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Autor(en): **Yannitsaros, A. / Economidou, E.**

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Studies on the adventive flora of Greece.

I. General remarks on some recently introduced taxa

A. YANNITSAROS & E. ECONOMIDOU

RÉSUMÉ

Au cours d'une étude sur la flore adventive de Grèce, les auteurs proposent une subdivision des néophytes en deux catégories principales: les endonéophytes et les exonéophytes, cette dernière est également subdivisée en homorophytes et xénophytes.

Une série de néophytes observés et récoltés en Grèce durant ces dernières années sont décrits à différents points de vue: origine géographique et distribution, voies d'introduction, modes de dissémination et écologie.

SUMMARY

The authors, studying the adventive flora of Greece, propose a subdivision of the neophytes into two main categories, viz. endoneophytes and exoneophytes, the latter ones being further subdivided into homorophytes and xenophytes.

A series of neophytes observed and collected in recent years in Greece are discussed from the following points of view: geographical origin and distribution, ways of introduction, patterns of spreading, and ecology.

ZUSAMMENFASSUNG

In einer Studie über die Adventivflora Griechenlands schlagen die Autoren vor, die Neophyten in Endo- und Exoneophyten zu unterteilen. Die letzteren werden weiterhin in Homorophyten und Xenophyten untergliedert.

Eine Reihe von in Griechenland beobachteter und während der letzten Jahre gesammelter Neophyten wurde in Hinblick auf geographischen Ursprung, Verbreitung, Art der Einführung, Ausbreitungsart, und Ökologie diskutiert.

Introduction and terminology

Botanists have been studying the flora of Greece for a long time and mainly the endemic plants of the country. However, there are some equally interesting problems connected with the adventive flora of Greece. Greuter (1971) has recently

made a contribution to this subject. Commenting on the relative terminology proposed by Thellung (1910, 1912, 1922) and Kornas (1968), he suggests the new term "xenophytes" for adventive plants introduced into a floristic region from other regions, which have no connection with the first one. He puts this group of plants in the general category of "neophytes" but he does not propose a term for the rest of the plants in the category. These plants have originated from floristic regions connected with the region into which they have been introduced, or have originated from other parts of the region itself.

An example of such a plant is *Capsella grandiflora* (Fauché & Chaub.) Boiss. which is an endemic of Western Greece and Albania. This species is considered to have been introduced into the district of Trieste in N. E. Italy and naturalized there (Fiori 1924, Chater 1964). It has been found recently in Attiki¹ in a locality where it appears to have been introduced involuntarily by man (Yannitsaros 1973). Another example is *Centranthus ruber* (L.) DC. which is spontaneous and native to the island of Kithira and to Peloponnisos and is considered as having been introduced into Kriti (Greuter 1971). These neophytes are cases of plants originating within the same floristic region. *Halophila stipulacea* (Forsk.) Aschers. is a species which was probably introduced into the Mediterranean from the Red Sea after the excavation of the Suez Canal (Fritsch 1895, Politis 1926). Thus it comes from a floristic region which is in contact with the Mediterranean one.

From the above it is evident that a further extension of the terminology based on Greuter's criterion for the term "xenophytes" is needed. Using this criterion the neophytes can be separated into the following categories:

1. **Endoneophytes:** Neophytes originating from other parts of the same floristic region.
2. **Exoneophytes:** Neophytes originating from floristic regions other than that into which they have been introduced.

Furthermore, the "exoneophytes" can be subdivided into:

a. **Homorophytes:** Exoneophytes which come from a floristic region in contact with that into which they have been introduced.

b. **Xenophytes:** With the meaning given by Greuter (1971).

According to the above proposed terminology *Capsella grandiflora* (Fauché & Chaub.) Boiss. is an "endoneophyte" for the areas of Trieste and of Attiki, and so is *Centranthus ruber* (L.) DC. for the island of Kriti. On the other hand, *Halophila stipulacea* (Forsk.) Aschers. could be considered as an "exoneophyte — homorophyte" for the Mediterranean region.

