Vicia articulata, a traditional crop legume, near extinction, found in Santorini (Thera), Greece; possible implication for archaeobotany/ palaeoethnobotany and its great value for its future need in agriculture.

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Abstract

Vicia articulate Horne. a not highly domesticated legume, which is used as green manure, fodder and, in times of stress, as food, is in the process of extinction. Although it was mentioned as cultivated up to the 1950s in many parts of Greece, lately, the only area, which is known to still cultivate it, is on the Cycladic island of Santorini, Thera, and referred to as 'lentil'.

The aim of this paper is threefold: a) to intercept its extinction, as it is an excellent plant for green manuring and fodder and enriches, the soil with nutrients and humidity, under arid conditions. Its importance in agriculture and husbandry needs to be redressed. It produces even under ≤ 300 mm of rain, which is of utmost importance in times of Climate Change. B) to draw the attention of archaeobotanists to pay more attention in identifying lentil-type legumes in the archaeological contexts, and widen our knowledge on the legumes cultivated in the past, as well as build their biographies regarding their domestication trajectories and use. C) Call for the attention of ethnobotanists, archaeobotanists and farmers to cooperate, protect and promote traditional systems of agriculture, which are more sustainable, in arid environments.

Introduction

In the circum-Mediterranean, archaeological sites, archaeobotanical material classified under the generic terms of cereals and legumes, as we know, are the most common taxa. Legumes though, which tend to be of a more elusive identification are often, when not identifiable in archaeobotanical studies, are noted as large, medium, and/or small legumes, much to our dismay, due to the problems of preservation and/or the difficulty of recognising identifiable morphological features. The lack of testa, which is often destroyed by exposure to fire, as well as the rare finds of the hila, amplify the problem of identification. Moreover, SEM work on the testa coatings is not always indicative of the genera (Butler 1990). Butler (1991:62) in her pioneering work on Old World *Viciacae*, mentions some 36 species which have been cultivated but a mere 1/3 of these have been identified archaeobotanically. It is, therefore, time to enlarge our identifiable spectrum and find more evidence of their cultivation in traditional societies and thus enlarge our knowledge concerning their use trajectory related to food, fodder, green manure and, of course, their dietary importance in ethnography. For the 2/3 of pulses which had been cultivated but are rare today, we have little information on the history of their cultivation and ethnography. It is a gap of knowledge which we need to fill for a multitude of reasons and, furthermore, would contribute to their identification in archaeobotanical assemblages of the past. This would provide evidence for their history, their 'biographies' *per se* and the geographical scope of their cultivation.

A second important reason of needing to identify legumes to variety, is our need to contribute to the dialogue concerning 'food and fodder', as well as 'famine and/or stress foods'. Yet, we need to be cautious on the factors we use to identify both categories, as there is a frail boundary between them which changes through time, geographical area, social and economic variables including the social needs as they are renegotiated throughout time. The caveats, intrinsic in the terms 'food' and 'fodder', have been

discussed by several archaeobotanists (inter alia Glynis Jones 1998; Valamoti & Charles 2005), ethnoarchaeologists and anthropologists and particularly in times of social, climatic and economic stress. This has been previously demonstrated by Halstead (1990), Forbes (1998:31), as fodder can, also, be consumed as food in some, especially, stressful, economical and/or social circumstances. This has been noted, as often mentioned by our informants, during our ethnobotanical work on Crete and Santorini. Thus, an additional traditional fodder and green manure plant will be presented from Santorini, Greece, *Vicia articulata* Hornem (some English common names are, bard vetch, single flowered vetch, Spanish lentil, black lentil and Auvergne lentil) (Maxted & Bennett 2001), which is today traditionally cultivated by an ever diminishing number of farmers as fodder (the foliage & ripe seeds) and green manure and is considered endangered (Hammer and Khoshbakht 2005:257) in many countries. Up to very recently, it had not been identified archaeobotanically but this alone does not prove its absence in antiquity. It should, rather, be considered as absence of evidence.

