



Efficient Irrigation Management
Tools for Agricultural Cultivations
and Urban Landscapes

IRMA

WP2 Information & Publicity

Low-water demand agricultural cultivations and local species for landscape design



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*This book is dedicated to Prof. George Gizas,
an admirer and expert of the natural flora of Epirus,
a distinctive colleague and a good friend.*

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Notes - favourite plants:.....

Notes - favourite plants:.....

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Introduction

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". Agriculture in this area is the main consumer, as it demands the 64% of the available water, while the domestic sector (including irrigation of gardens) demands about 14%. According to the same source, the efficiency of irrigation in Italy and Greece is between 60-70%. Taking the above into account, the importance of using drought tolerant plants for landscaping design and crops as well as applying methods aimed at efficient water use for irrigation in agriculture and landscaping is undeniable.

The present book is divided into two parts. In the first part the following information is given:

Climate data for regions of Puglia (Italy), Western Greece and Epirus (Greece) and climate change predictions. According to these predictions, rainfall reduction and temperature increase are expected by the end of the century.

Information regarding the mechanisms of xerophytic plants in order to handle water scarcity. This information is extremely useful given that the majority of local flora of the above regions consists of xerophytic plants.

Methods and practices for efficient water use. All the methods that are mentioned in this book can be applied in the project region. Some are very easy to adopt, while others require specialized equipment and knowledge.

In the second part, selected plants are described:

52 plants of the local flora that are used in landscaping.

9 xerophytic plant crops.

In each section of the book extensive literature for further reading is provided.

The authors hope that IRMA partners will disseminate the information contained in this guide and this will contribute to the efficient use of water in our regions.

Georgios K. Karras



PART I

CLIMATE, DRAUGHT & IRRIGATION

Current climate and future expectations

The climatic conditions in both Puglia and the western coast of Greece (Fig. 1) are similar and are characterized as the typical Mediterranean: mild and rainy winters, relatively warm and dry summers and, generally, extended periods of sunshine during most of the year. In climatological terms, the year can be broadly subdivided into two main seasons: the cold and rainy period lasting from mid-October until the end of March, and the warm and dry season lasting from April until September. Of course there is a variety of climate subtypes, always within the Mediterranean climate frame.

The climate of the above mentioned regions according to the Gaussem's xerothermic index, is submediterranean to xerothermomediterranean. This classification shows that seasonal irrigation in agriculture and landscape is essential. The Gaussem's ombrothermic charts, which are depicted below, present the dry months of the year in the main cities of western Greece and Puglia.

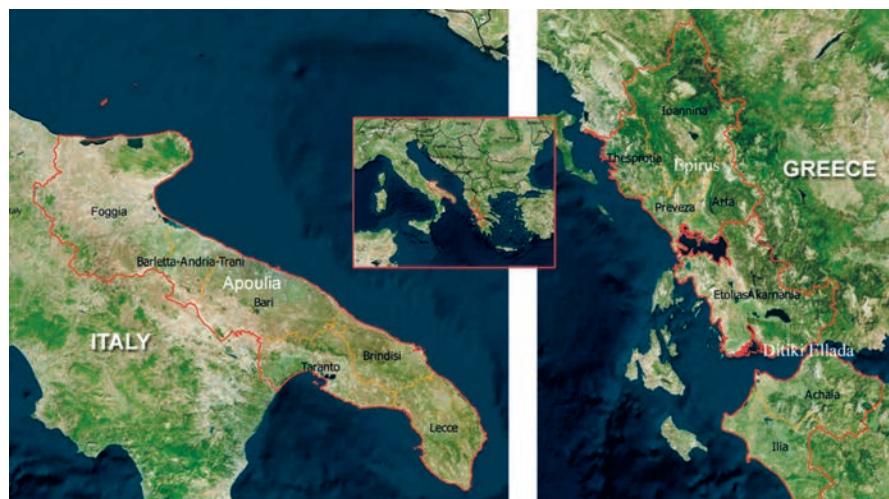


Fig.1: The south east part of Italy, where Puglia is located and the west and north-west part of Greece, where the Regions of Epirus (north) and Western Greece are located

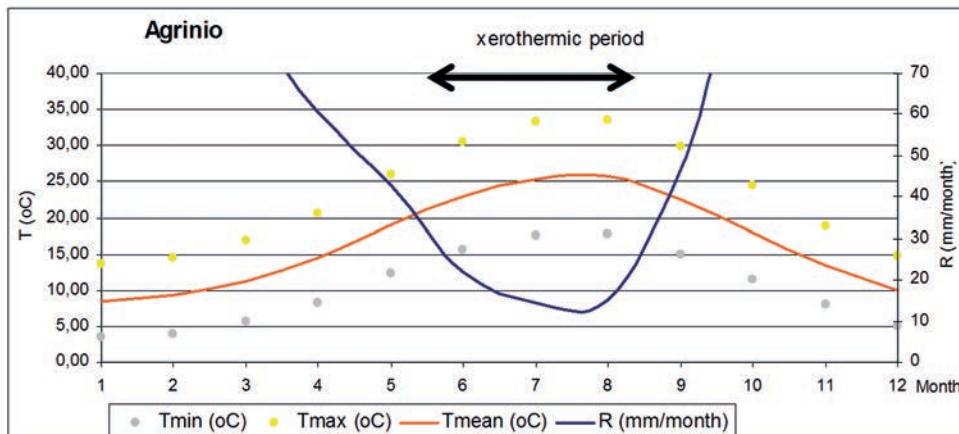


Fig. 2 Ombothermic chart for the area of Agrinio

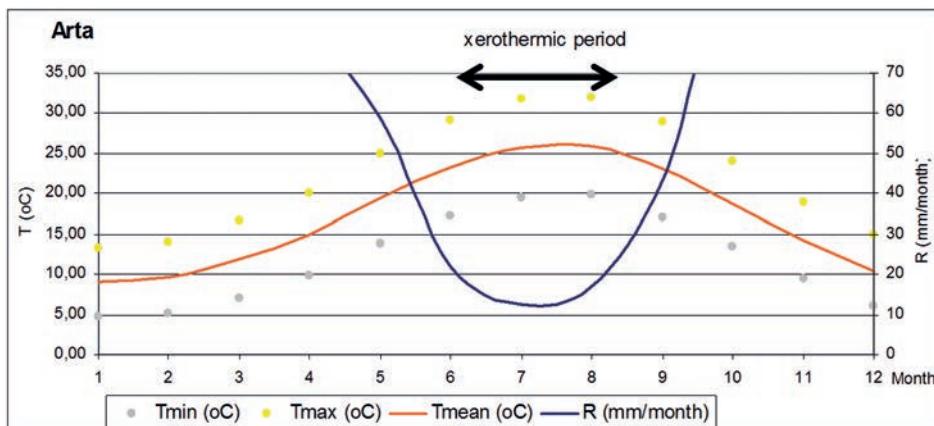


Fig. 3 Ombothermic chart for the area of Arta

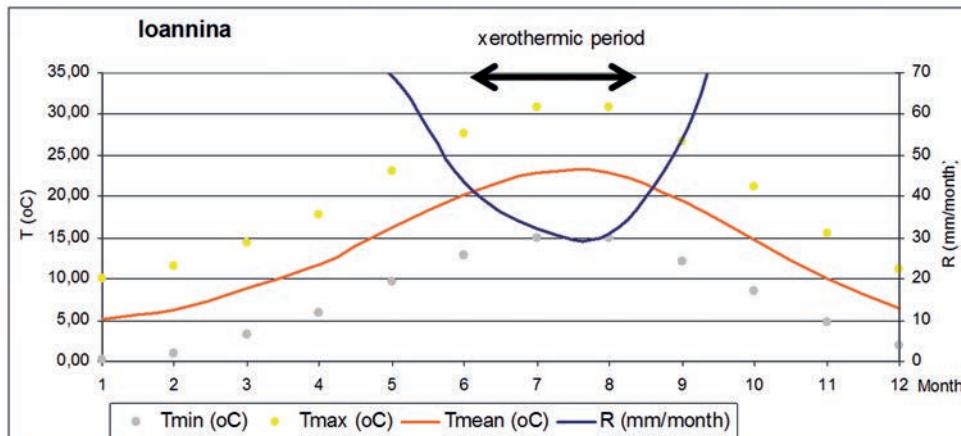


Fig. 4 Ombothermic chart for the area of Ioannina

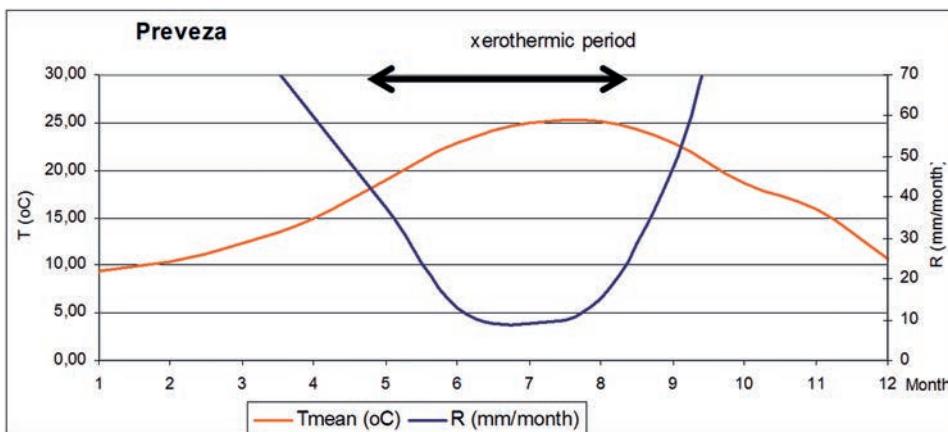


Fig. 5 Ombothermic chart for the area of Preveza

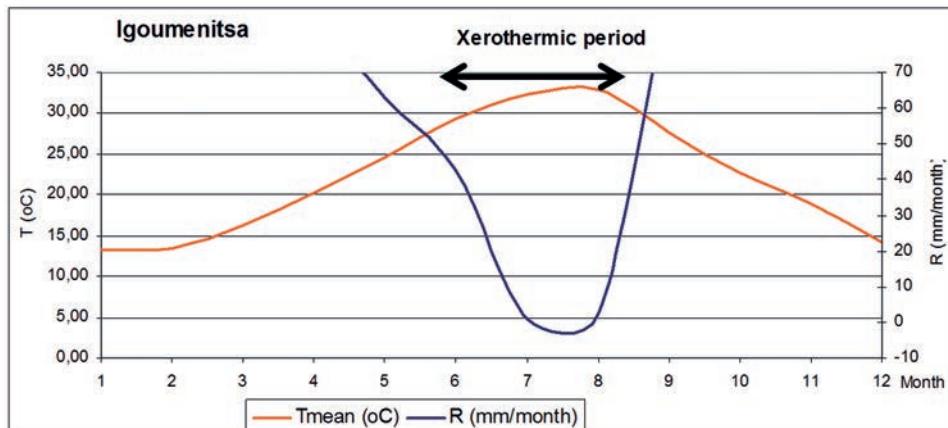


Fig. 6 Ombothermic chart for the area of Igoumenitsa

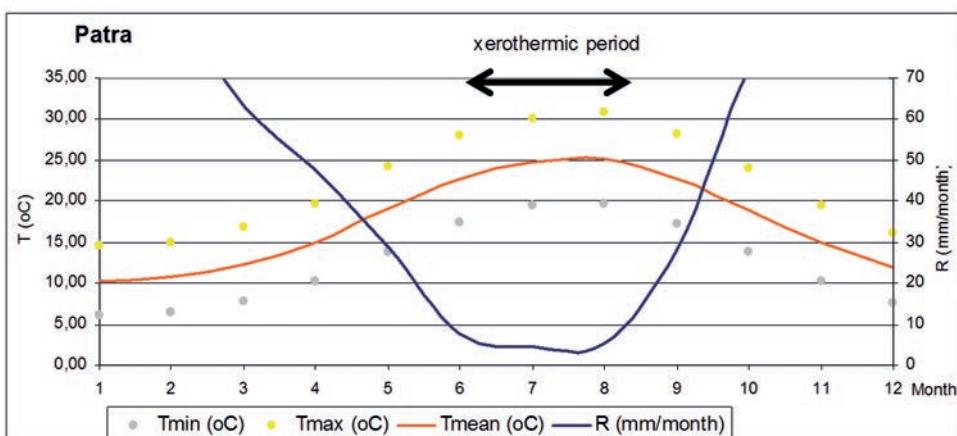


Fig. 7 Ombothermic chart for the area of Patras

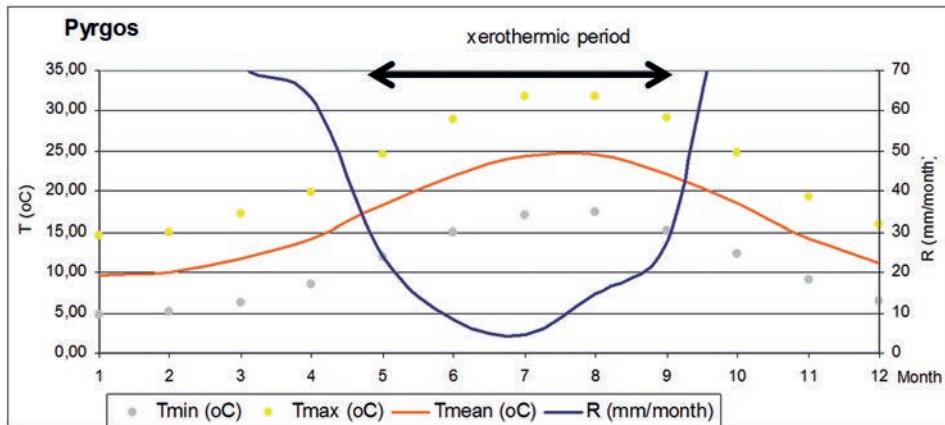


Fig. 8 Ombothermic chart for the area of Pyrgos

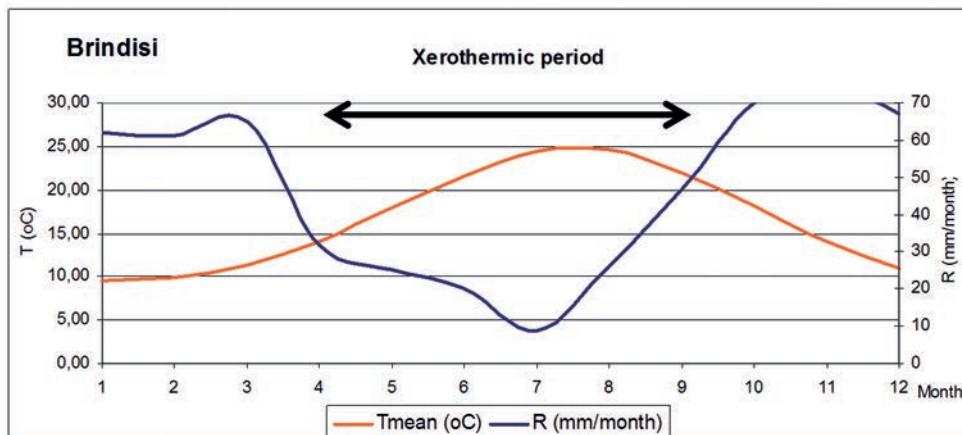


Fig. 9 Ombothermic chart for the area of Brindisi

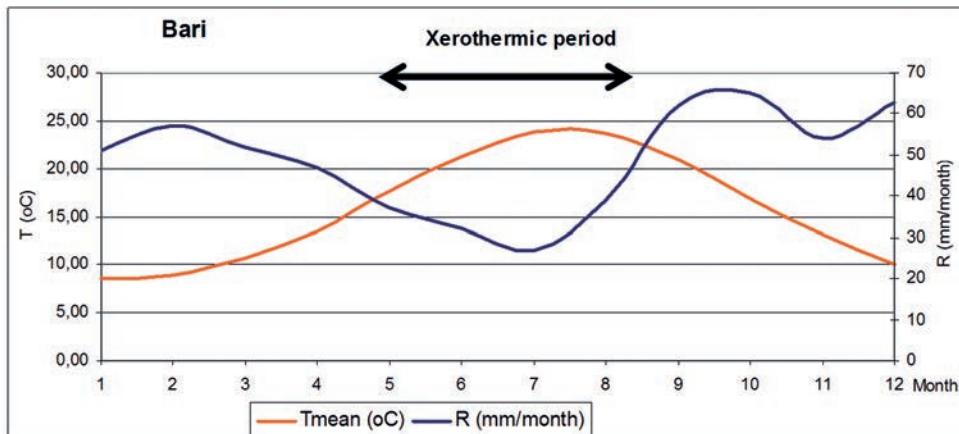


Fig. 10 Ombothermic chart for the area of Bari

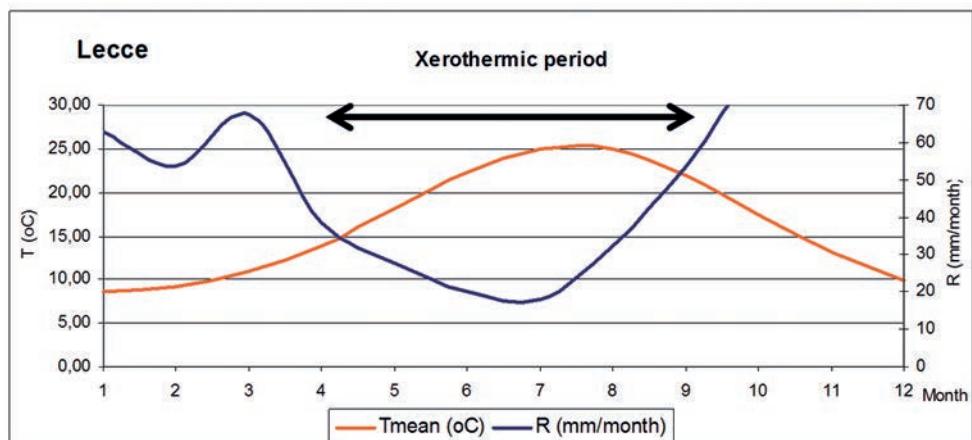


Fig. 11 Ombothermic chart for the area of Lecce

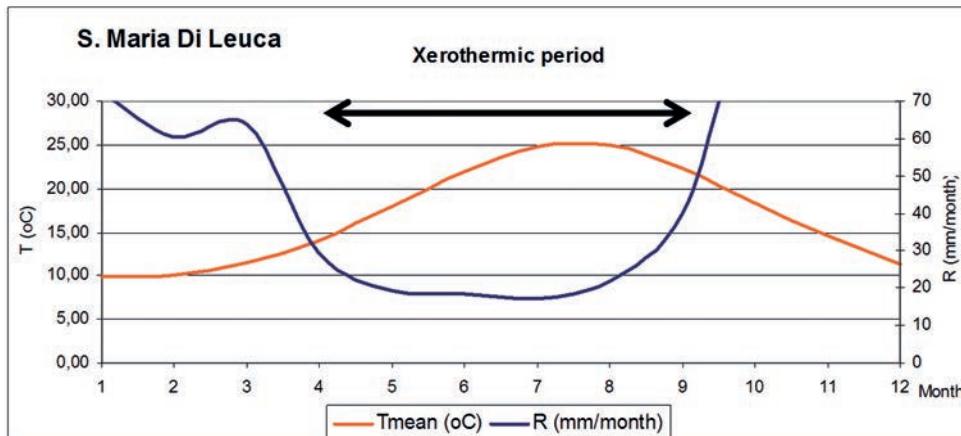


Fig. 12 Ombrothermic chart for the area of S. Maria Di Leuca

According to the ombrothermic charts the dry period (xerothermic period) lasts (on average) from May up to September. All this data is likely to change dramatically in the future according to many scientific predictions (UNEP/MAP-2009 Plan Bleu). In some cases, the change is already visible. Since 1970, temperature has risen by nearly 2°C and the rainfall has dropped by 20% in several Southern European regions, while the future looks inauspicious for the Mediterranean. In particular, it is expected:

An increase in air temperature of 2.2°C to 5.1°C in Southern European countries over the period between 2080-2099 by contrast to the period between 1980-1999.

