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Efficient Irrigation Management
Tools for Agricultural
Cultivations and Urban
Landscapes

IRMA

WP6

Specialized research actions



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Deliverable 6.2.1. Review regarding low water–demand agricultural crops and local plants for landscaping

A knowledge harvest and evaluation report

Chapter of:

WP6: Specialized research actions

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Introduction

The present deliverable is a literature review regarding drought resistance plants of Italian and Greek flora for both agricultural and landscaping sectors. According to the United Nations Environment Programme/Mediterranean Action Plan (UNEP/MAP, 2009), *“the issue of water will become a major challenge for sustainable development in the Mediterranean regions”*.



Fig. 1 Region of Apoulia (Italy) and Regions of Epirus and Western Greece (Greece) (source: Google Earth)

Agricultural sector in South-East Italy (Region of Apoulia or Puglia), Italy and Western Greece (Regions of Western Greece and Epirus), Greece is the main consumer of water, as it demands between 60 and 70% of the available resources, while the domestic sector (including watering) demands less than 20%.

In these regions which are characterised by hot and dry summers, drought tolerance is an important consideration when talking about plant selection.

The selection of proposed plants and crops results in considerable savings in water consumption. At the same time the use of native plants has some additional benefits as it:

- protects the environment, as require no, or less, agrochemicals and
- provides an ideal habitat for local wildlife.

Many administrative authorities, all over the world, have recognized the value of using xerothermic plant species in landscaping, and are applying specific projects for public awareness (Denver Water, Sidney Water Corporation, Arizona Department of Water Resources, etc.).

Drought and plants

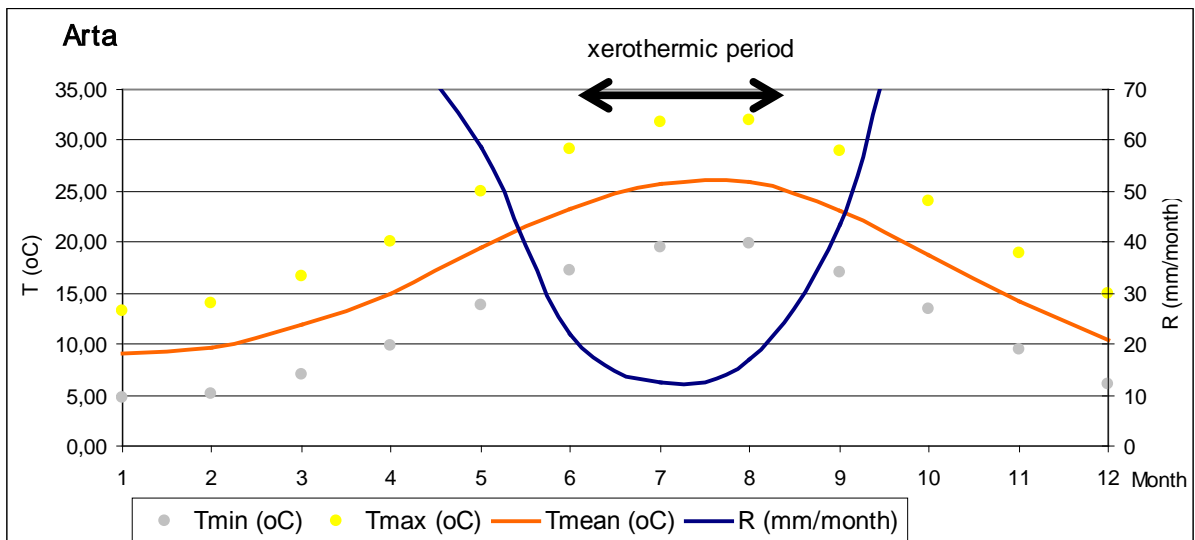
Drought can be difficult for people to understand, because what may be considered a drought in Malaysia (annual rainfall 2.875mm/year) would certainly not be considered a drought in Kuwait (annual rainfall 121 mm/year) (data from: THE WORLD BANK). Drought is viewed also, in different ways depending on the different needs of water users. That's the reason why it is difficult to form a universal definition of drought (Bindi et al., 2009). The following is a generic approach: *drought is the deficiency of precipitation over an extended period of time*. If this period with unusually dry weather persists long enough, environmental or economic problems may occur. According to Wilhite and Glantz (1985), droughts are classified into four categories, depending on the point of view from which the phenomenon is analyzed:

- Meteorological drought: It is based on climatic values. It is a situation when there is a significant decrease in rainfall from the normal over an area.
- Agricultural drought: It occurs when there is not enough humidity in the soil for a certain crop to develop.
- Hydrological drought: Meteorological drought, if prolonged, results in hydrological drought with marked depletion of surface water and consequent drying up of inland water bodies such as lakes, reservoirs, streams and rivers and fall in level of water table.
- Socioeconomic drought: It occurs when physical water shortages start to affect the health, well being and quality of life of the people or when the drought starts to affect the supply and demand of an economic product.

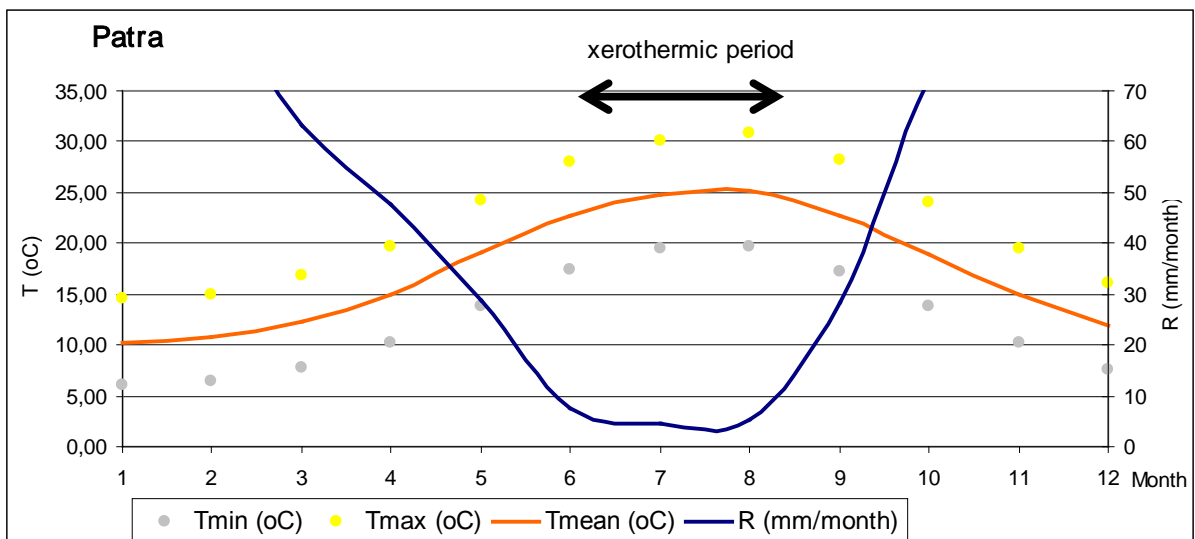
In a time sequence meteorological drought would come first, then the agriculture one and finally the hydrological one.

Climate of the area under consideration

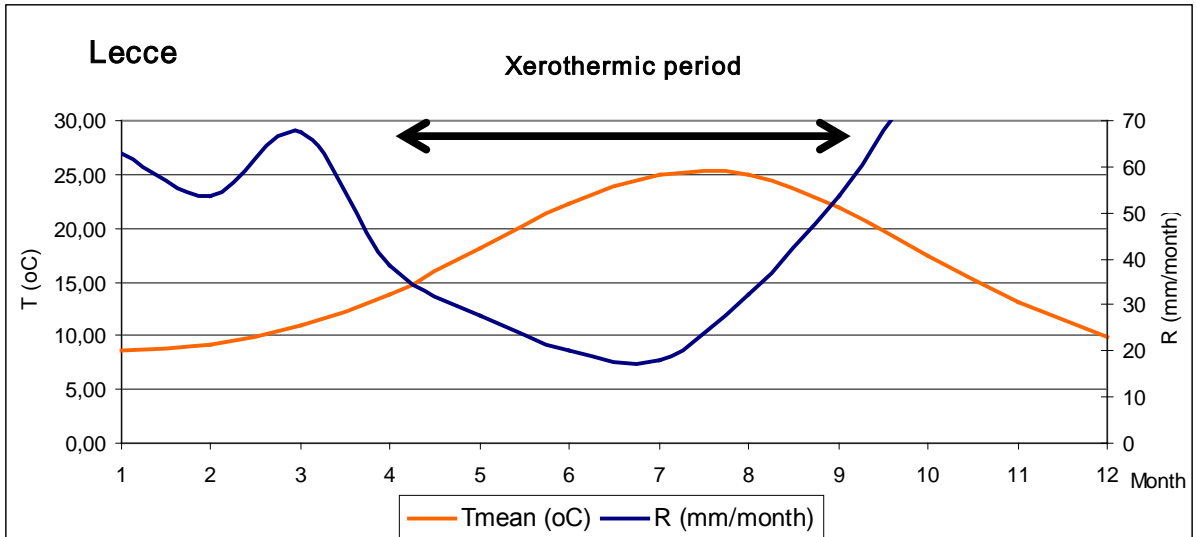
From our point of view the agricultural drought is essential, because according to Gausson's xerothermic index, the climate in Puglia and western coast of Greece is submediterranean to xerothermomediterranean. This classification shows that there is a stress summer drought (Mitrakos, 1980) in this ecosystem. In Fig. 2, are given the ombrothermic diagrams of four cities of Puglia and W. Greece. In these diagrams the summer drought is obvious.