As we shall see, *V. articulata* could, easily, be mistaken for lentils (*Lens culinaris*) and even *Vicia sativus* (Pierrogiovanni & Taranto 2005) when charred and could be, wrongly, identified as such. This is obvious by looking at its common names where the term 'lentil' is often part of the name. The seeds of 'single flowered vetch'/ 'Spanish lentil', when fresh, have a very different appearance to lentil, in that they are 'marbled', whereas lentils are, generally, of a unified colour (Fig.1). Their charred or mineralised state, when found at archaeological sites, though, masks this striking difference between the two species of legume. Their very close resemblance both in size and shape, are valid reasons for providing mistaken identifications. However, their hilum is of a slightly different shape, where the common lentil has a linear hilum, whereas *Vicia articulate* has a wedge-shaped one. (Fig. 2)

This paper is not an exhaustive biography and/or study of the identification of *V. articulata.* It is just an introduction, so to speak, and is, just, a warning to make us more cautious, even when it comes to identifying, what we archaeobotanists believe are easy identifications, such as the lentil. Ethnobotany needs to enrich more its database on the not 'highly domesticated' legumes used in the past, such as what *V. articulata* is considered (Hammer & Khoshbakht 2005:257). Archaeobotany, hand in hand with ethnobotany, needs to expand even more the identified taxa and enrich our knowledge concerning the palette of these legumes in human history. Ann Butler (1990) who did important research on legumes with the help of SEM, unfortunately, had not included *V .articulata* in her SEM list. It is, therefore, work that is awaited.

Botanical Identification

Seeds of 'lentil' were provided by a traditional farmer, on the island of Santorini/Thera, who claimed that he had always grown this crop for fodder and green manure. These were planted, provided mature plants and these, thus, were identified as *V. articulata* Hornem., which, according to the Euro +Med PlantBase (2022), and the Temperate Plants database, is native to S. Europe from Portugal and Spain to Greece and Bulgaria. In W. Asia it is found in Turkey and Iraq. It is also native to Egypt and Canary Islands. It has also been introduced in several countries of Central Europe.

Background- Insights Into Its Biography

Enneking (1995:86) claims that *V. articulata*, is an ancient grain and forage crop of the Mediterranean and South-West Asia and is very well adapted to dryland farming. It is adapted to very low rainfall (± 300 mm), with a relatively high seed yield and fairly large seed size; with seed protein in the range of 22-26%, low to moderate toxins (Francis et al., 2000, Table 2). In Turkey (tekçiçkeli fiğ), its use is mentioned as a pulse[4] (Butler1990:85; Davis 1969,Vol.3:296; Wright 2001:39) and it is marketed as 'yellow lentil' (Aysen Uzun et al., 2011:254). Uphof (2001:543) mentions that it had been cultivated in the Mediterranean, Asia Minor, Madeira and Canary Islands as fodder for cattle and as green manure. In the past two centuries, it was known in Apulia, Sicily and Sardinia (Piergiovanni 2021:2) and seems to still be consumed in those areas of Italy. Wright (2001:39; also Facciola 1992:97) claim that the Bedouins of the Negev and Sinai eat the thick and floury seeds as soup and Facciola (1992) mentions that they were also eaten boiled. Kavvadas (1956: 869) (Fig.2 & 3) reported it has been widely cultivated in all of Greece as a fodder and green manure probably before the 1950s. As far as we have been able to trace in the bibliography, *V. articulata* in Greece is currently found cultivated only on the island of Santorini, although elsewhere in Greece it grows spontaneously, but it could be an escape of prior wide cultivation. Hammer, and Khoshbakht (2005:257) as well as Sáchez Vioque et al. (2008:950) included *V. articulata* (articulate vetch, Spanish lentil) in the list of endangered crop plants. It was believed to have been in the list of crop species that disappeared in the 20th century in Italy until Langhetti et al., (2000) located a population on the island of S. Antioco off the coast of Sardinia. It has also been sighted at Bovesia (Calabrian Greece) (Laghetti et al,.2008).