A drop between -4% and -27% regarding raindrop in Southern Europe.

Increased periods of drought resulting in more frequent occurrences of day temperatures above 30°C.

Water resources will be inflicted by increased evaporation and decreased rainfall.

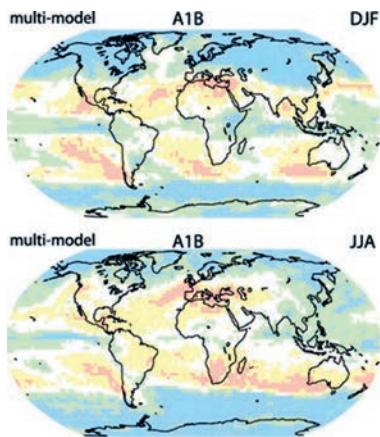


Fig. 13 Blue and green areas on the map are by the end of the century projected to experience increases in precipitation, while areas in yellow and pink are projected to have decreases. The top panel shows projections for the period covering December, January and February, while the bottom panel shows projections for the period covering June, July and August (Christensen et al., 2007)

Various global and regional climate model simulations reach the same conclusions. According to Christensen et al. (2007), a decrease in precipitation is projected in the Mediterranean basin (Fig. 13), while Giorgi and Lionello (2008) foresee that precipitation will decrease by 25 up to -30% and temperature will rise by 4 to 5°C in the same area.

These impacts are expected to be aggravated by current pressures from human activities on the natural environment.

Undoubtedly, the issue of water will become a major challenge for sustainable development in our countries which explains why the efficient use of water is essential.

Further reading

- Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, R. Jones, R.K. Kolli, W.-T. Kwon, R. Laprise, V. Magaña Rueda, L. Mearns, C.G. Menndez, J. Risnen, A. Rinke, A. Sarr and P. Whetton, 2007. Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
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- World Meteorological Organization WMO. Guide to Climatological Practices, WMO-No. 100, 2011, www.wmo.int

Drought and plants

Drought can be difficult for people to understand, because what may be considered as drought in Malaysia (annual rainfall 2.875mm/year) would certainly not be considered as 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 is because there is not a universal definition of drought (Bindi, 2009).

In simple terms, drought is a deficiency of precipitation over an extended period of time. If this period of unusually dry weather persists long enough, may cause environmental or economic problems. 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 one 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 a fall in level of water table.

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

Socioeconomic drought: It occurs when physical water shortages start to affect the health, well-being and quality of life of the people or when drought starts to affect the supply and demand of an economic product.

Drought adaptation of plants is controlled by complicated interactions between anatomy, physiology and biochemistry, all of which are directly or indirectly under genetic control (Bassett, 2013). The plants have adopted numerous adaptive mechanisms to survive in drought conditions. Their strategy choices can be summarized as follows:

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 extensive shallow root systems, allowing for the quick absorption of large quantities of water when it rains.



Fig. 14 Phrygana on a dry slope of Epirus region in May. The dominant species are *Phlomis fruticosa* and *Quercus coccifera*.

Deep root system. A lot of plants have an extensive root system, like *Ceratonia siliqua*, which penetrates the soil deeply. The plants can thus survive long periods of drought, as the roots secure water influx to the leaves (Battle and Tous, 1997., Rhizopoulou and Davies, 1991).

The plants have also adopted numerous mechanisms to reduce the rate of transpiration (Bassett, 2013., Levitt, 1980., Bruce, 1995., Polunin, 1980., UNLV, Galm's et al., 2006.) such as:

Small leaves (Lavender, Thymus, Winter Savory) or needle-like (Pines). These kinds of leaves reduce the total surface area of the leaf, causing less evaporation of water due to a 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 while the shiny surface reflects heat and so it lowers temperature.

Stomata may be sunk in pits in the epidermis; the moist air trapped here 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 they reduce transpiration. In addition, a smaller surface area of leaf is exposed to the drying effects of the wind.

Falling leaves during summer for saving water. A typical plant in this group is Tree Medick.

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 the Spanish broom.

A lot of Mediterranean plants (Margaris, 1981) are seasonally dimorphic species. They shed the larger winter and spring leaves, and develop smaller ones 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 the 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 to keep alive (UNLV).

The majority of flora of Greece and Puglia is characteristic and fully adapted in drought conditions. The dominant plant communities are: Maquis (macchie) and Phrygana (garrique) (Pollunin, 1980). 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. 14). 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.

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Water conservation methods

In this chapter a list of water saving practices is mentioned. These practices will lead to increased yields and more beautiful landscapes with less water consumed. We hope readers find this work useful. Please feel welcome to add other methods not included in this chapter.

Mycorrhizae

Mycorrhizae or mycorrhizas are fungi that colonize the roots of host plants (Fig 15). There are two main types of these: endomycorrhizae and ectomycorrhizae.

Both types grow in between the cells of a plant root. Endomycorrhizae form arbuscules (Arbuscular Mycorrhizal (AMF or AM)), which are structures that allow the fungus to penetrate the actual cells in the plant root. Ectomycorrhizae do not form arbuscules and do not enter the actual cells of the roots.

From this symbiotic relationship both organisms (plant and fungus) benefit. The plants give 10-20% of the carbon they obtain from photosynthesis and in return the fungus increases the surface area of the plant roots. This increased root area within the soil improves the drought tolerance of plants and can reduce water needs by 25-30% according to the existing literature. Aside from reducing water stress, mycorrhizal fungi also improve mineral absorption and reduce the need for fertilization.

This relationship, between the fungus and the plant, according to literature, also enables plants to grow in salty or contaminated soils, increases the temperature stress tolerance and enhances the protection of plants against infections by root pathogens, including *Phytophthora spp.*, *Pythium spp.*, *Fusarium spp.*, *Thielaviopsis spp.*, *Rhizoctonia spp.*, *Verticillium spp.*, *Alternaria spp.*, *Sclerotium spp.*.

The majority of Ectomycorrhizae species belong to Basidiomycetes and Ascomycetes, which mainly interact with forest tree species such as Pinaceae and Fagaceae. The most widespread species of the A.M. belong to the phylum Glomeromycota.

Over 90% of the world's plant species can be colonized by A.M. fungi and the most common plants are:

Fruit trees, shrubs and foliage plants except for rhododendron, azalea, and heath

Berries except for blue-berries, and cranberries

Flowers and vegetable except for brassica and beets

Cultivated grasses except for the weedy ones

According to the aforementioned, AM fungi reduce the drought stress of plants grown under droughty conditions and can have a positive impact on crop yield in areas where regular irrigation is impossible, impractical, or too costly.

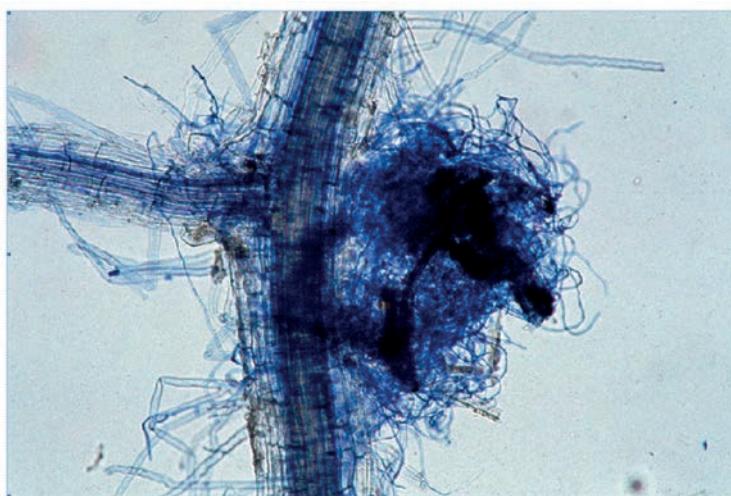


Fig. 15 Mycorrhizae formations

There are many products containing AM fungi, which can be applied directly to the soil. There are also cultural practices which encourage A.M. fungi growth in soils, such as: minimum tillage, non-use of agrochemicals, rotating, composting, and mulching with leaves. Quite the opposite, heavy tillage and fertilizers, fungicides, poor rotation, abundance of irrigation, hinder the ability of plants to form symbiosis with A.M. fungi.

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Mulching

Mulch is any material placed on a soil surface. It is a barrier of moisture movement out of the soil. It can reduce evaporation from soil by up to 70% and thus to reduce the irrigation water by 20-25%.

There are two types of mulches: organic and inorganic.

Organic mulches include straw, leaves, bark, pine needles, compost and similar materials.

Inorganic mulches include rock chips, plastic sheets, crushed glass, geotextile, and other non-plant materials.

Apart from water conservation, mulches have a lot of benefits, such as:

They keep the soil cooler in the summer and warmer in the winter and so they promote better root growth, early germination, and plant health.

They prevent the growth of many weeds.

They prevent the soil erosion by rain and wind.

They enrich the soil with humus as they decay and improve soil fertility (organic mulches).

They have an aesthetic value in the gardens and landscaping.

Mulches are used in the majority of crops as: tree orchards, vegetable fields, row crops, etc. They are even used in greenhouses. In Almeria (Spain), for example, the majority of growers cover the soil with 10-15 cm of sand or pebbles (Fig. 16).

Mulches are used also in gardening and landscaping, as there are a lot of inorganic mulches with high decorative value such as: crushed gravel, granite mulches, river rock, small stone mulches, lava rock, colorful stones, sand, etc.

Plastic sheets are usually applied in open field crops by machinery (mulch layers) and are combined with drip irrigation systems, where the emitters are laid under the mulch. The thickness, width or the color of plastic sheets depend on the crop, climate, soil, precipitation, and water quality. For instance, in summer crops the black film must not be used, as it causes "burning" or "scorching" of the young plants due to high temperature.

The layer thickness of organic mulches depends on mulch material and the crop. Usually 5 to 20 cm thick is sufficient. The rule is: the finer and smaller the particle size, the thinner the layer needs to be. A thick layer of organic mulch is possible to cause problems, as the root may rot, because of moisture excess. It can create a habitat for rodents, snails or slugs and prevent penetration of water and air if the mulch consists of fine texture materials.



Fig. 16 Mulcing with sand, in a cucumber crop, on the soil of greenhouse in Almeria (Spain).

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Reuse of irrigation tailwater

Irrigation tailwater or agricultural wastewater is the excess water that runs off the lower end of the field during surface irrigation. The amount of this wastewater, according to relevant studies, is estimated to be 20-30% of the total amount of irrigation water.

Reuse of irrigation tailwater carried out by a system that collects stores and transports it to the upper portion of the field.

A simple reuse system consists of:

- the capture pond -reservoir (tailwater ponds are usually excavated below ground level, allowing gravity flow to fill the pond)
- the return flow pump
- the tailwater return pipeline and
- the power unit (electric motor or a diesel engine for the return flow pump)

A tailwater reuse system is shown schematically in Fig. 17.

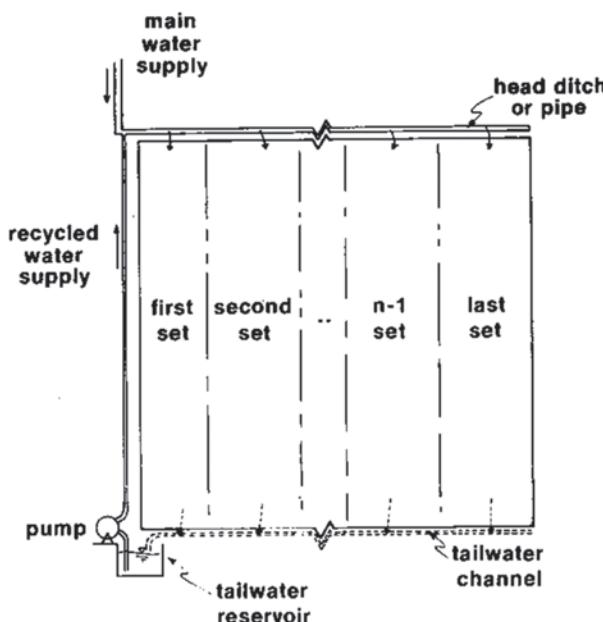


Fig. 17 Tailwater reuse system (Walker and Skogerboe, 1987)

The advantages and disadvantages of using a tail water return system are shown in Table 1. Tailwater return systems are generally not designed to store winter rainfall runoff. The reason is that the rainfall runoff volumes are often so large that storing them in a pond is not practical.

Table 1 Advantages and disadvantages of using tail water return system (Source: Schwankl L., 2007)

Advantages	Disadvantages
Minimizes environmental impacts	Increases costs, (installation, maintenance, operation and because land must be taken out of production for the pond and other system components).
Improves irrigation efficiency	
May reduce water costs	
Simplifies irrigation water management for flood systems	Requires timely recycling of <u>tailwater</u> pond contents to prevent groundwater pollution by chemicals in the <u>tailwater</u>
Removes standing water	

Tailwater is mainly associated with surface irrigation (furrow, border-strip, etc) and row crops (corn, cotton, etc). Sprinkler or microirrigation systems rarely produce tailwater runoff. The reuse of runoff water works best with laser leveling, and is effective with soils that have high water holding capacity. It is not recommended for areas where soils contain high concentrations of salt, as it may spread chemicals, diseases and weed seeds.

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Rainwater harvesting

Rainwater harvesting or collection, is the accumulation and storage of rainwater for reuse before it reaches the aquifer. The harvested water can be used for many purposes, such as: garden irrigation, various domestic needs, or water for livestock. Actually, on the mountains of Epirus there are a lot of constructions, which collect the rainfall for livestock watering during the summer (Fig. 18). In many areas of the world the harvested water is used even for drinking water.

Rainwater harvesting provides an alternative water source not only for the dry seasons but even when there is no kind of conventional, centralized government supply system, as well as in areas, where there is not a good quality of fresh surface water or groundwater. Rainwater harvesting is rarely used in big crops. The reason is that the rainfall runoff volumes are often so large that storing them in any tank or pond is not practical.



Fig. 18 Rainwater harvesting on mountain Mitsikeli (Epirus, Greece)



Fig. 19 Rainwater harvest tank at the hydroponic glasshouse of TEIEP (Arta, Greece)



Fig. 20 A simple rainwater harvesting system (Tsirogiannis, 2010)

A rainwater harvesting system consists of three basic parts: a collection area, a conveyance (transportation) system and storage tanks.

The collection area in most cases is the roof of a house or a building, the roof of a greenhouse (Fig. 19) or a prepared surface area on the ground. The conveyance system usually consists of gutters or pipes that deliver rainwater to cisterns or other storage vessels. A filter must be placed in such route in

order to remove debris. Finally the storage facilities may be barrels, tanks, cisterns or ponds, which are incorporated in the landscape. The surfaces of the collection area and conveyance system as well as the material of storage facilities should be constructed of chemically inert materials, in order to avoid adverse effects on water quality.



Fig. 21 A rainwater harvest pond can be also be a focal point of the garden

Rainwater harvesting has a lot of advantages. It provides a source of water at the point where it is needed and comprises an essential reserve in times of emergency. The construction is simple and can be installed with minimal skills. Additionally, the costs are low. We shouldn't forget that rainwater harvesting contributes to flood reduction. Finally, rainwater is free of salts and other minerals that harm plant growth while reduces soil EC.

The success of rainfall harvesting depends upon the frequency and amount of rainfall as well as storage capacities.

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Using gray water for irrigation

The use of gray water is another practice for water saving. There are three shades (categories) of grey water. The light shade is generated from wash hand basins, showers and baths (Fig 22). Laundry water is the second category of gray water. Finally, kitchen waste water is always considered to be dark grey. Some people also categorize kitchen wastewater as black water because it has quite a high organic loading relative to other sources of wastewater. For this reason the kitchen wastewater is not recommended for use as gray water if untreated. The gray water differs from the discharge of WC's which is black water and contains human waste. The wastewater sources and the percentages of household flow are presented in Table 2.

Table 2 Wastewater sources and percent of household flow

Source	%*	Category
Toilet	38	Black water
Kitchen waste	10	
Bath/shower	28	
Laundry	18	Gray water
Misc	6	

* Average from various sources

The light gray water contains soaps, shampoos, toothpaste and cleaning agents. Laundry water is chemically laden as it contains lots of sodium, phosphorus and boron. The kitchen waste water contains food, fats, feed bugs and dishwasher detergent.

There is a high amount of variability in the chemical and physical quality of gray water produced by any household, which is due to factors such as the source of household water, individual habits and products used in the household (e.g., detergents, shampoos, and soaps). On average, the chemical and physical characteristics of gray water are as follows: 140 to 160 mg/L BOD concentration, 50 - 150 mg/L suspended solids, 5 - 10 mg/L nitrogen, and 0.4 to 2 mg/L phosphorus. It is alkaline and contains many salts.

The reuse of gray water has many benefits. First of all, it reduces the need for fresh water and the amount of wastewater entering sewers. This means lower household water bills and, of course, the reuse of gray water has a broader community benefit in reducing demands on public water supply. There are also some risks of using gray water for both human health and the environment. It can contain large numbers of disease-causing organisms (human pathogens such as bacteria, viruses and protozoa). It can also

include a number of contaminants. Long-term watering with gray water containing these contaminants can affect both sensitive plants and the soil. A disadvantage of using gray water is the additional costs, as separate plumbing is required. Of course, the cost of gray water systems varies on how simple or complex the plumbing is, how large the yard is, and who is doing the installation.

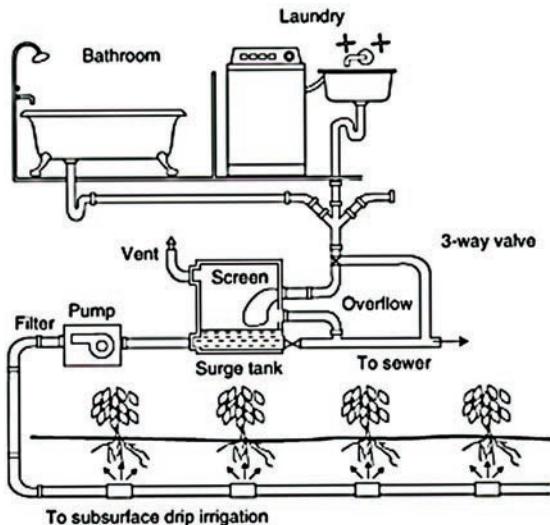


Fig. 22 Generic gray water system schematics

The light gray water can be used directly for garden irrigation, but it would be better if there was a treatment before used in the garden, especially when it contains laundry waste water. There are many ways in which gray water can be treated. The various methods used must be both safe for human health and not harmful to the environment.

When watering the garden with gray water the fact that a lot of plants thrive as well, must be taken into account, as: bird of Paradise, gardenia, callistemon, conifers, yuccas, hibiscus and many others. There are also plants that do not tolerate grey water as: bougainvillea, camellia, lavender, herbs, ferns, citrus, begonias, magnolias, violets hydrangeas and azaleas.

For safe use of gray water it is useful to apply the following rules:

The soil type must be taken into account. The chance of harmful compounds building up in clay soil is much greater than with light, sandy soils.

The lowest risk for gray water is in subsurface irrigation pipes, while hosing it onto the surface of the soil is considered a high-risk option, and spraying or misting with gray water may be even worse (gray water must be well filtered in order to become appropriate for drip irrigation).

The use of grey water on food plants must be avoided (vegetables, herbs, etc.).