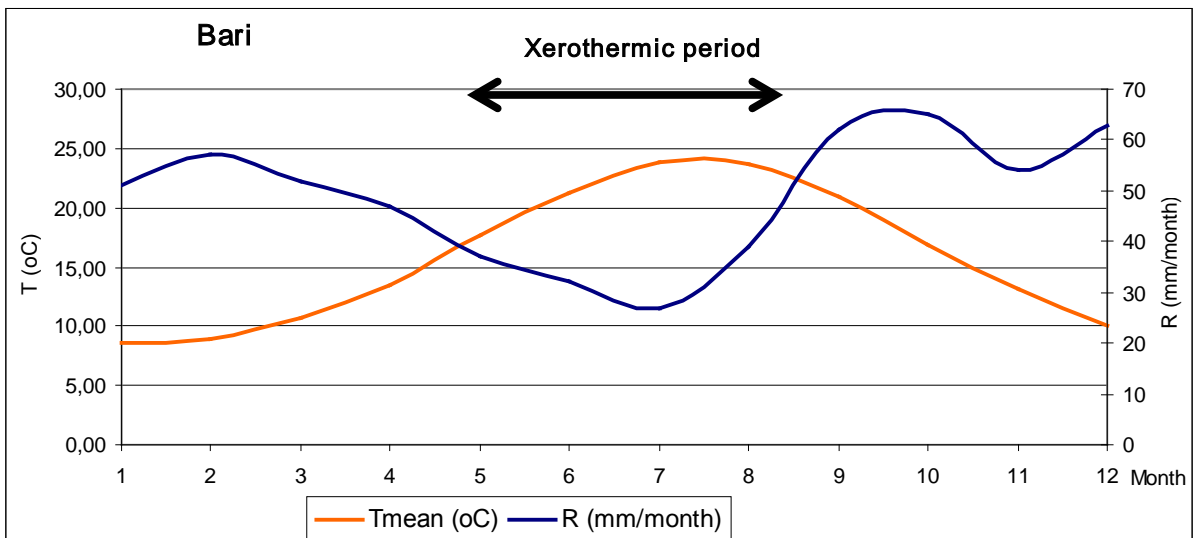
Data source: Hellenic National Meteorological Service
http://www.hnms.gr/hnms/greek/climatology/climatology_html



Data source: Hellenic National Meteorological Service
http://www.hnms.gr/hnms/greek/climatology/climatology_html



Data source: World Meteorological Organization (<http://www.wmo.org>)



Data source: <http://www.klimadiagramme.de/Europa/bari.html>

Fig. 2 Omvrothermic diagrams for selected cities of the project area

Typical local plants and drought adoption mechanisms

The flora of these regions is characteristic and fully adapted in the environmental conditions. The dominant plant communities according to Pollunin (1980) are: Maquis (macchie) and Phrygana (garrigue). Maquis is a dense scrub, composed of hard leaved evergreen shrubs. It occurs near the coast, in damper places. Phrygana is the most widespread dwarf scrub vegetation of dry slopes hills and islands Fig. 3. The most common species of the above ecosystems are: *Quercus coccifera*, *Cercis siliquastrum*, *Cistus* spp, *Phlomis fruticosa*, *Pistacia lentiscus*, *Myrtus communis*, *Spartum junceum*, *Cotinus coggygria*, *Arbutus unedo*, *Olea europea*, *Ruscus aculeatus*, *Euphorbia* spp, *Thymus* spp, *Ballota acetabulosa*, etc.

Drought adaptation of these plants is controlled by complicated interactions between anatomy, physiology and biochemistry, all of which are directly or indirectly under genetic control (Bassett, 2013).



Fig. 3 Phrygana on a dry slope of Epirus (Greece) in May. The dominant species are *Phlomis fruticosa* and *Quercus coccifera*.

The plants have adopted numerous adaptive mechanisms for survival in drought conditions. Their strategy choices can be summarized as follow:

- Drought escape plants. Most annuals and bulbs are a typical example of drought escape plants. They have a short life cycle and they complete their reproductive cycle before the dry season (De Micco and Aronne, 2010). These plants have usually an extensive shallow root system, allowing large quantities of rain water to be absorbed.
- Deep root system. A lot of plants have an extensive root system, which penetrates the soil deeply like *Ceratonia siliqua*. These plants can thus survive from long periods of drought, as the roots ensure water flux to the leaves (Rhizopoulou and Davies, 1991; Battle and Tous, 1997).

- The plants have also adopted numerous mechanisms to reduce transpiration rate (Levitt, 1980; Polunin, 1980; Bruce, 1995; Galmés et al., 2006; Bassett, 2013, University of Las Vegas) such as:
 - Small leaves (Lavender, Thymus, Winter Savory) or needle-like (Pines). These kind of leaves reduce the total surface area of the leaf, causing less evaporation of water. This occurs by the combination of less heat being absorbed by individual leaves and by the sun having a smaller surface area over which it can evaporate water.
 - Thick waxy, leathery or glossy cuticle (Myrtus, Ilex, Pistache, etc). This cuticle acts as a barrier to evaporation and also the shiny surface reflects heat and so lowers leaf temperature.
 - Stomata may be sunk in pits in the epidermis; moist air trapped there, lengthens the diffusion pathway and reduces evaporation rate.
 - Leaf rolled with stomata inside and the inner surface is covered in hairs. A typical plant in this group is Rosemary. The rolled leaf and hairs both serve to trap moist air so reducing transpiration. In addition, less leaf surface area is exposed to the drying effects of the wind.
- The main growing period of many plants, like salvia or Pink Rock-Rose, is during late winter and spring, when there is abundance of rain. The dry period is a time of minimum growth activity or hibernation (Polunin, 1980).
- Some plants shed their leaves, or part of them, during dry seasons and avoid water loss through transpiration (Kramer and Kozlowski, 1979). Some of them photosynthesize with their green stems, like Spanish broom.
- A lot of Mediterranean plants (Margaris, 1981) are seasonally dimorphic species. They shed the larger winter and spring leaves and develop smaller during summer, like *Cistus incanus* (Aronne and De Micco, 2001).
- Many drought tolerant plants have glaucous leaves (Greek horehound, Sage). This glaucescence, a powdery wax coating on the leaf surface, is responsible for a very high reflectance of ultraviolet radiation (Mulroy, 1979).

Some succulents have been naturalized in the Mediterranean region, like Prickly pear and Century Plant. These plants have adopted a different strategy. They can store large amounts of water in their thick stems or leaves and can draw on this water during drier times in order to survive (University of Las Vegas).

Drought tolerant local plants for landscaping

Italy and Greece host a rich diversity of vascular plants. Italy hosts 7.464 species and subspecies, while Greece 7.655. They are also two of the most important centers of endemism in Europe and the Mediterranean with 1.021 and 1.278 respectively endemic species (Table 1).

From the plethora of local plants, the authors suggest 52 representative species of Italian and Greek flora, which are fully adapted to xerothermic conditions. The majority of these plants are popular ornamentals all over the world such as: Rosemary, Yarrow, Red Valerian, and Lavender, to name a few. Some of the suggested plants are not well known, such as: Greek horehound, Rock samphire and Curry Plant, but according to the author's opinion and experience, these plants are marvelous ornamentals and deserve a place in the Mediterranean gardens. Of course there are dozens of xerothermic species of Italian and Greek flora, which can be used in gardening, but the reference of all species is not the aim of this deliverable.

Table 2 contains the English, Italian and Greek name of the suggested plant, as mentioned in the literature, in which the species are recommended for Mediterranean gardens or xeriscaping.

The description of the plants is based on: Flora Europaea, 1980; Polunin, 1980; Strid and Tan, 1991.

The distribution of the species is based on: Polunin, 1980 (for Greece), Pignatti, 1982 (for Italy) and Euro+Med PlantBase. The common Italian names of the plants are from Actaplantarum.

Table 1 The diversity of vascular plants in Italy and Greece

Country	Families	Genera	Species	Total (species and subspecies)	Endemic
Italy*	196	1.267	6.711	7.464	1.021
Greece**	185	1.072	5.752	7.655	1.278

*Conti et al. 2007

**Dimopoulos et al. 2013

***Achillea millefolium* - Asteraceae**

Herbaceous perennial plant, 0,2 - 1 m. in height. Its leaves are feathery (fern-like), aromatic, green, arranged spirally on the stems, 5 - 20 cm long. The flowers are tiny, long-lasting, and white, that appear in dense, flattened, compound corymbs.

It is widely distributed in Italy and Greece, from mountain pastures to the lowlands on the mainland.

***Agave Americana* - Agavaceae**

Evergreen succulent perennial plant. Its leaves form a basal rosette. They are thick, massive, grey-blue, up to 1,5 - 2 m long and 25 cm wide, with sharp spines on the margins and tips. It can reach a height of about 1 - 2 m and a width of about 1,0 - 1,5 m. The flowers are greenish-yellow, funnel-shaped, 8cm in length, in panicles to 8 m in length.