In Spain the 'moruna', i.e. *Vicia articulata* has been referred to by Remmers (1996:278; Remmers 1999; Remmers & González 1995) as the forgotten legume and, in the Alpujarra region, as 'algarroba'. It has been used as a green manure in diverse crop rotations and crop associations. Historically, the whole Alpujarra (Grenada province) and the neighbouring areas derived their sustainability from this green manure. One year of green manuring with *moruna* is said to sustain the associated crop yield for the next three years. It is, also, mentioned as having been cultivated in southern France, south-western Germany, Austria, Turkey and Syria (Langhetti et al., 2000:261). Townsend & Guest (1974:523) added Portugal, North Africa (Marocco, Algeria, Libya) and considered it adventive in North and Central Europe.

This legume could be intercropped with almonds, figs and grapes in rain fed agriculture and can also form a rotation with annual crops, such as cereals that generally alternated with *Vicia ervilia* and *Vicia sativa* (Remmers 1996:278). The important point is that of the three legumes, it best resists drought and it has been the only legume which historically is considered to have been used as green manure. As a drought resistant crop, it also requires the lowest soil fertility (Langhetti 2000:461). Traditionally, land which was considered 'poor' as well as semi-arid was planted with *V. articulata* and then ploughed under. It is important to note that it was considered better manure than dung, and fertilisers. 'La Moruna', *V. articulata*, a 'forgotten' legume (Remmers 1996:278) is consumed as fodder, as it is highly valued for sheep and goat, but can also be eaten by other animals too. Non-ruminants though should have a reduced intake as it can be toxic, due to L-canavanine.

What is strikingly difficult to understand is why such a useful crop has been led to near extinction, when it used to be one of the most important feed crops in Spain (Sánchez Vioque et al., 2009) and also widely used in Greece prior to the 1950s? Sánchez Vioque et al., (2009:646) believe that one reason is a) the marginalization of this crop from subsidies, b) its scarce domestication, which results in an absence of commercial varieties.

[4]*V.articulata* is still cultivated in South Eastern Turkey (Francis et al., 1999:8).

The Archaeobotanical Viewpoint

At the Mesolithic site of Balma Abeuradeur (France) lentils were found in Azilian levels, dated to c. 10,000 BP and they are believed to be, perhaps, *Lens nigricans* (Vaquer et al., 1986; Ladizinsky 1989:388). The same arguments are put forward by Hansen (1991) for the Mesolithic lentils from Franchthi Cave (Greece). It is interesting that Vaquer and Ruas (2009:777) (Grotte Abeuradeur-Late Glacial) refer to some lenticular seeds that could be 'confused' with *Vicia* sp. So, we would like to give them credit as stating the problem and, yet, this important statement remains buried within the text. It is indeed an open problem which I do not have the intention nor the tools, at present, to resolve but one which we need to keep an open mind to address, when we have a cache of seeds of lentil-type and where the archaeological contexts might indicate areas not particularly reserved only to human storage. Surely SEM work, morphometric studies and, probably, DNA analysis need to be applied to *V. articulata* in order to see whether segregation can be achieved from archaeobotanical samples of *Lens culinaris*, as well as its wild progenitor *L.culinaris ssp. orientalis* (Boiss) Ponert (Zohary et al., 2012:77) and other lenticular seeds.

Although *V. articulata* was highly cultivated in Early Modern times, in the Iberian Peninsula, there does not seem to be evidence for it in the Middle Ages, as stated by Peña-Chocarro, P. et al., (2019:63). Morales (2010), though, has identified the species in the Canary Islands dating back to the 14th century AD. Similarly, it has been, tentatively, found in a Late Medieval house at the site of Butrint (private communication Leonor Peña-Chocarro and publication is forthcoming). So far, this is all its visibility in archaeological contexts, but there is need of further work and a great deal of more sampling for archaeobotanical study.

