‘ECOPLANTMED’

ECOLOGICAL USE OF NATIVE PLANTS FOR ENVIRONMENTAL RESTORATION AND SUSTAINABLE DEVELOPMENT IN THE MEDITERRANEAN REGION

‘MANUAL FOR THE PROPAGATION OF SELECTED MEDITERRANEAN NATIVE PLANT SPECIES’

EcoplantMed

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CROSS-BORDER COOPERATION IN THE MEDITERRANEAN

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siliqua, *Cistus creticus*, *Daphne oleoides*, *Myrtus communis*, *Phillyrea latifolia*, *Pyrus syriaca, Rhamnus cathartica, Sorbus umbellata tree*), Andrea SANTO (*Anthyllis barba-jovis*, *Poterium spinosum*), Boutheina STITI *(Capparis spinosa)*.

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PREFACE

The objective of this manual is to improve the knowhow of the nursery sector, both public and private, about native plant species that are suitable for restoration ecology and gardening in the Mediterranean biogeographic region. The scientific results on seed germination obtained during the ECOPLANTMED project have been transferred into this manual in the form of easy-to-read protocols. The manual has focused in species which germination protocols were not published using seeds of local origin from the territories of the diverse ECOPLANTMED partners. In addition, standard of germination and plant propagation protocols for the most common Mediterranean species used in forestry and ecological restoration, have been included as an annex to complete the information provided. The manual also contains general recommendations for the collection and curation of seed lots.

This text is disposed for operations in seed germination laboratories, following simple and clear instructions, and trying to adapt them to the common procedures of nurseries that lack of specialized laboratories and infrastructures. We expect that the following methodologies can make easier the work of the diverse local nurseries with respect to propagation procedures for native plant species within their territories, as well as to encourage the use of national and international standards for seed collection, curation and storage. This manual is also directed to those persons or enterprises interested in the subjects of ecological restoration, garden or landscape design and other engineering and architectural works which require the use of native plant species –such as nurseries owners and workers, public administrations, architects, engineers, seed bank technicians, researchers, and more generally all plant users within the Mediterranean Region–. Particular attention is given to students, to whom we have tried to transfer, in simple terms, the research experience and results of experimentation undertaken by the Authors as well as the scientific literature available, with the objective of providing them with the most key elements of this field of study.

It is important to remember that the protection of biodiversity through conservation of genetic resources is not always reserved to public administrations, researchers and academics. The halt of the loss of plant diversity in the Mediterranean, can also be enhanced by the wide public and diverse professional sectors. The promotion of the use of native plant species of local origin in habitat restoration, landscape design and gardening, not only can contribute to stop the expansion of invasive exotic plants, but also to lead the expansion of a sustainable development model.

The manual is structured into two main chapters. The first chapter is an introduction that presents to the reader the variety of habitats within the Mediterranean Basin, explains the dangers in the use of exotic plant species as well as the advantages of using native ones, describes the commonly used methodologies for seed collection, its handling, storage and conservation, and the basic scientific and technical background needed to understand the diverse protocols used for seed germination. The actions described in the manual refer to the management and germination of modest quantities of seeds; however, it does not exclude the possibility of adapting the manual to larger quantities that may entail the use of mechanically operated techniques available in the cited literature. The second chapter, which is also the main block of this manual, is a collection of cards for selected Mediterranean native plant species presented with a simple and very graphic format, which have been prepared by the diverse partners of the ECOPLANTMED project according

to their local priorities. Finally, a technical glossary of terms considered important for a better understanding of the text, has been included.

The current work cannot and does not want to be described as the definitive guide, but should be considered as a dynamic tool in a constant state of development that can serve as a reference point for common methodologies. Space is left open for useful suggestions and comments that will help to improve the quality of this manual. Its transmission to a wider public and updates will be possible via the web on the internet site http://ecoplantmed.eu/. This manual has also been translated in the local languages of the diverse institutional partners within the ECOPLANTMED project, to make it accessible to the local stakeholders.

The Authors

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Eryngium maritimum L.

Eryngium maritimum L.

Foeniculum vulgare Mill. s.l.

Genista cinera (Vill.) DC.

Helianthemum caput-felis Boiss.

Helichrysum microphyllum (Willd.) Cambess. subsp. microphyllum - synonym: Helichrysum italicum (Roth) G. Don. subsp. microphyllum (Willd.) Nyman

Helichrysum microphyllum Cambess. subsp. tyrrhenicum Bacch., Brullo & Giusso Brullo & Giusso

Hypericum empetrifolium Willd. subsp. empetrifolium

Hypericum hircinum L. albimontanum (Greuter) N. Robson

Juncus subulatus Forssk.

Juniperus phoenicea L. subsp. turbinata (Guss.) Nyman

Lavandula dentata L.

Lavandula stoechas L. subsp. stoechas

Lonicera etrusca Santi

Lonicera implexa Aiton. subsp. implexa

Lonicera xylosteum L.

Magydaris pastinacea (Lam.) Paol.

Malus trilobata (Labill. ex Poir.) C.K. Schneid.

Medicago arborea L.

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Myrtus communis L.

Myrtus communis L.

Nepeta foliosa Moris

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INTRODUCTION

1.1. The importance of the use of native vs. exotic plant species

1.1.1 Definitions

A **native** (or autochthonous, or indigenous) plant species can be defined as a species existing within its natural distribution and dispersion range. When we say that a plant species is native to a certain country, this does not necessarily mean that the species occurs naturally in all the regions of the country, but it may occur within one region and be absent from other regions.

Conversely, an **exotic** (or alien, or introduced) plant species is not native to the region in which it occurs. An exotic species is introduced by humans to a region either intentionally or unintentionally. An exotic species come to be **naturalized** when it becomes established in natural or semi-natural ecosystems with free-living, self-maintaining and self-perpetuating populations without human intervention.

It may be understood that a plant species is exotic regardless when it was introduced, even in case of very distant times. However, the consideration of a species as native or exotic is sometimes controversial, since many exotic species are "assimilated", both naturally and socially. In Europe the definition of archaeophytes and neophytes is commonly used to differentiate plant species introduced before and after ca. 1500 AD, respectively, division that is approximately set with the beginning of the large explorations that took place originally in Europe and became widespread during the next centuries. In the case of archaeophytes, the term "exotic" has often been dismissed and they are regarded as an integral part of the local flora.

An **invasive alien plant (IAP)** is a naturalized exotic plant species which is an agent of change, and threatens human health, economy and/or native biodiversity. Although many exotic plant species never naturalize and only a few come to be considered invasive, IAPs are a major cause of biodiversity loss in the world, a situation that becomes worse especially for vulnerable habitats and ecosystems.

An **endemic plant species** has a distribution limited to a defined geographical area and cannot be found naturally anywhere else in the world (e.g. Fig. 1A). Therefore, we say that a species is endemic to a certain region, meaning that you can only find it naturally in that place. A species may be endemic to a mountain top or a lake, a mountain chain or a river system, an island, a country or even a continent.

1.1.2 Native and exotic plants in the Mediterranean context

The Mediterranean Basin is the third most significant plant diversity hotspot worldwide with more than 25,000 plant species, of which over half are endemic and only a small proportion are exotic later become naturalized. Many exotic plants are very common in Mediterranean gardens and new species continue to be introduced mainly through nurseries for both landscaping and domestic use. Only a small percentage of these introductions escapes from cultivation, becomes naturalized and invades natural or semi-natural ecosystems. Species that have become invasive have been intentionally used for silvicultural, ecosystem restoration, agricultural and other purposes. For example, many species of the genus *Acacia* have been introduced by humans, mainly as silvicultural and ornamental species (Fig. 1B). However, there are many other uses including the stabilisation of sand dunes and land reclamation, and the use as a livestock fodder.

IAPs contribute to the loss of plant diversity worldwide by impacting natural plant communities. Their impact

Figure 1. (A) *Nepeta foliosa,* endemic to Sardinia, grows exclusively on the Oliena Massifs. (B) The exotic plant species *Acacia saligna* growing in coastal areas of the Mediterranean (Photos: G. Bacchetta, V. Lazzeri).

may also cause major economic problems, establishing as highly persistent and vigorous agricultural weeds, damaging manmade environments or choking open spaces and waterways. The Mediterranean Region is affected by diverse IAPs (Fig. 2). Information and lists of IAPs in the Mediterranean are available from the European and Mediterranean Plant Protection Organization (EPPO)[1] and the DAISIE project[2]. EPPO and the Council of Europe have published a Code of conduct on horticulture and invasive alien plants[3].

[1]http://www.eppo.int/
[2]http://www.europe-aliens.org/
[3] Heywood V. & Brunel S, Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Nature and environment, no. 162. 2011. *Code of conduct on horticulture and invasive alien plants*. Council of Europe Publishing, 98 pages

Figure 2. From the left to right, *Agave fourcroydes, Eichhornia* sp. *and Opuntia ficus-indica*, IAPs growing in diverse areas of the Mediterranean Basin (Photos: M. Duran, L. Podda).