Gray water must be used within 24 hours. Unlike rainwater and fresh water, gray water contains nutrients and organic matter from soaps and dirt. As these start to decompose they use up the oxygen in the water, which raises a bad odor. So, if the soil is saturated or the plants do not need watering, the gray water should be released to the sewer system.

In order to avoid the concentration of salts and harmful nutrients in garden soil, it is useful to irrigate with clean tap water from time to time.

Gray water can contain pathogens. All systems must be designed so that water is absorbed into the ground and is not accessible to contact by people or animals. For this the relevant legislation must be followed.

The use of products which are salt and boron free, and have pH neutral is a key factor in gray water irrigation.

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Irrigation methods

When choosing an irrigation system, the water needs of the crops, the water availability, the soil type and how the water gets to the field must be taken into consideration.

The main types of irrigation systems are:

Flood irrigation that includes: wild flood, furrow, border and corrugation (small V-shaped furrows used for close growing crops).

Sprinkler irrigation that includes: mini gun, portable hand line, and solid set (a stationary system where water supply pipelines are below the surface and sprinkler nozzles are elevated above the surface).

Micro or trickle irrigation. It includes Micro-sprinkler (spray) irrigation and Drip irrigation systems which can be surface or subsurface.

In Table 3 a comparison among the above mentioned irrigation systems is presented.

Table 3 Irrigation System Comparisons

Irrigation System	Application Efficiency*	Cost** (irrigation labor not included)	Advantages	Disadvantages
Wild Flood	15 – 40%	0 – 15€ (home made plastic or canvas dam)	Low input cost Low maintenance	Low efficiency Increased labor Poor uniformity
Furrow	40 – 80% 40 – 55%	4,5 – 7,5 €/m	Control of	High labor
• Gated pipe • Corrugation	50 – 80%		delivery time and space	Low efficiency
Sprinkler Mini gun Portable hand lines Solid set	55 – 75% 60 – 85% 60 – 85%	1.500 - 2.000€ 6.000 €/ha	High efficiency Low labor Suitable for most crops	Higher cost Higher operation & maintenance

PART I CLIMATE, DRAUGHT & IRRIGATION

			Good choice for fields with varied soil & topography	Needs continuous supply of water Requires pressurized water source
Surface Drip	70 – 95%	1000 – 2000 €/ha	Higher efficiency Less time and labor Reduced runoff Reduced	High initial Cost Higher management time Needs continuous supply of
			Typically used for vegetables, windbreaks, trees, vines, and shrubs	Filtration required

* Application Efficiency refers to the percent of water delivered that ends up in the root zone of the crop. Efficiencies can be much lower due to poor design and management.

** Based on 2012 cost estimates

Source: Barta, et al. 2004. (from Byelich B., Cook J., Rowley C., 2013. Small Acreage Irrigation Guide. Issued in cooperation with USDA-Natural Resources Conservation Service and Colorado State University Extension.)

As it is evident from Table 3, the greater the efficiency of water use, the higher the cost. But the profit is that the irrigation efficiency can improve the beneficial use of limited and declining water resources which is needed to enhance crop and food production from irrigated fields.

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Urban meadows

A meadow is a field of natural grasses and native wildflowers that can be installed in any viable urban space from community gardens to churchyards, pavements to parks and roof gardens (Fig. 23). Meadows are an alternative to lawns. The conventional "green desert" lawns need a large quantity of chemical fertilizer and energy, and consume large amounts of water. Meadows do not only need less agrochemicals and water (especially when drought tolerance plants are used), but create a high quality habitat for birds, butterflies, and other wildlife, while they provide all-season natural beauty. Additionally the deep-rooted prairie plants encourage infiltration of rainwater into the soil, thus reducing storm water runoff and flooding.

Meadows are sown either in spring or autumn and can consist of grasses, annual and perennial species. This combination ensures a great splash of color and a year after year blooming.

Many administrative authorities, all over the world, have recognized the value of using local drought tolerance plant species in meadow scaping, and are applying specific projects for public awareness.



Fig. 23 An urban meadow as an alternative of turgrass (Parc de la Villette, Paris France)

Further reading

- Creating a meadow: Available at: http://www.themeanowproject.com/test/wp-content/themes/default/images/Inside/UrbanSuburbanMeadows_LookInside.pdf
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- Grow a Wild Flower Meadow. Available at: <http://www.motherearthnews.com/organic-gardening/grow-a-wild-flower-meadow-zmaz05amzsel.aspx#axzz2xZGo6OnM>
- Meadows and Prairies: Wildlife-Friendly Alternatives to Lawn. Available at: <http://extension.psu.edu/natural-resources/wildlife/landscaping-for-wildlife/pa-wildlife-5>
- Newcastle City Council. Creating & Managing Urban Meadows. Available at: https://www.newcastle.gov.uk/sites/drupalncc.newcastle.gov.uk/files/wwwfileroot/planning-and-buildings/planning-applications/wildlife_creating_managing_urban_meadows.pdf
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Irrigation practices in gardening

According to the American Water Works Association Research Foundation 30 percent of the water used by the average American household is devoted to outdoor water use (Fig. 24). Maybe this rate is different in Italy and Greece, but the fact is, that a large amount of water is spent in the garden. Some experts estimate that up to 50% of landscape water use goes to waste due to evaporation, wind, or runoff caused by overwatering.

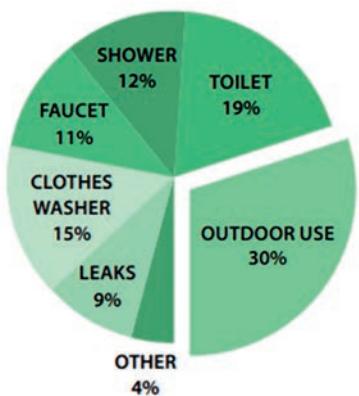


Fig. 24 Percentage water use by households in the United States, according to the American Water Works Association Research Foundation.

Apart from the practices that have already been reported (mulching, drought tolerance plants, reuse and harvesting of water), the following factors should be taken into account for the further reduction of water consumption in landscaping:

- Soil
- Landscape design
- Irrigation system design, construction and maintenance
- Irrigation system management

Soil

The appropriate soil absorbs and holds moisture and encourages plants to grow deep roots. A good soil is one that is light and rich in organic matter. Dense and heavy soils, such as clay, are slow to absorb water, so they are prone to runoff. The rich, in organic matter, soil holds water well, provides nutrients and allows water to penetrate several centimeters to reach deep roots.

Adding organic matter, such as compost or shredded leaves, is by far the most beneficial soil improvement affecting water use.

Landscape design and maintenance

Some simple guidelines for shifting the efficiency of the system are the following:

Plants with similar water needs must be placed together. For example, turf areas and shrub areas should always be separated into different hydrozones because of their differing water needs.

Heavy pruning should be avoided. Pruning stimulates growth, so plants require more water.

The lawn should not be mowed very short. Long grass leaves help shade each other and reduce evaporation.

Large lawns with conventional spray irrigation need large amounts of water. Lawn should be planted only where it has a practical function, such as in a play area.

Irrigation system design, construction and maintenance

Irrigation systems must be designed and constructed by certified professionals.

The appropriate maintenance of the irrigation system is essential for conserving water in landscaping. An audit must be contacted every year in order to spot problems and plan repairs.

Irrigation system management

The irrigation of gardens and other landscaping setups can be accomplished either manually or by using an automatic irrigation system.

Hand watering is the simplest and most common way for irrigation. Systems (either sprinklers or micro irrigation) with installation of outlets at permanent positions can be operated manually or automatically. If they are designed, constructed and managed properly they are the most efficient way for irrigating a landscaping project. The efficiency of sprinkler systems can be from 65-75%, this of microirrigation systems can be up to 85%, while underground driplines can reach 95%.

According to EPA¹ USA, homes with automatically controlled irrigation systems use about 50% more water outdoors than those without. This has mainly to do with inadequate scheduling and difficulties or incapability to follow the actual climatic conditions. For example, all contemporary controllers have water budget and rain delay functions but most of the times home owners or irrigation managers do not take advantage of these. The use of sensors, from the simplest rain sensor to the multi sensor evapotranspiration station can make the operation of automatic systems much more efficient.

¹ Environmental Protection Agency



Fig. 25 A modern evapotranspiration multi sensor connected to an irrigation controller

Some simple guidelines for shifting the efficiency of the system are the following.

The best time for watering is the very early morning hours, because evaporation is very low. Night or evening watering should be avoided because it can encourage the growth of mold or plant diseases.

New trees and shrubs should be watered longer and less frequently than shallow-rooted plants, which require smaller amounts of water more often.

When soil is dry or compacted, it does not absorb water quickly. So if water puddles, the watering should be stopped, until the water has time to soak in.

Further reading

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PART II - PLANTS

In regions with hot and dry summers, as Puglia and western Greece, drought tolerance is an important consideration regarding plant selection. In this part 52 plants of the local flora which can be used in landscaping and 9 xerophytic plant crops, which could be professionally cultivated, are presented.

Regarding landscaping, the surrounding natural landscape, the relevant local traditions, the wills of the owners and the creativity of the designer are the main factors that affect the selection of plants. When referring to agricultural production, relevant laws, central state or regional proposals, financing opportunities along with an analytic business plan should be taken into account before selecting a crop.

Proposed low water needs and draught tolerant plants for landscaping

Achillea millefolium - Asteraceae

Common names: Greek: Αχιλέα, Χιλιόφυλλο (Achillea, Chiliofillo), Italian: Achillea millefoglio, English: Common Yarrow.

Origin: Native to the temperate regions of the Northern Hemisphere.



Fig. 26 *Achillea millefolium*

Habitats: Coastal sand dunes, lawns, road verges, waste ground and montane grasslands.

Description: A herbaceous mat-forming, perennial plant with a spreading rhizomatous growth form. Produces several stems 0.2-1 meter in height.

Leaves: Feathery or fern-like leaves, aromatic, green, arranged spirally on the stems, 5-20 cm long.

Flowers: Tiny, long-lasting, white, that appear in dense, flattened, compound corymbs.

Cultivation and care: It prefers dry to medium, well-drained sandy loams in full sun, protected from strong winds. Plant stems tend to flop, particularly in hot, humid conditions. Cut to basal foliage after bloom.

Gardening uses: Cottage gardens, wild gardens, meadows, prairies, flowering ground cover. It is generally considered to be too weedy for borders.

Propagation: By division in spring or by seed. It is sown in a warm place in mid-winter.

***Agave americana* - Agavaceae**

Common names: Greek: Αγαύη, Αθάνατος (Agavi, Athanatos), Italian: Agave, English: Century Plant.

Origin: Originally from Mexico but it has naturalized in many regions including the Mediterranean basin.



Fig. 27 *Agave americana*

Habitats: Cliffs, urban areas, woodlands, grasslands, riparian zones, beaches, sandy areas, and rocky slopes.

Description: An evergreen, succulent, perennial plant (it lives from 10 to 25 years). It dies after blooming but it is replaced by small offshoots around the base. Leaves form a basal rosette. It can reach a height of about 1 - 2 m and a width of about 1.0 - 1.5 m.

Leaves: Thick, massive, grey-blue, up to 1.50-2.00 m long and 25 cm wide, with sharp spines on the margins and tips.

Flowers: Greenish-yellow, funnel-shaped, 8 cm in length, in panicles to 8m in length.

Cultivation and care: It prefers a very well-drained soil and a sunny position.

Gardening uses: City, coastal or courtyard gardens. Container plant.

Propagation: It propagates by offsets.

***Alcea rosea* - Malvaceae**

Common names: Greek: Αλθέα, Αλθαία, Αλτέα, Δενδρομολόχα (Althea, Altea, Dendromolocha), Italian: Malvone roseo, English: Common Hollyhock.

Origin: It was imported from China possibly before the 15th century. The species grows as a garden escape.



Fig. 28 *Alcea rosea*

Habitats: Roadsides, field margins, wastelands, heaps of earth.

Description Herbaceous, biennial or short-lived perennial. It can reach a height of about 2.4 m and a width of about 0.5-1.0 m.

Leaves: Alternate, stalked, rounded, shallowly 3-7 lobed, coarsely hairy.

Flowers: Funnel-shaped flowers in racemes, 10 cm across, with 5 satin like petals in pink, purple, red, white or yellow. A five lobed calyx and the epicalyx is six-seven lobed.

Cultivation and care: *Alcea rosea* prefers a full sun position. It grows in well-drained, poor or moderately fertile soil.

Slugs and caterpillars can damage the young growth.

Gardening uses: Cottage or informal gardens, flower borders and beds, wall-side borders. Suitable for coastal gardens.

Propagation: It is easily grown from seed. It is sown in situ or in pots in spring or in warm place in mid-winter. The seeds usually germinate in about 2 - 3 weeks at 20°C.

***Arbutus unedo* - Ericaceae**

Common names: Greek: Kouμαρία (Koumaria), Italian: Corbezzolo, English: Strawberry Tree.

Origin: Native to the Mediterranean and Ireland.



Fig. 29 *Arbutus unedo*

Habitats: Woodland, scrub and rocky hillsides.

Description: An evergreen tree or large shrub growing to 9 m by 8 m, with rough brown bark.

Leaves: Dark green, leathery, 5-10 cm long and 2-3 cm broad.

Flowers: Small, bell-shaped, creamy-white or pink, 4-6 mm in diameter followed by strawberry-like red fruits, 1-2 cm diameter, with a rough surface.

Cultivation and care: It prefers a nutrient-rich well-drained soil in sun or semi-shade. It grows well in heavy clay soils and in dry soils. Hardy to maritime locations.

Gardening uses: Coastal, low maintenance gardens, patio, and container plant, attracts birds.

Propagation: By seed and semi-hardwood cuttings.

***Armeria maritima* - Plumbaginaceae**

Common names: Greek: Αρμέρια, Χαλαβόχορτο (Armeria, Chalavochorto),

Italian: armeria, spillone palustre, English: Thrift, Sea thrift, Sea pink.

Origin: Native to the Northern Hemisphere, especially in Europe.



Fig. 30 *Armeria canescens*

Habitats: The plants are found mainly on coasts and salt marshes.

Description: There are a lot of species in Italy and Greece. The most common species are: *A. maritime* and *A. canescens*. Mat-forming evergreen perennial plants. They can reach a height and width of about 10-30 cm.

Leaves: The leaves form rosettes. They are numerous, narrow, grass-like, dark green, about 15 cm long. They usually have hairs along their margins.

Flowers: Flowers on erect wiry stems above the clumping foliage. The plant usually has pink flowers although they are infrequently white. The flowers, about 8mm wide, have five petals, and a hairy calyx.

Cultivation and care: The plant can grow in infertile, dry, well-drained, light (sandy) and medium (loamy) soils, in full sun. Foliage mounds tend to rot in the center if grown in moist, fertile soils or in heavy clay. Deadheads spend flower stems to encourage additional bloom. The plant can tolerate maritime exposure.

Gardening uses: Ground cover, cottage gardens, cut and dry flowers, green roof. Ideal for edges, rockeries and borders. Coast exposure.

Propagation: By division or seed. It is sown directly outdoors in summer, or indoors in late winter at 15-21°C.

***Atriplex alimus* - Amaranthaceae**

Common names: Greek: Αλιμιά (Alimia), Italian: Alimo, Alismo, Atriplice alimo, English: Mediterranean saltbush, Sea orache, Shrubby orache).

Origin: Native to the Iberian Peninsula, the Apennine Peninsula, France, Greece, Turkey, the Eastern Mediterranean and North Africa.



Fig. 31 *Atriplex alimus*

Habitats: Coastal sands by the sea, salt marshes.

Description: An evergreen shrub with a very deep root system well adapted to arid conditions. It can reach a height of about 2 - 3 m and a width of about 1.0 -1.5 m. The phenotypic characters have a high variability.

Leaves: Alternate, striking, silvery-grey ovate, or sub-triangular, or elliptic, to 5 cm long.

Flowers: Insignificant greenish flowers in loose inflorescences, between 10 and 50 cm. The flowers are monoecious. The male flowers are very few in number compared to those of the female ones.

Cultivation and care: An easily grown plant, it prefers full sun and dry, well-drained but not too fertile soils. It grows even in pure sands. It tolerates saline and very alkaline soils.

Gardening uses: City or courtyard gardens, coastal, cottage garden, gravel garden or hedging.

Propagation: It is grown from seed. It is sown in a cold frame in April- May. The seed usually germinates in 1 - 3 weeks at 13°C.

***Ballota acetabulosa* - Lamiaceae**

Common names: Greek: Βαλλότα, Λυχναράκι (Vallota, Lychnaraki), Italian: Ballota, English: Greek horehound.

Origin: Native to Southeast Greece, Crete, and West Turkey.



Fig. 32 *Ballota acetabulosa*

Habitats: Rocks and rough ground in dry hills to 900 meters.

Description: A bushy evergreen shrub with erect, white-felted stems, growing to 0.5 m by 0.8 m.

Leaves: Opposite, aromatic, rounded, hairy, grey-green leaves and whorls of small, often 2-lipped flowers.

Flowers: Small, pink, borne in whorls, with large funnel-shaped calyces.

Cultivation and care: It prefers poor, dry, well-drained soil in full sun.

Gardening uses: City and courtyard gardens. Cottage and informal garden. Flower borders and beds, gravel garden, ground cover.

Propagation: By semi-hardwood cuttings in early summer or by division in spring.

***Buxus sempervirens* - Buxaceae**

Common names: Greek: Πυξάρι (Pixari), Italian: Bosso commune, English: Boxwood.

Origin: Native to the Mediterranean, Western and Southern Europe, Northwest Africa, and Southwest Asia.



Fig. 33 *Buxus sempervirens* habitat

Habitats: Beechwood and scrub, usually on chalk and limestone.

Description: An evergreen shrub or small tree, growing to 4-8 m by 4-8 m,

with compact habit.

Leaves: Green to yellow-green small, simple, opposite glossy, oval, 1.5-3 cm long, and 0.5-1.3 cm broad.

Flowers: Inconspicuous, greenish-yellow, with no petals, followed by a 3-lobed capsule.

Cultivation and care: Adaptable in almost any soil that is well-drained. It prefers light shade and chalky soils. It can be scorched by strong winds.

Gardening uses: Screen, hedge, patio, container, ground cover, topiary.

Propagation: By cuttings.

***Capparis spinosa* - Capparidaceae**

Common names: Greek: Κάπαρη (kapari), Italian: Cappero, English: Caper.

Origin: Native to the Mediterranean and many other regions of the world.



Fig. 34 *Capparis spinosa*

Habitats: On rocks, old walls, cliffs and rocky hillsides.

Description: A perennial deciduous plant with trailing stems about 1-1.5 m long.

Leaves: Rounded, green, fleshy.

Flowers: Large, white to pinkish-white with numerous stamens.

Cultivation and care: It requires a hot, well-drained dry position in full sun.

Gardening uses: Rock, gravel, culinary gardens, old walls.

Propagation: By seed as soon as it is ripe in a greenhouse. By cuttings of half-ripe wood.

***Centranthus ruber* - Valerianaceae**

Common names: Greek: Μάνης, Κέντρανθος (Mais, Kentranthos), Italian: Camarezza commune, English: Red Valerian.

Origin: Native to the Mediterranean region.