Ethnobotany from Santorini/ Thera

On the island of Santorini, one of the authors, literally, just stumbled on this crop plant by pure chance, as it was nowhere mentioned as being cultivated. It took over twenty years, as we worked at the Bronze Age site of Akrotiri, to realise that what my informants meant when they mentioned 'lentil' was not the lentil we all know. They were referring to *Vicia articulata* (Fig.4) though, as the local term 'lentil' was used to designate this particular crop.

This 'lentil' (*Vicia articulata*) is a fodder crop and a green manure plant cultivated until very recently, and even now, on Santorini. Now-a-days, it is rarely cultivated and only 3 farmers have been located on the island, which still plant it to this day. Only one of them claims that it was eaten by humans in WWII. They

transformed it into ‘fava’ which means that they extracted the testa by grinding it and splitting the colyledons into two, as well as winnowing out the testa. However, an informer told us that it had such a bad taste that he could not even eat, later, the ‘fava’ made with *Lathyrus clymenum*, which is the staple dish in the present, on the island.

Green manure and Fodder

Beyond Green manure, this crop produces valuable straw (Francis, et al., 2000) and the cracked grain in quantities of up to 1/3 of the ration was mentioned as fattening the animals. Together with *Vicia ervilia*, *V.articulata* seems to have low to moderate toxins in the seeds. Two constituents though affect the nutritional quality of the seeds, and that is protein –which is quite stable- and L-canavanine content, which is a toxic non-protein amino acid and which could be detected by implementing near-infrared reflectance spectroscopy (NIRS). It could only be effectively discriminated between low, medium and high contents (Sánchez Vioque et al., 2009).

Cultivation On Santorini

The beginning of its cultivation on the island remains unknown. Elias Zorzos, a farmer from the village of Pyrgos, who cultivated fields, since his forefathers, on the mountain of Profitis Elias, said to have heard that Dimitris Drossos, who was born in the 1880s, cultivated ‘lentils’ for green manure. Although, it is known that ‘lentils’ had been cultivated in many areas in Greece (Kavvadas 1956), it is not known as to when it was first cultivated in Greece, but it seems to have disappeared elsewhere.

As it was demonstrated that it was an excellent green manure and that it provides a great deal of humidity, it was mainly ideally used for the cultivation of tomatoes on the island. The farmers claim that it holds humidity, which is equivalent to the water of 3 rainfalls. According to E.Zorzos, tomatoes were first cultivated on the island at Profitis Elias around 1860-70 by two brothers Peros and Michelios Karamolengos, from seed which was given to them by a Catholic priest.

‘Lentil’ is planted around St. Artemios’ feast (20th October) only if it has previously rained. In case it had not rained, many farmers did not plant it that year, as there was no time to transform it into green manure for the planting of tomatoes. It needed to be thickly planted, such as 10 kilos of ‘lentil’ for ~ 3000 sq.m. Occasionally, they planted it in vineyards.

After the end of the Christmas festivities, from St John’s feast (7th January) and until the 10-15th January they overturned and buried it, in order to give it time to transform into green manure around the feast of St. Charalambos (10 February), when they began the planting of tomatoes. Its manure was so good that it kept the production of the tomatoes going until December.

The ploughing in of the ‘lentil’ was done by the imported metal plough (Fig.5) which was drawn by 2 mules, a mule and a donkey or even by one mule. They started ploughing on one side of the field and this plough was followed by 2-3 people who pulled the plants and put them into the furrow with a mattock.

Then the plough returned alongside the first furrow and in the same direction and so forth. In the next planting year, they started ploughing at the opposite side, so that the soil would not be transferred on only one side of the field. The same method was used on the islet of Therasia, across Santorini.