Native of Mexico widely naturalized in Italy and Greece.

***Alcea rosea* - Malvaceae**

Herbaceous biennial or short-lived perennial. It can reach a height of about 2,4 m. Its leaves are rounded, shallowly 3 - 7 lobed, coarsely hairy and its flowers are funnel-shaped, 10 cm across, with 5, satin like, petals in pink, purple, red, white or yellow.

Naturalized in many regions of Italy but not in Puglia and Greece, where it grows as a garden escape.

***Arbutus unedo* - Ericaceae**

Evergreen tree or large shrub growing to 9 m by 8 m. Its leaves are dark green, leathery, 5 - 10 cm long and 2 - 3 cm wide. The flowers are small, bell-shaped creamy-white or pink, 4 - 6 mm in diameter followed by strawberry-like red fruits.

Native of Italy and Greece.

***Armeria maritime* - Plumbaginaceae**

Evergreen perennial and very variable species. It can reach a height and width of about 10 - 30 cm. Its leaves are narrow, grass-like, dark green, about 15 cm long and form rosettes. The flowers appear on erect wiry stems above the clumping foliage. The plant usually has pink or purple flowers and infrequently white.

It is distributed in a wide range of habitats in Greece, from the coasts to the high mountains. In Italy there is only the *Armeria maritima* subsp. *purpurea* in Friuli-Venezia Giulia.

***Atriplex halimus* - Amarantaceae**

Evergreen shrub. It can reach a height of about 2 - 3 m and a width of about 1 - 1,5 m. The phenotypic characters have a high variability. The leaves are alternate, striking, silvery-grey ovate, or

sub-triangular, or elliptic, to 5cm long. Its flowers are insignificant in loose inflorescences, between 10 and 50 cm.

Native of Italy and Greece usually in coastal sands by the sea.

***Ballota acetabulosa* - Lamiaceae**

Bushy evergreen shrub with erect, white-felted stems, growing to 0,5 by 0,8 m. Its leaves are opposite, aromatic, rounded, hairy, grey-green. Leaves and whorls often appear as small, 2-lipped flowers. The flowers are small, pink, borne in whorls, with large funnel-shaped calyces.

Native of Greece.

***Buxus sempervirens* - Buxaceae**

Evergreen shrub or small tree, growing to 4 - 8 m by 4 - 8 m., with compact habit. The leaves are green to yellow-green small, simple, opposite glossy, oval, 1,5 - 3 cm long, and 0,5 - 1,3 cm broad. The flowers are inconspicuous, greenish-yellow, with no petals, followed by a three-lobed capsule.

Native of Greece and central and north Italy.

***Capparis spinosa* - Capparidaceae**

Perennial deciduous plant with trailing stems about 1-1,5 m long. Its leaves are rounded, green, and fleshy. The flowers are large, white to pinkish-white with numerous stamens.

It is widely distributed in Italy and Greece, on rocks, old walls, cliffs, rocky hillsides near the sea.

***Centranthus ruber* - Valerianaceae**

Herbaceous perennial plant, bushy, clump-forming, woody-based, growing to 1 m. The leaves are opposite, simple, fleshy, gray-green, oval to lance-shaped. Its flowers are small, red, star-shaped and fragrant, in dense terminal clusters.

It is widely distributed in Italy and Greece, on rocks and walls.

***Ceratonia siliqua* - Caesalpiniaceae**

Evergreen tree, 15 - 17 m in height and width. Its trunk is thick with brown rough bark and sturdy branches. The leaves are shiny, green, leathery, long, alternate and pinnate. The flowers are without petals tiny, in short, slender racemes. The pod is 10 - 30 cm long and 1 - 2,5 cm wide, oblong, flattened, straight or slightly curved, tough and fibrous.

Native in Italy and Greece in rocky places near the sea shore, also cultivated for its sugary pods.

***Cercis siliquastrum* - Caesalpiaceae**

Deciduous small spreading tree with blackish stems, growing to 8 - 12 m. The leaves are heart shaped dark green, turning yellow in autumn. Its flowers are conspicuous, pink-red pea shaped before foliage in spring in clusters on the older wood.

Native in Italy and Greece.

***Cistus creticus* - Cistaceae**

Variable evergreen shrub, hairy, with hemispherical growth, growing to 1 by 1 m with many branches. Its leaves are simple, dark green, oval, rough, thick, with wavy margins. The flowers are pink, petals wrinkled, soon dropping, 4-6 cm in diameter.

There is confusion about its classification. Some botanists classify it, as a separate species, while others like subspecies of *Cistus incanus* (*Cistus incanus* subsp. *creticus*). *Cistus creticus* is native of Greece, while a subspecies of it (*Cistus creticus* subsp. *corsicus*) is native of Sardinia. *Cistus incanus* is widely distributed in Italy and Greece.

***Colutea arborescens* - Fabaceae**

Deciduous, vigorous, bushy shrub, growing to 3-4 m. The leaves are pale green, pinnate, with 3 - 6 pairs of oval leaflets. Its flowers are pea like, yellow, 2-3 cm in length, in short (3-8 flowers) racemes, followed by bladder-like fruits to 8 cm in length, with paper texture when dry.

Widely distributed in Italy and Greece.

***Cotinus coggygia* (*Rhus cotinus*) - Anacardiaceae**

Deciduous, multiple-branching, bushy, shrub or small tree, growing to 4 - 6 by 3 - 6m. Its leaves are rounded, simple, 3 - 8 cm long. The flowers are numerous, in large inflorescences, followed by yellowish-pink to pinkish-purple feathery plumes with 'smoke-like' appearance.

Native of central and north Italy (not in Puglia), widespread in Greece.

***Crithmum maritimum* - Apiaceae**

Herbaceous perennial plant growing to 30 cm. The leaves are alternate blue-green, fleshy, pinnate whose leaflets are generally held vertically. Its flowers are small, greenish to cream in a compound-umbel.

Widespread in the coasts of Greece and Italy.

***Cupressus sempervirens* - Cupressaceae**

A conifer 20 - 30 m in height. Trunk straight with thin bark, smooth and gray during first years, later becoming gray-brown. It grows in a spreading, open-horizontal or in a narrow-columnar form. Its

leaves are scale-like, small, ovate, obtuse, dark green, arranged in sprays very densely. The flowers are in cones between round and oblong, a few cm long and generally have 10-14 scales.

Native of many region of Italy (not in Puglia) and Greece, widely cultivated.

***Ebenus cretica* - Fabaceae**

Herbaceous perennial evergreen small shrub, 0,5 - 1 m tall. The aerial plant parts are densely covered with whitish non-glandular hairs. There is great morphological variability. Its leaves are compound, trifoliolate or pinnate-quinquefoliate, elliptic-oblong, silvery-haired. The flowers are bright pink, pea-like, in dense racemes.

Endemic species of Crete (Greece).

***Echinops ritro* - Asteraceae**

A clump-forming compact, herbaceous, perennial plant (thistle). Its leaves are coarse, spiny, deeply-dissected, gray-green leaves, whitish beneath. Its flowers are deep blue, in globes 2,5 - 4,5 cm in diameter.

Widespread in the coasts of Greece and Italy.

***Elaeagnus angustifolia* - Elaeagnaceae**

Small, deciduous tree or large shrub, often thorny with black bark. Its leaves are simple, alternate, lanceolate to oblong, 4 - 8 cm in length. The upper surface is light green in color and is covered with silvery star-shaped hairs, and the lower surface is silvery white and densely covered with scales. Its flowers are small, 1,2 - 1,5 cm wide, silvery outside and yellow within, highly aromatic, in umbel-like inflorescences, followed by olive-shaped fruits.

Native of Asia, but naturalized in many regions of Greece and Italy (Veneto, Friuli-Venezia Giulia, Emilia-Romagna).

***Euphorbia characias* - Euphorbiaceae**

Erect, herbaceous perennial sparsely-branched with milky sap. Its leaves are fleshy, oblong, grey-green in whorls. They are dense and crowded near the tips of the stems but are sparse or absent near the bases. The flowers are yellowish green flowers with bronze 'eyes' in cylindrical heads above the foliage.

Widespread in Greece and Italy.

***Geranium sanguineum* - Geraniaceae**

It is a perennial herbaceous plant, rhizomatous, hummock-forming. The leaves are dark green, deeply divided, with five lobes, petiolate, and the flowers are cup-shaped, pink to purple, borne singly.

Widespread in Greece and Italy.

***Helichrysum italicum* - Asteraceae**

In this genus there are a lot of xerothermic species, which can be used as ornamentals and *H. italicum* is one of them. It is a small bushy evergreen sub-shrub with woody at the base stems, 60 cm or more in height. Its leaves are small, linear, delicate, oblong, silvery-grey, hairy, curry-scented and its flowers are small, yellow, papery everlasting, ball shaped.

Widespread in dry places of Italy and Greece.

***Juniperus communis* - Cupressaceae**

Evergreen shrub, rarely a small tree to 10m with reddish-brown bark. Its leaves are in whorls of 3, 4-20 mm, linear to linear-oblong, jointed at the base, with a spiny point at the apex, green and keeled beneath with a single broad white band on upper side. It is a dioecious plant. The male cones are yellow, 2–3 mm long. The female cones are berry-like, spherical, purple-black, 4 - 12 mm in diameter.

