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***Euphorbia dendroides* (Euphorbiaceae): a monographic view on a Mediterranean species**

Abstract

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In this article single aspects of a monographical study on *Euphorbia dendroides* L. (Euphorbiaceae) are presented. Aspects of its biology and its systematic as well as sociocultural position are discussed. For the first time the age of single individuals could be distinguished. Based on field investigations of the author as well as on the interpretation of the literature and herbarium specimens a revised total area of *Euphorbia dendroides* is presented. Finally its phytosociological position is analysed.

Introduction

The tree spurge *Euphorbia dendroides* was already known in classical times: it is mentioned in books of Dioscorides (1st century A.D.) and Pliny (23-79 A.D.). From the very beginning of vegetation science *Euphorbia dendroides* is regarded as an element of the original vegetation of the Mediterranean coastal zone. It colonises rocky regions mostly cases directly near the sea until about 600 msm and can be found in the majority of the countries around the Mediterranean (not in Slovenia, Bosnia, Cyprus, Syria, Lebanon and Morocco).

In the following investigations on biology, sociocultural position, distribution and phytosociology of the tree spurge are presented. These results are part of a recently published monographical study on *Euphorbia dendroides* (Eichberger 2001) worked out at the Institute of Botany, University of Salzburg (Prof. Heiselmayer).

Material and methods

Based on a first interpretation of the literature on the distribution of the species (Ozenda 1950; Lavagne & al. 1974; Browicz 1983; Bianco & al. 1983-1984a, b; Trinajstić 1986) and with the important help of Dr. Th. Raus (Berlin), Prof. F. Pedrotti (Camerino) and Prof. J. Loidi (Bilbao) suitable sites were sorted out. Afterwards large coastal areas were covered by car and the populations of *Euphorbia dendroides* were finally chosen. Between 1994 and 1997 in Greece (including Crete), Italy (including Sicily and Sardinia), France (including

Corsica) and Spain (including the Balearic Islands) 300 relevés were taken, following the method of Braun-Blanquet (1964) and Dierschke (1994). In France and Spain (1996) investigations on the morphology and the growth form of *Euphorbia dendroides* were done. In addition the age of spurge individuals could be determined rather precisely for the first time (see below).

To design and complete a distribution map with the total area of *Euphorbia dendroides* the relevant literature was scanned and further information from corresponding colleagues was added. In addition the specimens of *Euphorbia dendroides* of the large as well as the locally important herbaria were analysed. Finally all localities of *Euphorbia dendroides* were checked critically.

In this brief paper the results and the discussion of the single monographic aspects are presented together to reach a clear arrangement.

Results and Discussion

Systematic position

The name *Euphorbia dendroides* was chosen by Linnaeus (1753: 462¹). In former times up to the 18th century the species was often called "Tithymal(l)os dendroides" or "Tithymal(l)us arboreus". Since Boissier (1862) it is attributed to the primitive subsect. *Pachycladae* Boiss. resp. sect. *Pachycladae* (Boiss.) Tutin (Tutin 1968; Smith & Tutin 1968), recently to a sect. *Balsamis* Webb & Berthel. (Radcliffe-Smith 1982; Benedí & al. 1997). The particular species are for the most part limited to the Macaronesic region. *Euphorbia dendroides* represents the only Mediterranean exponent.

Caryological investigations showed similar results: $2n = 18$ (cf. D'Amato 1946 in Moore 1982; Darlington & Wylie 1955; Hans 1973; Hurosawa & Shimoyama 1976; Moore 1982 a.o.).

After Linnaeus (1753) two hardly used synonyms were published: *Euphorbia divaricata* Jacq. (Jacquin 1781-1786) and *Euphorbia laeta* Aiton (Aiton 1789; for older synonyms as well as generally not accepted variants and forms see Eichberger 2001: 20 ff.).

Biology, growth form, age

The flowers of *Euphorbia dendroides* are mostly cross-pollinated by flies. After the bursting of the trivalvate capsule the seed dispersal takes place by ants which are attracted by the albuminous and fatty caruncle. In autumn, from September onward the sprouting of the leaves begins. The flowering at the earliest starts in December. At the end of April the first seeds ripen – in northern regions not before June. Finally in May or June the often red coloured foliage falls. Against browsing the semisucculent shrub (Jacobsen 1981) is protected by its poisonous latex (Hegnauer 1989).