In other cases, the burying of the 'lentil' was done by hand and this 'overturning' of the soil c. 35-40 cm. was done with a mattock and a spade, in such a manner as to bring the top soil underneath and vice versa. It was done by hand where the animals could not be used, as when the terraces were too narrow, or when they wanted to enrich the soil in a field. This was always done at the top end of the field (not on the edge of the terrace) so as to bring the soil towards (i.e. not the edge) the interior. This was a precaution against erosion.

They fed sheep and goat with 'lentil', as they believed it made them produce more milk. They also fed equids with it, but in small quantities, as they believed it could provoke diarrhoea in large quantities.

Food For Humans

On Santorini, it has been mentioned as used for humans only in times of food stress, although until the 20th century, *Vicia articulate* was consumed by the poorest Apulian people (Piergiovanni 2021). We were given no information on how they extracted the toxins, although their toxins are low, they still need detoxification techniques, as to make them edible. Piergiovanni (2021) mentioned that at Soleto, Italy, *Vicia articulata* needed to be soaked for 16 hours before cooking; whilst cooking took some 25 minutes. Lathyrism, otherwise, would provoke the loss of muscular control, paralysis of the lower limbs and could even lead to death. Ayyagari et al., (1989) mention that in order to detoxify *L. sativus*, a fermentation step was implemented, where they reduced 95% the neurotoxic substance. Moreover, pre-soaking the seeds and discarding the water reduced the toxins considerably. This method is suggested as practiced in prehistoric Greece (Valamoti et al., 2011) for *Lathyrus sativus* and *Vicia ervilia* but more research and experimentation needs to be conducted to provide the spectrum of detoxification methods. Butler et al., (1999:129) states that leaching, roasting, dehulling and boiling does reduce toxins. This is practiced in the highlands of Ethiopia and no lathyrism has been detected. The process was said to soak in hot water, but not boiling water, for about 10 minutes and this was thought sufficient to leach out most of the harmful toxins. It was followed by 30 minutes of exposure to the sun and followed by roasting for another 5 minutes on a hot plate on top of the oven or fire. The testas, which are believed to have most of the toxins, are then carefully ground and only at that stage are hulls believed to be safe, to give for animal feed. Enneking 1994 claims that they have also been used for human consumption in times of famine and in Equador as well, and *V.articulata* were referred to as the black lentil.

Beyond the obvious traps of language, dialect and culture, there are other caveats which need to be cleared. What's in a name after all? This axiom is something that needs to be juggled and questioned whilst doing ethnobotany, and, in general, ethnography.

Epilogue

Having said the above, it must be admitted that there is a sense of insecurity, as an archaeobotanists, regarding the identification of lentils after having encountered this crop. Up to now, lentil identification was an easy case, especially when we were dealing with periods from the Bronze Age and later. Earlier periods such as lentils from the Early Neolithic, Mesolithic and even earlier can be tricky, as we could be dealing with other species such as *L.orientalis*, *L.nigricans* and even *L.ervoides* (Ladizinsky 1989; Hansen 1991). The three of them have the same chromosome number (Ladizinsky 1979:179) and all of which are found in the wild in Greece (inter alia Sonnante et al., 2009:24). Yet, Ladizinsky (1979a:186) states that L. culinaris is much closer to L. orientalis than to L. nigricans. 'It is apparent that lentil was not domesticated at the southwestern part of the Fertile Crescent in the Middle-East', and it is believed to have been accomplished in a single step event (Ladizinsky 1979b). Therefore, instead of solving a problem in this paper and accumulating knowledge, I am truly very sorry to be deconstructing accepted premises. This is the only way to widen and enrich our knowledge concerning legumes, which are a source of food, fodder and manure, that will be increasingly important for sustainability studies.