Physiology and adaptations of native and exotic plants in the Mediterranean

Summer drought gives uniqueness to the Mediterranean climate and is currently the selective pressure with more direct and indirect influence on natural and human systems typical of these areas. In addition, other climatic features should be considered, such as the irregular inter-annual rainfall, the frequent storms, the mild or moderately cold winters and the hot summers. These climatic characteristics have conditioned very similar evolutionary pathways and functional responses along the different biogeographical areas of the Mediterranean climate in the world. This is apparent in the common adaptive strategies, appearance and functional features of the Mediterranean vegetation.

The summer drought and the high temperatures produce the gradual depletion of the soil water reserves, the increase of evapotranspiration levels in the vegetation, and the atmospheric dryness. To survive in these conditions of periodic low water availability, Mediterranean plants have adapted their metabolism in order to reserve water. Many physiognomic features of the native Mediterranean vegetation are presumably consequence of these adaptive strategies or responses. For example, deep roots to survive water depletion from the top-soil, special leaves (e.g. sclerophyllous plants) to prevent heating and evapotranspiration or to reduce the sun exposure, presence of hairs or scales that limit evaporation and reflect sunlight, special location and protection of stomata to reduce evapotranspiration, total or partial loss of leaves during the dry season, and, in some cases, succulence. In addition, other less noticeable features are the result of adaptations to these conditions, such as low rate of photosynthetic activity during unfavorable periods or conservation mechanisms of the plant metabolism. Other adaptations are directed to resist fire, with many Mediterranean plants showing great re-sprouting ability, fire-induced germination, or other defense mechanisms.

The Mediterranean climatic characteristics that influence the physiology and adaptations of the native Mediterranean vegetation worldwide, also influence the type of exotic plants that grow well in these regions and those that can become invasive. In this sense, plants native to certain areas with Mediterranean climate grow easily and can become invasive in other areas with Mediterranean climate. For example, *Carpobrotus edulis* and *Oxalis pes-caprae* that are native to South Africa (Fig. 3), and *Acacia saligna* that is native to Southwest Australia are well-documented examples of IAPs in the Mediterranean Basin. Similarly, within the

Mediterranean Basin, species that are native to some areas can become invasive in others, such as *Hyparrhenia hirta* that is considered native in northern Africa and southern Mediterranean areas and is deemed exotic and potentially invasive in France and other northern Mediterranean countries.

Figure 3. *Carpobrotus edulis* and *Oxalis pes-caprae* are native to areas with Mediterranean climate that have become invasive in the Mediterranean Basin (Photos: L. Podda).

Additionally, many IAPs have ecophysiological features not found in native flora that make them more competitive. Among them, there are a wider germination temperature range and the production of high competitive seedlings, often with rapid growth and juvenile periods of short duration. Some species show a great capacity in the rapid clonal propagation, the facility to reproduce both sexually and vegetative, or a high frequency of hermaphroditic individuals that often use also self-fertilization. Other species have a good adaptability to a wide range of environmental conditions, including the capacity to adjust their phenology regarding the water availability, or suitable adaptations (e.g. succulence) that are critical to resist the summer drought. In addition, some species are more competitive in low nutrient soils due to their large roots and diverse adaptations to favor nitrogen absorption. To all this is associated the absence of antagonists and the production of allelopathic substances that act as herbicides for native plants and are toxic to herbivores. More information and examples can be found in specialized literature (see references for this chapter).

1.1.3 Importance of the use of native plant species in restoration ecology and gardening

Using native plants for habitat restoration or as a substitute for exotic ornamental plants on both public and private land can contribute to long-term protection and enhancement of our natural and cultural heritage as well as landscape protection. Furthermore, using native plants can increase ecosystem resilience to climate change and combat the proliferation of IAPs. Although exotic plant species will continue to be used and introduced, it is very important to avoid their use in restoration actions, while for ornamental or other uses it is important to prevent the use of those with known invasive potential. Cooperation of scientists and technicians with the plant production sector can lead to the replacement of the growth and trade of invasive

plants with native ones. An interesting initiative of this kind took place in France where substitute plants were proposed for the 15 most invasive plants in the Mediterranean area[4].

For restoration actions, it is important not only the use of native plants, but there should also be genetic considerations (explained later). According to a related study of FAO[5], increasing the use of native species in restoration activities provides real environmental and livelihood benefits, but also involves clear risks, mainly related to the selection of the appropriate genetic source for the target plant species. Four important considerations are the following:

(1) increasing the use of native species in restoration activities contributes to the conservation of the species themselves and their genetic diversity;

(2) if planting material represents not only a native species but originates from seed sources local to the planting site, it evolves together with other native flora and fauna of the area. It should therefore be well adapted to cope with the local environment and should support native biodiversity and ecosystem resilience to a greater extent than would introduced (exotic) planting material;

(3) native species may be less likely either to become invasive or to succumb to introduced or native pests than exotic species;

(4) native species may correspond better to the preferences of local people, and chances that local people hold ethnobotanical and ethno-ecological knowledge of these species are higher, which may facilitate their successful use in restoration projects.

This manual therefore aims to promote the use of native plants by also taking into consideration that, especially for restoration actions, native plants of local origin should be used.

1.1.4 Risks of using exotic plants

Landscape alteration: for restoration actions, exotic plants that become invasive can dramatically alter unique landscapes, not only visually but also induce irreversible modifications.

Hybridization: when introducing exotic species in an ecosystem, hybridization may occur between the exotic and native species. Hybridization, also named genetic contamination, leads to the loss of the genetic diversity among native species and could lead to the loss of local genotypes or rare and threatened native species. Additionally, hybrids could present new morpho-types and adaptations with profound ecological effects on native species, especially when they compete with natives for the ecosystem resources. Besides, new hybrids may invade new habitats and extend their distribution range.

[4]Agence Méditerranéenne de l'Environnement, Conservatoire Botanique National Méditerranéen de Porquerolles (2003) Plantes envahissantes de la région méditerranéenne. Agence Méditerranéenne de l'Environnement. Agence Régionale Pour l'Environnement Provence-Alpes-Côte d'Azur. Accessed on 27-05-2015 from: http://www.tela-botanica.org/reseau/projet/fichiers/PELR/14436/PELR_14438.pdf

[5]FAO 2013. State of Mediterranean Forests 2013. Pdf version available at: http://www.fao.org/docrep/017/i3226e/i3226e.pdf

Changes in soil microbiota: soil microbial communities may differ significantly between invaded and not invaded areas. Shifts of soil microbial communities by invasive species may have impact on native plant fitness and on the ecosystem function.

Insects/pollinators imbalance: exotic plants and especially IAPs as a new resource can affect directly the performance of native phytophagous leading in some cases to the host shifts of the herbivores. Paradoxically, a particular IAP could be highly suitable as host and nutrition resource for native insects, or conversely, could be toxic and affect negatively their diversity and abundance. Alternatively, IAP can have an indirect effect on the behavior of native insects by altering native plants quality, abundance, diversity and the structure of their habitat. In addition, exotic plants and particularly IAPs can negatively affect pollination of native plants by competing for pollinators or by increasing hetero specific pollen deposition, especially if IAPs produce higher number of flowers, bigger and more colorful than native ones. Furthermore, IAPs may affect directly pollinators by its nectar or pollen, which could be toxic to insects. Another aspect to take into account is the introduction of damaging insects associated to some exotic plants, such as the red palm weevil, that is affecting not only ornamental exotic palms, but also some local flora (e.g. *Chamaerops humilis*).

Economic impacts: IAPs have important economic impacts like the high management and eradication cost of invasive species. For example, to eradicate *Carpobrotus edulis* and *C. acinaciformis* in different parts of the Mediterranean, especially in Spain, hundreds of thousands of euros are expended annually. Moreover, IAPs can reduce crop yields, reduce land value and could damage infrastructure. For example, in Morocco, the value of invaded lands by *Solanum elaeagnifolium* decrease 25%, and without treatment, they lose 64% and 78% of maize and cotton yields respectively.

Human health: some exotic plants have a direct impact on humans, such as those species that have become new sources of pollinosis (allergies) for local residents.

1.2 Mediterranean habitats

1.2.1 Mediterranean

The word Mediterranean evokes in most people an ancient heritage and history, characterized by mild-warm weather, healthy food seasoned with olive oil and aromatic herbs, and the smell of the sea. However, Mediterranean has numerous definitions depending on the context that is used.

From a climatic point of view, the Mediterranean is a particular variety of subtropical climate. Areas with **Mediterranean climate** occur between approximately 30° to 45° north and south latitude on the west sides of continents (Fig. 4A). The lands around the Mediterranean Sea form the largest area where this climate type is found (Fig. 4B), but it also prevails in much of California, in parts of Western and South Australia, in southwestern South Africa, and in central Chile. The Mediterranean climate is characterized by **hot-dry summers and humid-cool winters**, but it can also be notoriously capricious with **sudden torrential downpours** or bouts of high winds occurring at various times of the year.