Widespread in dry places of Italy and Greece.

***Lavandula* sp - Lamiaceae**

There are a lot of interesting species in this genus. *L. anustifolia*, *L. stoechas* and *L. dentata* are the most common species and often cultivated. All species are small aromatic evergreen shrubs to 0,5 - 1 m tall. Their leaves are simple, narrow, toothed or lobed, grey-green, depending on species. The flowers are small, tubular, violet-purple or deep blue or purple (depending on species) in dense spikes.

L. anustifolia and *L. stoechas*, are widespread in Greece and west Italy (not in Puglia). *L. dentata* is found only in Puglia.

***Limonium sinuatum* - Plumbaginaceae**

Tender short live perennial, herbaceous, upright plant, 30 - 60 cm tall. Its stems are winged and branched. Its leaves are olive-green with sinuate margins, (12 - 18cm long) in basal rosettes. The flowers are funnel-shaped, tiny, white, with colored papery bracts (blue, violet, lavender, purple, pink, rose, orange, yellow and white), in one-sided ranked clusters at stem ends.

Widespread in Greece in coastal areas and native in Calabria, Sicilia, Sardinia (Italy).

***Medicago arborea* - Fabaceae**

Evergreen shrub growing to 2 by 2 m with globular form. Its leaves are downy, green, compound with 3 leaflets and its flowers are yellow, pea-like, followed by curious snail-shaped pods.

Native in Greece and mainly in west Italy.

***Myrtus communis* - Myrtaceae**

Evergreen bushy shrub, 1,5 - 2 m tall. It develops an irregular upright oval form. The leaves are simple, aromatic, glossy, opposite, ovate to lanceolate. Its flowers are white, fragrant, followed by purplish-black berries.

Widespread in Italy and Greece.

***Nerium oleander* - Apocynaceae**

Evergreen shrub or small tree, with erect, grayish, stems. The leaves are thick, leathery, dark-green, narrow lanceolate, with an entire margin. Its flowers are white pink or red, with a soft perfume.

Widespread in Italy and Greece.

***Olea europea* - Oleaceae**

This typical evergreen fruit tree of Mediterranean is also a wonderful ornamental tree, growing to 8-15 by 8 - 10 m, with oval growth. Its trunk is gnarled and twisted. Also grows as multi trunk. The leaves are silver-green, oblong, 4 - 10 cm (depending on variety) long and 1 - 3 cm wide. Its flowers are small, white, feathery, followed by a small drupe 1 - 3 cm long (depending on variety).

***Opuntia ficus-indica* - Cactaceae**

Perennial cactus growing to 3 - 5 m in height. The stems are cladodes. These are very thick, succulent, oblong to spatulate, full of spines. Some varieties are spineless. The leaves are generally reduced to thorns. Its flowers are yellow or orange, on the perimeter of the cladodes, cup-shaped, 6-7 cm long by 5 - 7 cm across followed by a fruit, oblong, 5 - 10 cm long by 4 - 9 cm across, succulent, green at first ripening to yellow, orange, red or purple, edible.

Native of tropical America widely naturalized in Italy and Greece.

***Origanum vulgare* - Lamiaceae**

Herbaceous, perennial plant, aromatic, woody-based, growing to 20 - 90 cm in height. The leaves are olive-green, ovate, opposite, smooth or very shallowly toothed. The flowers are white to purplish, two-lip corolla, five-toothed calyx, 4 - 8 mm long, in erect spikes

Widespread in Italy and Greece.

***Phillyrea* sp. - Oleaceae**

Phillyrea is a genus of two species: *Phillyrea angustifolia* and *Phillyrea latifolia*. They are evergreen shrubs or small trees growing to 3 -5 m tall. Their leaves are green, oblong, leathery, in opposite pairs, 2 - 6 cm long and 0,5 - 3 cm width (depending on species: *Phillyrea angustifolia* has more narrow and long leaves than *Phillyrea latifolia*) with short petiole (4 - 8 mm) and salient midrib. The flowers are greenish white, sweet-scented, melliferous, small, in small groups on the shoots of previous year. The fruit is small drupe (3 - 5 mm), like olive but not edible.

Both species are widespread in Italy and *Phillyrea latifolia* in Greece.

***Phlomis fruticosa* - Lamiaceae**

Evergreen bushy shrub growing to 1,5 m, with erect shoots. The leaves are fuzzy, grey-green, 12 cm long, lance-shaped - ovate, heart-shaped at the base. The flowers are yellow, 3cm in length, hooded. Arranged in whorls, with several flowers on one vertical stalk

Widespread in Greece and in Abruzzo, Puglia, Calabria, Sicilia, Sardinia (Italy)

***Pinus halepensis* - Pinaceae**

Evergreen conifer, rugged, irregularly branched, upright and globose with age, growing to 15 -25 m by 7 - 10m, with thick, orange-red and deeply fissured bark. The leaves are light green, needle-like, in pairs, 6 - 12 cm long. It is a monoecious plant, with male cones on lower part and female on upper part of tree.

Widespread in Greece and Italy.

***Pinus pinea* - Pinaceae**

Evergreen conifer, round-topped, ultimate height of 10 - 25m and spread of 10 - 20 m. Brown bark with a rough texture. Its leaves are mid or dark-green, needle-like, in pairs of two, 10 - 20 cm long. It is a monoecious plant and the female cones are rounded-ovoid, to 15 cm long with edible seeds.

Widespread in Greece and in many regions in Italy (not in Puglia).

***Pistacia lentiscus* - Anacardiaceae**

Evergreen, dioecious, shrub or small tree, much branched, growing to 5 by 3 m, with round growth habit. Its leaves are alternate, leathery, compound, without terminal leaflet, with five or six pairs of deep-green leaflets. The flowers are green and inconspicuous.

Widespread in Greece and in central and south in Italy.

***Punica granatum* - Lythraceae**

Deciduous shrub, rounded, sometimes spiny, much-branched, and extremely long-lived. The leaves are glossy, simple, narrowly oblong, bronze in spring, yellow in autumn. Its flowers are bright red, funnel-shaped, 3 cm in diameter, with four to five petals, followed by spherical edible fruits.

Native of S.W. Asia, widely cultivated and naturalized in Greece and Italy.

***Quercus coccifera* - Fagaceae**

Evergreen shrub or little tree growing to 4 - 6 by 4 m. Mid-grey bark, with scaly segmentation on older trees. Its leaves are elliptic or ovate, dark green, with spiny tips and sides. The flowers are inconspicuous, followed by acorns.

Widespread in Greece and in Puglia, Basilicata, Sicilia, and Sardinia (Italy).

***Quercus ilex* - Fagaceae**

Evergreen tree with an ovoid crown that reaches a height of between 8 and 25 m and a crown width of 8 to 10 m. Its bark is black, finely cracked. The leaves are simple, lanceolate–ovate, glossy dark green above and a downy whitish or grayish green below. The tree is monoecious. The male flowers are grouped in pendulous catkins and the females grow solitary. Its fruits are dark brown acorns.

Widespread in Italy and Greece.

***Rosmarinus officinalis* - Lamiaceae**

Evergreen, perennial, aromatic, woody, fragrant shrub, growing to 1,5 m. Its leaves are narrow, aromatic needle-like, without petiole, sticky, 2 - 4 cm long and 2–5 mm broad. Dark green above, white below, with dense, short, woolly hair. The flowers are small, axillary, white, pink, purple or deep blue in massed clusters, two-lipped with two long-exserted stamens.

Widespread in Italy and Greece.

***Ruscus aculeatus* - Asparagaceae**

Evergreen, rhizomatous, rounded shrub, normally dioecious, growing to 0,8 by 1 m, with flattened, leaf-like cladophylls. The cladophylls give the appearance of stiff, spine-tipped, glossy, lance-shaped leaves. Its flowers are small, pale green, in the centre of the cladodes, followed on female or hermaphrodite plants by glossy red berries.

Widespread in Italy and Greece.

***Salvia fruticosa* - Lamiaceae**

Perennial evergreen with long, hairy branches, spreading shrub, aromatic, growing to 60 - 100 cm tall (It is a bit taller than *S. officinalis*). The leaves are bright green, various sizes, oblong, felt-like and are accompanied by two lobes each. Its flowers are pinkish-lavender, with a red five-pointed hairy calyx, in whorls along the inflorescence.

Widespread in Greece and Lazio, Puglia, Calabria, Sicilia (Italy).

***Salvia officinalis* - Lamiaceae**

Perennial evergreen semi-woody, bushy, spreading shrub, aromatic, growing to 0,6 m tall with a similar spread. Its leaves are grey-green, thick, wooly, oval, in opposing pairs, to 8 - 10 cm long, finely veined with a lemony, slightly bitter fragrance. The flowers are 2-lipped, blue, lilac, borne in erect axillary racemes.

Widespread in Italy and Greece.

***Santolina chamaecyparissus* - Asteraceae**

Small, evergreen, aromatic, tender, semi-woody shrub with a clump forming growth form. The leaves are narrow, grey-green, woolly, pinnately divided with a rough texture. Its flowers are bright yellow, in dense button-like flowerheads, 2cm in width, long-stalked above the foliage.

