resistance to injurious winter fungi, and it is one of our safest plants. On the other hand ryegrass (*Lolium*) does not flourish in Finland, except some strains of English ryegrass, due to the damage caused by the injurious winter fungi. In the control of clover rot PCNB preparations are now beginning to be used.

In winter turnip rape damage is caused by the *Typhula* sp. (*T. betae* Rostr.) fungi and the *Sclerotinia* disease (*Sclerotinia sclerotiorum* (Lib.) de Bary). It is likely that PCNB preparations will be used for the control of these fungi.

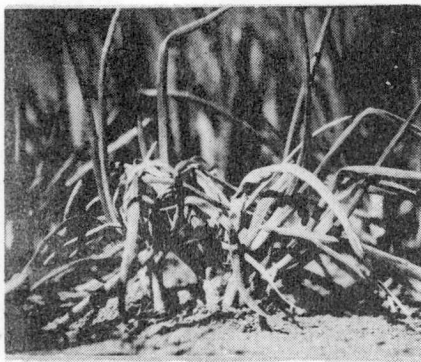
The most injurious disease of the potato is potato late blight (*Phytophthora infestans* (Mont.) de Bary). In northern parts of the country the blight, however, cannot cause very much damage because of early autumn frosts. Potato wart disease (*Synchytrium endobioticum* (Schilb.) Pers.) chiefly occurs in southern parts of the country where it has spread especially in the neighbourhood of some towns and other thickly populated areas (30). Other fungus diseases of potato are: *Alternaria* blight (*Alternaria solani* (Ell. & Martin) L. R. Jones & Grant), *Verticillium* wilt (*Verticillium albo-atrum* Reinke & Borth), and common scab and powdery scab (*Actinomyces* sp. and *Spongospora* sp.). Virus diseases (streak, crinkle, and mild mosaic virus) are found in

the potato fields of this country, but they are not of the same importance as in many more southern countries where the seed potato must be changed every two or three years. Leaf roll of potato is of minor significance in Finland. Finland ought to have good possibilities of exporting seed potatoes which are free of virus diseases. - The most important of the diseases damaging potatoes in storage is potato blight. The second place is taken by the bacteria rotting potato tubers. Even dry rot caused by the *Fusarium* fungi (*Fusarium coeruleum* (Lib.) Sacc.) is found in stored potatoes.

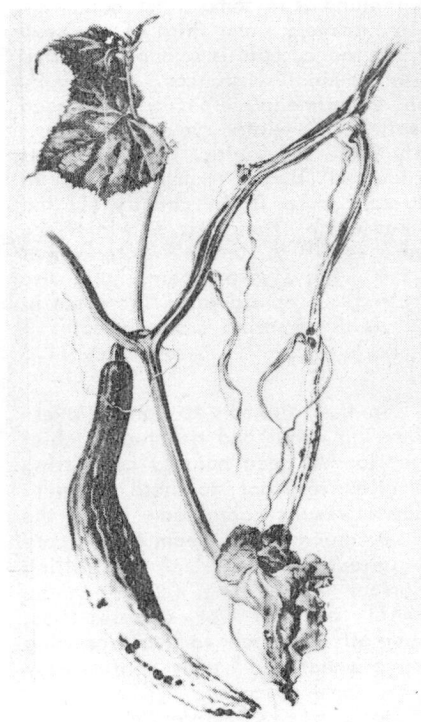
One of the most important means of controlling potato diseases is the cultivation of varieties resistant to blight, and during the last decades farmers have increasingly begun to grow such varieties. During the last ten years spraying with chemicals to control the potato blight has been done in the southern parts of the country.

In sugar-beet heart rot due to a boron deficiency used to cause damage, but with the greater prevalence of the use of boron it is now of no importance. Damping-off can often great havoc in sugar-beet cultivations.

The most important of the diseases affecting vegetable and root crops during the growth period are: damping-off (caused by *Rhizoctonia solani* Kühn and *Pythium debaryanum* Hesse), the Sclerotinia disease (*Sclerotinia sclerotiorum* (Lib.) de Bary) especially on tomato, cucumber, pea and bean, *Verticillium* wilt (*Verticillium albo-atrum* Reinke & Borth.), club root of crucifers (*Plasmidiophora brassicae* Woron), anthracnose of cucumber (*Cladosporium cucumerinum* Ell. & Arth.), downy mildew of onion (*Peronospora destructor* (Berk.) Casp.), the virus disease of onion (*Allium virus 1*), blossom end rot of tomato, streak of



Virus disease of onion.