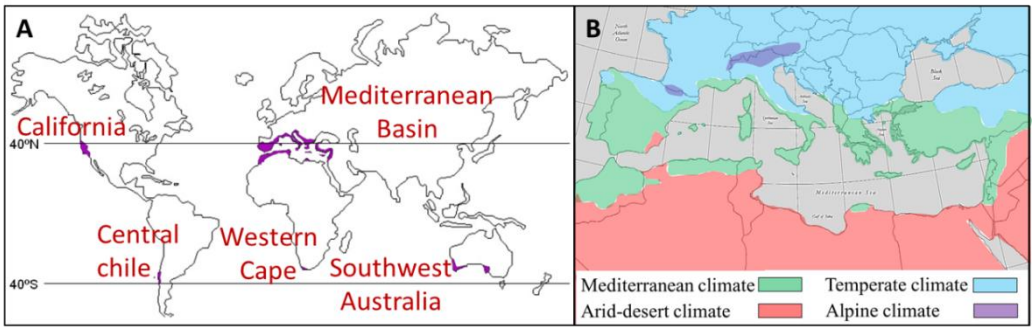


Figure 4. Mediterranean climate in the world (A). Distribution of the main climates along the countries of the Mediterranean Basin (B). Maps adapted from the Köppen-Geiger climate maps published by Kottek et al. (2006) and Peel et al. (2007).

If we take into account a geographic point of view, Mediterranean is the 2.5 million Km² sea that is connected to the Atlantic Ocean by the Strait of Gibraltar in the west and to the Black Sea by the Bosporus in the east. The **Mediterranean Sea** is part of the coastlines of diverse countries from three different continents (Africa, Asia, and Europe). However, not all of the countries around the Mediterranean Sea possess exclusively a Mediterranean climate. For example, Spain, Italy or France possess wide areas where the temperate climate is prevalent. Similarly, large areas of countries of the Maghreb and Levant fall within the arid/desert climate zones (Fig. 4B).

The particular conditions of the Mediterranean climate, the varied and contrasting topography of the lands around the Mediterranean Sea, as well as its geological history, have had a profound influence on the vegetation growing in these areas. The combination of the climatic, geographic, geological, but particularly, floristic points of view, brings us the biogeographical term **Mediterranean Region** or **Mediterranean Basin.**

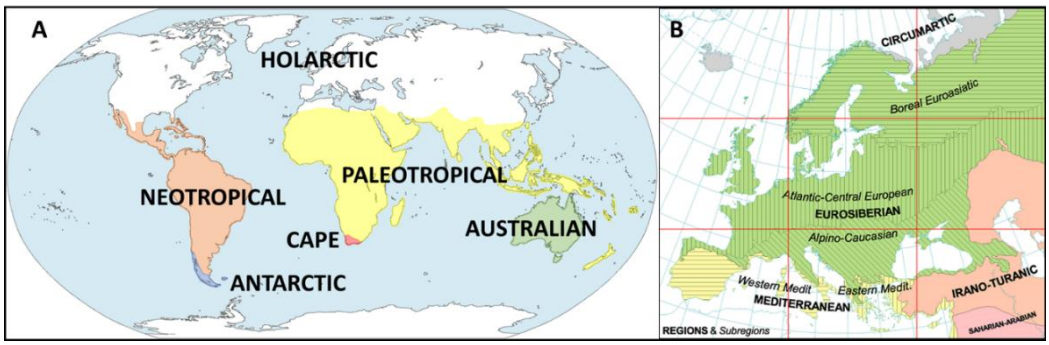


Figure 5. Biogeographic kingdoms of the world (A). Mediterranean Region within the Holarctic kingdom (B). Maps adapted from Rivas-Martinez (2004).

Biogeography is the science that studies the distribution of plant species and communities on the Earth, its causes, and relationships. From a biogeographic point of view, the planet is divided in five Kingdoms, where the area that is extended over the continents north of the Tropic of Cancer is the Holarctic kingdom (Fig. 5A). This kingdom consists of 11 regions, in which the Mediterranean Region surrounds the Mediterranean Sea (Fig. 5B). The climate of the Mediterranean Region is typically Mediterranean as defined above.

The Mediterranean Region or Basin encompasses 24 countries, from Portugal in the west to Lebanon in the east, not all of them touched by the Mediterranean Sea. It offers an ever-changing landscape of high mountains, rocky shores, impenetrable shrub, semi-arid steppes, coastal wetlands, sandy beaches and myriad islands of various shapes and sizes. Because of these particular topographical and climatic conditions, Mediterranean plant communities are highly diverse, and rich in native -often endemic- species that are well suited to recover from droughts, floods, and fires. Not surprisingly, the Mediterranean Region is considered one of the top biodiversity hotspots in the world.

The other areas of the world with Mediterranean climate are classified within other regions of the Holarctic Kingdom, such as the Californian Region, or belong to other kingdoms, such as the Capense Region (Paleotropical kingdom), the Mesochilean-Patagonican Region (Neotropical-Austroamerican kingdom), and the Australian Mediterranean Region (Neozelandian-Australian kingdom). The flora and habitats of all these regions share some similarities. Particularly distinctive of the Mediterranean climate regions are the sclerophyllous shrublands, called maquis in the Mediterranean Basin, chaparral in California, matorral in Chile, fynbos in South Africa, and mallee and kwongan shrublands in Australia. Interestingly, all these regions are also considered biodiversity hotspots in the world.

1.2.2 "Mediterranean habitat" definition under the ECOPLANTMED project

With all the diversity of definitions for "Mediterranean", two questions may come to our mind: What can we consider "Mediterranean habitat"? What are the plant species that are suitable to be used for habitat restoration in the Mediterranean?

For the scope of the ECOPLANTMED project, and particularly the plant species showed in this manual, we have considered that **Mediterranean habitats** are those **present** in the **Mediterranean Region**

(biogeographical definition), and that are **characteristic** of it. Those habitats from other parts of the world with Mediterranean climate (Chile, California, South Africa and Australia) are completely excluded for the scope of this manual. Those habitats present in countries of the Mediterranean Basin that fall into other biogeographical regions (e.g. habitats of the Eurosiberian region of Spain, Italy, Greece and other EU Mediterranean countries, habitats of the Irano-Turanic Region in the Eastern Mediterranean countries, and habitats of the Saharo-Arabian Region of Tunisia and other North African Mediterranean countries) are completely excluded as well.

A list of some Mediterranean habitats of the Mediterranean Region, grouped by ecosystems, can be found in table 1 of Annex 1. Comprehensive descriptions of most Mediterranean habitats and their characteristic species can be found online[6,7].

It is possible that within the Mediterranean Region we find habitats that are not characteristic of the Mediterranean Region, and belong to other biogeographical regions. For example, the mesophilous forests of secondary species (*Acer pseudoplatanus, Fraxinus excelsior, Ulmus glabra, Tilia cordata*) of coarse scree, abrupt rocky slopes or coarse colluvions of slopes, present in Valencia region of Spain. These habitats (and the plant species therein) may be considered in this manual since they have particular characteristics due to their relict character, but principally to their conservation status within the provinces they occur (table 2 of Annex 1).

1.2.3 General description of the Mediterranean habitats

The Mediterranean Region harbours more than half of the habitat types listed in the EU Habitats Directive. Of these, 37 occur only in this region. The large number reflects not only the region's warm climate, variable geology and complex topography with many isolated areas, but also the fact that much of the region was spared by the ravaging effects of the last Ice Age that spread across Europe.

Mediterranean forests are often open with ample light, giving room for layers of shrubs and dwarf shrubs, resulting in a complex vertical structure. Forest, shrubs and heathlands often appear in close interconnection and may merge into one another. Mediterranean forests are highly diverse in species composition. It is estimated that more than 100 tree species contribute to the various forest types. The forests are mainly broadleaved, but conifers occur at mountainous sites with shallow soils, or as plantations (*Pinus pinaster and Pinus halepensis*). Many of the dominant broadleaved tree species are sclerophyllous (evergreen with leathery leaves): cork oak (*Q. suber*) (Fig. 6A), holm oak (*Quercus ilex* and *Q. rotundifolia*) (Fig. 6B), Aleppo oak (*Q. infectoria*), kermes oak (*Q. coccifera*), and Palestine oak (*Q. calliprinos*) (Fig. 6C). These forests usually have a rich layer of vines (*Clematis* sp., *Lonicera* sp., *Smilax* sp. and *Rubia* sp.), and in the more humid and mesophilous zones, they are rich in shrubs and small broadleaf tress with lauroid leaves, often entire, evergreen and leathery (*Arbutus*, *Viburnum*, *Myrtus* and *Laurus*).

[6]http://www.eea.europa.eu/data-and-maps/data/corine-biotopes
[7]http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf.

Over the course of the last two – three millennia these oak forests have progressively replaced other deciduous oak trees (*Q. brachyphylla, Q. canariensis*, *Q. congesta*, *Q. faginea*, *Q. ichnusae*, *Q. pyrenaica*, *Q. virgiliana*), which are now mostly found at higher altitudes or in areas with deep soils and higher humidity.