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Figures

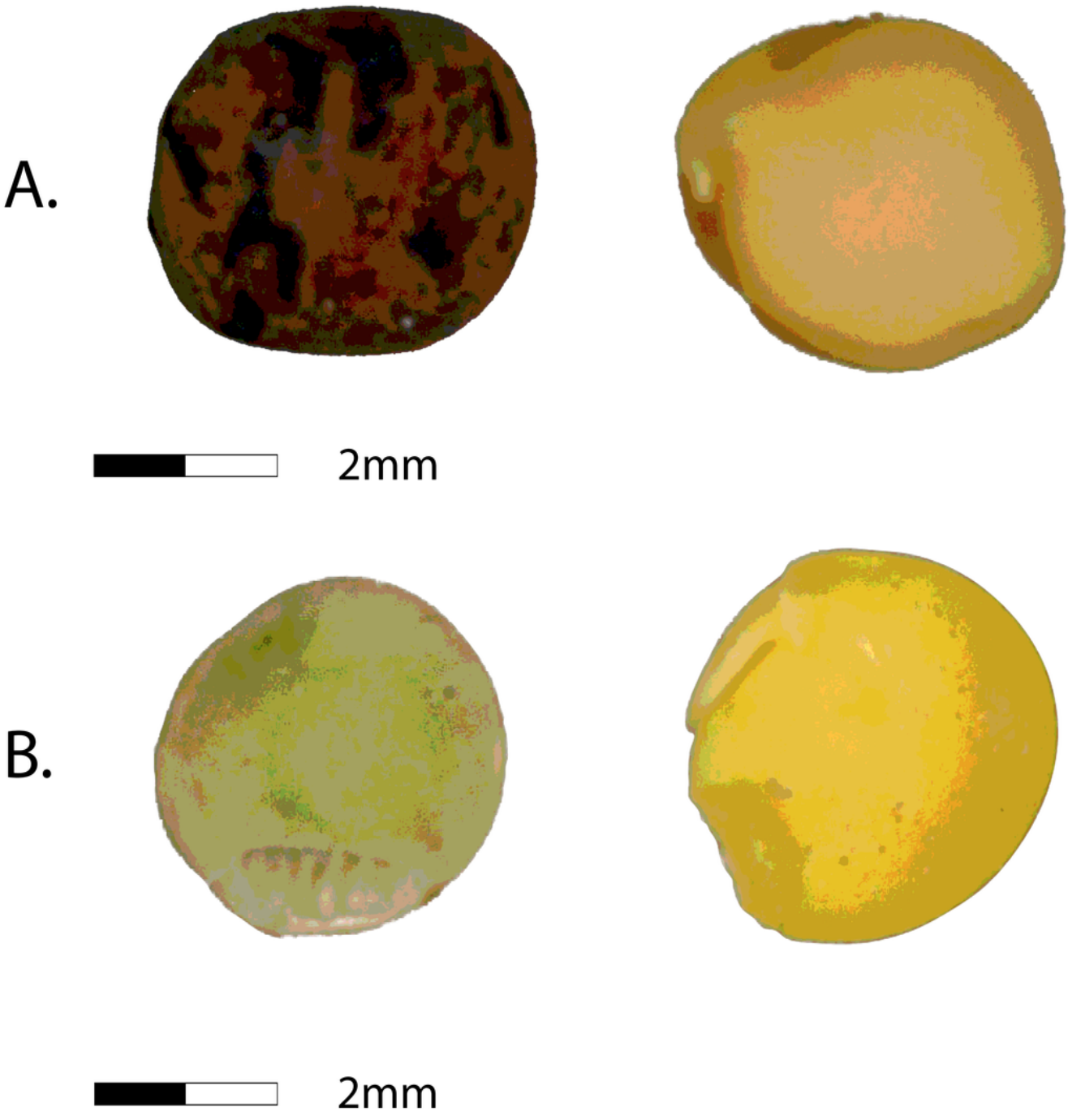

Figure 1

(A) *Vicia articulata* (*Vicia monanthos*), marbled testa and testa removed; (B) *Lens culinaris* with testa and removed testa.