Naturalized in Italy, cultivated in Greece.

***Satureja thymbra* - Lamiaceae**

Evergreen, erect, perennial, aromatic shrub, up to 1 m high. The leaves are simple, sessile, obovate - elliptic. The flowers are large, pink, highly aromatic and spicy, arranged in whorls inapical, elongated racemes.

Widespread in Greece (mainly in islands) and in Sardinia (Italy).

***Senecio cineraria* - Asteraceae**

Evergreen shrub growing to 0,6 by 1 m, densely branched. The stems are stiff and woody at the base. The leaves are ovate, pinnately lobed, strikingly silvery-white, 5 - 15 cm long and 3 - 7 cm broad, stiff, and like the stems, covered with long, thinly to thickly matted with grey-white to white hairs. The flowers are yellow daisies in loose clusters, 12 - 15 mm in diameter.

Native of Italy and Greece.

***Spartium junceum* - Fabaceae**

Vigorous, deciduous shrub growing to 3,5 by 3 m., with thick, somewhat succulent grey-green shoots. The leaves are small, 1 to 3 cm long and up to 4 mm broad. The leaves fall away early and the photosynthesis occur in the green shoots. The flowers are large, yellow, pea-like, 1 to 2 cm across, followed by legumes 8 - 10 cm long.

Widespread in Greece and Italy.

***Teucrium fruticans* - Lamiaceae**

Evergreen, perennial shrub, bushy, growing to 1 m tall by 4 m wide, with velvety white shoots. The leaves are small, ovate, glossy, bluish grey, white beneath and its flowers are small, blue, two-lipped, 2,5 cm long in terminal racemes.

Native of Liguria, Toscana, Lazio, Campania, Puglia, Basilicata, Calabria, Sicilia, Sardinia (Italy).

***Thymus capitatus* - Lamiaceae**

Evergreen woody-based perennial shrub, growing to 0,3 by 0,3 m. The leaves are small ovate aromatic, narrow, fleshy, 2 cm long. The flowers are tubular, two-lipped, 10 mm long, purple, pink or white in terminal whorls.

Widespread in Greece and south Italy.

***Verbascum olympicum* - Scrophulariaceae**

Short-lived perennial, usually dying after flowering, with grey-woolly stems. It can grow up to 2.5m in height and 60 cm in spread after around 2 - 5 years. Its leaves are silvery-grey, woolly, lance shaped, in wide rosettes. Each leaf can be 30cm long and nearly half as wide. The flowers are bright, clear yellow with paler yellow to white filaments, in tall candelabra-like spikes.

Native of Greece.

***Vitex agnus-castus* - Verbenaceae**

Deciduous shrub growing to 3 by 3m. The leaves are grey-green to dark green above and lighter beneath, aromatic, palmately compound with 5 to 7 fingerlike leaflets, 7 - 10cm in diameter. The flowers are small, violet, blue, deep purple or lavender, in dense clusters on new wood. Flowers are followed by a fleshy fruit.

Widespread in Greece and Italy.



Fig. 4 This plant fence is consisted by rows of Rosemary, Lavender and Rosebay.

Table 2 Literature for the species of Greek and Italian flora for landscaping

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Achillea millefolium</i>	Asteraceae	Common Yarrow	Achillea millefoglio, Millefoglio comune	Αχιλλέα, χιλιόφυλλο (achillea, chiliofillo)	Shubert, 1977; Huxley, 1992; Denver Water, 1996; Ghatto, 1998; Kingsbury, 1996; Gildemeister, 2002; Thomas, 2004; Bird, 2004; Karras, 2006; Cox, 2006; Readers Digest, 2007; Easton et al., 2009; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Hawthorne, 2009; Ogden, 2011; Springer Ogden, 2011; Beucher, 2013; Williams, 2013
<i>Agave americana</i>	Agavaceae	Century Plant	Agave Pitta, Zabbara, Zammara,	Αγαύη, αθάνατος (agavi, athanatos)	Hoyt, 1998; Ghatto, 1998; Huxley, 1999; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Easton et al 2009; Beucher, 2013;
<i>Alcea rosea</i>	Malvaceae	Common Hollyhock	Malvone roseo, Malvarosa, Rosone,	Αλθέα, αλθαία, αλτέα, δενδρομολόχα (althea, althea, altea, dendromolocha)	Shubert, 1977; Gildemeister, 2002; Bird, 2004; Cox, 2006; Filippi, 2008; Springer Ogden, 2011; Williams, 2013; Beucher, 2013
<i>Arbutus unedo</i>	Ericaceae	Stawberry Tree	Albatro, Arbuto, Cocomero, Rossello, Rossetto, Suorvo, Corbezzolo	Κουμαριά (Koumaria)	Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Easton et al 2009; Beucher, 2013; Gizas, 2014
<i>Armeria maritima</i>	Plumbaginaceae	Thrift, Sea thrift, Sea pink	Armeria, Spillone palustre	αρμέρια, χαλαβόχορτο (armeria,	Kingsbury, 1996; Hoyt, 1998; Ghatto, 1998; Gildemeister, 2002; Patlis, 2008a; Patlis, 2008b; Springer Ogden, 2011; Williams, 2013; Penick, 2013; Royal Hort Society;

Latin name	Family	English name	Italian name	Greek name	Literature
				chalavochorto)	
<i>Atriplex halimus</i>	Amarantaceae	Mediterranean saltbush, Sea orache, Shrubby orache	Alimo, Alismo Atriplice alimo.	αλιμιά (alimia)	Huxley, 1992; Gildemeister, 2002; Cox, 2006; Arnold-Forste, 2008; Filippi, 2008
<i>Ballota acetabulosa</i>	Lamiaceae	Greek horehound	ballota	βαλλότα, λυχναράκι (Vallota, lychnaraki)	Huxley, 1992; Ghatto, 1998; Chatto, 2000; Raven, 2001; Gildemeister, 2002; Bird, 2004, Cox, 2006; Filippi, 2008; Beucher, 2013; Royal Hort Society
<i>Buxus sempervirens</i>	Buxaceae	Boxwood	Bosso comune	Πυξάρι (Pixari)	Shubert, 1977; Gildemeister, 2002; Bird, 2004; Royal Hort Society, Cox, 2006; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Beucher, 2013;
<i>Capparis spinosa</i>	Capparidaceae	Caper	Cappero	Κάπαρη (Kapari)	Barbera et al 1984; Phillips and Rix, 1998; Rhizopoulou, 1990; Pugnaire, 1991; Barbera et al 1991; Filippi, 2008; Patlis, 2008a; Gildemeister, 2002; Beucher, 2013;
<i>Centranthus ruber</i>	Valerianaceae	Red Valerian	Camarezza commune	Μάης, κέντρανθος (mais, kentranthos)	Kingsbury, 1996; Ghatto, 1998; Royal Hort Society, Hoyt, 1998; Latymer, 2001; Gildemeister, 2002; Bird, 2004; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Ogden, 2011; Springer Ogden, 2011; Beucher, 2013; Hendy, 2014;
<i>Ceratonia siliqua</i>	Caesalpiaceae	Carob, St John's Bread	Carrubo	Χαρουπιιά, ξυλοκερατιά (Charoupia, xylokeratia)	Huxley, 1992; Bianchiniet al1988; Howes, 2001; Latymer, 2001; Gildemeister, 2002; Patlis, 2008; Gizas, 2014;

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Cercis siliquastrum</i>	Fabaceae	Judas tree	Albero di Giuda	Κουτσουπιά (Koutsoupia)	Ghatto, 1998; Latymer, 2001; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Beucher, 2013;
<i>Cistus creticus</i>	Cistaceae	Pink Rock-Rose, Hoary Rock-Rose	Cisto di Creta	Λαδανιά (Iadania)	Kingsbury, 1996; Ghatto, 1998; Chatto, 2000; Patlis, 2008a; Filippi, 2008; Cox, 2006; Beucher, 2013; Hendy, 2014; Royal Hort Society;
<i>Colutea arborescens</i>	Fabaceae	Bladder Senna	Vesicaria	Φούσκα (Fouska)	Chatto, 2000; Gildemeister, 2002; Thomas, 2004a; Bird, 2004; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Beucher, 2013; Gizas, 2014; Royal Hort Society;
<i>Cotinus coggygria</i>	Anacardiaceae	Smoke Tree, Smoke Bush	Sommacco selvatico	Χρυσόξυλο (Chrysoxylo)	Shubert, 1977; Huxley, 1992; Denver Water, 1996; Ghatto, 1998; Chatto, 2000; Latymer, 2001; Raven, 2001; Gildemeister, 2002; Bird, 2004; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Easton et al 2009; Hawthorne, 2009; Ogden, 2011; Springer Ogden, 2011; Beucher, 2013; Gizas, 2014;
<i>Crithmum maritimum</i>	Apiaceae	Rock Samphire, Sea Fennel	Finocchio marino	Κρίταμος (Kritamos)	Huxley, 1999; Patlis, 2008a; Gildemeister, 2002;
<i>Cupressus sempervirens</i>	Cupressaceae	Italian cypress	Cipresso commune	Κυπαρίσσι (kiparissi)	Rushforth, 1987; Ghatto, 1998; Hoyt, 1998; Latymer, 2001; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Gizas, 2014;
<i>Ebenus cretica</i>	Fabaceae	Ebenus of Creta	Ebenus di Creta	Αρχοντόξυλοπλουμί (Archontoxylo,	Vrachnakis, and Vlahos, 2006; Syroset al 2006; Filippi, 2008; Patlis, 2008a