Figure 6. Diversity of forests of broadleaved trees in the Mediterranean Basin. Forest of *Quercus suber* (A), *Quercus ilex* (B) and *Quercus calliprinos* (C). (Photos: G. Bacchetta).

Taxus (Fig. 7). Some of these are endemic trees, as the cedar of Lebanon (*Cedrus libani*) (Fig. 7B) which is particularly renowned for its timber, having been utilized for thousands of years and now holding pride of place on the Lebanese flag. In addition, there are few palm species native to Europe and present in the Mediterranean Basin, such as the Mediterranean dwarf palm (*Chamaerops humilis*) (Fig. 8A) and the Cretan date palm (*Phoenix theophrasti*) (Fig. 8B).

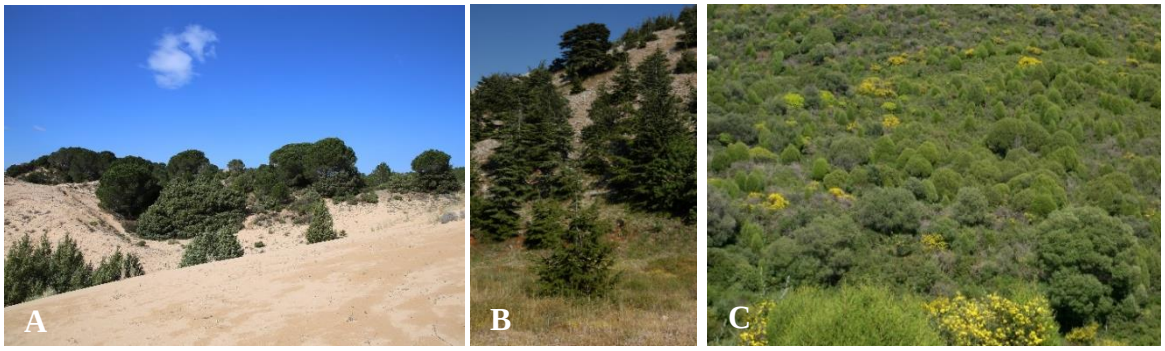


Figure 7. Diversity of Mediterranean conifer's forests. Coastal pine formations of *Pinus pinea* (A), cedar of Lebanon forest (B), *Juniperus phoenicea* subsp. *turbinata* formation (C). (Photos: G. Bacchetta).

Figure 8. Mediterranean palm formations: *Chamaerops humilis* formations in Western Mediterranean (B), *Phoenix theophrasti* (Cretan date) in the Eastern Mediterranean (A) (Photos: G. Bacchetta).

The forests have been much degraded by overgrazing and exploitation for firewood, but also as a result of fires. Such forest areas may become open, secondary forests with several understories, but if not properly managed they may turn into varied types of high or low dry shrubs, or in some areas to heathlands, or degrade into sparsely vegetated areas. Only very limited forest areas remain without influence from human activities. The fragments are fragile and under high pressure, and comprise areas with old oaks, pines and wild olive such as oak formations in Sardinia and Tuscan Archipelago, and Mediterranean fir formations in restricted areas in the south and southwestern part of the region. In Sicily very few individuals remain of the critically endangered and relic Sicilian fir (*Abies nebrodensis*) ca. 20 mature individuals exist and replanting have had limited success.

Mediterranean heathlands, shrubs, grasslands, and arid lands. The bush and dwarf-shrub occupy a large extension of the Mediterranean Region's landscape. The ubiquitous Mediterranean shrub comes in a variety of shapes and sizes, and is named as matorral, maquis, garrigue and phrygana depending on their geographical location, altitude, exposure, soil, degree of degradation, human usage and species composition (Fig. 9). But in reality these habitat types often merge into one another to form an intricate yet inherently mobile mosaic pattern across the landscape.

The height of the shrub can sometimes be used as a simple rule of thumb. Maquis (Fig. 9A), for instance, tends to form dense impenetrable thickets 1–4 meters high and is usually dominated by small trees like the strawberry tree (*Arbutus unedo)*, the lentisc (*Pistacia lentiscus)*, the wild olive (*Olea europaea* var. *sylvestris)* or the myrtle (*Myrtus communis)*, or less frequently juniper and laurel. Garrigue (Fig. 9C) on the other hand is more open and the vegetation barely reaches knee height. Here leathery-leaved plants like the rock-roses (*Cistus* sp.) and aromatic shrubs like *Lavandula* sp., *Teucrium* sp., *Thymus* sp. and *Rosmarinus* sp. are mostly in evidence, filling the air with their perfume. Phrygana (Fig. 9B), which mainly occurs in the eastern part of the Mediterranean, usually along the coast, is the lowest form of shrub of all and is composed of spiny cushion (e.g. *Poterium spinosum*, *Satureja thymbra*) forming bushes and ground-hugging shrubs.

These habitats contain many types of species adapted to light and drought (e.g. *Anthyllis hermanniae*, *Genista acanthoclada*).

The complexity of the vegetation structure makes the Mediterranean shrublands exceptionally rich in wildlife.

Figure 9. Typical Mediterranean shrub-lands such as a maquis characterized by *Euphorbia dendroides* (A), a phrygana dominated by *Poterium spinosum* (B) and a garrigue with *Helianthemum caput-felis* (Photos: G. Bacchetta).

Intensively flowering shrub species are dominant, many also being highly aromatic: *Artemisia*, *Cistus*, *Genista*, *Helichrysum*, *Phlomis, Salvia*, *Teucrium*, *Thymus,* etc. Other colorful flowers typical from Mediterranean shrublands are geophytes like wild tulips, narcissus, crocuses and alliums as well as many species of bee or mirror orchids. Together they put on a brief but spectacular display of flowers every spring, but may dry out in summer. These areas are highly vulnerable to erosion and to new establishment of plants, though the deep-penetrating roots will protect the existing established vegetation for a long time. The characteristic plant genera often show a large number of species, though many may have limited geographical distribution.

Other parts of the Mediterranean are simply too dry for trees or dense vegetation and are, instead, covered in vast swathes of grasslands (Fig. 10). At first sight, these semi-arid steppic areas may appear barren and lifeless but on closer inspection they reveal an equally rich wildlife. The wintergreen Mediterranean dry grasslands (*Lygeo-Stipetea* class) are constituted by perennial caespitose, or sometimes stoloniferous, bunchgrasses. This vegetation is widely distributed from the sea level to above 2000 m of elevation, often as a serial stage linked to the degradation of woodlands and maquis. For example, the dry grasslands dominated by *Stipa tenacissima* (known as “espartales” in the Iberian Peninsula) constitute one of the most characteristic formations of the occidental Mediterranean semi-arid areas (Fig. 10A). *Stipa tenacissima* steppes are mostly distributed in a thin latitudinal fringe in North Africa (Libya, Tunisia, Algeria, and Morocco) and in the southeastern portion of the Iberian Peninsula. In Sardinia and Sicily, and the Iberian Peninsula, grasslands characterized by the dominance of *Brachypodium retusum*, along with other grass species (*Hyparrhenia hirta*, *Ampelodesmos mauritanicus* and *Lygeum spartum*), are quite widespread (Fig. 10B). The Mediterranean Region presently only contains minor areas that are so arid as to be included in pre-desert or desert in e.g. Spain, Portugal, Sicily, Turkey, Tunisia, and other Maghreb countries.

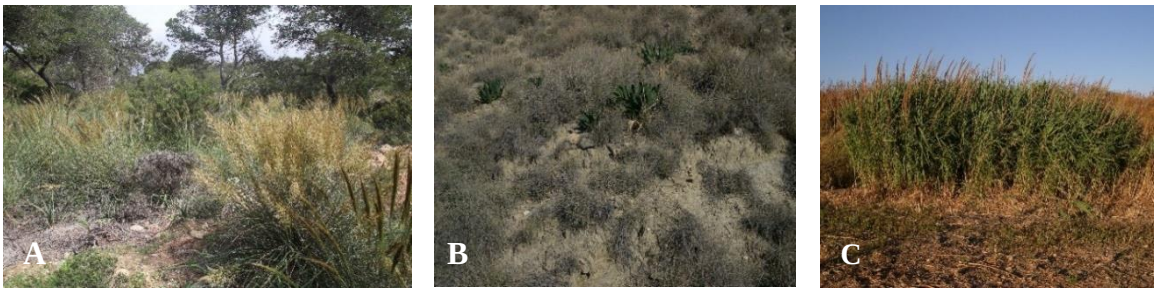


Figure 10. Mediterranean grass formations dominated by (A) feather grass (*Stipa tenacissima*), (B) esparto grass (*Lygeum spartum*), and (C) the cane (*Arundo micrantha*) (Photos: G. Bacchetta).

Mediterranean freshwaters include a variety of ecosystems such as rivers, creeks, lagoons, diverse wetlands, and temporary ponds. Many Mediterranean rivers have low annual volume and irregular regimes. The predominant fluvial regime is characterised by an extended summer period of low or absent water. Because of the water deficits in most of the region, wetlands such as mires, bogs and fens are naturally limited. However, there are some very spectacular and ecologically important wetlands in the region.