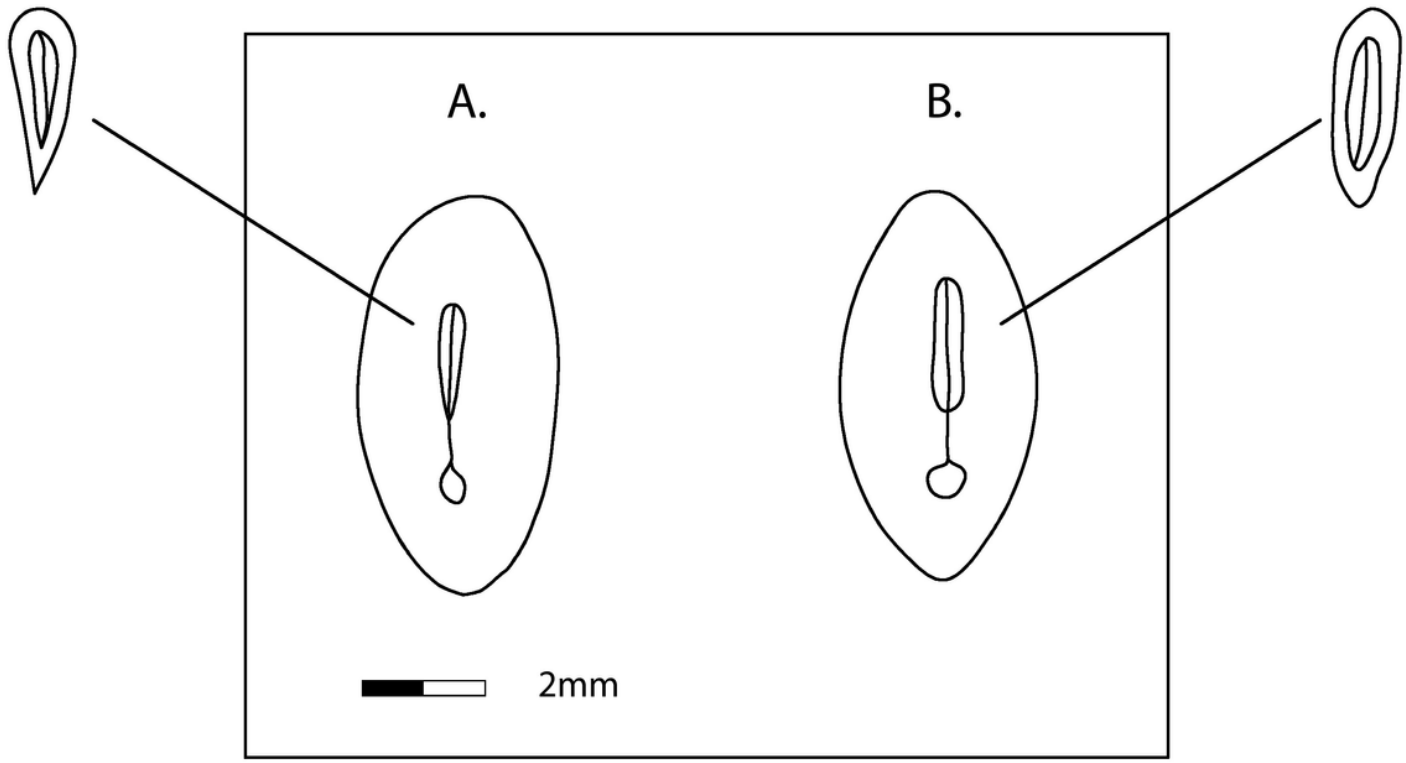

Figure 2

Schematic drawing of seeds (A) Vicia articulata, wedge-shaped hilum; (B) *Lens esculenta*, linear hilum.