Latin name	Family	English name	Italian name	Greek name	Literature
				ρλουμπί)	
<i>Echinops ritro</i>	Asteraceae	Globe Thistle	Cardo-pallottola coccodrillo	Εχίνοπας Αχινός (Echinopas, achinos)	Shubert,1977; Huxley, 1992; Ghatto, 1998; Readers Digest, 2007; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Hawthorne, 2009; Williams, 2013; Beucher, 2013; Royal Hort Society;
<i>Elaeagnus angustifolia</i>	Elaeagnaceae	Oleaster, Russian olive	Olivagno	Ελαίαγνος, μοσχοϊτιά (Elaegnos, mosxoitia)	Shubert,1977; Taylor,1990; Huxley,1992; Latymer,2001; Gildemeister,2002; Patlis, 2008a; Patlis, 2008b; Filippi,2008; Beucher, 2013; Gizas, 2014; Royal Hort Society;
<i>Euphorbia characias</i>	Euphorbiaceae	Mediterranean spurge	Euforbia aghiandole scure	Γαλατσίδα (Galatsida)	Ghatto,1998; Raven, 2001; Lancaster, 2001; Gildemeister, 2002; Cox, 2006; Hawthorne, 2009; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Beucher, 2013; Williams, 2013;
<i>Geranium sanguineum</i>	Geraniaceae	bloody cranesbill, bloody geranium	Geranio sanguigno	Γεράνιτοαιματώδες (Gerani ematodes)	Ghatto, 1998; Raven, 2001; Bird R, 2004; Filippi, 2008; Patlis G, 2008; Hawthorne, 2009; Beucher, 2013;
<i>Helichrysum italicum</i>	Asteraceae	Curry Plant, Everlasting	Perpetuini d'Italia	Ελίχρυσσο, αμάραντος (Helichryso, amarantos)	Ghatto,1998; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Beucher,2013;
<i>Juniperus communis</i>	Cupressaceae	Juniper	Ginepro comune	Άρκευθος, αγριοκυπαρίσσι (Arkefthos,	Shubert, 1977; Denver Water, 1996; Hoyt, 1998; Ghatto, 1998; Latymer, 2001; Gildemeister, 2002; Britwell, 2003; Bird, 2004; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Easton

Latin name	Family	English name	Italian name	Greek name	Literature
				agriokyparissi)	et al 2009; Ogden, 2011; Springer Ogden, 2011; Beucher, 2013; Royal Hort Society;
<i>Lavandula sp</i>	Lamiaceae	Lavender	Lavanda.	Λεβάντα (Levanta)	Shubert, 1977; Kingsbury, 1996; Hoyt, 1998; Ghatto, 1998; Chatto, 2000; Latymer, 2001; Gildemeister, 2002; Bird, 2004; Karras, 2006; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Easton et al 2009; Hawthorne, 2009; Ogden, 2011; Springer Ogden, 2011; Penick, 2013; Beucher, 2013; Hendy, 2014; Royal Hort Society;
<i>Limonium sinuatum</i>	Plumbaginaceae	Wavyleaf sea-lavender	Limonio sinuato	Στατική, αμάραντος (statiki, amarantos)	Hoyt, 1998; Ghatto, 1998; Bird, 2004; Karras, 2006; Cox, 2006; Springer, 2011; Royal Hort Society
<i>Medicago arborea</i>	Fabaceae	Tree Medick, Moon Trefoil	Erba medica arborea, ginestrone	Μηδικήδενδρώδης (Midiki dendrodis)	Huxley, 1992; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Gizas, 2014;
<i>Myrtus communis</i>	Myrtaceae	Myrtle.	Mirto	Μυρτιά, σμυρτιά (mirtia, smirtia)	Kingsbury N, 1996; Ghatto Beth, 1998; Latymer H, 2001; Gildemeister H, 2002; Bird R, 2004; Cox Freda, 2006; Patlis, 2008a; Patlis, 2008b; Filippi O, 2008; Gizas George, 2014;
<i>Nerium oleander</i>	Apocynaceae	Rosebay	Oleandro	Πικροδάφνη (pikrodafni)	Taylor Jane 1990; Hoyt S R, 1998; Latymer H, 2001; Gildemeister H 2002; Cox Freda, 2006; Filippi O, 2008; Patlis, 2008a; Patlis, 2008b; Britwell M F, 2003; Beucher P, 2013; Gizas George, 2014; Royal Hort Society;
<i>Olea europea</i>	Oleaceae	Olive	Olivo	Ελιά (elia)	Huxley, 1992; Latymer, 2001; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Beucher, 2013; Gizas, 2014;

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Opuntia ficus-indica</i>	Cactaceae	Prickly Pear	Fico d' India	Φραγκοσυκιά (Fragosikia)	Latymer, 2001; Gildemeister, 2002; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Penick Pam, 2013,
<i>Origanum vulgare</i>	Lamiaceae	Oregano	Origano commune	Ρίγανη (Rigani)	Ghatto, 1998; Chatto, 2000; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Hawthorne, 2009; Easton, et al 2009;
<i>Phillyrea sp.</i>	Oleaceae	Mock Privet	Ilatro	Φιλλίκι (Filliki)	Hoyt, 1998; Gildemeister, 2002; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Gizas, 2014;
<i>Phlomis fruticosa</i>	Lamiaceae	Jerusalem sage	Salvione giallo	Ασφάκα (asfaka)	Kingsbury, 1996; Hoyt, 1998; Ghatto, 1998; Chatto, 2000; Lancaster, 2001; Gildemeister, 2002; Latymer, 2001; Bird, 2004; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Hawthorne, 2009; Ogden, 2011; Beucher, 2013; Hendy, 2014; Royal Hort Society;
<i>Pinus halepensis</i>	Pinaceae	Aleppo Pine	Pino d'Aleppo	Πεύκο, Χαλέπιος πεύκη (Pefko. Chalepios pefki)	Rushforth, 1987; Huxley, 1992; Hoyt, 1998; Lancaster, 2001; Latymer, 2001; Gildemeister, 2002; Patlis, 2008a; Patlis, 2008b; Williams, 2013; Gizas, 2014; Royal Hort Society;
<i>Pinus pinea</i>	Pinaceae	Italian Stone Pine, Mediterranean Stone Pine, Umbrella Pine	Pino domestico, Pino da pinoli	Πεύκοκουκουναριά (Pefko. koukounaria)	Huxley, 1992; Hoyt, 1998; Latymer, 2001; Lancaster, 2001; Gildemeister, 2002; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Williams, 2013; Beucher, 2013; Gizas, 2014; Royal Hort Society;
<i>Pistacia lentiscus</i>	Anacardiaceae	Pistache	Lentisco	Σχίνος (Schinos)	Latymer, 2001; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis G, 2008 a; Gizas, 2014;

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Punica granatum</i>	Punicaceae	Pomegranate	Melograno	Ροδιά (Rodia)	Latymer, 2001; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Ogden, 2011; Beucher, 2013; Gizas, 2014; Royal Hort Society;
<i>Quercus coccifera</i>	Fagaceae	Kermes	Quercia coccifera	Πουρνάρι (pournari)	Gildemeister, 2002; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Gizas, 2014;
<i>Quercus ilex</i>	Fagaceae	Holm oak, Evergreen oak, Holly oak, Ilex	Leccio	Αριά (aria)	Hoyt, 1998; Latymer, 2001; Gildemeister, 2002; Patlis, 2008a; Patlis, 2008b; Filippi, 2008; Beucher, 2013; Gizas, 2014; Royal Hort Society;
<i>Rosmarinus officinalis</i>	Lamiaceae	Rosemary	Osmarino, Ramerino, Smarino, Trasmarino, Usmarino, Rosmarino	Δενδρολίβανο (Dendrolivano)	Ghatto, 1998; Hoyt, 1998; Latymer, 2001; Gildemeister, 2002; Bird, 2004; Cox, 2006; Payne, 2007; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Easton, et al 2009; Ogden, 2011; Penick, 2013; Beucher, 2013; Hendy, 2014; Gizas, 2014; Royal Hort Society;
<i>Ruscus aculeatus</i>	Asparagaceae	Butcher's Broom	Uscolo pungitopo	Ρούσκος, κρυφός έρωτας, λαγομηλιά (Rouskos, krifos erotas, lagomilia)	Beckett, 1979; Gildemeister, 2002; Royal Hort Society;
<i>Salvia fruticosa</i>	Lamiaceae	Greek Sage	Salvia triloba	Φασκόμηλο (Faskomilo)	Chatto, 2000; Raven, 2001; Gildemeister, 2002; Bird, 2004; Readers Digest, 2007; Filippi, 2008; Patlis G, 2008a; Ogden, 2011; Springer Ogden, 2011; Beucher, 2013; Royal Hort Society;
<i>Salvia officinalis,</i>	Lamiaceae	Sage,	Salvia domestica	Φασκόμηλο (Faskomilo)	Denver Water, 1996; Ghatto, 1998; Chatto, 2000; Raven, 2001; Gildemeister, 2002; Readers Digest, 2007; Easton, et al, 2009; Filippi, 2008; Patlis G, 2008a; Springer Ogden,