Many species of submerged plants are types of pondweeds, such as *Potamogeton pectinatus*, which covers one third of the area of lake Ichkeul in Tunisia, and is the main species consumed by wintering duck populations. When the water is saltier, the pondweeds are replaced by tassel-weeds (*Ruppia* sp.), whereas in areas that remain dry for more than one month, there are shallow water communities such as stoneworts (*Chara* sp.), which can withstand summer drought.

The reed *Phragmites australis* is clearly a dominant species among the large emergent macrophytes of freshwater marshes. This species grows where conditions remain wet through most of the year. In areas that are permanently flooded it can form floating masses. When there is intensive grazing, the reeds can be replaced by prostrate grasses such as *Aeluropus littoralis*, or by sea club-rush *Scirpus maritimus*, which tolerate salt better, and flourish in lightly grazed areas, often on the banks of deep lakes. The most extensive beds are found in the Daimiel wetland in the centre of Spain and in the marshes of the Crau in the Camargue.

Most river forests (riparian forests and alluvial woods) (e.g. Fig. 11B) have disappeared from the European floodplains, although in certain deltas, some fragments remain, as is the case at the Nestos, in Greece, in which there remain sixty hectares of seasonally-flooded deciduous forest, or in the Ebro delta where there are stands of poplars (*Populus* sp.), alders (*Alnus* sp.), and white willows (*Salix alba)*. Due to the torrential character of most Mediterranean rivers, Mediterranean riparian vegetation fits a seasonally water-stressed environment. Plant communities in these ecosystems are structurally similar, with a developed shrub layer, few dominant trees, and a patchy mosaic of herbaceous (Fig. 11A), shrub-dominated, and closed-canopy ecotypes that are associated with distinct geomorphic landforms and/or soil moisture regimes. Common plant genera along the Mediterranean riparian forests include *Celtis, Fraxinus, Nerium, Populus, Salix, Tamarix, Ulmus* and *Vitex*. The composition of the diverse plant communities varies along geographical location, altitude, exposure, soil-composition and river flow. These habitats contain many types of species adapted to light and drought. Some differences exist within the Mediterranean Basin, for example there is a

greater presence of *Platanus, Eleagnus, Pterocarya,* and *Cercis* in the eastern part of the Basin. Examples of relict *taxa* within riparian communities include *Rhododendron ponticum* in the western Basin (Portugal, Spain) and *Liquidambar orientalis* in the eastern Basin.

The temporary ponds form some of the most distinctive plant communities. A great number of these very diverse plants, and in particular several species of quillworts (*Isoëtes* sp.) and other pteridophytes (e.g. *Marsilea* sp., *Pilularia minuta*), can only be found in this region (Fig. 11C).

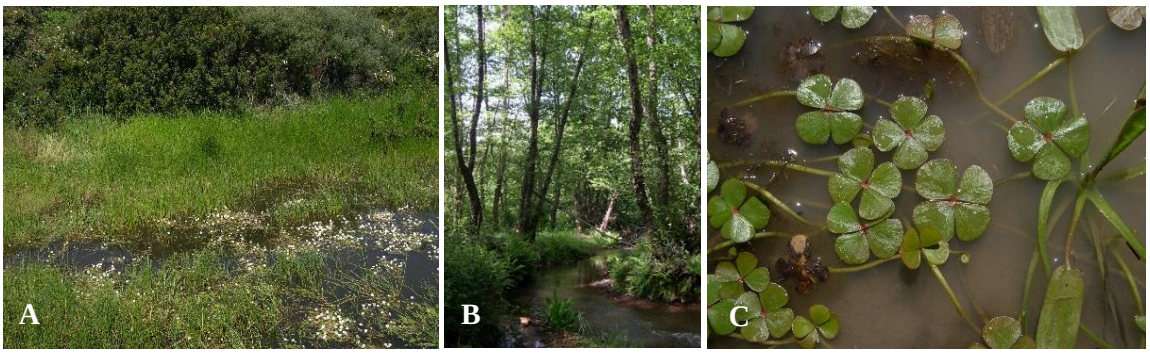


Figure 11. Diversity of Mediterranean freshwater habitats. Hydrophylous communities with *Juncus* sp. and *Ranunculus* sp. (A), riparian forest of *Alnus glutinosa* (B), temporary ponds with *Marsilea strigosa* (C) (Photos: G. Bacchetta).

Mediterranean coastal habitats are very diverse, even within short distances, with rocky stretches and sandy and gravely beaches or coves, including habitats such as rocks and sea cliffs, sandy dunes, caves, lagoons and deltas. Vast areas of dunes and wetlands have totally disappeared.

Posidonia oceanica is a marine plant endemic to the Mediterranean Sea. It forms dense underwater meadows at a depth of up to 40 meters (Fig. 13A). Much like the grasslands on land, these *Posidonia* beds are exceptionally rich in wildlife and play a key role in protecting the coastline. However, *Posidonia* beds are under strict protection, as over a half of them have regressed or disappeared in the Mediterranean in the last 30 years or so.

Dunes play a major role in preserving beaches and protecting the forests, biological communities and amenities situated behind them. However, only few areas remain untouched. Dunes are the exclusive habitat of many endemic plant and animal species. One third of the dune flora is endemic to the Mediterranean. Many dune species are useful pioneer plant species, which help to colonize or to repair sandy substrata, such as *Eryngium maritimum*, *Pancratium maritimum, Cakile maritima, Silene* sp., *Malcolmia* sp., *Matthiola* sp. Diverse coastal dune grassland communities include species as *Ammophila australis, Elymus farctus*, and *Euphorbia terracina* (Fig. 12A). Coastal dunes are often colonized by Mediterranean thermophilous pines (*Pinus halepensis* and *P. pinea*), or are the habitats of diverse *Juniperus* sp. microforests (e.g. *J. macrocarpa* and *J. phoenicea* subsp. *turbinata*), leading to unique habitats where diverse species are found (Fig. 12B). Indigenous dune vegetation is also in this region endangered by the invasion of exotic species, which have escaped from private gardens, such as *Carpobrotus* sp. or *Acacia* sp. The decline in Mediterranean dunes has been severe: more than 70% are estimated to be lost since 1900.

Most of the former dune area has been used for urbanization, for tourism purposes, or they have been planted to stabilize moving sands and have gradually been turned into dry forests, often with pines and/or *Acacia* sp.

Sea-grasses are found on the seaward edges of lagoons, where the two types of environments blend

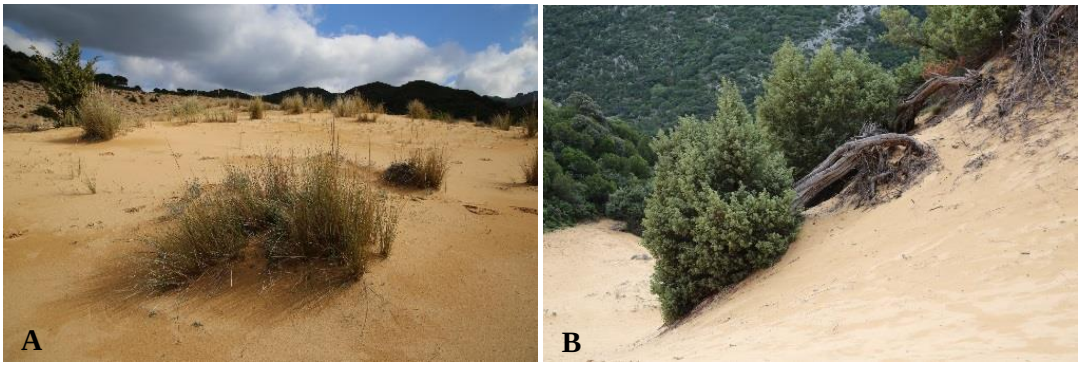


Figure 12. Coastal dune grassland communities of *Ammophila arenaria* subsp. *arundinacea* (A), and dunes with *Juniperus macrocarpa* (B) (Photos: G. Bacchetta).

together. In the intertidal zones, the vegetation is generally dominated by eelgrasses *Zostera* sp., which is generally replaced by *Ruppia* sp. in the calmer, more enclosed, and warmer waters of saline ponds. On the banks, in marshy zones that are seasonally flooded, there are annual and perennial halophyte species that germinate in the dry season, when the water recedes below the surface of the ground; in particular, *Salicornia*, *Arthrocnemum*, and the grasses of brackish marshes that are resistant to both winter flooding and intensive grazing. *Salicornia* (glassworts) occupy wide areas of brackish marshland in the Mediterranean Basin (Fig. 13B), in particular in the deltas, on the edges of lagoons, and around salt lakes in Northern Africa. They help maintain these structures by capturing sediments, which leads to the emergence of a characteristic land form dotted with mounds. Other communities of halophyte plants proliferate on the edges of marshes, such as rushes (*Juncus* sp.), which can form a belt just a few metres wide around ponds (Fig. 13B), at the upper limit of the zones that are flooded in winter, just before the tamarisks (*Tamarix* spp.), which give way to wet grassland as you move away from the shore.