It is quite certain that in the past, the dispersal of many plants within the same floristic region or into neighbouring regions has been affected in a similar way. Verification of such transfers is, in most of the cases, extremely difficult if not

¹Names of localities and districts of Greece in the text follow those cited in the Times Atlas of the World — South Europe (Bartholomew 1956). For the climatic factors we refer to Mariolopoulos (1938, 1960) and Mariolopoulos & Carapiperis (1955a, 1955b).

impossible. Nevertheless we can trace transfers, which have taken place recently, between countries with a well known flora.

The transfer and the establishment of neophytes from one part of a floristic region into another part of the same region seem to be a rather frequent phenomenon today. However, the establishment of neophytes in neighbouring floristic regions appears to be a rare situation under present-day climatic conditions. Generally, the effective establishment of exoneophytes takes place mainly in regions with a similar climate. This does not happen in neighbouring floristic regions where the climatic conditions are dissimilar.

So, most of the exoneophytes of the Mediterranean area do not come from the neighbouring floristic regions but from others with a similar climate such as the Cape Region (South Africa) and the warm temperate and subtropical areas of the Americas. Baker (1972) similarly assumed that most of the introduced weeds of California have their origin mainly from the Mediterranean region, and secondarily from Chile, Argentina, South Africa and Australia.

In Greece, several naturalized neophytes of this type are known for a long time. Most of these are today widespread over the greater part of the Mediterranean area. Some species of this category are: *Oxalis pes-caprae* L. a native of South Africa, *Opuntia ficus-barbarica* A. Berger, *Nicotiana glauca* R. Grah., *Datura metel* L., *Erigeron canadensis* L., and *Agave altissima* Zúñiga which come from America, *Ailanthus altissima* Swingle originating from Eastern Asia, and many species of *Xanthium*, *Amaranthus* and *Chenopodium*.

In addition to the above aliens, a new series of neophytes were observed and collected in recent years during our field work. Up to now these plants were unknown or they have been recorded only from some districts or from a few scattered localities in Greece. Some of these neophytes which we are going to discuss briefly are the following:

- Coronopus didymus* (L.) Smith (*Cruciferae*);
- Solanum elaeagnifolium* Cavanilles (*Solanaceae*);
- Aster squamatus* (Sprengel) Hier. (*Compositae*);
- Tagetes minuta* L. (*Compositae*);
- Halophila stipulacea* (Forsk.) Aschers. (*Hydrocharitaceae*);
- Paspalum distichum* L. subsp. *paspalodes* (Michaux) Thell. (*Gramineae*);
- Paspalum dilatatum* Poir. (*Gramineae*).

Geographical origin and distribution

Coronopus didymus (L.) Smith is a South-American species which has been introduced into most of the countries of Western, Central and Southern Europe where it is naturalized now. This plant has not been recorded from the mainland of Greece until now. It was discovered in Laconia in 1971, and later in Attiki by the senior author (Yannitsaros, sub praelo). However, it has been reported previously from the Ionian islands of Zakinthos (Bormüller 1928) and Lefkas (Hofmann 1968) and also from the island of Rhodos (Hansen & Snogerup 1966).

Solanum elaeagnifolium Cavanilles had not been recorded from Greece until quite recently. In a recent paper by Zahariadi (1973), he cites this species together with other new or rare plants for Greece. According to him this species is distributed throughout Ohio, Kansas, Texas, Arizona, Florida in N. America, and it has been introduced into the Mediterranean region. In 1956, Martino reported this species as being spontaneous in Kansas, Colorado, Arizona, Mexico and S. America. According to "Index Kewensis" it is distributed throughout Tropical America.