The very original growth form of *Euphorbia dendroides* is named "round-topped tree", "candelabra (-shaped) tree" and the like (Rauh 1939; Meusel 1970). The spherical form is the result of a first monopodial growth which after the first development of flowers is

¹ "EUPHORBIA umbella multifida: dichotoma, involuclis subcordatis: primariis triphyllis, caule arboreo." (Linnaeus 1753: 462; *Euphorbia* No. 53).

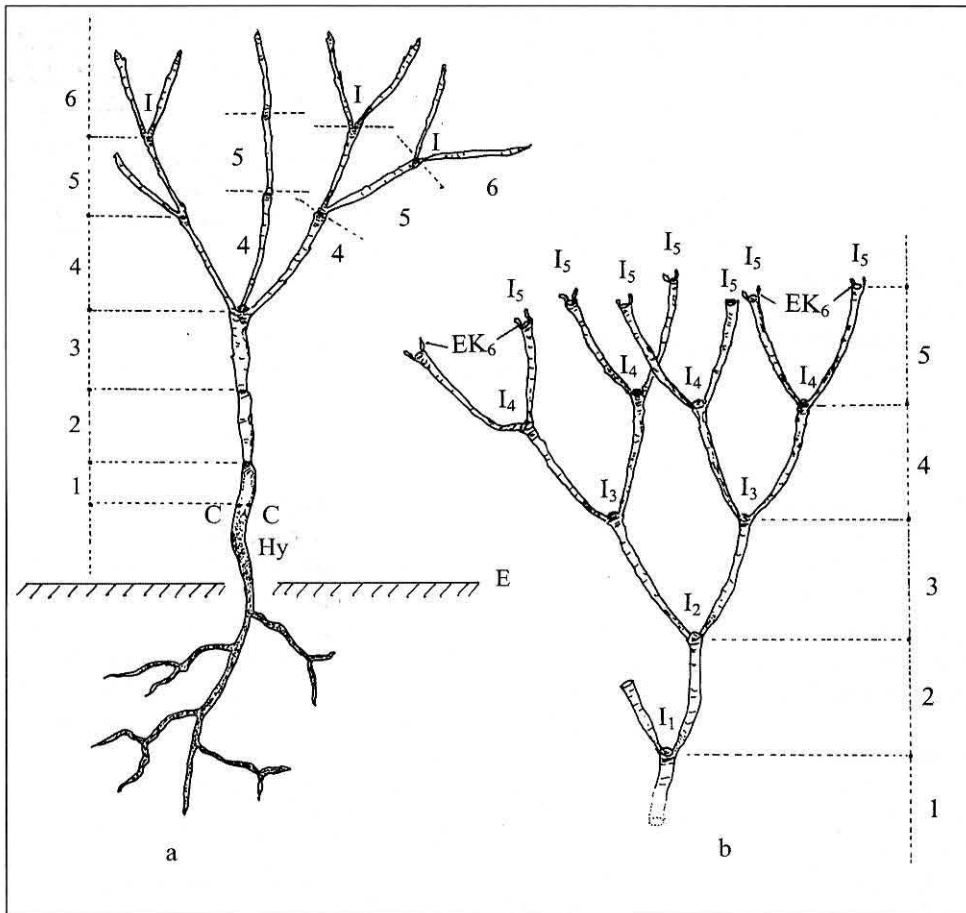


Fig. 1. Development and branching of *Euphorbia dendroides* (C cotyledons; E earth line; Hp hypercotyl; Hy hypocotyl; I innovation buds; W root; dotted lines mark one-year shoots); a: a 6 year old plant, which completed its monopodial growth after the 3rd year with a terminal inflorescence; further on a sympodial branching system predominated, only one non flowering shoot shows still a monopodial growth; b: detail of 5 shoot periods of an older individual (I resp. I₁₋₅ innovation buds; EK₆ innovation buds of the 6th year); drawn from herbarium material of the author with regard to delineations of Rauh (1939).

replaced by an acrotonous sympodial shoot innovation with generally two lateral buds (Figs 1, 4). On the thickened shoot tips with their compressed internodes signs of annual growth can be clearly identified in the most cases. This allows a relatively precise fixing of the age. Only on thick main stems of older individuals the limits of the annual growth can not be distinguished doubtless.