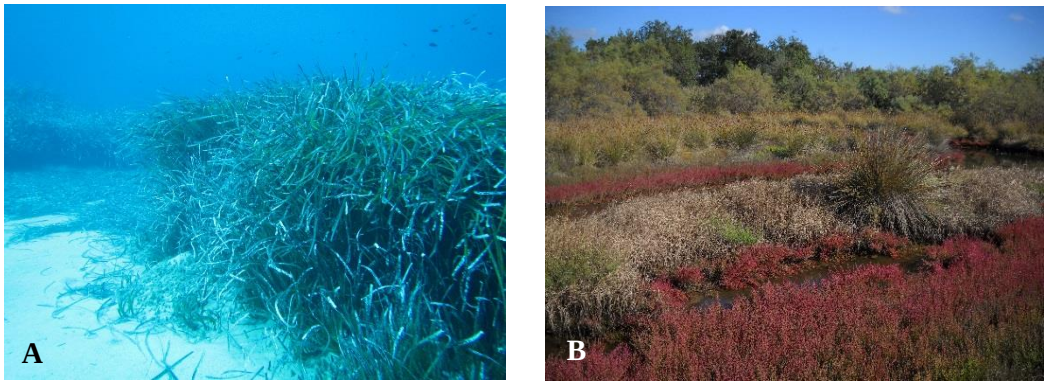


Figure 13. Diversity of Mediterranean coastal habitats. *Posidonia oceanica* beds (A), brackish marshes with glassworts (*Salicornia* sp.) and rushes (*Juncus* sp.) on the edges (B) (Photos: Life-ResMaris, G. Bacchetta).

Along the coasts, rocky landscapes with cliffs, gorges, crevices and caves are frequent (Fig. 14A). They present extreme living conditions for plants as well as for animals and vegetation is sparse. Cliffs and gorges harbour cliff-dwelling plants and a number of tree and shrub species with dwarf forms because of water and nutrient limitations as Phoenician juniper (*J. phoenicea* subsp. *turbinata*), *Genista* gr. *acanthoclada*, *Anthyllis barba-jovis*, or *Astragalus* gr. *massiliensis*. Narrow crevices serve as micro-habitats for a large number of endemic species (*Bellium* sp., *Silene* gr. *mollissima*, *Limonium* sp.).

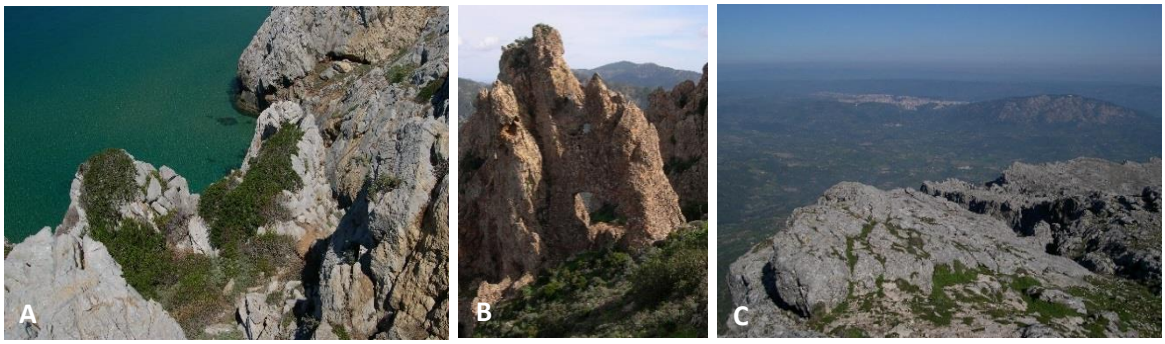


Figure 14. Diversity of Mediterranean vegetation growing on cliffs and rocks: coastal habitats (A), siliceous rocks (B), inland limestones (C) (Photos: G. Bacchetta).

1.3 Criteria for the selection of the species included in this manual

It is important for environmental restoration that measures are implemented with the aim of encouraging the development of natural vegetation through the planting of species ecologically suited to start the natural dynamics, which can lead to the formation of communities stabilized, well-structured and floristically adapted to the environmental context. The rule that must always be observed is the one that requires to select only species ecologically and genetically compatible with the site of introduction. This is important because these species can find favorable conditions to grow and establish itself permanently, without causing damage due to hybridizations or genetic pollution.

In this chapter, we introduce the criteria used to select the species included in this manual within the context of the ECOPLANTMED project**.** This set of criteria was selected after several discussions and consensuses, and is based in diverse scientific literature on ecological restoration and the practical experience of the diverse partners. For the scope of the ECOPLANTMED project, criteria were exclusive, thus a plant species were selected if met all the criteria exposed in table 1. The criteria for species selection for ecological restoration in the Mediterranean area are detailed in the *Guide of Good Restoration Practices for Mediterranean Habitats* also edited by the ECOPLANTMED project.

CRITERIA	Characteristics that a species must meet to be included in this manual
1	**Woody and perennial herbaceous species.** Woody species (mainly half-shrubs and shrubs; very few trees - biological forms: phanerophyte, nanophanerophyte or chamaephyte) fit better with the aims of the project because, being perennial, are able to colonize degraded and stressed environments. Where necessary, it is also possible to select herbaceous rhizomatous perennial species, if they are capable of forming mass and therefore can contribute to habitat restoration.
2	**Species from habitats chosen on the base of the Corine biotopes habitat classification[8] or on the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora[9]**. Corine classification is more general and based on the physiognomy of the habitats, while the classification in the Directive "Habitats" is based on a phytosociological definition of vegetation; it is possible to select the classification according to the type and degree of knowledge of the habitat and the species. The selected habitats were ordered according to the classification proposed by the Steering Committee, in the following four major groups: forest, heats, shrubs and grasslands, freshwater and coastal.
3	**Species of structural importance for the habitat**; also the species important from the point of

[8]http://www.eea.europa.eu/data-and-maps/data/corine-biotopes
[9]http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31992L0043

	view of the functionality have to be considered.
4	**Species for which we can collect large quantities of seeds, that are easy to work with during cleaning and testing, suitable for reproduction in nurseries.**
5	**Species selected for their importance from a local point of view** or, just for the scope of ECOPLANTMED project, on the basis of a common scientific interest among the diverse partners.
6	**Species for which there is no published scientific protocol.** The ideal is to work with completely new species, in the sense that the data of germination should not be published in scientific journals that have undergone a scientific review. In order to meet the need to have a good number of species, we propose that in the case of already published data, we can adopt a biogeographic criterion structured on three levels: • **First level**: to divide the European continental area from the Circum-Mediterranean (e.g., *Gentiana lutea*, data are available for the European area, but not for the Mediterranean - for us it is a suitable species). • **Second level**: we divide the Mediterranean area into two areas: the Western Mediterranean and the Eastern Mediterranean (e.g., *Poterium spinosum*, data are available for the eastern area but not the western one - for us it is a suitable species). • **Third level**: we divide each Mediterranean subareas into three regions: ➢ Western Mediterranean: Iberian Peninsula, North Africa, Tyrrhenian Region. ➢ Eastern Mediterranean: Balkan Peninsula, island systems, Near East. ➢ (E.g. *Helianthemum caput-felis*, data are available for the Iberian Peninsula, but not for the Tyrrhenian region - for us it is a suitable species).

Table 1. Set of common criteria for selecting the target species included in this Manual. Output of the Work Package 4, action 4.1 in the ENPI-ECOPLANTMED project.

1.4 Legislation for native plants

Several international conventions and regulations emphasize the importance of biodiversity conservation, as for example the genetic diversity that plays a critical role in the ability of resources to adapt to environmental changes and in their resistance to pests, diseases and other stresses. When planning any work on habitat restoration, the use of plant materials from a known (local) origin, with a rich genetic diversity, and good quality, guarantees the execution of a good practice of habitat restoration, and guidance for this can be found in the *Guide of Good Restoration Practices for Mediterranean Habitats* edited by the ECOPLANTMED project. However, in order to conduct an optimal project of this kind, the propagation of the plant species that will be introduced is crucial. This chapter guides the reader in the international, national and local legal regulations that control the following topics[a]: 1) the collection of native plants, 2) the production and trade of native plants, and 3) the production and trade of exotic plants. In addition, it exposes regulations on 4) quality analysis and certificates for seeds and other germplasm, as well as their correct 5) storage and conservation, and 6) germination/multiplication. This chapter is focused on the legal aspects. Good practices and technical recommendations for all these topics will be explained in the following chapters of this manual.

1.4.1 International legal frame

When talking about the regulatory frame related to the propagation of native plant species, it is important to differentiate between: “the things that are mandatory to be done and can be subjected to penalties if they are not done” (i.e. laws), and “the correct (ethical, scientific) things to do” (i.e. Suggestions / Recommendations / Plans / Strategies, which we will call SRPS). This chapter introduce mostly laws, but it also highlights important international SRPS which most of the laws are built (or are being built) from. The following table summarizes the main international (global or European) laws and SRPS that regulate the six topics introduced above.