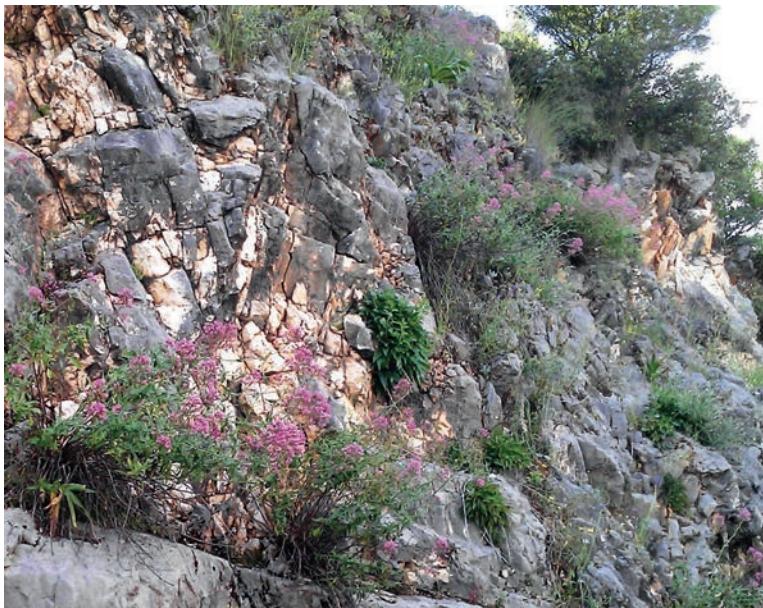


Fig. 35 *Centranthus ruber*

Habitats: Rocky places, waste land, old walls.

Description: A herbaceous perennial plant, bushy, clump-forming, woody-based, growing to 1.0 m.

Leaves: Opposite, simple, fleshy, gray-green, oval to lance-shaped to 10-12 cm long.

Flowers: Small, red, star-shaped, fragrant, in dense terminal clusters (cymes).

Cultivation and care: It prefers poor, dry, well-drained soil in full sun.

Gardening uses: Cottage, wildlife, coastal and informal garden. Wall-side borders and beds.

Propagation: By seed sown in spring.

***Ceratonia siliqua* - Caesalpiniaceae**

Common names: Greek: Χαρουπιά, Ξυλοκερατιά (Charoupia, Xylokeratia), Italian: Carrubo, English: Carob, St John's Bread.

Origin: Native to the Mediterranean region.



Fig. 36 *Ceratonia siliqua*

Habitats: Rocky places near the sea shore.

Description: An evergreen tree, 15-17 m in height and width, with semi-spherical crown. Thick trunk with brown rough bark and sturdy branches.

Leaves: Shiny, green, leathery, long, alternate, pinnate, 10 to 20 cm long with or without terminal leaflet.

Flowers: The tree is dioecious (both male and female flowers on different trees). There are also bisexual cultivars. 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.

Cultivation and care: It prefers well-drained, sunny soil and can grow in nutritionally poor soil.

Gardening uses: Screen, hedged.

Propagation: By seed. Fresh seeds germinate quickly, dry hard seeds need treatment. It also propagates by grafting.

***Cercis siliquastrum* - Caesalpiniaceae**

Common names: Greek: Κουτσούπια (Koutsoupia), Italian: Albero di Giuda, English: Judas tree.

Origin: Native to Southern Europe and Western Asia.



Fig. 37 *Cercis siliquastrum*

Habitats: In stony slopes and in arid warm woods.

Description: A deciduous small spreading tree with blackish stems, growing to 8-12 m, after 20-50 years.

Leaves: Heart shaped dark green, turning yellow in autumn.

Flowers: Pink-red pea shaped before foliage in spring in clusters on the older wood. Fruit is a flattened purplish pod to 12 cm in length.

Cultivation and care: It prefers well-drained soil and can grow in very alkaline soils and in semi-shade.

Gardening uses: Suitable for small urban gardens and parks and for attracting wildlife.

Propagation: By seed, or by semi-hardwood cuttings.

***Cistus creticus* - Cistaceae**

Common names: Greek: Λαδανιά (Ladania), Italian: Cisto di Creta, English: Pink Rock-Rose, Hoary Rock-Rose.

Origin: Native to the Eastern Mediterranean region.



Fig. 38 *Cistus creticus*

Habitats: Scrub and bushy places on rocks, dry hills to 1000 m.

Description: An evergreen shrub, hairy, with hemispherical growth, growing to 1 m by 1 m with many branches. A polymorphic species.

Leaves: Simple, dark green, oval, rough, thick, with wavy margins, hairy, to 2-6 mm long (depending on season). Fragrant on warm sunny days.

Flowers: Pink, petals wrinkled, soon dropping, 4-6 cm in diameter.

Cultivation and care: It requires a sunny position, dry or moist well-drained light sandy soils.

Gardening uses: Cottage, wildlife, in Mediterranean and informal gardens. Flowers are very attractive to bees.

Propagation: By seed.

***Colutea arborescens* - Fabaceae**

Common names: Greek: Φούσκα (Fouska), Italian: Vesicaria, English: Bladder Senna.

Origin: Native to Southern Europe and the Mediterranean.

Habitats: Open woods, roadsides, often on calcareous soils.



Fig. 39 *Colutea arborescens*

Description: A deciduous, vigorous, bushy shrub, growing to 3-4 m.

Leaves: Pale green, pinnate, with 3 - 6 pairs of oval leaflets.

Flowers: 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.

Cultivation and care: A low maintenance plant. It prefers full sun positions but tolerates light shade. It grows in poor dry soils.

Gardening uses: Cottage, wild life, and informal gardens. In landscaping for erosion control.

Propagation: By seed, or by softwood cuttings.

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

Common names: Greek: Χρυσόξυλο (Chrysoxylo), Italian: Sommaco selvatico, English: Smoke Tree, Smoke Bush.

Origin: Native to Southern Europe and Asia.



Fig. 40 *Cotinus coggygria*

Habitats: Dry hillsides, rocky places and open woods, usually on limestone.

Description: Deciduous, multiple-branching, bushy, shrub or small tree, growing to 4-6 m by 3-6 m.

Leaves: Rounded, simple, 3-8 cm long, green, turning yellow, orange and red in autumn.

Flowers: Numerous, in large inflorescences, followed by yellowish-pink to pinkish-purple feathery plumes with "smoke-like" appearance.

Cultivation and care: Adaptable to most but well-drained soils in sunny positions. It tolerates light shade.

Gardening uses: Cottage or informal gardens, flower borders and beds, cut or dried flowers.

Propagation: By seed but usually by semi-hardwood cuttings.

Crithmum maritimum - Apiaceae

Common names: Greek: Κρίταμος (Kritamos), Italian: Finocchio marino, English: Rock Samphire, Sea Fennel.

Origin: Coastal regions of Europe, including the Mediterranean.



Fig. 41 *Crithmum maritimum*

Habitats: Stony beaches, cliffs, rocks, or sand, by the sea.

Description: A herbaceous perennial plant growing to 30 cm.

Leaves: Alternate blue-green, fleshy and pinnate whose leaflets are generally held vertically.

Flowers: Small, greenish to cream in a compound-umbel.

Cultivation and care: It prefers light (sandy or gravelly) well-drained soil and can grow in nutritionally poor soil. It requires sunny positions and saline conditions.

Gardening uses: Coastal, rock and informal garden.

Propagation: By seed. Germination usually takes place within 3 - 6 weeks at 15°C.

***Cupressus sempervirens* - Cupressaceae**

Common names: Greek: Κυπαρίσσι (Kiparissi), Italian: Cipresso commune, English: Italian Cypress.

Origin: Native to the eastern Mediterranean region.



Fig. 42 *Cupressus sempervirens*

Habitats: Rocky mountainous areas, usually near the coast.

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

Leaves: Scale-like, small, ovate, obtuse, dark green, arranged in sprays in a very dense way.

Flowers: Cones between round and oblong, a few cm long with generally 10-14 scales.

Cultivation and care: It prefers well-drained sandy loams in full sun.

Gardening uses: Screen, specimen.

Propagation: By seed, or by semi-hardwood cuttings. It also propagates by grafting.

***Ebenus cretica* - Fabaceae**

Common names: Greek: Κατσουλιά, Αρχοντόξυλο, Πλουμί (Katsoulia, Archontoxylo, Ploumbi), Italian: Ebenus di Creta, English: Ebenus of Crete.

Origin: Native to Crete.



Fig. 43 *Ebenus cretica*

Habitats: On rocks and steep banks at 800 m of Crete.

Description: A herbaceous perennial evergreen, small shrub, 50-100 cm tall. The aerial plant parts are densely covered with whitish non-glandular hairs. There is great morphological variability.

Leaves: Compound, trifoliate or pinnate-quinquefoliate, elliptic-oblong, silvery-haired and amphistomatic, 15-30 mm long.

Flowers: Bright pink, pea-like, in dense racemes, 5-15 cm long.

Cultivation and care: It prefers a border with full sun and a well-drained soil. It needs protection from hard frosts and a dryish winter atmosphere.

Gardening uses: Gravel, rock gardens. Flower borders and beds, wall-side borders.

Propagation: By seed or by shoot cuttings by using growth regulators.

***Echinops ritro* - Asteraceae**

Common names: Greek: Εχίνοπας, Αχινός (Echinopas, Achinos), Italian: Cardo-pallottola coccodrillo, English: Globe thistle.

Origin: Native to Central, Eastern Europe and Central Asia.



Fig. 44 *Echinops ritro*

Habitats: Gravely places on mountain slopes, roadsides.

Description: A clump-forming compact, herbaceous, perennial plant (thistle), growing to 60 cm. tall.

Leaves: Coarse, spiny, deeply-dissected, gray-green leaves, whitish under. Basal leaves grow to 20-30 cm long, but stem leaves grow shorter.

Flowers: Deep blue, in globes 2.5 cm - 4.5 cm in diameter.

Cultivation and care: It prefers dry to medium, well-drained soils in full sun. It tolerates a wide range of soils.

Gardening uses: Sunny borders, cottage gardens, cutting gardens, dry flowers. It attracts butterflies.

Propagation: By seed sown in seed beds in mid spring.

***Elaeagnus angustifolia* - Elaeagnaceae**

Common names: Greek: Ελαίαγνος, Μοσχοϊτιά (Eleagnos, Moshoitia), Italian: Olivagno, English: Oleaster, Russian olive.

Origin: Native to western and central Asia, naturalized in many Mediterranean regions.



Fig. 45 *Elaeagnus angustifolia*

Habitats: By streams and along river banks.

Description: A small, deciduous tree or large shrub, often thorny with black bark, growing to 7-9 m by 7 m.

Leaves: Simple, alternate, lanceolate to oblong, 4-8 cm in length. The upper surface is light green in color, covered with silvery star-shaped hairs, while the lower surface is silvery white and densely covered with scales.

Flowers: Small, 1.2-1.5 cm wide, silvery outside and yellow within, highly aromatic, in umbel-like inflorescences, followed by olive-shaped fruits, dry, mealy, yellow-red, edible.

Cultivation and care: It prefers full sun, hot dry positions. It is easily grown in most well-drained soils. It can tolerate maritime exposure.

Gardening uses: Woodland, coastal, wild life gardens. As a hedge and a flowering tree.

Propagation: By seed - best sown as soon as it is ripe. By cuttings of half-ripe wood, by layering in autumn.

***Euphorbia characias* - Euphorbiaceae**

Common names: Greek: Γαλατσίδα (Galatsida), Italian: Euforbia a ghiandole scure, English: Mediterranean spurge.

Origin: There are two subspecies. *E. characias* sub sp. *Characias* is found from Portugal to Crete, while *E. characias* sub sp. *Wulfenii* from Southern France to Asia Minor.



Fig. 46 *Euphorbia characias*

Habitats: Dry and rocky hillsides, (generally limestone), scrub land.

Description: Erect, herbaceous, perennial, sparsely-branched with milky sap. It can reach a height and a width of about 1.0-1.5m.

Leaves: 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.

Flowers: Yellowish green flowers with bronze 'eyes' in cylindrical heads above the foliage.

Cultivation and care: It prefers full sun places and well-drained soils. Cut back flowering shoots to ground level in late summer or autumn to avoid self sowing.

Gardening uses: As a perennial border and cut flowers.

Propagation: By seed, directly where they are to grow in fall, or indoors in deep plugs or pots before last frost. Germination is generally very slow.

By division in early spring.

***Geranium sanguineum* - Geraniaceae**

Common names: Greek: Γεράνι το αιματώδες (Gerani ematodes), Italian: Geranio sanguigno, English: Bloody cranesbill, Bloody geranium.

Origin: Native to Europe.



Fig. 47 *Geranium sanguineum*

Habitats: Woods, deciduous forests, forest edges, dry bushy hillsides, arid grasslands and rocky slopes.

Description: A hardy perennial herbaceous plant, rhizomatous, hummock-forming, 30-50 cm in height and 30-50 cm in width.

Leaves: Dark green, deeply divided, with five lobs, petiolate.

Flowers: Cup-shaped, pink to purple, borne singly, 2.5 to 4 cm in diameter.

Cultivation and care: It prefers full sun and well-drained soil.

Gardening uses: Cottage, informal, rock, wildlife gardens. Flower borders and beds, ground cover, wildflower meadow.

Propagation: By seed, basal cuttings or division.

***Helichrysum italicum* - Asteraceae**

Common names: Greek: Ελίχρυσο, Αμάραντος (Helichryso, Amarantos), Italian: Perpetuini d'Italia, English: Curry Plant, Everlasting.

Origin: Native to the Mediterranean.



Fig. 48 *Helichrysum italicum*

Habitats: Arid hills, rocky or sandy ground, rocks and cliffs.

Description: A small bushy evergreen sub-shrub with woody stems at the base, 60 cm or more in height.

Leaves: Small, linear, delicate, oblong, silvery-grey, hairy, curry-scented.

Flowers: Small, yellow, papery everlasting, ball shaped blossoms in domed clusters.

Cultivation and care: It prefers a light well-drained soil in a sunny sheltered position.

Gardening uses: Gravel, rock, gardens. Flower borders and beds, meadows, dry flowers.

Propagation: By seed or by cuttings of half-ripe wood, 5 cm with a heel.

***Juniperus communis* - Cupressaceae**

Common names: Greek: Άρκευθος, Αγριοκυπαρίσσι (Arkefthos, Agriokyparissi), Italian: Ginepro comune, English: Juniper.

Origin: Native to the temperate Northern Hemisphere.



Fig. 49 *Juniperus communis*

Habitats: Calcareous heaths or grasslands, coastal dunes.

Description: An evergreen shrub with a habit of varying from procumbent to erect and narrow, rarely a small tree to 10m with reddish-brown bark.

Leaves: 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.

Flowers: 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.

Cultivation and care: It grows in any well-drained soil.

Gardening uses: Woodland, wildlife, rock and culinary (juniper berries) gardens. As a ground cover.

Propagation: By seed or semi-hardwood cuttings.

***Lavandula* sp - Lamiaceae**

Common names: Greek: Λεβάντα (Levanta), Italian: Lavanda, English: Lavender.

Origin: Most species are native to the Mediterranean region.



Fig. 50 *Lavandula angustifolia*

Habitats: Dry hills, garigue and open woods on limestone or granite soils.

Description: All species are small, aromatic, evergreen shrubs 0.5-1.0 m tall.

Leaves: Simple, narrow, toothed or lobed, grey-green, depending on species.

Flowers: Small, tubular, violet-purple or deep blue or purple (depending on species) in dense spikes.

Cultivation and care: All species prefer a well-drained soil in a sunny position. Hardy at coastal locations.

Gardening uses: City or courtyard gardens. Cottage, informal gardens. Flower borders and beds, gravel, wildlife, rock coastal gardens, patio and container.

Propagation: By seed and semi-hardwood cuttings.

***Limonium sinuatum* - Plumbaginaceae**

Common names: Greek: Στατική, Αμάραντος (Statiki, Amarantos), Italian: Limonio sinuato, English: Wavyleaf sea-lavender.

Origin: Native to the Mediterranean region.



Fig. 51 *Limonium sinuatum*

Habitats: Coastal, salt-marshes.

Description: A tender short live perennial (suggested use as annual), herbaceous, upright plant, 30-60 cm tall. Stems are winged and branched.

Leaves: Olive-green with sinuate margins, (to 12-18 cm long) in basal rosettes.

Flowers: 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.

Cultivation and care: It prefers full sun places, well-drained, sandy loams soil.

Gardening uses: As borders, rock gardens, cut flower, meadows, dry flowers.

Propagation: By seed, directly where they are to grow in fall, or indoors.

***Medicago arborea* - Fabaceae**

Common names: Greek: Μηδική δενδρώδης (Midiki dendrodis), Italian: Erba medica arborea, Ginestrone, English: Tree Medick, Moon Trefoil.

Origin: Native to the Mediterranean region and throughout Europe.



Fig. 52 *Medicago arborea*

Habitats: Scrub and rocky hillsides.

Description: An evergreen shrub growing to 2 m by 2 m with globular form.

Leaves: Downy, green, compound with 3 leaflets.

Flowers: Yellow, pea-like, followed by curious snail-shaped pods.

Cultivation and care: It requires a warm position in full sun, dry or well-drained moist soils.

Gardening uses: Shrub borders, backyard, cottage gardens.

Propagation: By seed (pre-soak for 12 hours is needed), and by cuttings of half-ripe wood.

***Myrtus communis* - Myrtaceae**

Common names: Greek: Μυρτιά, Σμυρτιά (Mirtia, Smirtia), Italian: Mirto, English: Myrtle.

Origin: Native to Southern Europe and Northern Africa.



Fig. 53 *Myrtus communis*

Habitats: Scrub, not in calcareous soils.

Description: An evergreen bushy shrub with small leaves, 1.5-2 m tall. It develops an irregular upright oval form.

Leaves: Simple, aromatic, glossy, opposite, ovate to lanceolate. Aromatic when brushed against.

Flowers: Profuse white, fragrant, 2 cm in width, followed by purplish-black

berries.

Cultivation and care: It prefers full sun positions and well-drained soils.

Gardening uses: City and courtyard gardens. Coastal, cottage, informal gardens, flower borders and beds, hedging, screens, low maintenance and Mediterranean gardens, bee plant.

Propagation: By seed, or semi-hardwood cuttings.

***Nerium oleander* - Apocynaceae**

Common names: Greek: Πικροδάφνη (Pikrodafni), Italian: Oleandro, English: Rosebay.

Origin: Native to or naturalized through the Mediterranean and many other regions in the world.



Fig. 54 *Nerium oleander*

Habitats: River banks, river gravels, around dry stream beds.

Description: An evergreen shrub or small tree that grows to 2-6 m tall, with erect, grayish, stems.

Leaves: Thick, leathery, dark-green, narrow lanceolate, 5-21 cm long and 1-3.5 cm broad, in pairs or whorls of three, with an entire margin.

Flowers: White, with a soft perfume, pink or red, 2.5-5 cm in diameter, with a deeply five-lobed corolla, in clusters at the end of each branch, followed by a narrow capsule 5-23 cm long.

Cultivation and care: Adaptable to a variety of soils, in sunny positions. Very tolerant of heat and drought.

Gardening uses: Screen, specimen, hedge, patio, container, roadsides.

Propagation: By seed or by cuttings of mature wood.

***Olea europaea* - Oleaceae**

Common names: Greek: Ελιά (Elia), Italian: Olivo, English: Olive.

Origin: Native to the Mediterranean basin.



Fig. 55 *Olea europaea*

Habitats: Woods and scrubs in dry rocky coastal places.

Description: An evergreen tree growing to 8-15 m by 8-10 m, with oval growth. Trunk gnarled and twisted. Also grown as multi trunk.

Leaves: Silver-green, oblong, 4-10 cm (depending on variety) long and 1-3 cm wide.

Flowers: Small, white, feathery, followed by a small drupe 1-3 cm long (depending on variety).

Cultivation and care: It prefers a well-drained deep soil in sunny positions. It tolerates salty air.

Gardening uses: Woodland, sea coast, low maintenance gardens. Focal point

Propagation: By cuttings of half-ripe wood, 5-10 cm with a heel. It also propagates by grafting.

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

Common names: Greek: Φραγκοσικία (Fragosikia), Italian: Fico d' India, English: Prickly Pear.

Origin: Native to Mexico and naturalized in the Mediterranean region.



Fig. 56 *Opuntia ficus-indica*

Habitats: Dry arid and rocky places.