The tree spurge can reach an age of probably more than fifty years on primary rocky locations; here the length of the annual shoots amounts less than 3-5 cm. On secondary habits however individuals were found which were hardly older than thirty years, but here

Age(years)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vital plants	.	3	2	.	1	2	.	.	.	2	.	1	.	1	1	3	2	5	.	2
Dead plants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
4	.	2	.	1	1	2	.	.	1	.	1	1	.	1	.	1	.	1	1	.	.	2
1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	1

44	45	46	47	Total
.	1	.	1	46
.	.	.	.	6

Fig. 2. Age structure of an *Euphorbia dendroides* population on a stony pasture approx. 3 km E. of El Port (de Valldemosa), Mallorca, Balearic Islands, Spain (approx. 200 msm, 10° W; 160 m², coverage 80%; 13.4.1996).

the length of the annual shoots exceeds 20-30 cm. The oldest explored individual was found near Valldemosa on the island of Mallorca (Spain): it reached 47 years (see Fig. 2).

In a competitive situation (for not getting overshadowed) *Euphorbia dendroides* can reach a maximal height of 4-6 m (> 4 m: South of Marina di Patti in North Sicily; island of Korčula in Croatia: Trinajstić 1984b; 3-4 m: Sithonia peninsula in North Greece; Trikkeri peninsula in Thessaly, Greece; Cap Roux, South France a.o.). Generally regular round-shaped shrubs grow 1-2 meters high.

Sociocultural position

Unlike many other Mediterranean plants *Euphorbia dendroides* obviously shows no mythological background. Very abundant however are the pharmacological reports on this species beginning with *Dioscorides* (4, 164, 9: 11-15 following Wellmann 1906-1914) and Pliny (26, 45, 71 resp. König 1983). From the 16th century onward the species is described by authors like Micheli (approx. 1530 in De Toni 1940), Anguillara (1561), Mattioli (1557, 1586), Caesalpinus (1583) or Prospero Alpino (1627). Like many *Euphorbia*-species the tree spurge was used as a purgative (especially the seeds). *Dioscorides* (4, 164, 9) described a lot of pharmacological effects of *Euphorbia*-species; he mentioned that δεινδροειδής (= *Euphorbia dendroides*) has similar effects as other *Euphorbia*-species. In more recent Pharmacopoeias no more *Euphorbia*-species are mentioned for medical purposes (Imbesi 1964).

Euphorbia dendroides however was used even in the 19th and 20th century as a fish poison in Greece (Heldreich 1882) and Sardinia (Camarda & Valsecchi 1983). Fishermen put the latex into the water of brooks and lakes to drug the fresh-water fish.

Distribution

The area of *Euphorbia dendroides* as shown in Figure 3 covers the Balearic Islands and Catalonia in Spain, South-East France, Corse, Sardinia, the Ligurian and the whole Tyrrhenian coast of Italy, further on Sicily, the Salentine peninsula, sporadically the Italian and Croatian Adriatic coasts, Montenegro, Albania, Greece and Crete. It also occurs

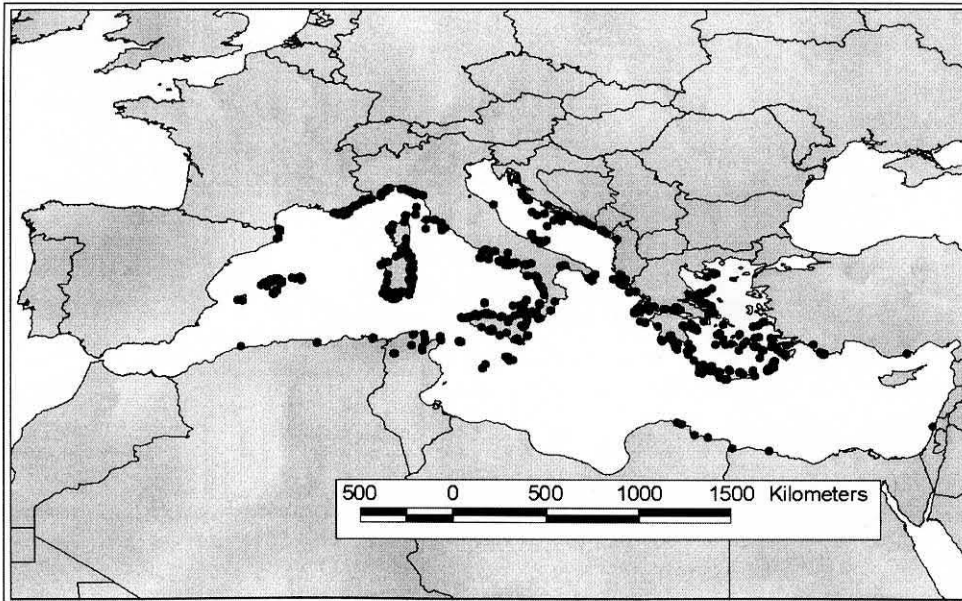


Fig. 3. Revised total area of *Euphorbia dendroides* based on field investigations of the author as well as on data from the literature and herbarium specimens (data source: ESRI Inc., Redlands, CA, USA; cartography: M. Weinberger & A. Blaschka, Salzburg).