International regulations, conventions and SRPS	Description/contents	Topics[a]	Tools
(G) CITES, 1973[10]	International trade of endangered species threatened by extinction.	1, 2, 3	Four dossiers reporting the species subjected to international regulations in their commercial activity.
(G) Barcelona Convention, 1976[11]	Convention for the protection of the marine environment and the coastal region of the Mediterranean. There are 22 contracting parties determined to protect the Mediterranean marine and coastal environment, while boosting regional and national plans to achieve sustainable development.	1	Annex II: Endangered or threatened species that the parties shall manage with the aim of maintaining them in a favorable state of conservation. They shall ensure their maximum possible protection and recovery.
(E) Bern Convention, 1979[12]	Protection of wildlife and the wild environment of Europe	1, 2	Dossier I indexes the wild floral species that are under rigorous protection, for whom the gathering, collection, cutting or the intentional uprooting is banned (exceptions and derogations in article 5).
(G) Convention on Biological Diversity, 1992[13]	Biodiversity conservation. Definition of the guidelines to elaborate common strategies towards the safeguard of animal and plant species as well as habitats.	1, 2, 3, 4, 5, 6	- Global Strategy for plant conservation[14] - European Strategy for plant conservation[15] - Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization[16]. - Aichi Biodiversity Targets[17]

[10]www.cites.org
[11]http://eunis.eea.europa.eu/references/1818/species
[12]http://www.coe.int/t/dg4/cultureheritage/nature/bern/default_en.asp
[13]http://www.cbd.int/
[14]http://www.cbd.int/gspc/
[15]http://www.plants2020.net/regional-strategies/
[16]https://www.cbd.int/abs/about/default.shtml
[17]https://www.cbd.int/sp/targets/

(G) IUCN-Red Lists[18]	The IUCN Species Programme working with the IUCN Species Survival Commission has been assessing the conservation status of species, subspecies, varieties, and even selected subpopulations on a global scale for the past 50 years in order to highlight *taxa* threatened with extinction, and therefore promote their conservation.	1	The IUCN Red List of Threatened Species™ is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. It plays an increasingly prominent role in guiding conservation activities of governments, NGOs and scientific institutions.
(E) Regulation 1143/2014 on Invasive Alien Species[19]	Establishes rules to prevent, minimize, and mitigate the negative effects of the introduction and spread, deliberate and accidental, of invasive alien species on biodiversity and related ecosystem services, and on other areas of economic and social importance.	3	The European Commission has opened a growing list of invasive alien species of concern, which is periodically updated and revised. The species mentioned in the list shall not be intentionally introduced into the EU, nor can they be kept, bred, transported to, from or within the Union, marketed, cultivated or released into the environment.
(E) Directive 92/43/EEC[20]	Conservation of natural and semi-natural habitats, wild flora and fauna. Principal instrument for the protection of species of community interest.	1, 2	Appendix B for "plant species of community interest for whom conservation needs the designation of Special Zones of Conservation". Appendix D for "plant species of community interest which require rigorous protection", and Appendix E for "plant species of community species whose removal from nature and whose exploitation can be subject to regulations".

[18]http://www.iucnredlist.org/
[19]http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1417443504720&uri=CELEX:32014R1143
[20]http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

(E) Directive 99/105/EC[21]	Ensure that forest reproductive material supplied for any site within the EU is suitable for that site's geographic location.	1, 2, 4, 5, 6	Each Member State holds a national register to control the material that may be marketed. An EU list is drawn up based on the national lists. Annexes II, III, IV and V lay down the minimum requirements for the approval of the basic material intended for the production of reproductive material to be certified as "source-identified", "selected", "qualified" and "tested" respectively. Annex VI specifies the categories under which reproductive material from the different types of basic material may be marketed.
(E) Forest Europe – Strasbourg[22]	Conservation of European forests, and development of a collective decision-making at a Pan-European level.		Resolution 2 regarding the conservation of forest genetic resources, commits the Signatory States to implement in their own countries a policy for the conservation of forest genetic resources, using whatever methods seem most appropriate

Table 2. Summary of the main international regulations, conventions and SRPS that regulate the six topics related to the propagation of Mediterranean native plant speciesa. (G) indicates that the ambit of application is global or involves countries from diverse continents, (E) indicates that the ambit of application is just the European Union.

In conclusion, the current principal international regulations protect native plant species within specific habitats, control the collection of wild species that are under rigorous protection and the import/export of native (endangered) and exotic plant species, and obligate the certification of quality and origin of forest reproductive material within Europe. Certification of quality and origin of wild (non-forest) reproductive material are not currently regulated by international rules and conventions.

[21]http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:011:0017:0040:EN:PDF
[22] http://www.foresteurope.org/ministerial_conferences/strasbourg1993

1.4.2 National-Regional-Local legal frames

A large number of national, regional and local regulations are usually the incorporation of the international SRPS or normative into the legal frame of each country. Most Mediterranean countries of the EU have already assimilated most SRPS and normative exposed in table 1, although there are some exceptions. The situation of other Mediterranean countries outside of the EU will also be exposed, particularly for the cases of Tunisia and Lebanon.

Greece - Greece has ratified the Bern Convention (Law 1335/1983[23]), the CITES Convention (Law 2055/1992[24]), and the Convention on Biological Diversity (Law 2204/1994[25]). The trade of CITES and other endangered non-CITES species is regulated by Common Ministerial Decision 125188/246[26].

Habitat Directive 92/43/CEE was incorporated in the national law through Common Ministerial Decisions 33318/3028/11-12-1998[27] and Η.Π. 14849/853/E103/4-4-2008[28]. Article 12 of the former Decision, as amended by Article 2, Paragraph 5 of the latter, prohibits the collection of plant species of Community interest that require strict protection (Annex IV in Article 6b of the latter). Directive 1999/105/EC was incorporated in the national law through the Presidential Decree 17/2003[29] and sets the conditions for germplasm collection, production and marketing of forest reproductive material, though referring only to forest tree species.

Two very important Decrees for the protection of the wild flora and the plant genetic resources of Greece were issued in 1981 and 1990, respectively. Presidential Decree 67/1981[30] for the protection of the wild fauna and flora of Greece declares a list of plant species (about 860 taxa) as protected and prohibits any collection or other use of these species with exceptions for scientific research. Presidential Decree 80/1990[31] for the protection of the country's plant genetic resources states that a permit is required for the collection or trade of aromatic and medicinal, ornamental and other useful plants, and wild relatives of cultivated plants. The permit may or may not be granted depending on the purpose of the collection or trade, and the rarity and importance of the plant. In the more recent law for the conservation of biodiversity (Law 3937/2011[32]),

[23] Νόμος 1335/1983 (ΦΕΚ 32/Α/14-03-1983) «Κύρωση Διεθνούς Σύμβασης για τη διατήρηση της άγριας ζωής και του φυσικού περιβάλλοντος της Ευρώπης»
[24] Νόμος 2055/1992 (ΦΕΚ 105/Α/30-6-92) «Κύρωση Σύμβασης διεθνούς εμπορίας ειδών της άγριας πανίδας και χλωρίδας που κινδυνεύουν να εξαφανιστούν με τα Παραρτήματα Ι και ΙΙ αυτής»
[25] Νόμος 2204/1994 (ΦΕΚ 59/Α/15-04-1994) «Κύρωση Σύμβασης για τη βιολογική ποικιλότητα.»
[26] Κοινή Υπουργική Απόφαση 125188/246/22-01-2013 (ΦΕΚ 285/Β/13-02-2013) «Εμπορία των ειδών της άγριας πανίδας και της αυτοφυούς χλωρίδας»
[27] Κοινή Υπουργική Απόφαση 33318/3028/11-12-1998 (ΦΕΚ 1289/Β/28-12-98) «Καθορισμός μέτρων και διαδικασιών για τη διατήρηση των φυσικών οικοτόπων (ενδιαιτημάτων) καθώς και της άγριας πανίδας και χλωρίδας»
[28] Κοινή Υπουργική Απόφαση Η.Π. 14849/853/Ε103/4-4-2008 (ΦΕΚ 645/Β/11-4-08) «Τροποποίηση των υπ' αριθμ. 33318/3028/1998 κοινών υπουργικών αποφάσεων (Β΄1289) και υπ' αριθμ. 29459/1510/2005 κοινών υπουργικών αποφάσεων (Β΄992), σε συμμόρφωση με διατάξεις της οδηγίας 2006/105 του Συμβουλίου της 20ης Νοεμβρίου 2006 της Ευρωπαϊκής Ένωσης.»
[29] Προεδρικό Διάταγμα 17/2003 (ΦΕΚ 14/Α/27-01-2003) «Δασικό πολλαπλασιαστικό υλικό, σε συμμόρφωση προς την οδηγία 1999/105/Ε.Κ.»
[30] Προεδρικό Διάταγμα. 67/81 (ΦΕΚ 23/Α/30-01-1981) «Περί Προστασίας της αυτοφυούς Χλωρίδος και Άγριας Πανίδος και καθορισμού διαδικασίας συντονισμού και Ελέγχου της Ερεύνης επ' αυτών.»
[31] Προεδρικό Διάταγμα 80/1990 (ΦΕΚ 40/Α/22-03-1990) «περί προστασίας του φυτικού γενετικού υλικού της χώρας»
[32] Νόμος 3937/2011 (ΦΕΚ 60/Α/31-03-2011) «Διατήρηση της Βιοποικιλότητας και άλλες διατάξεις.»