Description: A perennial cactus growing to 3-5 m in height. The stems are cladodes. These are very thick, succulent, oblong to spatulate, 30-40 cm long and 18-25 cm wide, full of spines. Some varieties are spineless.

Leaves: These are generally reduced to thorns. They may exist on young cladodes some true leaves, but they fall quickly.

Flowers: 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. Flowering occurs on 1-2 year-old cladodes.

Cultivation and care: It prefers a sandy or very well-drained soil and a pH

in a range between 6 to 7.5.

Gardening uses: Ideal for xeriscape landscaping and for preventing soil erosion. Rock and gravel gardens.

Propagation: By seed, in early spring, in very well-drained compost in a greenhouse.

By cuttings of leaf pads, when the base of the leaf pad is thoroughly dry and has begun to callous.

***Origanum vulgare* - Lamiaceae**

Common names: Greek: Ρίγανη (Rigani), Italian: Origano commune, English: Oregano.

Origin: Native to the Mediterranean, Europe, Southern and Central Asia.



Fig. 57 *Origanum vulgare*

Habitats: Grassland and scrub, usually in rocky areas and on calcareous soils.

Description: A herbaceous, perennial plant, aromatic, woody-based, growing to 20-90 cm in height.

Leaves: Olive-green, ovate, opposite, smooth or very shallowly toothed, 10-40 mm long and 5-25 mm wide.

Flowers: White to purplish, two-lip corolla, five-toothed calyx, 4-8 mm long, in erect spikes.

Cultivation and care: It prefers dry, warm, well-drained, slightly alkaline soils in full sun.

Gardening uses: Ground cover, meadow, cultivated beds, culinary, cottage, informal gardens, bee plant.

Propagation: By seed, division and cuttings.

Phillyrea sp. - Oleaceae

Common names: Greek: Φιλλίκι (Filliki), Italian: Ilatro, English: Mock Privet.

Origin: Native to the Mediterranean.



Fig. 58 *Phillyrea angustifolia*

Habitats: Evergreen thickets and rocky slopes, mainly on limestone.

Description: *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.

Leaves: Green, oblong, leathery, in opposite pairs, 2-6 cm long and 0.5-3 cm broad (depending on species: *Phillyrea angustifolia* has more narrow and long leaves than *Phillyrea latifolia*) with a short petiole (4-8mm) and a salient midrib.

Flowers: Greenish white, sweet-scented, melliferous, small, in small groups on the shoots of previous year. The fruit is a small drupe (3-5 mm), like an olive though not edible.

Cultivation and care: They prefer full sun, well-drained soils and do well even in poor, infertile soils. They tolerate most pH of soil and partial shade.

Gardening uses: Very useful for hedges. City, courtyard, cottage, informal, coastal gardens.

Propagation: By seed but usually by semi-ripe cuttings with a heel.

***Phlomis fruticosa* - Lamiaceae**

Common names: Greek: Ασφάκα (Asfaka), Italian: Salvione giallo, English: Jerusalem sage,

Origin: Native to the *Balkan Peninsula* (Albania, Greece, Former Yugoslavia, Italy, Turkey and Cyprus).



Fig. 59 *Phlomis fruticosa*

Habitats: Rocky places in limestone hills to 1000 meters.

Description: An evergreen, bushy shrub growing to 1.5 m. with erect shoots.

Leaves: Fuzzy, grey-green, 12 cm long, lance-shaped -ovate, heart-shaped at the base.

Flowers: Hermaphrodite yellow flowers 3 cm in length, hooded. Arranged in whorls, with several flowers on one vertical stalk.

Cultivation and care: It prefers a well-drained soil in full sun. It grows well in poor gravelly soils. It prefers very little water in the summer, pruning in spring for abundant flowering.

Gardening uses: Coastal and low maintenance gardens. Cottage, informal garden, flower borders and beds.

Propagation: By softwood cuttings in summer or by division in spring. It also propagates by seed.

***Pinus halepensis* - Pinaceae**

Common names: Greek: Πεύκο, Χαλέπιος πεύκη (Pefko, Chalepios pefki), Italian: Pino d' Aleppo, English: Aleppo Pine.

Origin: Native to the Mediterranean.

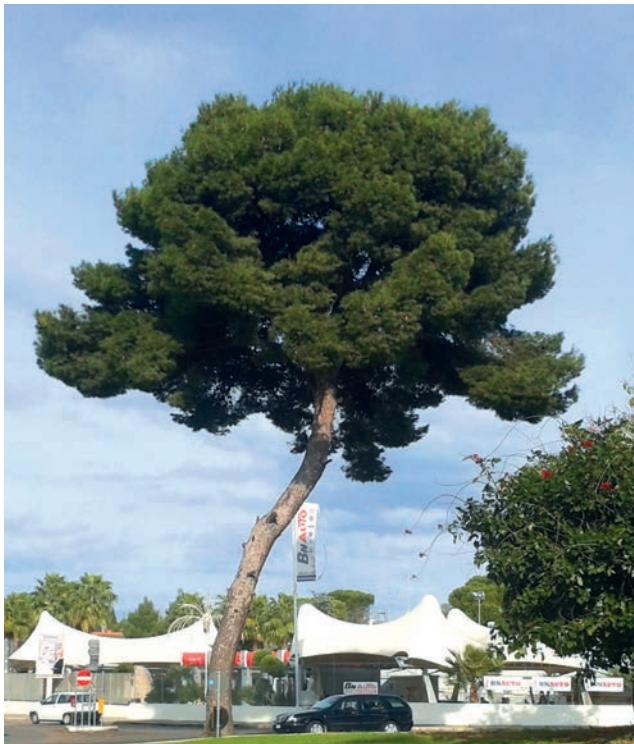


Fig. 60 *Pinus halepensis*

Habitats: Rocky places and hills by the sea.

Description: An evergreen tree, rugged, irregularly branched, upright and globose with age, growing to 15 -25 m by 7-15 m, with a thick, orange-red and deeply fissured bark.

Leaves: Light green, needle-like, in pairs, 6-12 cm long.

Flowers: A monoecious plant, with male cones on the lower part and female ones on the upper part of the tree. The female cones are narrow, conic, 5-12 cm long and 2-3 cm broad.

Cultivation and care: It prefers light, well-drained sandy or gravelly soils. It is wind resistant and very tolerant of maritime conditions.

Gardening uses: Parks, large civic landscapes and large residential gardens because of its great size.

Propagation: By seed.

***Pinus pinea* - Pinaceae**

Common names: Greek: Πεύκο, Koukounariά (Pefko, Koukounaria) Italian: Pino domestico, Pino da pinoli, English: Italian stone pine, Mediterranean stone pine, and Umbrella pine.

Origin: Native to the Mediterranean.



Fig. 61 *Pinus pinea*

Habitats: Maritime sands, and places by the sea.

Description: Evergreen conifer, round-topped, ultimate height of 10-25m and spread of 10-20m. The bark is brown with a rough texture.

Leaves: Mid or dark-green, needle-like, in pairs of two, 10-20 cm long.

Flowers: A monoecious plant. The female cones are rounded-ovoid, to 15 cm long. Its seeds are edible.

Cultivation and care: It prefers light well-drained sandy or gravelly soils. Very tolerant of maritime conditions.

Gardening uses: Parks, large civic landscapes and large residential gardens because of its great size.

Propagation: By seed.

***Pistacia lentiscus* - Anacardiaceae**

Common names: Greek: Σχίνος (Schinos), Italian: Lentisco, English: Pistache.

Origin: Native to the Mediterranean.



Fig. 62 *Pistacia lentiscus*

Habitats: Open woods, scrub on dry hillsides, often by the coast.

Description: An evergreen, dioecious, shrub or small tree much branched, growing to 5 m by 3 m., with a round growth habit.

Leaves: Alternate, leathery, compound, without terminal leaflet, with five or six pairs of deep-green leaflets.

Flowers: Small, inconspicuous, green.

Cultivation and care: It prefers a hot dry position in full sun, a well-drained to dry sandy or stony alkaline soil. Adaptable in all types of soils and well grown even in salty or saline environments.

Gardening uses: Shrub borders, patio tree, hedge, background foliage.

Propagation: By seed, cuttings of half-ripe wood, layering.

***Punica granatum* - Lythraceae**

Common names: Greek: Ποδιά (Rodia), Italian: Melograno, English: Pomegranate.

Origin: Native to Asia (from Iran to the Himalayas). Cultivated and naturalized throughout the Mediterranean region.



Fig. 63 *Punica granatum*

Habitats: Mainly in dry limestone soils.

Description: A deciduous shrub, rounded, sometimes spiny, much-branched, and extremely long-lived.

Leaves: Glossy, simple, narrowly oblong, 3-7 cm long and 2 cm broad, bronze in spring, yellow in autumn.

Flowers: Bright red, funnel-shaped, 3 cm in diameter, with four to five petals, followed by spherical edible fruits, 5-12 cm in diameter.

Cultivation and care: It prefers a well-drained fertile soil and hot dry positions.

Gardening uses: Woodland, city or courtyard gardens. As a hedge, patio, container, and wall-side borders.

Propagation: By seed but usually by cuttings of half-ripe wood, 4-5 cm with a heel, and by cuttings of mature wood, 20-25 cm long. By suckers in the dormant season.

***Quercus coccifera* - Fagaceae**

Common names: Greek: Πλουράρι (Pournari), Italian: Quercia coccifera, English: Kermes.

Origin: Native to the Mediterranean region and Northern Africa.



Fig. 64 *Quercus coccifera*

Habitats: Dry, sunny slopes places on limestone and siliceous rocks.

Description: An evergreen shrub or little tree growing to 4-6 m by 4 m. Mid-grey bark, with scaly segmentation on older trees.

Leaves: Elliptic or ovate, dark green, with spiny tips and sides, 1.5-4 cm long and 1-3 cm broad.

Flowers: Inconspicuous green flowers, followed by acorns, 2-3 cm long and 1.5-2 cm in diameter.

Cultivation and care: A very hardy species, it grows well in all types of soils in sunny positions, lime tolerant. Young plants tolerate reasonable levels of side shade.

Gardening uses: Screen, specimen, hedge, patio, container, bird protection.

Propagation: By seed, in deep pots in a cold frame or in situ.

***Quercus ilex* - Fagaceae**

Common names: Greek: Αριά (Aria), Italian: Leccio, English: Holm oak, Evergreen oak, Holly oak, Ilex.

Origin: Native to the Mediterranean region.



Fig. 65 *Quercus ilex*

Habitats: Arid places, maquis, woods and hills on limestone.

Description: An 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.

Leaves: Simple, lanceolate-ovate, 4 to 9 cm long, glossy dark green above and a downy whitish or greyish green underneath.

Flowers: Male and female flowers in the same plant (monoecious). The male flowers are grouped in pendulous catkins of 3 to 8 cm in length and the females grow solitary. Its fruits are dark brown acorns of 1.5 to 3.5 cm in length.

Cultivation and care: It prefers a good deep fertile and free draining soil. It grows well in sandy soils.

Gardening uses: Suitable for parks and gardens.

Propagation: It is grown from seed and sown in a cold frame or seedbed as soon as it is ripe. It also propagates by grafting in mid-autumn or late winter.

***Rosmarinus officinalis* - Lamiaceae**

Common names: Greek: Δενδρολίβανο (Dendrolivano), Italian: Rosmarino, English: Rosemary.

Origin: Native to the Mediterranean region and Caucasus.



Fig. 66 *Rosmarinus officinalis*

Habitats: Dry scrub land and rocky places, especially near the sea.

Description: An evergreen, perennial, aromatic, woody, fragrant shrub, growing to 1.5 m.

Leaves: Narrow, aromatic needle-like, without petiole, sticky, 2-4 cm long and 2-5 mm broad. Dark green above, white underneath, with dense, short, woolly hairs.

Flowers: Small, axillary, white, pink, purple or deep blue in massed clusters, two-lipped with two long-exserted stamens.

Cultivation and care: It prefers a hot sunny position and a slightly alkaline light dry soil. It dislikes very heavy soils. It is tolerant of maritime exposure and very tolerant of salt spray.

Gardening uses: City, coastal, cottage, woodland, culinary, rock gardens. Flower borders and beds, wall-side borders. A bee plant.

Propagation: By seed but usually by cuttings of young shoots in spring. By layering in summer.

***Ruscus aculeatus* - Asparagaceae**

Common names: Greek: Ρούσκος, Κριφός Έρωτας, Λαγομηλιά (Rouskos, Krifos erotas, Lagomilia), Italian: Ruscolo pungitopo, English: Butcher's broom.

Origin: Native to Eurasia.



Fig. 67 *Ruscus aculeatus*

Habitats: Woodlands, hedgerows and in uncultivated ground especially on chalk.

Description: An evergreen, rhizomatous, rounded shrub, normally dioecious, growing to 0.8 m by 1 m, with flattened, leaf-like cladophylls.

Leaves: The cladophylls give the appearance of stiff, spine-tipped, glossy, lance-shaped leaves, 2.5 cm in length.

Flowers: Small pale green, in the centre of the cladodes, followed on female or hermaphrodite plants by glossy red berries.

Cultivation and care: It grows in any but waterlogged soils. It is adaptable in shade and bad growing conditions.

Gardening uses: Woodland, wildlife gardens, shady edge, ground cover, cut or dried flowers, as stems may be used in floral arrangements.

Propagation: By seed or by division in early spring

***Salvia fruticosa* - Lamiaceae**

Common names: Greek: Φασκόμηλο (Faskomilo), Italian: Salvia triloba, English: Greek Sage.

Origin: Native to the Mediterranean.



Fig. 68 *Salvia fruticosa*

Habitats: Dry rocky hillsides, stony places, usually in limestone areas. Also in maquis shrubland.

Description: A perennial evergreen with long, hairy branches, spreading shrub, aromatic, growing to 60-100 cm tall (it is a bit taller than *S. officinalis*). Leaves: Bright green, of various sizes, oblong, felt-like and accompanied by two lobes each.

Flowers: Pinkish-lavender, or white, 1.3 -1.5 cm long, with a red five-pointed hairy calyx, in whorls along the inflorescence.

Cultivation and care: It prefers light, moist, but well-drained soil in full sun in a sheltered position. Wet soils can be fatal.

Gardening uses: Cottage, wild, gravel, rock, coastal, herb, culinary gardens. Flower borders and beds, meadows, patio, container.

Propagation: By seed or by cuttings of half-ripe wood.

***Salvia officinalis* - Lamiaceae**

Common names: Greek: Φασκόμηλο (Faskomilo), Italian: Salvia domestica, English: Sage.

Origin: Native to the Mediterranean.



Fig. 69 *Salvia officinalis*

Habitats: Dry rocky hillsides, stony places, usually in limestone areas. Maquis shrubland.

Description: A perennial evergreen semi-woody, bushy, spreading shrub, aromatic, growing to 60 cm tall with a similar spread.

Leaves: Grey-green, thick, woolly, oval, in opposing pairs, to 8-10 cm long, finely veined with a lemony, slightly bitter fragrance.

Flowers: 2-lipped, blue, lilac, white, borne in erect axillary racemes.

Cultivation and care: It prefers light, moist, but well-drained soil in full sun in a sheltered position. Wet soils can be fatal.

Gardening uses: Cottage, wild, gravel, rock, coastal, herb, culinary gardens. Flower borders and beds, meadows, patio, container.

Propagation: By seed or by cuttings of half-ripe wood.

***Santolina chamaecyparissus* - Asteraceae**

Common names: Greek: Σαντολίνη, Λεβαντίνη (Santolini, Levandini), Italian: Crespolina di Marchi, English: Cotton Lavender.

Origin: Native to the western and central Mediterranean.



Fig. 70 *Santolina chamaecyparissus*

Habitats: Dry ground, stony banks and rocks.

Description: A small, evergreen, aromatic, tender, semi-woody shrub with a clump forming growth form. It reaches an ultimate height of 0.4-0.5 m and spread of 0.3-0.5m.

Leaves: Narrow, grey-green, woolly, pinnately divided with a rough texture.

Flowers: Bright yellow, in dense button-like flowerheads, 2 cm in width, long-stalked above the foliage.

Cultivation and care: It prefers hot, sunny, well-drained sites.

Gardening uses: Cottage, informal, herb, gravel, rock gardens. Container plant, flower border and bed, ground cover, terraces, dwarf hedge along

walkways.

Propagation: By seed or by semi-hardwood cuttings in spring.

***Satureja thymbra* - Lamiaceae**

Common names: Greek: Θρούμπι (Throumbi), Italian: Santoreggia sarda, English: Satureia, Winter Savory.

Origin: Native to the Mediterranean (Aegean Islands, Crete, Sardinia).



Fig. 71 *Satureja thymbra*

Habitats: Dry rocky hills in sunny areas.

Description: An evergreen, erect, perennial (may be grown as an annual in areas with colder winters), aromatic shrub, up to 100 cm high.

Leaves: Simple, sessile, obovate - elliptic. Each leaf can be 7-18 mm long and 2-7 mm wide.

Flowers: Large, pink, highly aromatic and spicy, arranged in whorls in apical, elongated racemes.

Cultivation and care: It prefers sunny positions and well-drained, dry, neutral to alkaline soil. The plants are intolerant of temperatures below freezing.

Gardening uses: Borders, cottage, dry, culinary, or Mediterranean gardens.

Propagation: By seed.

***Senecio cineraria* - Asteraceae**

Common names: Greek: Σινεράρια, Αργυρόφυλλο (Sineraria, Argyrofyllo), Italian: Senecione cinerario, English: Silver Ragwort, Dusty miller.

Origin: Native to the western and central Mediterranean region.

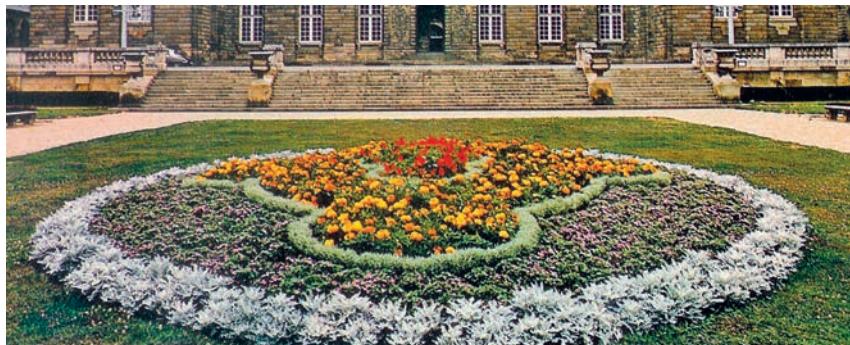


Fig. 72 *Senecio cineraria*

Habitats Maritime cliffs.

Description: An evergreen shrub growing to 0.6 m. by 1 m, densely branched. The stems are stiff and woody at the base.

Leaves: 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.

Flowers: Yellow daisies in loose clusters, 12-15 mm in diameter.

Cultivation and care: It prefers sunny positions in well-drained sandy soils. Adaptable to maritime exposure.

Gardening uses: Dwarf hedges. Beds or mixed borders. Edgings, containers, cottage informal, gardens.

Propagation: By seed, by cuttings of mature wood and by division in spring.

***Spartium junceum* - Fabaceae**

Common names: Greek: Σπάρτο (Sparto), Italian: Ginestra commune, English: Spanish broom, Weaver's broom.



Fig. 73 *Spartium junceum*

Origin: Native to the Mediterranean and Southern Europe.

Habitats: Sunny and dry sites, usually amongst rocks and in bushy places on sandy or limestone soils.

Description: A vigorous, deciduous shrub growing to 3.5 m by 3 m., with thick, somewhat succulent grey-green shoots.

Leaves: Small, 1 to 3 cm long and up to 4 mm broad. Considered as a leafless plant and the photosynthesis occurs in the green shoots.