Latin name	Family	English name	Italian name	Greek name	Literature
					2011; Ogden, 2011; Beucher, 2013; Royal Hort Society;
<i>Santolina chamaecyparissus</i>	Asteraceae	Cotton Lavender	Crespolina di Marchi	Σαντολίνη, λεβαντίνη (Santolini, levandini)	Denver Water, 1996; Kingsbury, 1996; Ghatto, 1998; Chatto, 2000; Latymer, 2001; Raven, 2001; Gildemeister, 2002; Britwell, 2003; Bird, 2004; Karras, 2006; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Hawthorne, 2009; Ogden, 2011; Springer Ogden, 2011; Penick, 2013; Beucher, 2013; Royal Hort Society;
<i>Satureja thurmba</i>	Lamiaceae	Satureia, Winter Savory	antoreggia sarda	Θρούμπι (Throumbi)	Gildemeister, 2002; Filippi, 2008
<i>Senecio cineraria</i>	Asteraceae	Silver Ragwort, dusty miller.	Senecione cinerario	Σινεράρια, αργυρόφυλλο (Sineraria, argyrofyllo)	Shubert, 1977; Ghatto, 1998; Gildemeister, 2002; Karras, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Williams, 2013;
<i>Spartium junceum</i>	Fabaceae	Spanish Broom, Weaver's Broom.	Ginestra comune	Σπάρτο (Sparto)	Hoyt, 1998; Chatto, 2000; Latymer, 2001; Gildemeister, 2002; Cox, 2006; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Ogden, 2011; Gizas, 2014; Royal Hort Society;
<i>Teucrium fruticans</i>	Lamiaceae	Tree Germander, Shrubby Germander	Camedrio femmina	Τεύκριο (Tefkrio)	Ghatto, 1998; Hoyt, 1998; Latymer, 2001; Gildemeister, 2002; Bird R, 2004; Cox, 2006; Patlis, 2008a; Patlis, 2008b; Hawthorne, 2009; Ogden, 2011; Beucher P, 2013; Gizas, 2014;
<i>Thymus capitatus</i>	Lamiaceae	Thymus	Timo arbustivo	Θυμάρι (Thymari)	Hoyt, 1998; Ghatto, 1998; Chatto, 2000; Latymer, 2001; Filippi, 2008; Easton, et al, 2009; Hawthorne, 2009;

Latin name	Family	English name	Italian name	Greek name	Literature
					Springer Ogden, 2011; Williams, 2013; Beucher P, 2013;
<i>Verbascum olympicum</i>	Scrophulariaceae	Olympian mullein	Verbasco	Φλόμος (flomos)	Shubert, 1977; Ghatto, 1998; Raven, 2001; Gildemeister, 2002; Bird, 2004; Hawthorne, 2009; Royal Hort Society;
<i>Vitex agnus-castus</i>	Verbenaceae	Chaste Tree, Chasteberry.	Lagano.	Λυγαριά (Lygaria)	Gildemeister, 2002; Britwell, 2003; Readers Digest, 2007; Filippi, 2008; Patlis, 2008a; Patlis, 2008b; Beucher, 2013; Gizas, 2014; Royal Hort Society;

Drought tolerant crops for agricultural cultivations

The options for drought tolerant crops are far fewer than those of plants for landscaping. This is expected, as these crops must ensure a satisfactory income to growers. For this reason the authors suggest crops, which, according to their estimation, could become profitable options for growers.

For every crop a short description, origin, water requirements of the plant, and some market information is given. In Table 3 the English, Italian and Greek name of the suggested plants, is mentioned, as well as the most important literature, in which the crops are recommended for cultivation in regions like Puglia in Italy and Epirus - Western Greece in Greece.



Fig. 5 Typical rural view of Salento (Apoulia, Italy)

Aloe vera (A. barbadensis) - Xanthorrhoeaceae

It is an evergreen perennial succulent, lent, stemless, in typical rosette shape (Nilanjana and Chattopadhyay, 2004). The majority of aloes have spines of various rigidity along the edges of their succulent leaves (UCDBC).

The origin of the plant is unknown. Some authors presume the Macaronesian region, others prefer Arabia. At present *Aloe vera* is widely distributed throughout the tropics and subtropics (Aguilar and Brink, 1999).

Aloe is cultivated for its leaves, which can be processed to make aloe juice and aloe latex.

The Dominican Republic, Mexico, and Venezuela are the main producers, as well as supplying about 60% of the aloe gel to the world market. Asia and Australia produce the remainder of the internationally traded product, with China and Thailand to be the most important producers (PROTA, 2008).

The plant grows in a wide range of climatic conditions but tends to grow most heartily in areas with higher heat and less rainfall (IASC). The amount of irrigation water to apply can be best calculated based on crop coefficients (K_c) between 0,20 and 0,30 (Genet and van Schooten, 1992). The plant cannot withstand temperatures below of -3°C (Aguilar and Brink, 1999).

Ceratonia siliqua - Caesalpiaceae

It is a slow growth evergreen tree. Its leaves are sclerophyllous (Mitrakos, 1988), shiny, green, and leathery. The tree is dioecious. There are also bisexual cultivars. The fruit (pod) is 10 - 30cm long and 1 - 2,5 cm wide, oblong, flattened, straight or slightly curved, tough and fibrous. To pod contains numerous uniform seeds. They are hard, ovate-oblong, 8 - 10 mm long, 7 - 8mm wide and 3 - 5 mm thick (Battle and Tous, 1997).

The place of origin of *C. siliqua* is not clear (Battle and Tous, 1997). It is native in North Africa (Algeria, Libya, Morocco, Tunisia), Western Asia (Israel, Lebanon, Syria, Turkey) and South Europe (Albania, Former Yugoslavia, Greece, Italy, France, Spain) (USDA).

According to FAOSTAT (2102), *Ceratonia siliqua* is cultivated in many countries. The top 5 carob producing countries are Spain (43.000 ha), Portugal (9.800 ha), Morocco (9.750 ha), Italy 5.672 ha, and Greece (5.600 ha).

The fruits of *C. siliqua* are used as fodder and in food industry. They are a source of many products such as gum, sugar, and alcohol (Carlson, 1986).

C. siliqua, due to its interesting morphophysiological characteristics, such as resistance to drought and salinity and adaptation to poor soils (Battle and Tous, 1997) requires little maintenance (Fletcher, 1997). According to Battle and Tous (1997), Carob can survive and produce fruits without irrigation with annual rainfall between 350 and 500 mm per year.

***Ficus carica* - Moraceae**

The fig is a deciduous small tree, with gray stems and branches. Its leaves have three to seven lobes and its fruit are green to purplish, pear shaped (Pollunin, 1980).

The origin of fig is west Asia and has been cultivated for thousands of years in Mediterranean (Morton, 1987(a)). It is cultivated for its fruits, which can be consumed fresh or dried. The Food and Agricultural Organization of the United Nations (FAO, 2006) estimates that figs are harvested from 427.000 ha, producing more than one million metric tons per year. Turkey produces about the 26% of the world's figs and, when combined with Egypt, Iran, Greece, Algeria, and Morocco, these top six producing countries account for about the 70% of the world's annual production.

Fig is especially well adapted to Mediterranean environments, with cool winters and hot, dry summers (Stover et al., 2007). According to Flaishman et al. (2008), there is little information about water requirements. Tapia et al. (2003) examined the effect of four irrigation rates on growth of six fig cultivars. They found that three-year-old trees of most the cultivars performed adequately when irrigated at 17% of pan evaporation. It must be noticed that rains during fruit development and ripening are detrimental to the crop, causing the fruits to split.

***Lavandula sp* - Lamiaceae**

There are 40 species of Lavender. The most important cultivated species are *L. angustifolia* (True lavender), *L. latifolia* (French lavender) and Levandin (*Lavandula x intermedia*), which is hybrid of *L. angustifolia* and *L. latifolia* (DAFF, 2009). All species are small aromatic evergreen shrubs (Adam, 2006) to 0,5 - 1 m tall with simple, narrow, toothed or lobed, grey-green, depending on species. The flowers are small, tubular, violet-purple or deep blue or purple (depending on species) in dense spikes (Pollunin, 1980).

Most species are native of Mediterranean basin, but several botanists think that India also may have been part of the native range (Spector Platt, 2009).

Lavender species are cultivated for its essential oil. The part used for oil distillation is the flowers and, in smaller quantities, leaves (DAFF, 2009). The essential oil is used in cosmetics, soaps, etc., and as household herbal remedy.

The major market in the world for Lavender's essential oil is USA, followed by Japan and Europe. The production of essential oil is concentrated in Europe, with seven of the world's largest essential oil processing firms.

Many regions of West Greece and Puglia are ideal for Lavender cultivation according to the literature, as the plant can grow and produce well with a rainfall range from 300 to 1400mm per year (DAFF, 2009).