Concerning its distribution within the Mediterranean region, Zahariadi (1973) cites only Egypt besides Greece. He considers it as unknown in Israel, Bulgaria, Italy, Spain, Morocco and Tunisia. But as a matter of fact, it is known in Israel as a well-established and widespread neophyte (Zohary 1962). Also it is reported from Sicily, as *S. elaeagnifolium* Cav. var. *leprosum* (Martino 1956, 1967).

According to Zahariadi (1973) the first specimen in Greece was collected in 1949 and the species has since been spread to several localities, viz. Rhodopi, Thessaloniki, Elasson, Tirnavos, between Agrinion and Amfilokhia, Attiki, Leonidion, and Kalamata.

This plant was observed or collected by us in and around Thessaloniki, in Attiki, on Kriti, and in the area between Agrinion and Arta. It is very abundant around Thessaloniki where, during the summer, it covers great abandoned fields and the margins of roads. Also, it is frequent on roadsides between Agrinion and Amfilokhia. In Attiki, it has been observed in several localities, but the number of plants on each spot was small. On Kriti it was found for the first time in 1972 and only in one locality (voucher specimen: Nomos Chanion, Soudha, 18.8.1973, leg. A. Yannitsaros 5409, in herbarium A. Yannitsaros). So, the species seems to be new to Ipiros and Kriti. It has not been recorded from these districts by Zahariadi (1973) or by Greuter (1973).

The species *Aster squamatus* (Sprengel) Hier., a native of Central and South America, has been naturalized as a weed in many parts of the Mediterranean region in the last decades. Among others, Greuter (1973) records it from the island of Kriti. In Greece, except for Kriti, this plant has been reported quite recently from Attiki as *Conyza squamatus* (Zahariadi 1973). It was collected or observed by us in many places in Attiki and in Western Greece (Aitolia, Acarnania, Ipiros), on the Ionian island of Lefkas and on the island of Skiathos (Northern Sporades). So, it seems to be new to Western Central Greece (Sterea Ellas), Ipiros, the Ionian Islands and the Northern Sporades.

Tagetes minuta L., a native of Tropical America, is new to Greece. In the Eastern Mediterranean it has been reported, until now, only from Yugoslavia under its synonym *Tagetes glandulifera* Schrank. The only records for this region known to us are those of Hayek & Markgraf (1931) for Dalmatia and of Maly (1935) for Herzegovina. A recent record is that of Micevski (1970) from Yevyeli. Also, it is a rare xenophyte in the Mediterranean part of France (Fournier 1961).

In Greece, *T. minuta* L. was found only on the Aegean island of Lesbos in a place called "Mallionda", west of the village of Mesotopos (voucher specimen, in flower, 25.11.1972, G. Yannitsaros s.n.; in herbarium A. Yannitsaros). It is to note that not only the species but also the genus is new to Greece.

Halophila stipulacea (Forsk.) Aschers. is a salt-water Monocotyledon distributed in the Red Sea and in the western part of the Indian Ocean. In Greece it has been discovered first by Nemetz in the harbour of Rhodos in 1894 (Fritsch 1895). In 1923, Pinatsis found it on Siros, and Politis on the shores of the peninsula of

Piraeus (Politis 1926). Later it was found at Phaliron, on the islands of Aiyina, Tinos, Cithnos (Politis 1926), and Samos, and near the Cape Tainaron or Matapan (den Hartog 1970). It was collected by us in the Saronic Gulf, near the place called "Lemos Vouliagmenis", on a sandy bottom, at a depth of about 4 meters.

Paspalum distichum L. subsp. *paspalodes* (Michaux) Thell. came from the Tropical and Subtropical Americas. It has been introduced into most of the Mediterranean countries and is naturalized there. It was first recorded from Greece by Oberdorfer (1954). He discovered it in some localities in Makedhonia in 1944. Later Lavrentiades (1956) found it at other stations in the same district.