Flowers: Large, yellow, pea-like, 1 to 2 cm across followed by legumes 8-10 cm long.

Cultivation and care: It prefers poor, but well-drained soils in sunny positions. Good for coastal situations.

Gardening uses: Wall-side borders, coastal gardens, hedge.

Propagation: By seed (pre-soak is needed).

***Teucrium fruticans* - Lamiaceae**

Common names: Greek: Τεύκριο (Tefkrio), Italian: Camedrio femmina, English: Tree germander, Shrubby germander.

Origin: Native to the western Mediterranean.



Fig. 74 *Teucrium fruticans*

Habitats: Garigues, rock sides and maquis.

Description: An evergreen, perennial shrub, bushy, growing to 1 m tall by 4 m wide, with velvety white shoots.

Leaves: Small, ovate, glossy, bluish grey, white beneath.

Flowers: Small, blue, two-lipped, 2.5 cm long in terminal racemes.

Cultivation and care: It prefers a sheltered border with full sun and a well-drained neutral to alkaline soil.

Gardening uses: City, coastal, cottage, informal gardens. Flower borders and beds, hedges.

Propagation: Usually by softwood cuttings in early summer, or semi-ripe cuttings in midsummer.

***Thymus capitatus* - Lamiaceae**

Common names: Greek: Θυμάρι (Thymari), Italian: Timo arbustivo, English: Thymus.

Origin: Native to the Mediterranean.



Fig. 75 *Thymus capitatus*

Habitats: On dry, usually calcareous soils.

Description: An evergreen woody-based perennial shrub, growing to 0.3 m by 0.3 m.

Leaves: Small ovate aromatic, narrow, fleshy, 2 cm long.

Flowers: Tubular, 2-lipped, 10 mm long, purple, pink or white in terminal whorls.

Cultivation and care: It prefers a light, well-drained calcareous soil and a sunny position. It dislikes wet conditions.

Gardening uses: City, cottage, wildlife, culinary gardens, flower borders and beds.

Propagation: By seed in spring in a cold frame or in autumn in a protected place.

***Verbascum olympicum* - Scrophulariaceae**

Common names: Greek: Φλόμος (Flomos), Italian: Verbasco, English: Olympian mullein.

Origin: Native to Greece and Turkey.



Fig. 76 *Verbascum olympicum*

Habitats: Open hillsides, cliffs, scrub and roadsides.

Description: Short-lived perennial, usually dying after flowering, with grey-woolly stems. It can grow up to 2.5 m in height and 60 cm in spread after around 2-5 years.

Leaves: Silvery-grey, woolly, lance shaped, in wide rosettes. Each leaf can be 30 cm long and nearly half as wide.

Flowers: Bright, clear yellow with paler yellow to white filaments, in tall candelabra-like spikes.

Cultivation and care: Poor, well-drained soils in full sun.

Gardening uses: Borders, cottage, dry, gravel, informal or Mediterranean gardens.

Propagation: By seed in pots in a cold frame in late spring to early summer.

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

Common names: Greek: Λυγαρία (Lygaria), Italian: Lagano, English: Chaste tree, Chasteberry.

Origin: Native to the Mediterranean region.



Fig. 77 *Vitex agnus-castus*

Habitats: Damp places by streams.

Description: A deciduous shrub growing to 3 m by 3 m.

Leaves: Grey-green to dark green above and lighter beneath, aromatic, palmately compound with 5 to 7 fingerlike leaflets, 7.6-10 cm in diameter.

Flowers: Small, violet, blue, deep purple or lavender, in dense clusters on new wood. Flowers are followed by a fleshy fruit.

Cultivation and care: It requires full sun or partial shade and a well-drained soil.

Gardening uses: Shrub borders, backyard, specimen plant, focal point, attracts butterflies.

Propagation: By seed and cuttings of mature wood of the current season growth.

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Proposed low water needs and draught tolerant plants for agricultural cultivations

Aloe vera (A. barbadensis) - Xanthorrhoeaceae

Common names: Greek: Αλόη (Aloī), Italian: Aloe, English: Aloe vera.

Origin: The origin of the plant is unknown. Some authors indicate the Moroccan region, others that of Arabia.

Description: Evergreen, perennial, succulent, stemless, in typical rosette shape, 0.6 - 1m tall, with tuberous and fibrous roots.

Leaves: Green, fleshy, thick, radically arranged in two or three circles, 30-50 cm long and 10 cm broad at the base, with serrated margins. The majority of aloe species have spines of various rigidity along the edges of their succulent leaves.

Flowers: Bright yellow, with a tubular corolla of 3 cm in diameter, pendulous, in a flower spike up to 0.9m.

Growing conditions: Aloe prefers sandy and well-drained soils. The sub-tropical climates are ideal for the plant. It is intolerant of freezing temperatures (-3°C).

Cultural practices: The establishment of the aloe plantations is done by 15-18 cm long suckers (pups). The number of pups amounts to 12.000-15.000 per hectare. The suggested pup spacing is 1.1 - 1.4m between the rows and 60 cm between the plants. Both plant-to plant and row-to-row, 60-80 cm x 60-80 cm spacing is recommended by some growers as well. For the final plant density, the mechanization or not of the cultivation should be taken into account (such as weed control, removal of harvested leaves, etc.).

Irrigation is necessary soon after planting. In established plants the amount of applied water irrigation, can be best calculated based on crop coefficients (K_c) between 0.20 and 0.30.

A fertilization of about 50 kg/ha of nitrogen four times a year, is essential for high yield.

The crop can be harvested after 18 months. The harvest takes place 3-5 times a year and 10-12 kg of leaves per plant is the expected yield per year.

Diseases and enemies: Generally, aloe is rarely affected by pests. According to the bibliography, the reported enemies of aloe are the following: aloe mite (*Aceria aloinis*), aloe white scale (*Duplachionaspis exalbida*) and aloe aphid (*Aloe phagus myersi Essi*). The most common diseases are: aloe rust (*Phacopsora pachyrhizi*), basal stem rot (*Fusarium* sp), bacterial soft rot (*Pectobacterium chrysanthemi*) and Sooty mold (*Cladosporium*, *Aureobasidium*, *Antennariella*). Sooty mold develops as a secondary infection usually caused by the presence of Aloe aphid.

Uses: The leaves of aloe contain over 75 nutrients and 200 active compounds. These include vitamins, especially the A, B complex, C and E an-

tioxidant vitamins, minerals, amino acids, and many other beneficial compounds.

The leaves can be processed to make three raw material components: leaf juice, inner leaf juice, and aloe latex. These substances are commercially used as ingredients in a variety of cosmetic and pharmaceutical preparations. They are also used as an ingredient in yogurts, beverages, as well as in some desserts.

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Ceratonia siliqua - Caesalpiniaceae

Common names: Greek: Χαρούπιά, Ξυλοκερατιά (Charoupia, Xylokeratia), Italian: Carrubo, English: Carob, St John's bread.

Origin: Native to the Mediterranean region.

Description: An evergreen tree, 15-17m in height and width, with a semi-spherical crown. It has a thick trunk with brown rough bark and sturdy branches.

Leaves: Shiny, green, leathery, sclerophyllous, long, alternate, pinnate, 10 to 20 cm long with or without terminal leaflet.

Flowers: The tree is dioecious (male and female flowers on different trees). There are also bisexual cultivars. 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. The pod contains numerous uniform seeds. They are hard, ovate-oblong, 8-10 mm long, 7-8mm wide and 3-5 mm thick.

Growing conditions: *C. siliqua* is a xerophytic species, well adapted to the environmental conditions of the Mediterranean region and tolerant of hot and humid coastal areas.

It is adaptable to a wide range of soils (poor, sandy soils, rocky hillsides) while it withstands salinity and high lime. It tolerates pH in a range between 6.2 and 8.6.

It does not like to be waterlogged, and prefers well drained soils.

Although drought resistant, carob trees do not bear commercial crops unless they receive at least 350mm of annual rainfall.

Cultural practices: The suggested plant spacing is 10m by 7m which responds to 110 trees/ha. (Fig. 78). The plants can be established in the orchard by sown directly into the field (from pre-germinated seed) or by transplanting, of 8-10 cm tall, young seedlings.

The established seedlings must be grafted. This is necessary as the seed usually produces about 70% male plants. For a normal production, an orchard should contain about 95% female plants.

Pruning is necessary for the first 4-5 years. The aim is a single, 1.0-1.5m stem before going into 3-4 stem vase.

Although *C. siliqua* is drought resistant, the availability of water is a requirement for a good production. According to bibliography, a sum of 500mm of water per year ensures a very good commercial yield. Irrigation is essential for the first 2 years after planting for the establishment of young plants.

Recently, most bibliographic references have highlighted the benefits of fertilization. An application of 50 kg of N, 20 kg of P₂O₅ and 50 kg of K₂O per hectare is recommended.

Carob trees need about 6-8 years in order to start providing commercial yield and then 7-10 more years before they come to full bearing. The yield of a

tree is depending on cultivation conditions. An adult tree could yield about 100-200 kg/year.

Diseases and enemies: *C. siliqua* is normally free from severe damages from insects and pathogens. Therefore, it is suitable for organic farming.

According to the bibliography, in Spain, the greater danger comes from the larva of the *Zeuzerapyrina*, which causes severe damage to younger trees. In Cyprus, the larva of *Asphondylia* spp. attacks on pods. The *Odium ceratoniae* attacks on pods, leaves and twigs in different periods of the year, depending on the weather conditions.

Uses: Carob pods contain about 55% sugars, 10% protein and 6% fat, and can be used for human consumption, either fresh or roasted, or in the form of ground powder or syrup. Both the powder and the syrup can be used as a flavoring in drinks, confectionery, cakes and biscuits. The powder can also be used as a caffeine-free chocolate substitute. Under the number E 410 it is approved and licensed as a food additive, including organic food.

The Carob seed is used for the production of carob gum. This gum is very useful as a thickening agent in food products as in ice cream, desserts and soups. It is also used to make glue. Carob is also useful as fodder for cattle, sheep, or goats.



Fig. 78 Carob orchard

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***Ficus carica* - Moraceae**

Common names: Greek: Συκιά (Sikia), Italian: Fico commune, English: Fig.

Origin: West Asia. It is native of the Mediterranean basin.

Description: It is a deciduous tree, 3-9m in height. All parts of the plant contain milky latex, which may cause photodermatitis.

Leaves: Large (25 cm in length and width), thick, palmate, divided into 3 to 7 lobes.

Flowers: Numerous, tiny, which are massed on the inside of the synconium. The synconium is the fruit. This is a fleshy, hollow receptacle, like small pear, with a small opening at the top. The mature fig is juicy and sweet and varies in color from yellowish to bronze, or purple.

There are four types of fig trees. The first, (common fig), has only female flowers into the syconium and needs no pollination (parthenocarpic). The second, "Caprifig" has both male and female flowers and requires visits by a tiny wasp, *Blastophaga grossorum*. The third ("Smyrna" fig), needs cross-pollination by Caprifigs, and finally the "San Pedro" fig which is intermediate, with its first crop independent, like the common fig, and its second crop dependent on pollination.

Growing conditions: The fig is well adapted to Mediterranean environments, with cool winters and hot, dry summers. It can be grown on a wide range of soils, except for soils with high acidity. The perfect pH ranges between 6.0 and 6.5. The tree is tolerant to moderate salinity.

Cultural practices: Fig trees are easily propagated by hardwood cuttings. This is the standard method of propagation worldwide. After 12 to 15 months in the nursery the young trees are planted when dormant.

Orchards for dried-fig production are typically planted in a wide spacing (6-12 m between trees), receive pruning to sustain adequate annual growth, while figs are harvested from the manicured orchard floor after abscission.

Orchards for fresh-fig production are usually planted in 4-5m in the row with 5-7m spacing between rows. The usual practice in pruning is an open-vase shape with four or five main structural branches. This system allows for an easy access to fruit for picking (Fig. 79).

Nitrogen is the only nutrient that is regularly applied to fig orchards, but not more than 0.2 to 0.5 kg N should be applied per tree per year.

The frequency of irrigation depends on tree size, vigor, soil type and rainfall. Tapia et al. found that three-year-old trees of most cultivars performed adequately when irrigated at 17% of pan evaporation.



Fig. 79 Fig orchard during the winter

Diseases and enemies: The most serious enemies in the Mediterranean climates are: *Ceroplastes rusci* (fig wax scale), *Homotoma ficus* (fig psylla), *Silba adipata* (Mediterranean black fig fly) and *Ceratitis capitata* (Mediterranean fruit fly). Fig trees are also prone to attack by nematodes (Root knot nematodes, especially *Meloidogyne* spp.)

Anthracnose is a common fungal disease that affects leaves and fruit, mainly in coastal areas, while a number of fungi like *Phytophthora*, *Penicillium*, *Botrytis*, *Fusarium*, and *Alternaria* may cause rotting of fruits.

Uses: Processed figs are made into various bakery products, jams and jellies. In many regions of Mediterranean countries, low-grade figs are converted into alcohol.

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Lavandula sp - Lamiaceae

Common names: Greek: Λεβάντα (Levanda), Italian: Lavanda, English: Lavender.

Origin: Most species are native of the Mediterranean basin, but several botanists believe India may have also been part of the plant native range.

Description: The most important cultivated species are *L. anqustofolia* (True lavender), and *Levandin* (*Lavandula x intermedia*), which is a hybrid of *L. anqustofolia* and *L. latifolia*. *L. latifolia* (French lavender) is also cultivated in a small scale.

All species are small aromatic, multi-branched, evergreen shrubs at 0.5-1.0m in height and 30-60 cm in width.

Leaves: Simple, narrow, toothed or lobed, opposite, grey-green, depending on species. A silvery down covers the leaves.

Flowers: Small, tubular, violet-purple or deep blue or purple (depending on species) in dense spikes.

Growing conditions: Warm, dry conditions are ideal for lavender. The soil must be well-drained, light, sandy or sand-loam in full sun, rich in lime, with a pH between 5.8-8.3. Moist soils are not suitable for the plants, because they will cause poor growth and may shorten the life of the plant.

Cultural practices: Lavender is propagated by seed, cuttings, layering, tissue culture and division of roots. Cuttings from soft wood is the most popular method.



Fig. 80 Lavender cultivation

The new plants are planted in 30 to 60 cm in the row with 1.2 to 2.0m spacing between rows. Spacing is depending on available moisture (dry areas-low density), cultivar size and mainly on mechanical cultivation and harvesting.

Lavender needs a small amount of fertilizers. The recommended nitrogen rate is 80 to 100 kg/ha applied from 3 to 4 times throughout the growing season. Phosphorus and potassium requirements are low and will vary according to soil type and nutritional status.

Irrigation is necessary for the first 2 years until the crop has been established. Lavender produces well with a rainfall range from 300 to 1400mm/year. If rainfall is low, irrigation at crucial stages (flower initiation) might still be necessary. Drip irrigation is recommended as it will also assist with weed control. Weed control is very important for high yields. As there is very little information on herbicides that can be used, the hand-hoeing and mechanical weeding is recommended. Mulching also reduces the weed incidence and increases soil moisture retention.

Table 4 Chemical profile of Lavender (Source: Adam, 2006)

	<i>L. angustifolia</i>	Lavandin
Camphor	0.5-1%	4-11%
Caryophylene	3-12%	
Cineole	1-2%	5-10%
Linalool	30-49%	30-40%
Linalyl acetate	30-45%	20-30%
Ocimene	2.5-6%	

The harvesting of lavender for essential oil should be undertaken when the flowers are well developed and the lower half is starting to open. The harvesting can be by hand, mechanically. The harvesting of flowers for fresh and dried markets usually takes place one week later than that for oil production. The productive life of lavender is about 10 years, although plants can live for 20 years. True lavender yields 8 to 30 kg and lavandin 40 to 220 kg/ha essential oil, as well as 500 to 1000 kg/ha dried flower stems.

Diseases and enemies: No serious diseases have been reported on lavender production. As the plant is a natural pest repellent, insignificant numbers of them occur on lavender.

Uses: Lavender is grown commercially for its oil. The part used for oil distillation is the flowers and, in smaller quantities, leaves. *L. angustifolia* has the finest fragrance as contains lower camphor (sweeter fragrance). For this reason the price of its oil is more expensive than lavandin. The chemical profile of True Levander and Lavandin is shown in Table 4.

Essential oil is used for medicinal purposes (it is a powerful antiseptic and can also treat headaches, palsy, toothaches, coughs, and the digestive system), in cosmetics, perfumes, lotions, soaps, etc., and in culinary uses as well.

Flower spikes are used for fresh cut flowers or dried flower arrangements and in potpourris.

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***Olea europaea* - Oleaceae**

Common names: Greek: Ελιά (Elia), Italian: Olivo, English: Olive.

Origin: Native to the Mediterranean, Asia and Africa.

Description: An evergreen tree, 8-15m in height with a broad crown with many thin branches. It can live to a great age. The bark is pale and the trunk is typically gnarled and more or less twisted. Its root system is capable of regenerating the tree even if the above-ground part is destroyed.

Leaves: Pale green above and silvery below, opposite, oblong or lanceolate, 4-10 cm long and 1-3 cm wide.

Flowers-fruits: Flowers 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 depending on the variety. The fleshy part is filled with oil and contains a single seed (rock or stone).

Growing conditions: Olive trees need a Mediterranean climate with mild winters and long, warm, and dry summers. They are sensitive to hard, freezing environments. Temperatures below -5°C will kill small wood and branches, and below -10°C, they will kill or severely damage an olive tree.

The olive tree tolerates shallow, stony soil, with little fertilizer, but prefers non-stratified, moderately fine textured soils because they provide aeration for root growth. Sandier soils do not have good nutrient or water holding capacity. Heavier clays often do not have adequate aeration for root growth and will not drain well. It prefers moderately acid soils (pH greater than 5) or moderately basic ones (pH less than 8.5).

Cultural practices: The 80% of world olive tree production is propagated by leaf-cuttings. The 1-2 year old trees are planted in spring or autumn in three different spacings:

In traditional culture the density is 100 trees/ha. (10-12m x 10-12m) (Fig. 81)

In medium-density plantation the number of trees is about 300 trees/ha. (5-7m x 5-7m) (Fig. 82) and

Finally in high-density plantation the number of trees is about 1500-1800 trees/ha (1.35-2.5m x 3.5-4.7m). For this density only few traditional low-vigor cultivars for oil-production are appropriate or some new varieties grafted on dwarfing rootstock. This system reduces the productive years of olive trees (12-13 years) because of the plant dimensions that must be compatible with straddle harvesters (maximum height: 3m, maximum width: 1.5m).

Pruning is a basic cultural practice in the olive tree orchard. The aim of pruning is:

To develop a tree shape that will facilitate all cultural practices

To have the maximum yield

To prolong the productivity of the trees

In order to achieve the above aim, three types of pruning are applied:

Pruning for developing the tree shape during the first years.

Pruning for fruiting, in order to minimize the non-bearing period.

Rejuvenation pruning.



Fig. 81 Traditional plantation



Fig. 82 Medium density plantation

Olive trees make demands on potassium, magnesium, nitrogen and boron mineral elements at most. The best way for fertilizers application is according to the results of soil and plant leaves analyses. If there are not these analyses, a general practice of fertilizers application is shown in Table 5.

Olive is successfully cultivated without irrigation as it is a very drought toler-

ant tree. (It can survive with an annual rainfall as little as 200-250mm) and the annual rainfall in Puglia and Western Greece usually covers its needs. Lately, for much better yields and annual bearing, irrigation is applied, especially in areas where the rainfall is low.

The table olives are harvested by hand, as the fruit must not be damaged. Olives for oil production are harvested by hand and by various mechanical methods, but the quality of the oil decreases with the increase of mechanization. It is obvious that the best method of all, but the least efficient and so the most costly one, is that by hand.