sporadically in North Algeria, North Tunisia and North-East Libya. Only very isolated locations exist in South Anatolia, on Monte Carmel near Haifa in Israel and in North-West Egypt. The area of the tree spurge largely corresponds with the extension of the thermo-respectively eumediterranean zone (IV₁ in Walter & Lieth 1960-1967), in some areas it even advances into the transitional zone to semiarid conditions (IV(III) in Walter & Lieth 1960-1967), as for instance in South and East Crete, the Argolis and Attica in Greece as well as in South Sicily and Southwest Sardinia.

The maximum height above sea level the tree spurge reaches northwest of Nicosia in Sicily (province of Enna) at about 900 msm (D'Urso & Gentile 1959). The author found *Euphorbia dendroides* at approx. 700 msm north of S. Fratello (province of Messina, Sicily) and in rocks between Itea and Delphi (Phokis, Greece). Inside of the Monti Alburni (Campania, province of Salerno, Italy), west of La Turbie (South France, Département Alpes-Maritimes) and near Lluch (Mallorca, Spain) *Euphorbia dendroides* reaches 600 msm.

Normally the tree spurge only occurs on rocky habitats very close to the sea. Only in South Italy (Buccino: 37 km; Romagnano: 44 km; Monti Alburni: 30 km) and in Tunisia *Euphorbia dendroides* advances into the interior of the country (near El Kef, Tunisia, 80 km: leg. Cosson & al. 1883: P; leg. Letourneux 1886: P; Djebel Dyr, 4,2 km northeast of El Kef: leg. Pitard 1909: G; leg. Vogt & Oberprieler 1994: B). In the South and the West increasing dryness, in the North winter coldness form the boundary of the area; the reason for the sporadic occurrence in the East however seems to be vague. In South Anatolia and



Fig. 4. Rich flowering *Euphorbia dendroides* on a rocky rhyolith slope near Pointe du Cap Roux, south of Le Trayas (France, Provence-Alpes-Côte d'Azur, Département Var, Corniche de l'Estérel; approx. 60 msm, 30° SSO; 11.5.1996; Orig.).

Israel suitable rocky coasts get colonised very rarely, from Cyprus there exist no records at all. Illustrating data of vegetation history are not available – a result of the poor durability of the wood and the uniformity of the *Euphorbia*-pollen (M. Reille, Marseille 1998: in litteris).

The typically heliophilous species is responding very sensitively to shadow; though it passes the summer leafless, it needs an adequate supplying with humidity. Due to a certain nitrophily *Euphorbia dendroides* can also colonise secondary sites as abandoned terraces or falling down stone walls.

Phytosociology

Due to different methods of the particular authors in making relevés, the phytosociological classification raised many problems, especially owing to the very individual selection and small dimension of the sample plots. Due to these and other difficulties an alternative syntaxonomical classification was worked out (see Eichberger 2001). On the basis of a constancy table containing 540 relevés (including relevés of those authors who used similar methods e.g. Bolòs & Molinier 1958; Bolòs & al. 1970; Lavagne & al. 1974; Lapraz 1975; Mariotti & Barberis 1985; Brullo & Marcenò 1984; Trinajstić 1984a; Franquesa i Codinach 1995; Caneva & al. 1997) is clearly proved that the populations of Greece remarkably differ from those in Spain, France, Italy and Croatia. The very self-

contained groups can be interpreted as two associations: *Asparago acutifolii-Euphorbietum dendroidis* Eichb. 2001 from Spain to Croatia and *Phlomidio fruticosae-Euphorbietum dendroidis* Eichb. 2001 in Greece. *Euphorbia dendroides* alone remains as the only character species. As very constantly found species, especially Quercetea ilicis class character species are in evidence. The association *Oleo-Euphorbietum dendroidis* Trinajstić (1973) 1984 was originally described for *Euphorbia dendroides*-communities of the northern parts of the western Mediterranean. (cf. Trinajstić 1973, 1984a; Trinajstić & Šugar 1977); later the name was used for different communities from almost all parts of the Mediterranean.

Due to these and further syntaxonomical problems (cf. *Cisto-Euphorbietum dendroidis* Molinier 1937; *Euphorbietum dendroidis* Guinochet 1944) the *Oleo-Euphorbietum dendroidis* Trinajstić was proposed for rejection (nom. amb. rejic. propos.; for further details see Eichberger 2001: 190 ff.).

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