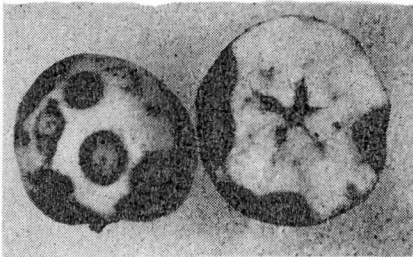


Sclerotinia disease on cucumber.

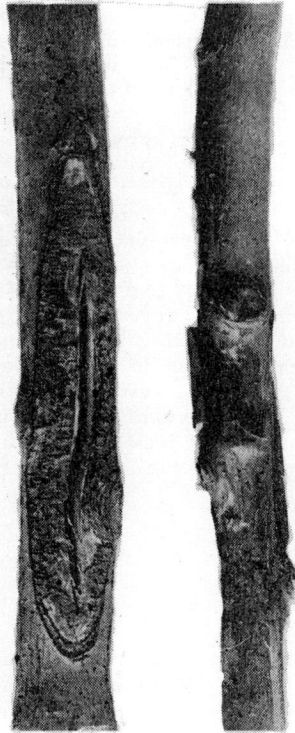
tomato, brown roots of tomato, potato late blight (*Phytophthora infestans* (Mont.) de Bary), leaf mould (*Cladosporium fulvum* Cooke) on tomato, and anthracnose of beans (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav.). Of the diseases damaging stored plants may be mentioned the *Sclerotinia* disease (*Sclerotinia* sp.) and grey mould (*Botrytis* sp.), black rot of carrot (*Stemphylium* sp.), and grey mould of onion (*B. allii* Munn.).

The control of the diseases of vegetable crops presents difficult problems, as the protectants used against them have not always proved sufficiently effective (vide p.). A more wide-spread disinfection of the soil is one of the most important tasks (22).

Of the diseases of fruit-trees, apple scab (*Venturia inaequalis* (Cooke) Wint.) is common and injurious. Brown rot (*Sclerotinia fructigena* (Aderh. & Ruhl.) Honey) often damages the yield of apples, as does also the internal cork disease (due to a deficiency of boron). The greatest damage on cultivations of fruits and berries is caused by frost. 60-70 % of the fruit-trees in Finland were destroyed during the severe frost winters 1939-1942. Considerable frost injuries have also occurred during many subsequent winter. Of other diseases of fruit-trees may be mentioned crown gall



Gloeosporium rot of apples



Stems of apple trees damaged by frost.

(*Agrobacterium tumefaciens* (E.F. Sm. & Towns.) Conn.), pocket plums (*Taphrina pruni* (Fuck.) Tul.), shot hole in plums and cherries, and silver leaf. In storage much damage is caused by the bitter rot of apple (*Gloeosporium* spp.).

The following diseases occurring on cultivations of berries may be mentioned: American mildew (*Sphaerotheca mors uvae* (Schw.) Berk.), spur blight of raspberry (*Didymella applanata* (Niessl.) Sacc.), yellowing of leaves and virus diseases of raspberry, leaf spot of *Ribes* species



(*Pseudopeziza ribis* Kleb.), *Septoria* leaf spot (*Septoria ribis* Desm.), rust fungi (*Cronartium ribicola* J.E.Fischer, *Puccinia pringsheimiana* Kleb., and *P. ribis* (DC).), leaf spot of strawberry (*Mycosphaerella fragariae* (Tul.) Lindau), and grey mould (*Botrytis* sp.) in the berries of strawberry.

The spraying of fruit-trees in order to control the parasitic fungi has lately become common in Finland. Plans for spraying fruit-trees and berries have been mapped out by the Plant Pathology and Pest Investigation Departments of the Agricultural Research Centre. The timing spray system has begun to be applied to the conditions prevailing in Finland.

The cultivation of ornamental plants is at present of considerable economic value even in Finland.

Diseases caused by fungi as well as physiogenic diseases are significant factors hampering the cultivation of these plants. The Plant Pathology Department has been accordingly giving growers some instruction concerning the diseases of ornamental plants, chiefly on the basis of information obtained from literature. The Department has had only limited possibilities of investigating the diseases of ornamental plants. Among the most harmful diseases of ornamental plants the following examples may be mentioned: mildew of begonia (*Oidium begonae* Putt.), rose mildew (*Sphaerotheca pannosa* (Wallr.), Lév.), carnation wilt (*Verticillium* sp.), *Fusarium* wilt of carnation, leaf scorch (*Stagonospora* sp.) and leaf spot of Phlox (*Septoria* sp.).

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