Table 5 Fertilizers application in olives (g/tree) (Source: <http://www.aua.gr/roussos/Roussos/pdf/OliveBr.pdf>)

For olive oil production			
Productivity per tree	N	P ₂ O ₅	K ₂ O
Low productivity (30 kg/tree)	500 g	300 g	600 g
Medium productivity (30 kg/tree)	700 g	400 g	800 g
High productivity (>70 kg/tree)	1000 g	500 g	1200 g
For table olives production			
Productivity per tree	N	P ₂ O ₅	K ₂ O
Low productivity (30 kg/tree)	600 g	200 g	400 g
Medium productivity (30 kg/tree)	800 g	300 g	600 g
High productivity (>70 kg/tree)	1400 g	400 g	800 g

Diseases and enemies: The most serious enemy of olive is *Bactrocera oleae*, (formerly *Dacus oleae*). Other insects that reduce the yield and the quality of the fruits are: scale insects (i.e. *Icerya purchase*), *Prays oleae*, *Saissetia oleae*, *Rhynchites cribripennis* and *Calocoris trivialis*. Various fungi can infect the trees such as: *Cycloconium oleaginum*, *Gleosporium olivarum*, *Verticillium dahliae*, *Cercospora cladosporioides*, while a species of bacterium, *Pseudomonas savastanoi* pv. *oleae*, induces tumor growth in the shoots.

Uses: Olive is mainly cultivated for olive oil and table olives. The majority of harvested olives are turned into oil (about 90%) and the rest are used as table olives. Both products constitute the base of the Mediterranean diet.

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Opuntia ficus-indica - Cactaceae

Common names: Greek: Φραγκοσικιά (Fragosikia), Italian: Fico d' India, English: Prickly pear.

Origin: Native to Mexico and naturalized in the Mediterranean region.

Description: A perennial cactus growing to 3-5 m in height. The stems are cladodes. These are very thick, succulent, oblong to spatulate, 30-40 cm long and 18-25 cm wide, full of spines. Some varieties are spineless. These varieties are particularly suitable for fodder.

Leaves: These are generally reduced to thorns. They may exist on young cladodes some true leaves, but quickly fall.

Flowers: 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. Flowering occurs on 1-2 year-old cladodes.

Growing conditions: The plants thrive in a wide variety of soils, temperatures, and moisture levels, but grow best in a sunny position in well-drained sandy loam. The best temperatures for Opuntia production range between 18 and 26°C, although some varieties can tolerate temperatures as high as 40°C and as low as -8°C. They grow in zones with annual precipitation of 200 to 250mm, but the limits to commercial production are around 450 mm/yr.

Cultural practices: The establishment of the Opuntia plantations is done by young rooted plants or by cuttings. The second way is most common. Complete pads (cladodes) from donor plants are the most suitable cuttings. Seed propagation is not used commercially.

Cladode cuttings should be allowed to heal and dehydrate for a better establishment. For their protection from rotting, a treatment with Bordeaux mixture or with a fungicide is necessary.

The suggested plant spacing for fruit production is 4 or 5m between rows by 2.5-3m between plants (Fig. 83). For mechanized weed control the rows should be at least 5m apart.

The suggested plant spacing for fodder or forage is 1.0 to 1.2m between rows, with a distance of 40 cm between plants.

Pruning should be a regular practice in commercial orchards. The aims of pruning are: extension of the productive life of the plant; control of plant size, maintenance of the fruiting areas within hand, harvest facilitation, reduction of damage from pests and diseases, application of fertilizers and pesticides facilitation if needed, rejuvenation of old plants and facilitation of transit of people and machinery in the orchard.

Fertilization increases yield and is strongly influenced by soil moisture. For this reason fertilization should be applied, when the amount of soil moisture can guarantee its efficacy. Combining manures with synthetic fertilizers or fertilizers with low N, has given the best results in fruit orchards. A higher

N application (from 0 to 160 kg/ha) has given the best results in forage orchards.

Irrigation increases yield dramatically as cacti use water more efficiently than conventional crops.

Weed control is essential and can be done mechanically or with herbicides. According to the bibliography three pre-emergent herbicides (*Terbuthiuron*, *Diuron* and *Ametryne*) were effective and did not damage opuntia.

Fruit yields are highly variable. *Opuntia* can be harvested 3 years after seedling. Maximum productivity in fresh fruits is obtained when the plants are over 10 years old. Year to year there is a great variation due to the phenomenon of biennial bearing. This is common in most cultivated varieties. In good conditions, 40 t/ha of dry matter can be achieved and fruit yields of up to 20 t/ha are possible.



Fig. 83 Opuntia orchard

Diseases and enemies: According to the bibliography the most important enemy is *Diaspis echinocacti* ("mould" or "louse").

The main disease is the cladode rot, caused by various fungi such as: *Lasiostiplodia theobromae*, *Sclerotium rolfsii*, *Scytalidium lignicola*, *Fusarium solani*, *Rhizoctonia solani*, *Macrophomina sp.* and *Pollacia sp.* The most important bacterial disease is the black soft rot, caused by *Erwinia sp.*

Uses: The most known use of opuntia is for its fruits in Greece is known as

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fragosika and in Italy as ficudinnia. The fruits of *O. ficus-indica* contain water (92%), carbohydrates (4-6%), protein (1-2%), minerals (1%) and a moderate amount of vitamins, mainly A and C.

Jams, jellies and drinks are produced also from the fruits. In Italy (Sicily) a liqueur is produced called Ficodi, in Mexico an alcoholic drink called Colonche and in Malta, a liqueur called Bajtra.

Tender pads of *Opuntia* are also consumed in many regions of the world as a vegetable.

Opuntia is used in medicine too. According to the bibliography it is recommended for type 2 diabetes, high cholesterol, obesity, alcohol hangover, colitis, diarrhea, benign prostatic hypertrophy, etc. It is also used to fight viral infections.

Opuntia is an interesting forage or fodder for cattle, sheep and goats, especially in very dry areas since it may be an emergency source of water and food.

In many countries *Opuntia* is cultivated for a red dye production from a scale insect: *Dactylopius coccus*. This insect lives on *Opuntia*, and produces carminic acid, which deters predation by other insects. The carminic acid can be extracted from the body and eggs of the insect to make the red dye.

A very expensive oil is produced from *Opuntia* seeds, used in cosmetology as an anti-aging serum against skin aging.

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***Origanum vulgare* - Lamiaceae**

Common names: Greek: Ρίγανη (Rigani), Italian: Origano commune, English: Oregano.

Origin: Most species of Oregano are native to the Mediterranean and Eurasia.

Description: A herbaceous, perennial aromatic herb, erect, woody-based, growing to 20-90 cm in height.

Leaves: olive-green, ovate, 1-4 cm long, opposite, smooth or very shallowly toothed.

Flowers: white to purplish, with a two-lip corolla and a five-toothed calyx, 2-4 mm long, in erect spikes.

There are three subspecies of *O.vulgare* in Greece: *O. vulgare* ssp. *hirtum* *O. heracleoticum* (Greek oregano), *O. vulgare* ssp. *viridulum* and *O. vulgare* ssp. *vulgare*. The first (Greek oregano) is the most widespread subspecies. In Italy (*Emilia-Romagna*, *Molise*, *Campania*, *Puglia*, *Basilicata*, *Calabria*, *Sicilia*, *Sardegna*) there are only the subspecies: *O. vulgare* ssp. *viridulum* and *O. vulgare* ssp. *vulgare*

Growing conditions: Oregano prefers dry climates and thrives better in well drained sunny soils, with a pH between 6.0 to 8.0, with an ideal pH 6.8. The plants can grow in a temperature range 4-33°C, with optimum growth temperature 18-22°C.



Fig. 84 Oregano cultivation

Cultural practices: Oregano can be propagated by cuttings, tissue culture, seed and division. Young plants, at least with 8-10 true leaves are planted, in September-October, in 30-40 cm in the row with 50-80 cm spacing between rows.

Oregano needs no or little amount of fertilizers, but an application of 200 Kg/ha of ammonium phosphate (16-20-0) on poor soils in autumn, has positive results. Excessive nitrogen fertilization gives plants less flavor.

Established plants of oregano are drought tolerant and do not need irrigation. Winter rain is usually sufficient for the crop. Supplemental watering is needed only during extremely dry conditions.

Weed control is essential and can be done mechanically or with herbicides. According to the bibliography, the pre-emergent herbicides, that is chlordanzon, oxyfluorfen and oxadiazon are effective and do not damage oregano plants. Mulching also reduces the weed incidence and increases soil moisture retention.

The harvesting of oregano should be undertaken when the flowers are fully developed. The stems should be cut in a height of 10 cm above ground. The harvesting can be by hand or mechanically.

The productive life of oregano is about 8-12 years, depending on cultural and environmental conditions. Oregano yields 3.000 to 4000 kg/ha of fresh stems (1000 to 1500 of dried stems).

Diseases and enemies: According to the bibliography, pests are not a serious problem for Oregano. Some fungal diseases as *Puccinia* sp. (Rust fungi), *Fusarium oxysporum*, *Phytophtora* sp. or *Botrytis* sp. may afflict Oregano plants.

Uses: *Origanum vulgare* contains 1.1-8.2% (ml/100gr dry weight) essential oil. The main ingredient of this oil is carvacrol, which is the signature chemical, largely responsible for the sharp, pungent oregano flavor.

Oregano (dried or oil) has long been used as a medicinal herb in treatment of various conditions such as fevers, diarrhea, indigestion, jaundice and vomiting. Recent studies have shown that oregano displays anti-oxidant, anti-fungal and antibiotic properties.

Apart from the medicinal uses, oregano is by far the largest selling herb today for culinary uses. It is also used as a food preservative. Oregano and its cultivars are ideal for xerothermic gardens.

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Punica granatum - Lythraceae

Common names: Greek: Ποδιά (Rodia), Italian: Melograno, English: Pomegranate.

Origin: Native to Asia (from Iran to the Himalayas). Cultivated and naturalized throughout the Mediterranean region.

Description: A deciduous, small multi-stemmed shrub or tree, rounded, sometimes spiny, and extremely long-lived.

Leaves: Glossy, simple, narrowly oblong, 3-7 cm long and 2 cm broad, bronze in spring, yellow in autumn.

Flowers: Bright red, funnel-shaped, 3 cm in diameter, with four to five petals, followed by spherical edible fruits, 5-12 cm in diameter.

Growing conditions: Pomegranates favor a semi-arid climate and are extremely drought tolerant. The seasonal water requirement is 125 mm with a mean annual rainfall 1000 mm. It thrives on a wide range of soils, from calcareous, alkaline to acidic loam. It can be severely injured by temperatures below -12°C.

Cultural practices: The Pomegranate is propagated mainly by hardwood cuttings. After 12-18 months in the nursery, pomegranates are planted in the field. The planting distances are generally 6x4 m, or 6x5 m, except for the semi dwarf cultivars where planting distances could be 3-4 m in the row with 5m spacing between rows.

In modern orchards the plants are trained to grow as a tree with a 60-75 cm main stem and after an open vase form, with 3-5 trunks. For renewing old trunks, new branches are left one per trunk. They can replace a trunk within 2-3 years of growth. Another way of training is the multi-stem system with 5-7 central branches. After the 3rd year, only suckers and dead branches are removed. In both training systems the height of the plants should not exceed 3-3.5 m. With the aforementioned distances and the proposed training the light penetrates the trees from between the rows as well as from the inside of them. Of course thinning should be done occasionally to ensure both good aeration and interception of sunlight.

In order to obtain big fruits of high quality, there is a need to thin fruits. The aim of thinning is about 5 fruits on a group of small branches with a distance about 20 cm between the fruits. The touching fruits are also removed.



Fig. 85 Multi-stem system

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Drought conditions or plenty of rains close to harvesting may cause splitting of fruits. For this reason, in the case of drought, regular irrigation is important. A general guide, in case of drought, is a daily amount of 50 m³/hectare/day during the last summer days and in the beginning of autumn, close to harvesting. Drip irrigation, one or two lines of drippers per row, is the best way for water application.

Fertilization takes place according to the soil test, which is the best way to determine soil nutrient levels. If there is not a soil test, a usual application amounts to 200 kg/ha/year of N, 120-200 kg/ha/year of K, and 60 kg/ha/year of P. Application of micro nutrients is very important as Mn, Zn, B deficiency may cause splitting of fruits. For this reason the application of micro nutrients is recommended at least twice a year through foliar spray.

Weed control can be done mechanically or with the appropriate herbicides. The productive life of pomegranate is 25-30 years. The plants take 3-5 years to come into bearing. Pomegranate yields 25-35 tons/ha after the 8th year, depending on variety, nutrition and environmental conditions.

Diseases and enemies:

According to the literature the enemies of the pomegranate are as follows: *Aphis punicae*, *Amphicerus bimaculatus*, *Capnodis tenebrionis* and *Aleurothrixus floccosus*. In Israel the following are reported: *Virachola livia*, *Criptoblabos gridiella*, *Planococcus citri*, *Apphis punica*, *Tenupalpus granati*, and *Enzophera sp.*

The most common diseases are caused by: *Pilidiella granati*, *Alternaria alternata*, *Botrytis cinerea*, *Aspergillus sp.*, *Penicillium sp.*, *Xanthomonas axonopodoides* pv.*punicae* and *Colletotrichum gloeosporioides*.

Uses: Pomegranate is a nutritionally rich fruit with unique flavor, taste, and health promoting characteristics. It can be consumed as a fresh fruit or as juice. In Table 6 the food value per 100 g of Edible Portion is shown.

Table 6 Nutritional value per 100 g of edible portion (Source: Morton, 1987)

Calories	63-78	Iron	0.3-1.2 mg
Moisture	72.6-86.4 g	Sodium	3 mg
Protein	0.05-1.6 g	Potassium	259 mg
Fat	Trace only to 0.9 g	Carotene	None to Trace
Carbohydrates	15.4-19.6 g	Thiamine	0.003 mg
Fiber	3.4-5.0 g	Riboflavin	0.012-0.03 mg
Ash	0.36-0.73 g	Niacin	0.180-0.3 mg
Calcium	3-12 mg	Ascorbic Acid	4-4.2 mg
Phosphorus	8-37 mg	Citric Acid	0.46-3.6 mg

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Vigna unguiculata - Fabaceae

Common names: Greek: Αμπελοφάσουλα, Γιφτοφάσουλα, Μαιρομάτικα φασόλια (Ampelofasoula, Giftofasoula, Mauromatica fasolia), Italian: Fagiolo dall' occhio, English: Cowpea, Black eye pea.

Origin: Cow pea is one of the most ancient crops and is native to West Africa. In our days it is cultivated on a commercial scale in many countries all over the world, mainly in semi-arid and subtropical regions.

Description: 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. It typically reaches a canopy height of 60 to 100 cm.

Leaves: 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, usually about 10 cm long and 7 or 8 cm wide.

Flowers: Borne in groups on 30 cm long stems, pale violet or mauve, about 2.5 cm across, followed by pods 10 - 20 cm long and 4 - 12 mm in diameter. The seeds are bean-like with an eye depending on the variety. They vary in color, eye color, size and shape. They may be square to oblong, from 5,000 to 12,000 seeds per kg. The seed color may be cream, brown, red, black, spotted, and speckled. The eye color may be pink, maroon, black or without color.

Growing conditions: Cowpea is adaptable to a wide range of soils, but prefers well-drained sandy loams or sandy soils with a pH between 5.5 and 7. It tolerates heat and is grown under both irrigated and non-irrigated conditions as it is a drought tolerant plant. It can grow under rainfall ranging from 400 to 700 mm per year. Irrigation can increase yields especially in periods of severe droughts. The most critical moisture requiring period is just prior to and during bloom.

The optimum temperature for growth and development is around 26-30°C.

Cultural practices: The best time for sowing is after the late frost of spring. Seeds should be placed at a depth of about 20 to 30 mm. In compact soils the depth must be 10-20 mm. Seed spacing is based on growth habit and the maturity of the variety. In Table 7 is given the spacing and the seed rate according to the above criteria.

Cowpea type	Maturity	Spacing (cm)	Kg/ha
Erect	Extra early	50 X 20	25
Semi-erect	Early/medium	75 X 20	20
Prostrate(Creeping)	Medium/late	75 X 30	16
Prostrate	Late	75 X 50	12

Table 7 Plant spacing and seed rate based on growth habit and maturity (Source: Dugje et al. 2009)

Weed control may be mechanical or chemical and is an essential cultural practice for high yields. Mechanical weed control takes place 2 weeks after planting and secondly 4-5 weeks after planting. For chemical weed control an application of mixture of Paraquat and Pendimethalin within 2 days of planting is recommended.

Cowpea, as legume, fixes its own nitrogen, and does not require too much of it. However, in fields poor in nitrogen, there is a need of application of about 15 kg/h of nitrogen as a starter dose. Of course a soil test is the best way to determine soil nutrient levels. According to Davis et al., at least 25 Kg/ha of P are recommended on soils of medium fertility.

Cowpea can be harvested in three stages: while the pods are young and green, mature and green, and dry. The yield depends on the maturity and irrigation of the variety. According to literature, the average yield ranges from 350 and 2000 Kg/ha for dry seed.

Diseases and enemies: According to the literature the enemies, during the growing period of cowpea, are as follows: *Riptortus spp.*, *Nezaraviridula*, *Acantomiasp*, *Aphis faba*, *Aphis craccivora*, *Mylabris sp*, *Maruca vitrata*. *Collosobruchchus sinensis* is also mentioned as a storage pest. A severe root disease induced by root-knot nematodes is also mentioned (*Meloidogyne spp.*).

The most significant diseases are: *Pythium sp*, *Rhizoctonia solani*, *Phytophthora spp.* which cause seed decay and seedling mortality. *Alternaria cassiae*, *Erysiphe sp* which cause foliar damages. *Pythium ultimum* which is responsible for stem, collar and root damages. *Cercospora* leaf spot disease caused by *Pseudocercospora cruenta*. Powdery mildew is induced mainly by *Oidium spp.*

Cowpea is also infected by various viruses.

Uses: All parts of the cowpea crop are used in the human diet, and as nutritious animal feed as well.

Young leaves immature pods and green cowpea seeds are used as vegetables.

The dry mature seeds are a very nutritious food. They contain protein 23%, carbohydrate 67%, fibers 1.8%, fat 1.3% and water 8-9%. They contain also thiamine, niacin and riboflavin. Green or mature seeds are suitable for boiling and canning.

In many countries, cowpea is cultivated only for livestock feed. It may be used green or as dry fodder. Cowpea is often cultivated with maize (Intercropping) as whole-crop forage.

It is also used as a green manure crop, cover crop, a nitrogen fixing crop, or for erosion control.