***Origanum vulgare* - Lamiaceae**

The genus *Origanum* includes over 200 genera. The most important cultivated species is *O. vulgare*, which includes many subspecies. Oregano is a herbaceous, perennial plant, aromatic, woody-based, growing to 20 - 90 cm in height. Its leaves are olive-green, ovate, opposite, smooth or very shallowly

toothed. The flowers are white to purplish, with two-lip corolla and five-toothed calyx, in erect spikes (Pollunin, 1980).

Most species of Oregano are native to the Mediterranean and Eurasia (THSA, 2005).

Oregano is used as a culinary spice and a food preservative. It is used also in medicine (Pitzer, 1999).

Oregano is by far the largest selling herb today. Turkey has a dominant position in the worldwide trade of oregano (*Origanum* sp), followed by Greece and other Mediterranean countries. Though Italy harvests large amounts of oregano, which most of them are consumed domestically (Kintzios, 2002). In many sources, Mexico is referred as a major producer of oregano. However, this oregano is from the genus *Lippia* quite distinct from *Origanum* (Kintzios, 2002).

The environmental conditions are ideal, in many regions of Puglia and Greece, for high quality production of oregano as it is cultivated in dry climatic conditions. Winter rain is usually sufficient for the crop, but to increase the yield and to obtain a second cutting in autumn it is necessary to irrigate during the summer, soon after cutting. It is also advisable to irrigate the crop in spring if there has been no rain over a long period during the winter (Padulosi, 1997).

***Olea europea* - Oleaceae**

Olive tree is 8-15m in height with a broad crown with many thin branches. Its leaves are pale green above and silvery below, opposite, oblong or lanceolate, 4 - 10 cm long and 1 - 3 cm wide. The flowers are small, cream or white, in feathery racemes, born on the previous year's wood from the axils of the leaves. The fruit is a drupe. It is dark purple, 1 - 2,5 cm long depended on the variety. The fleshy part is filled with oil and contains a single seed (rock or stone)

The olive is native to the Mediterranean region and Western Asia, and has been cultivated for at least 5.000 to 6.000 years ago (Vossen, 2007a).

The three largest producing countries according to the International Olive Oil Council (IOOC, 2013) are Spain, Italy and Greece. According to FAOSTAT (2011) ten Mediterranean countries produce 95% of the world's olives. Italy and Spain are the greater exporters in olive oil.

Olive is successfully cultivated without irrigation in areas where the average annual rainfall is greater than 600 mm, but can survive with as little as 200 - 250 mm (Feres, 2012).

Taking into account the increasing world demand in olive oil and table olives, the cultivation of olives trees has bright prospects.

***Opuntia ficus-indica* - Cactaceae**

Opuntia is perennial cactus. The stems are cladodes. These are very thick, succulent, and oblong to spatulate, 30 - 40 cm long and 18 - 25 cm wide, full of spines. Some varieties are spineless. The leaves are generally reduced to thorns. The flowers are yellow or orange, followed by a fruit, oblong, succulent, reddish, ellipsoid, 7 cm long and edible. (Pollunin, 1980; Heuzé and Tran, 2011).

Opuntia is native to Mexico (USDA, 2009) and naturalized in the Mediterranean region (Pollunin 1980). It is cultivated mainly for its fruits (Ecocrop, 2009). Tender pads of *Opuntia* are also consumed in many regions of the world as vegetable. It is also an interesting forage or fodder for cattle, sheep and goats, especially in very dry areas (Reynolds and Arias, 2001; Heuzé and Tran, 2011).

It is cultivated in more than 30 countries (Ecocrop, 2009) and is the most widespread and most commercially important cactus, and has been, and continues to be, widely introduced as a commercial fruit and fodder crop. In Italy (mainly Sicily) there is a long tradition in *Opuntia* cultivation (Barbera et al., 1992). The water needs of *Opuntia* are very low. It can survive with a rainfall of 25 - 50 mm per year. The production is much higher if there is single irrigation or rainfall during growing period (Lancaster, 2006). For Italy and Greece there is no matter of irrigation as the plant is ideal for semi-arid regions (150-500 mm per year of rainfall) (Reynolds and Arias, 2001)

During the last years, *Opuntia* plantations have been installed both in Puglia and Greece.

***Punica granatum* - Punicaceae**

It is a small multi stem shrub/tree. Its leaves are opposite, oblong or ovate, 2 - 8 cm long. The flowers are orange-red solitary or in fascicles at apices, followed by around fruit, 5 - 12 cm, with leathery pericarp (Orwa et al., 2009a). The interior of the fruit is separated by membranous walls and white spongy tissue (rag) into compartments packed with transparent sacs filled with tart, flavorful, fleshy, juicy, red, pink or whitish pulp. In each sac, there is one white or red, angular, soft or hard seed (Morton, 1987).

The pomegranate tree is native from Iran to northern India (Morton, 1987), and has been cultivated since ancient times in Italy and Greece (Stove and Mercure, 2007).

Punica granatum is mainly cultivated for its fruits, which can be consumed fresh or as juice.

In India more than 100.000 ha of pomegranate are produced (Indian Council of Agricultural Research, 2005). In Iran, 65,000 ha of pomegranate produce 600,000 tons of fruit annually, with about 30% of yield exported (Mehrnews, 2006). Turkish production in 1997 was 56,000 tons/year (Gozlekci and Kaynak, 2000). Spain, with about 3000 ha, is the largest western European producer of pomegranate (Costa and Melgarejo, 2000).

The plant favors a semi-arid climate and is extremely drought - tolerant (Morton, 1987) although regular and deep watering helps fruit development. According to Shanan and Tadmor (1979) the seasonal requirement is 125 mm of water with a mean annual rainfall 1000 mm (Orwa et al 2009a).

***Vigna unguiculata* - Fabaceae**

It is an annual legume with a strong taproot. It has varying growth forms depending on variety. It may be erect, trailing, climbing or bushy. Its leaves are dark green, hairless, trifoliate, alternatives with the terminal leaflet longer and larger than the lateral leaflets. There is a wide range in leaf size and shape depending on the variety. The flowers are in groups, pale violet or mauve. The seeds are bean-like with an eye depending on the variety. They vary in color, eye color, size and shape (Davis et al., 1991).

Cowpea is believed to have originated from West Africa. Others believe that it is originated from Southern Africa (DAFF, 2011).

Cowpea is a part of the diet of about 110 million people (DAFF, 2011) but it has great flexibility in use: farmers can choose to harvest them for grains or to harvest forage for their livestock (Gomez, 2004).

More than 5.4 million tons of dried cowpeas are produced worldwide, with Africa producing nearly 5.2 million. Nigeria is the largest producer and consumer (IITA, 2009). Cow pea is cultivated in many regions of Greece and Italy for grains or for vegetable as the water needs are, in many varieties, less than 500 mm/year (Dugje et al., 2009).

Table 3 Literature for the drought tolerant crops

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Aloe vera</i> (A. <i>barbadensis</i>)	Xanthorrhoeaceae	Aloe vera	Aloe	Αλόη (Aloi)	Genet and van Schooten, 1992; Saksandish-shalom-Gordon, 1995; Aguilar and Brink, 1999; Nilanjana and Chattopadhyay, 2004; IASC;
<i>Ceratonia siliqua</i>	Caesalpiniaceae	Carob, St John's Bread	Carrubo	Χαρουπιά, ξυλοκερατιά (Charoupia, xylokeratia)	Mitrakos, K, 1981; Battle and Tous, 1997; Fletcher, 1997; Race et al 1999; Orwa et al., 2009;
<i>Ficus carica</i>	Moraceae	Fig	Fico	Σύκο (Siko)	Morton, 1987a; Tapia et al., 2003; Stover et al, 2007; Flaishman et al., 2008;
<i>Lavandula sp</i>	Lamiaceae	Lavender	Lavanda	Λεβάντα (Levanta)	McGimpsey et al., 1999; Curtis, 2005; Adam, 2006; Spector, 2009; DAFF 2009; McNaughton, 2010;
<i>Olea europea</i>	Oleaceae	Olive	Olivo	Ελιά (Elia)	Pontikis, 2000; Fiorino, 2003; Sibbett et al., 2005; Vossen, 2007b; Alfei et al., 2013
<i>Opuntia ficus-indica</i>	Cactaceae	Prickly Pear	Fico d' India	Φραγκοσουκιά (Fragosikia)	Barbera et al., 1992; Ecocrop, 2009; Orwa et al., 2009a; Heuzé and Tran, 2011; Stratoudakis, 2013;
<i>Origanum vulgare</i>	Lamiaceae	Oregano	Origano commune	Ρίγανη (Rigani)	Padulosi, 1997; Pitzer, 1999; Kintzios, 2002; THSA, 2005; Crocker, 2005;

Latin name	Family	English name	Italian name	Greek name	Literature
<i>Punica granatum</i>	Punicaceae	Pomegranate	Melograno	Ροδιά (Rodia)	Shanan & Tadmor, 1979; Morton, 1987; Costa & Melgarejo, 2000; Stover and Mercure, 2007; Orwa et al., 2009;
<i>Vigna unguiculata</i>	Fabaceae	Cowpea, Black eye pea.	Fagiolo dall'occhio	Γυφτοφάσουλα, μαυρομάτικα (Giftofasoula, mauromatic)	Davis et al., 1991; Quinn, 1999; Dugje et al., 2009; DAFF, 2011; Heuzé and Tran, 2013;

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