On our field trips, this taxon was collected or observed near Lamia, at Levadia, near the bridge of the river Megdhova, near Arta, at Vonitsa and Mesolongi, and on the island of Lefkas. Consequently this plant is new to Central Greece (Sterea Ellas), Ipiros and the Ionian Islands.

As far as we know *Paspalum dilatatum* Poirlet has not been recorded up until now from countries of the Eastern Mediterranean, except for Greece (the island of Lefkas, Hofmann 1968). This South-American species has also been recorded from Iraq (Bor 1964). In Europe it has been found in Germany (Bergdolt & al. 1936) and in France (Bonnier & Douin 1931, Fournier 1961). Except for Lefkas, where the plant was found by us in 1973, *Paspalum dilatatum* Poirlet was discovered recently in the area of Lamia in Sterea Ellas. Thus it is a new record for the mainland of Greece.

A detailed list of the localities of all the mentioned taxa, maps of distribution and other data will be published in the near future.

Ways of introduction

At present, it is difficult to determine, with certainty, the way in which the above taxa were introduced into Greece, as the data on this subject are very limited.

For *Solanum elaeagnifolium* Cavanilles there is evidence that one of the Greek localities into which it was first introduced, probably directly from America, is the American Agricultural School near Thessaloniki. This opinion is supported by the fact that this species is commonly found in an extensive area around this School. Another locality, to which the plant seems to have been introduced, probably also directly from America, is an old abandoned forest nursery now included in the Athens University Campus. This species was fairly abundant in this locality some years ago, but due to human activities in the area its population has decreased considerably. Its presence in the area between Agrinion and Amfilokhia is probably connected with introduced tobacco seeds. The introduction of this species to Soudha (Kriti) is apparently very recent. There it was first observed by Yannitsaros in the summer of 1972. During his previous visits and explorations of the area (1969), he is rather certain that the plant was not there and it is suspected that its introduction is connected with the harbour and the import of various plant materials.

Aster squamatus (Sprengel) Hier. has been very frequently noted on the outskirts of Athens in the last two years (1972-1973). Already in 1965, this species was observed in the old abandoned forest nursery of the Athens University Campus.

In the same year, the plant was found in the "Botanical Garden of Julia and Alexander Diomidis" at Dafni, Attiki, where a forest tree nursery had been previously established. In 1965 a few plants of *Solanum elaeagnifolium* Cavanilles were also observed on the same site. For these reasons it is supposed that the way of introduction of these two species into our country was through these nurseries.

From the studies of Fritsch (1895) and Politis (1926) it is known, that *Halophila stipulacea* (Forsk.) Aschers. came into the Mediterranean and the Aegean Seas after the excavation of the Suez Canal. It is assumed that this species was transferred from the Red Sea on the hulls of ships to which fragments of the plant were attached. In our opinion, sea-currents have also greatly aided the transfer and spread of this plant in the Aegean.

Evidently, *Paspalum distichum* L. subsp. *paspalodes* (Michaux) Thell. was introduced into Greece through the northern districts of the country as it has been found there since 1944 (Oberdorfer 1954). It is interesting that this plant has not been recorded up till now from Peloponnisos although there are no climatic reasons to check its spreading.

Paspalum dilatatum Poiret was introduced for the first time into Greece in 1885 by Gennadios and it was successfully planted in the then Municipal Arboretum of Athens. The species was kept there under cultivation at least until 1914 (Gennadios 1959, Cavvadas 1956). It was probably cultivated in some localities as a fodder plant. However, today it is known as subsponaneous only from two localities in Greece. On the contrary, *Paspalum distichum* L. subsp. *paspalodes* (Michaux) Thell. has a more or less wide distribution in Northern and Central Greece. This taxon seems to have greater ability to adapt to new environments than *Paspalum dilatatum* Poiret and generally a greater dynamic for dispersal and the occupation of new habitats.

Patterns of spreading

The patterns of spreading within an area for some of the above plants are very interesting. This subject has not been studied in detail, because the plants are newly introduced and our observations cover a rather short period. Our intention is to continue these studies in the future.