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ANNEX I: Terminology, selected terms in English, Greek and Italian

Term	Explanation in English	Greek	Italian
achene	A small, dry, hard, one-celled, one-seeded fruit that stays closed at maturity	αχαίνιο	achenio
acorn	A smooth oval nut in a rough cuplike base	βελανίδι	ghianda
alternate	Occurring at different levels on opposite sides of a stem. No two leaves are directly across from each other	κατ' εναλλαγή	alternato
amphistomatic	Stomata are found on both sides of a leaf	έχει στόματα και στις δύο πλευρές του φύλλου	stomi si trovano su entrambi i lati di un foglio
apex	The end of a leaf or growing tip of a shoot	κορυφή	apice
apical	denoting an apex	ακραίος	apicale
arid	too dry, having little or no rain	ξηρός (χωρίς βροχές)	arido
axillary	Pertaining to or growing from the axil of plants; produced in the axil (AXIL: The angle formed between a leaf's petiole and a stem where an axillary bud develops)	μασχαλιαίος	Ascellare
bisexual	A flower containing both male and female organs	διγενής	Bisessuale
bladder	Bubble-like urinary bladder	φούσκα που μοιάζει με ουροδόχο κύστη	bolla come vescica

Term	Explanation in English	Greek	Italian
Bordeaux mixture	Is a mixture of CuSO ₄ and Ca(OH) ₂ , used as a fungicide	βορδιγάλειος πολτός	<u>poltiglia</u> <u>bordolese</u>
B.O.D.	Biochemical Oxygen Demand		
bushy	growing thickly into or so as to resemble a bush	θαμνώδης	Cespuglioso
callous	Any unusually hard, thickened area or swelling on a plant, such as the thickening that is formed over wounds (such as the base of a cutting) by which the inner tissues are protected and healing is effected	κάλος	<u>callo</u>
canopy	The aboveground portion of the plants (crown)	το υπέργειο μέρος του φυτού	chioma
capsule	A pod or seed vessel made of two or more cells, which becomes dry and splits open when mature to release its seeds	κάψα	<u>capsula</u>
catkin	A dense, scaly spike of flowers that fall after flowering or fruiting	ίουλος	amento
cladode	Flattened leaf-like stem	φυλλοκλάδιο	cladodio
climbing	A plant that clammers upward by attaching itself to other plants or objects	αναρριχώμενο	<u>rampicante</u>
clump-forming	form into a clump or mass	σχηματίζων συστάδα -τούφα	<u>cespitosa</u>
cluster	a group of similar things or occurring closely together	μάτσο, τσαμπί, συστάδα	<u>gruppo</u> , <u>mazzo</u>
cold frame	A bottomless box consisting of a wooden or metal frame with a glass or polyethylene top. It is placed on the ground over		

Term	Explanation in English	Greek	Italian
	plants to protect them from cold or frost		
compound leaf	A leaf that is divided into two or more leaflets	σύνθετο φύλλο	foglia composta
compound-umbel	A flat-topped or rounded flower cluster, in which each flower's stalk rises from a central point. In a compound umbel each primary stalk ends in an umbel	σύνθετο σκιάδιο	ombrella composta
cone	A dry, usually elongated, multiple fruit formed of compactly overlapped scales (such as those of Pines, Firs and Spruces), in which a pair of naked seeds is borne upon the upper side of each scale (technically called a strobilus or strobile)	κώνος, στρόβιλος	cono, strobilo
corolla	The usually conspicuous part of a flower, called the petals. They are contained within the calyx and immediately surround the stamens and pistil	στεφάνη ἀνθους	corolla
corymb	A flat-topped or dome-shaped flower cluster with the outer flowers opening first, as in species of the group <i>Achillea</i>	κόρυμβος	corimbo
cottage garden	It is a distinct style of garden that uses an informal design, traditional materials, dense plantings, and a mixture of ornamental and edible plants		
crosspollination	When a pollination, occurs only when pollen is delivered to a flower from a different plant	διασταυρούμενη γονιμοποίηση	impollinazione incrociata
culinary gardens	It is an "edible garden", where vegetables and herbs are cultivated		
cultivar	A group (or one among such a group) of cultivated plants clearly distinguished by one or more characteristics and which retains these characteristics	ποικιλία	varietà

Term	Explanation in English	Greek	Italian
	when propagated		
cuticle	The layer of cutin covering the epidermis of the aerial parts of plants (e.g. leaves)	στρώμα από κηρώδη ουσία (cutin) που καλύπτει την επιδερμίδα των φύλλων	<u>cuticola</u>
cutting	A section of a stem that is removed and used for propagation	<u>μόσχευμα</u>	<u>talea</u>
cutting garden	A functional garden used to grow flowers for indoor use rather than outdoor display	κήπος που χρησιμοποιείται για δρεπτό άνθος	<u>giardino per fiori recisi</u>
cyme	Flat-topped or dome-shaped flower head with the inner flowers opening first	ετερόπλευρο κύμα (είδος κυματοειδούς ταξιανθίας)	<u>cima bipara</u>
deciduous	Losing its leaves annually at the end of the growing season (in the winter)	<u>φυλλοβόλο</u>	<u>deciduo</u>
dimorphic	The occurrence of two distinct forms of flowers, leaves, or other parts on the same plant	<u>διμορφικός</u>	<u>dimorfico</u>
dioecious	Bearing male and female flowers on separate plants	<u>δίοικο</u>	<u>dioico</u>
division	A method of propagation by which a plant clump is lifted and divided into separate pieces, which include roots and a growing point, during dormancy. The pieces are immediately replanted	<u>διαίρεση</u>	<u>divisione</u>

Term	Explanation in English	Greek	Italian
downy	covered with soft hairs or down	χνοώδης, χνουδωτός	<u>tomentoso</u>
drupe	A stone fruit having a hard, nut-like inner part surrounded by a fleshy or fibrous outer layer	δρύπη	<u>drupa</u>
epicalyx	A calyx-like <u>involucre</u> of bracts below the true calyx, as in the mallow, or of sepals, as in the <u>potentilla</u>	επικάλυκας	<u>epicalice</u>
erect	Rigidly upright	ορθιας ανάπτυξης	<u>eretto</u>
evergreen	Keeping its leaves all year long, although losing some of the older leaves regularly throughout the year	αειθαλής	<u>sempreverde</u>
fern-like		μοιάζει με φτέρη	come la <u>felce</u>
fertilization	The act of rendering land fruitful or productive, the application of fertilizer	λύπανση	<u>fertilizzazione</u>
fibrous		ινώδης	<u>fibroso</u>
filament	The stalk of a stamen that bears the anther	νήμα στήμονα	<u>filamento</u>
fissured		με σχισμές	<u>fessurato</u>
globose	Spherical, or nearly so	σφαιρικός	<u>globale</u>
glossy		γυαλιστερός	<u>lucente</u>
grafting	Method of propagation by which an artificial union is made between different parts of individual plants	εμβολιασμός	<u>Innesto</u>
grassland		λιβάδια, λειμώνες, χορτολιβαδικές εκτάσεις	<u>prateria, terreno erboso</u>
gravel garden	It is a great option for a low		

Term	Explanation in English	Greek	Italian
	maintenance garden. Lots of Mediterranean plants suit gravel gardens		
half-ripe wood cutting	A semi-hardwood section of a stem that is removed and used for propagation	ημιξυλώδες μόσχευμα	<u>talea semilegosa</u>
hectare		1 ha = 10 στρέμματα	<u>ettaro</u>
heel (cutting with heel)	When a cutting it taken with a "heel" of wood, it means a piece of the old branch or shoot is detached from the old branch or shoot along with the cutting	μόσχευμα με τακούνι	<u>scudetto</u>
herbaceous	A non-woody plant in which the upper parts die back to the rootstock at the end of the growing season	ποώδες	<u>erbaceo</u>
hermaphrodite	Bisexual, bearing both male and female organs in the same flower; having fully developed stamens and pistils in the same flower	ερμαφρόδιτος	<u>ermafrodito</u>
hibernation	Dormancy: a period of arrested plant growth. It is a survival strategy exhibited by many plant species, which enables them to survive in climates where part of the year is unsuitable for growth, such as winter or dry seasons	λήθαργος	<u>letargo</u>
hummock-forming		έχει το σχήμα λοφίσκου	
humus	The organic residue of decayed vegetable matter in soil. Also often used to describe partly decayed matter such as <u>leafmold</u> or compost	χούμος	<u>humus</u>
infertile		άγονος	<u>non fertile</u>
inflorescence	A group of flowers borne on a single axis (stem)	ταξιανθία	<u>infiorescenza</u>

Term	Explanation in English	Greek	Italian
informal garden	A garden that follows the natural terrain by using curved lines. Balance is created not through symmetry (as in a formal garden) but with plant material characteristics such as plant shape, color, size, and texture		
intercropping	growing a crop among plants of a different kind	συγκαλλιέργεια	consociazione
irrigation		άρδευση	irrigazione
lance-shaped, lanceolate	Long and thin and broadest below the middle, tapering to a point like a lance	λογχοειδής	lanceolate
larva	The active immature form of an insect, especially one that differs greatly from the adult and forms the stage between egg and pupa	προνύμφη, κάμπια	larva
latex	A milky, usually white or yellowish fluid produced by plants	γαλακτώδης χυμός	latice
layering	A method of propagation in which a shoot of a living stem is bent and pegged down to the soil. The shoot develops roots while still attached to the parent plant; once established, it is cut from the mother plant to form a separate plant, which can then be potted up	καταβολάδες	margotta
leaflet	A subdivision of a compound leaf	φυλλάριο σύνθετου φύλλου	fogliolina
legume	Is a plant in the family Fabaceae. Most of them have symbiotic nitrogen-fixing bacteria.	ψυχανθές	legume
lobed	A lobed leaf is one whose indentations are large, but don't reach the midrib as compound leaves do	με λοβούς, ελλοβό	lobato
margin	The edge or border of something	περιθώριο, περιφέρεια	margine

Term	Explanation in English	Greek	Italian
		φύλλου	
mat-forming		σχηματίζει χαλί, εδαφοκάλυψη	forma un tappeto
midrib	Central vein or rib of a leaf	κεντρική νεύρωση φύλλου	nervatura centrale di foglia
monoecious	Having male and female flowers on the same plant	μόνοικο	monoica
offshoot	A young plant produced by the parent, usually as its base	βλαστοί που δημιουργούνται στη βάση του φυτού, παραβλαστήματα	polloni basali
opposite	Leaves, which are arranged in pairs. Two leaves grow from one node directly across from each other on each side of a stem	αντίθετα	opposto
orchard	A piece of land planted with fruit trees	οπωρώνας	frutteto
ovate	The leaf is egg-shaped; the broadest part is below the middle	ωοειδές	ovate
palmately compound	Having four or more leaflets radiating from a single point	σύνθετο παλαμοειδές	Palmatocomposto
pea-like		άνθος μπιζελιού (άνθος της οκογένειας Fabaceae)	fiore della famiglia delle Fabaceae
pendulous	Hanging down loosely	κρεμάμενος, κρεμοκλαδές	pendulo
petiolate	Having petiole (petiole: the stalk of a leaf)	έμμισχο	picciolata
petiole	The stalk of a leaf	μίσχος	picciuolo
pinnate	Resembling a feather in structure with the parts arranged on both sides of an axis; A compound leaf in which the leaflets grow in a row on each side of the midrib	πτεροειδής	pennate

Term	Explanation in English	Greek	Italian
plantation		φυτεία	piantagione
pod	A dry fruit or seed vessel that bursts open when mature and is more or less elongated and cylindrical or flattened	μακρύς καρπός, λοβός	baccello
pollination	The transfer of pollen from the anther to the stigma of the same or a different flower to ensure fertilization of the ovules to produce seeds	επικονίαση	impollinazione
pre-germination	Pre-germination involves soaking seeds in <u>water</u> and, when the first seeds show signs of germination, removing the seeds and planting them. However, there are also other considerations	προβλάστηση	pre-germinazione
pre-soak	An act of immersing the seeds in water for a period of time	μούλιασμα	ammollo
procumbent	Trailing or lying flat without taking root	έρπουσα, πλαγιόκλαδη μορφή	prono, prostrato
prostrate	Lying flat on the ground (creeping)	έρπουσα μορφή φυτού	prostrato
pruning	Trimming branches or parts of trees and shrubs, in order to strengthen those that remain or to bring the tree or plant into a desired shape	κλάδεμα	potatura
pup		άλλη ονομασία των suckers στην αλοή	polloni basali di aloe vera
quiquefoliate	Having five leaflets	με πέντε φυλλάρια	Quinata: foglia composta da cinque foglioline
raceme	An unbranched inflorescence of stalked flowers	βότρυς, βοτρυώδης	racemo
riparian zone		παρόχθια ζώνη	zona ripariale
rootstock	A robust plant which provides the root system in grafting. Also	υποκείμενο εμβολιασμού (το	portainnesto (La pianta

Term	Explanation in English	Greek	Italian
	known as a stock	φυτό που φέρει τις ρίζες)	innestata,quella con radici)
sap	The fluid, chiefly water with dissolved sugars and mineral salts that circulates in the vascular system of a plant	χυμός	linfa
Scale-like	Thickened leaves which constitute a bulb, and also applied in the <i>Coniferae</i> (Conifer or Evergreen family) to the leaves or bracts of the cone	όπως τα λέπια	come squame
sclerophyllous	With hard leaves and short internodes	σκληρόφυλλος	sclerofille
seedling	A young plant, especially one raised from seed and not from a cutting	σπορόφυτο	piantina
semi-hardwood cutting	A semi-hardwood section of a stem that is removed and used for propagation	ημιξυλώδες μόσχευμα	talea semilegnosa
serrated	Leaves and other plant parts that have sharp "teeth" along their edges pointing toward the tip	οδοντωτός	seghettato
sessile	Leaves and other plant parts that have no stalk, but instead grow directly from the stem of the plant	αμισχός	sessile
shoot	A young branch or sucker springing from the main stock of a tree or other plant	βλαστός	stelo
shrub	A woody plant, usually smaller than a tree, which produces several stems rather than a single trunk from the base	θάμνος	arbusto
sinuate	Having a very wavy edge	κυματοειδής, οδοντωτός	sinuate
softwood cutting	Cutting from wood consisting of soft, immature tissue	μοσχεύματα μαλακού ξύλου	talea di legno verde
sparsely-branched		αραιά διακλαδισμένος	scarsamente ramificate
spatulate	Spatula-shaped; oblong or	σε σχήμα	spatolato

Term	Explanation in English	Greek	Italian
spike	rounded with a long, narrow base, as a <u>spatulate</u> leaf or petal Long, narrow, unbranched cluster of sessile flowers produced along a central axis	<u>σπάτουλας</u> <u>ταξιανθία σταχυού</u>	<u>spiga</u>
stamen	The male floral organ, bearing the anther, which produces pollen	<u>στήμονας</u>	<u>stame</u>
stemless	Having no stem, <u>acaulescent</u>	<u>χωρίς βλαστό</u>	
stoma (pl. stomata)	A pore on a plant's stem or leaf, which through opening and closing, controls the exchange of gases with the outside	<u>στόμα - στομάτια των φύλλων</u>	<u>stoma</u>
striking		<u>εντυπωσιακά</u>	<u>impressionante</u>
sturdy		<u>ανθεκτικός,</u> <u>γερός</u>	<u>robusto</u>
succulent	A plant with thick fleshy leaves and/or stems that are adapted to store water	<u>παχύφυτο</u>	<u>succulento</u>
sucker	Shoots that grow from the <u>understock</u> on which a tree or shrub is budded	<u>βλαστοί που δημιουργούνται στη βάση του φυτού,</u> <u>παραβλαστήματα</u>	<u>polloni basali</u>
syconium	A multiple fleshy fruit composed of a hollow receptacle containing numerous reduced flowers, as in the fig	<u>συκόνιο</u>	<u>Siconio</u>
taproot	The main, downward-growing root of a plant, which grows deeply and produces lateral roots along its length	<u>η κύρια ρίζα</u>	<u>fittone</u>
thinning	Make less dense	<u>αραίωμα</u>	<u>assottigliamento</u>
toothed		<u>οδοντωτός</u>	<u>dentate</u>
trailing	Having a long stem which spreads over the ground	<u>έρπουσα μορφή φυτού</u>	<u>pianta strisciante,</u> <u>plagiotropo,</u> <u>prostrato</u>
training	The operation of forming young trees (or any other plant) in a desired shape	<u>κλάδεμα,</u> <u>διαμόρφωση</u>	<u>potatura</u>

Term	Explanation in English	Greek	Italian
transpiration	The loss of watery vapor from the surface of foliage	διαπνοή	traspirazione
transplanting	To lift and reset a plant in another soil or situation	μεταφύτευση	trapiantando
trifoliate	Having three leaves	με τρία φυλλάρια	trifogliate
trunk	The main woody stem of a tree	κορμός	fusto arboreo
tuberous	Resembling a tuber, bearing tubers		
twig	A slender woody shoot growing from a branch or stem of a tree or shrub	μικρά κλαδιά	ramoscello
weed control		ζιζανιοκτονία	controllo delle infestanti
wild life garden	A garden that is attractive to various forms of wildlife such as birds, insects, and so on	κήπος που προσελκύει διάφορα είδη άγριας πανίδας (εντομα, πουλιά, κλπ)	
winged	With a dry membranous expansion or thin extension on stems	με πρόεκταση σαν μεμβράνη	con una espansione membranosa
xeriscape	A landscape designed with drought-tolerant plants		
xerophytic	A plant that is adapted to living and growing with limited water because their formation provides water storage or limits transpiration	ξηροφυτικός	xerofilo
yield	The full amount of an agricultural product	σοδειά	prodotto, raccolto

ANEX II Images sources

SOURCE

- Fig. 1** Stavros Bacis
- Fig. 2** Hellenic National Meteorological Service
- Fig. 3** Hellenic National Meteorological Service
- Fig. 4** Hellenic National Meteorological Service
- Fig. 5** Hellenic National Meteorological Service
- Fig. 6** Hellenic National Meteorological Service
- Fig. 7** Hellenic National Meteorological Service
- Fig. 8** Hellenic National Meteorological Service
- Fig. 9** <http://www.klimadiagramme.de/Europa/brindisi.html>
- Fig. 10** <http://www.klimadiagramme.de/Europa/bari.html>
- Fig. 11** World Meteorological Organization
- Fig. 12** World Meteorological Organization
- Fig. 13** <http://www.epa.gov/climatechange/images/science/GlobalPrecipMap-large.png>
- Fig. 14** Dr. Karras G. - Mr. Kyrkas D.
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- Fig. 17** <http://www.fao.org/docrep/t0231e/t0231e07.htm>
- Fig. 18** Dr. Karras G. - Mr. Kyrkas D.
- Fig. 19** Dr. Tsirogiannis I.
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- Fig. 21** Dr. Tsirogiannis I.
- Fig. 22** <http://courses.washington.edu/onsite/GraywaterPresentation.pdf>
- Fig. 23** Dr. Tsirogiannis I.
- Fig. 24** http://www.epa.gov/WaterSense/docs/water-efficient_landscaping_508.pdf
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- Fig. 43** [http://upload.wikimedia.org/wikipedia/commons/f/f2/
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de/Geranium_sanguineum_Leeds_B.jpg](http://upload.wikimedia.org/wikipedia/commons/d/de/Geranium_sanguineum_Leeds_B.jpg)
- Fig. 48** [http://upload.wikimedia.org/wikipedia/commons/1/1b/
Helichrysum_italicum_subsp_micropodium_g07.jpg](http://upload.wikimedia.org/wikipedia/commons/1/1b/Helichrysum_italicum_subsp_micropodium_g07.jpg)
- Fig. 49** Mr. Fillis E.
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- Fig. 67** http://www.webphotos.com.au/photo_view.aspx?id=473
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- Fig. 71** http://wildherbsofcrete.blogspot.gr/2010_05_01_archive.html
- Fig. 72** Dr. Karras G.
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- Fig. 75** Mr. Kyrkas D.
- Fig. 76** [http://www.hiddenhollowfarmwv.com/imagelib/sitebuilder/misc/show_image.html?linkedwidth=actual&linkpath=
\[http://hiddenhollowfarm.fatcow.com/sitebuildercontent/
sitebuilderpictures/mullein005.JPG&target=tlx_pic9jxi\]\(http://hiddenhollowfarm.fatcow.com/sitebuildercontent/sitebuilderpictures/mullein005.JPG&target=tlx_pic9jxi\)](http://www.hiddenhollowfarmwv.com/imagelib/sitebuilder/misc/show_image.html?linkedwidth=actual&linkpath=http://hiddenhollowfarm.fatcow.com/sitebuildercontent/sitebuilderpictures/mullein005.JPG&target=tlx_pic9jxi)
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Notes - favourite plants:.....

Notes - favourite plants:



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