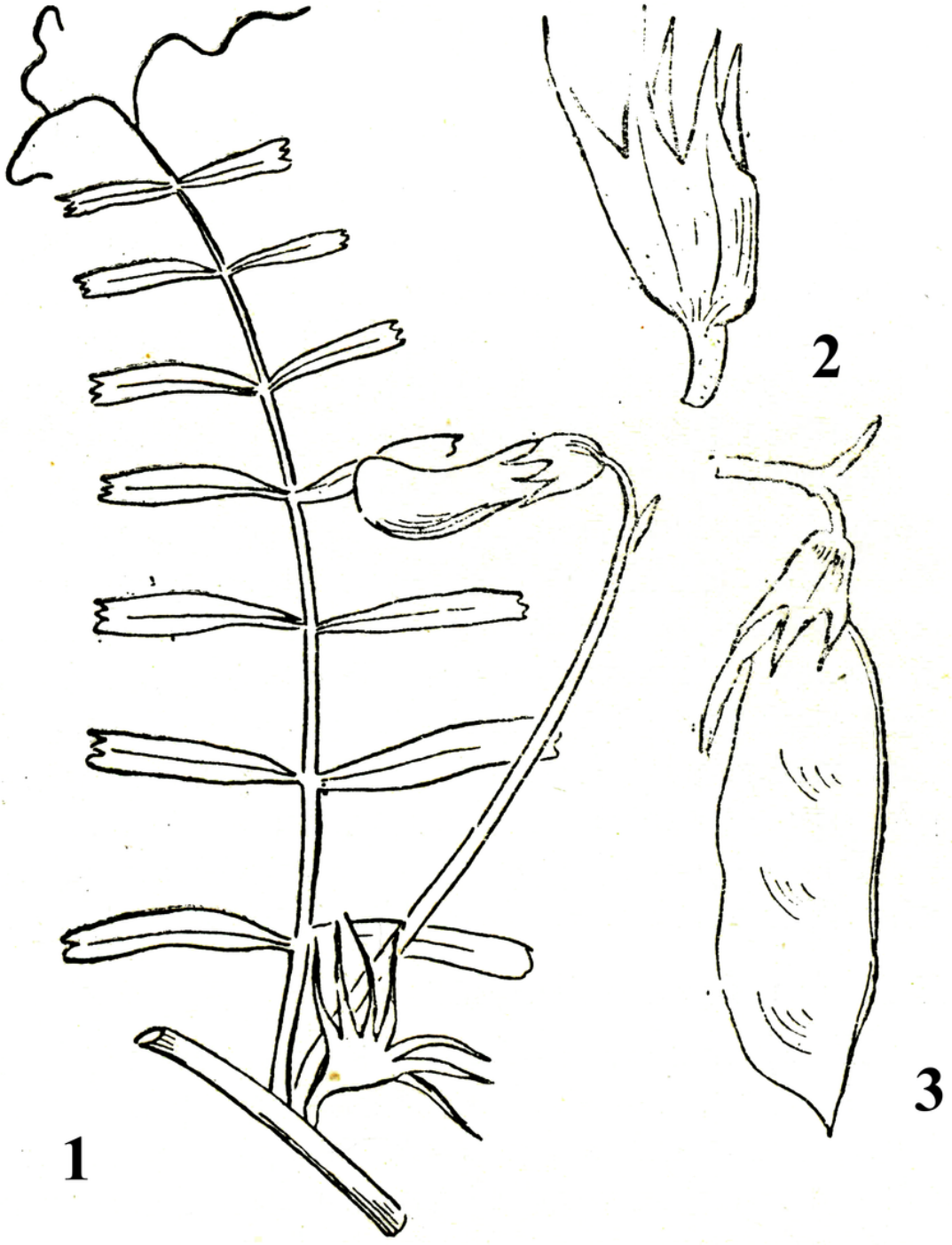

Figure 3

Vicia articulata (*Vicia monanthos*) plant drawn by Kavvadas (1956:869, fig.1141) himself: 1) a shoot; b) a calyx; c) the fruit, a legume.

Figure 4

Vicia articulata (*Vicia monanthos*) plant (photo by M.Skoula).

Figure 5

Ploughing with a metal plough on the island of Santorini in order to prepare to plant *Vicia articulata* (Photo by Harry Katsipis).