Solanum elaeagnifolium Cavanilles has a characteristic pattern of spreading. This particularly is evident in the area of Thessaloniki, a centre where it exists at high frequency. From this centre, which probably represents the point of its first introduction and establishment, the plant is spreading in all directions. This spreading is not continuous but occurs by leaps. The space between the neighbouring colonies enlarges the further we go from the centre.

Aster squamatus (Sprengel) Hier. has a rather similar pattern of spreading, while *Coronopus didymus* (L.) Smith has very scattered and sporadic appearances.

Ecology, habitats

Coronopus didymus (L.) Smith grows, in Greece, mainly in sandy or pebbly places usually near the edges of roads. It seems to be a thermophilous, but not a strictly hygrophilous species as it has been considered by some European authors (Markgraf 1962, Oberdorfer 1962), because in some cases it exhibits tendencies to become naturalized in dry habitats (Yannitsaros, sub praelo).

Solanum elaeagnifolium Cavanilles grows in small or large groups as it reproduces not only by seeds but also by rhizomes. Its habitats include fallow abandoned fields, abandoned forest nurseries and frequently the edges of roads.

From a climatic point of view, *Solanum elaeagnifolium* Cavanilles prefers warm and dry habitats. Thus, it grows mainly in areas which are characterized by a high summer temperature and a low percentage of annual precipitation (Attiki, the area around Thessaloniki, the area between Agrinion and Amfilokhia, Leonidion, Soudha). A few individuals of this species were found in a humid habitat in one instance only. Specifically, it was collected by us at Arta, near the old bridge over the river Arachthos, together with *Sambucus ebulus* L. and subsponaneous individuals of *Helianthus tuberosus* L. This habitat was cool and shady, but not situated near the water. In any case we consider that this habitat is not a typically characteristic one for *Solanum elaeagnifolium* Cavanilles. In our opinion the most significant factors affecting the distribution of this species are temperature and humidity. This conclusion is reached on the basis of its habitats and general distribution in America and in the Mediterranean region (Sicily, Greece, Egypt, Israel), and also on the basis of its morphological characters which are strongly xeromorphic.

Aster squamatus (Sprengel) Hier. grows in warm habitats of Central Greece. It seems that this species has a wider range of adaptation to humidity than *Solanum elaeagnifolium* Cavanilles, as it is met with in Attiki, a very dry district, as well as in humid and wet habitats of W. Central Greece. We found this plant growing in moist ditches near the old bridge of Arachthos.

The most usual habitat of *Aster squamatus* (Sprengel) Hier. is along the edges of roads. It is one of the commonest plants of urban sites. In some suburbs of Athens it grows frequently together with *Erigeron canadensis* L. on curbs and sidewalks.

Tagetes minuta L. was found in a warm and more or less humid locality, growing as a weed in vegetable gardens or in their vicinity.

The two taxa of *Paspalum* are hygrophytes. They are met with near streams, rivulets and rivers or other moist places. They also grow on irrigated soil, such as is found in cotton-fields and orchards. It seems that *Paspalum distichum* L. subsp. *paspalodes* (Michaux) Thell. tolerates low winter temperatures, as it has been found growing in several localities of Northern Greece.

Work plan

At least some of the above mentioned plants seem to have become completely naturalized in Greece. These are *Solanum elaeagnifolium* Cavanilles, *Aster squamatus*

(Sprengel) Hier., *Paspalum distichum* L. subsp. *paspalodes* (Michaux) Thell., and *Halophila stipulacea* (Forsk.) Aschers. The first three ones have a rapid expansion and will perhaps become very troublesome weeds, as has happened with *Oxalis pes-caprae* L. As all the taxa in question are very interesting from a biological point of view and as they are very little known in Greece, we are planning to continue our investigations on their morphology, ecology, chorology, etc.

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