Article 11 prohibits the collection of endemic plants with the exception of some species that are important for local production and consumption unless there are other specific national and EU regulations, and action plans for these species. Permits may be given upon request for research purposes. Finally, the national forest legislation has several regulations for the protection of native flora, and Forest Directorates may issue specific regulations for the collection and trade of wild plant species at local level.

For the propagating material of native plants not regulated by all the above, the organisation of production and trade are specified, as for cultivated plants, in Law 1564/1985[33] as amended by Law 2325/1995[34] and Ministerial Decision 290235/17-5-1988[35], and in the "Technical Regulations for the Control, Certification, and Marketing of Propagating Material of Cultivated Plant Species". Examples of technical regulations related to native plants include regulations incorporating EU directives for aromatic and medicinal plants (Ministerial Decision 7594/115508/12-9-2014 [36]), ornamental plants (Common Ministerial Decisions 436691/27-12-1994[37], 387966/7-12-1999[38], and 378556/4-7-2000[39]), and fodder plant seed mixtures (Common Ministerial Decision 184167/14488/27-12-2011[40]).

More information about Greek legislation is available in the Greek versions of the websites of the Ministry of Reconstruction of Production, Environment and Energy (http://www.minagric.gr/, and http://www.ypeka.gr/). For collection of native species it is advisable that the Ministry is contacted for information on the protected status of the species and any required permits.

Italy **-** In the case of Italy, CITES was ratified by the Law 874/1975[41], the Bern Convention and the plants protected in their annexes were ratified by the Law 503/1981[42], while CBD by the Law 124/1994[43]. The incorporation of the Directive "Habitat" 92/43/EEC into the Italian laws was realized by the Decree of the

[33] Νόμος 1564/1985 (ΦΕΚ 164/Α/26-09-1985) «Οργάνωση παραγωγής και εμπορίας πολλαπλασιαστικού υλικού φυτικών ειδών.»
[34] Νόμος 2325/1995 (ΦΕΚ 153/Α/27-07-1995) «Τροποποίηση διατάξεων του ν. 1564/1985 και άλλες διατάξεις.»
[35] Υπουργική Απόφαση 290235/17-5-1988 (ΦΕΚ 399/Β/15-06-1988) «Παραγωγή και εμπορία πολλαπλασιαστικού υλικού.»
[36] Υπουργική Απόφαση 7594/115508/12-9-2014 (ΦΕΚ 2663/Β/08-10-2014) «Τεχνικός Κανονισμός Εμπορίας Πολλαπλασιαστικού Υλικού Αρωματικών και Φαρμακευτικών Φυτών.»
[37] Κοινή Υπουργική Απόφαση 436691/27-12-1994 (ΦΕΚ 16/Β/16-01-1995) «Τεχνικός Κανονισμός εμπορίας του υλικού πολλαπλασιασμού των καλλωπιστικών φυτών και των καλλωπιστικών φυτών, σε συμμόρφωση προς τις οδηγίες 91/682/ΕΟΚ του Συμβουλίου ΚΑΙ 93/49/ΕΟΚ, 93/63/ΕΟΚ και 93/78/ΕΟΚ της Επιτροπής.»
[38] Κοινή Υπουργική Απόφαση 387966/7-12-1999 (ΦΕΚ 2246/Β/30-12-1999) «Τεχνικός Κανονισμός Εμπορίας πολλαπλασιαστικού υλικού καλλωπιστικών φυτών, σε συμμόρφωση προς την οδηγία 98/56/ΕΚ/ του Συμβουλίου.»
[39] Κοινή Υπουργική Απόφαση 378556/4-7-2000 (ΦΕΚ 931/Β/27-07-2000) «Τεχνικός Κανονισμός Εμπορίας Πολλαπλασιαστικού Υλικού Καλλωπιστικών Φυτών, σε συμμόρφωση προς τις Οδηγίες της Επιτροπής 1999/66/ΕΚ, 1999/67/ΕΚ, 1999/68/ΕΚ, 1999/69/ΕΚ.»
[40] Κοινή Υπουργική Απόφαση 184167/14488/27-12-2011 (ΦΕΚ 3261/Β/30-12-2011) «Μέτρα για την κατά παρέκκλιση εμπορία μειγμάτων σπόρων κτηνοτροφικών φυτών που χρησιμοποιούνται για τη διαφύλαξη του φυσικού περιβάλλοντος, σε συμμόρφωση προς την Οδηγία 2010/60/ΕΕ της Επιτροπής της 30ης Αυγούστου 2010 (L.228).»
[41]Legge 19 dicembre 1975, n. 874. Ratifica ed esecuzione della convenzione sul commercio internazionale delle specie animali e vegetali in via di estinzione, firmata a Washington il 3 marzo 1973.
[42]Legge 5 agosto 1981, n. 503. Ratifica ed esecuzione della convenzione relativa alla conservazione della vita selvatica e dell'ambiente naturale in Europa, con allegati, adottata a Berna il 19 settembre 1979.
[43]Legge 14 febbraio 1994, n. 124. Ratifica ed esecuzione della convenzione sulla biodiversità, con annessi, fatta a Rio de Janeiro il 5 giugno 1992.

President of the Republic 357/1997 (modified by the Decree of the President of the Republic 120/2003)[44]. Article 9 refers to the protection of the plant species with regards to their collection, transport, production, and trade. In this regulation, native plants collection is regulated for all habitats within the Natura 2000 net. In addition, native plants collection is regulated in Italy through the specific regulations of the other protected natural areas, including National and Regional Parks, Natural Monuments, and Protected Marine Areas[45]. Furthermore, nearly all Regions and Autonomous Provinces have specific provisions in situ and most of these have compiled a list of protected species. Some provinces have enacted regulations for the protection of wild flora. One region has legislation for the safeguard of flora, but does not have a list of species (Marche). Some regions (Apulia, Sardinia, Sicily) have no legislation in place[46]. Attending to these ratifications and regional regulations, lists of protected species in Italy can be found for example in: CITES Italy[47] and CITES Sardinia[48], the Directory of protected flora of the Ministry of the Environment and the Protection of the Territory (Ministero dell'Ambiente e della Tutela del Territorio e del Mare)[49], and the Red list of the Italian Flora[50].

The Decree 386/2003[51], implementing the Directive 99/105/EC, is currently the only legal reference that regulates "the production, storage, trade and distribution of any kind of forest material for propagation" (topics 1, 2). At a regional level, there are diverse degrees of commitment depending on the region. In the particular case of Sardinia, the regional resolution 502/2014[52] has established the "Regional Register of basic materials". This Register intends to contain information about each population classified for the collection of forest reproductive material and improves the protection of biodiversity of the forests of Sardinia and the knowledge of the sites where you can collect seeds and fruits for the species of interest for forestry plantation.

Regarding the certification of origin and quality of the forest material for propagation (topics 4, 5, 6), Italy also has the Ministerial Decree of 1992[53], called the "Official methods for analysis of seeds". This legal regulation constitutes the way by which someone in Italy can determine seed quality of herbaceous, shrubby, arboreus, floricultural and medicinal plant species, whether cultivated or not. They are of particular importance in the commerce of seeds where the price is linked to quality. The dossier of the decree

[44]Decreto del Presidente della Repubblica (D.P.R.) 8 settembre 1997, n.357 Regolamento recante attuazione della direttiva 92/43/CEE relativa alla conservazione degli habitat naturali e seminaturali, nonché della flora e della fauna selvatiche. (Testo aggiornato e coordinato al D.P.R. 12 marzo 2003 n. 120)
[45]http://www.parks.it/Eindex.php
[46]Bacchetta G, Fenu G, Mattana E, Piotto B, Virevaire M (Eds). 2006. Manuale per la raccolta, studio, conservazione e gestione ex situ del germoplasma. Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici (APAT), Rome.
[47] http://www.minambiente.it/pagina/cites-convenzione-di-washington-sul-commercio-internazionale-delle-specie-di-fauna-e-flora
[48]http://www.sardegnaambiente.it/documenti/19_425_20131113141415.pdf
[49]http://www.minambiente.it/pagina/repertorio-della-flora-italiana-protetta
[50]http://www.minambiente.it/sites/default/files/archivio/biblioteca/protezione_natura/lista_rossa_flora_italiana_policy_species.pdf
[51] Decreto Legislativo 10 novembre 2003, n. 386. Attuazione della direttiva 1999/105/CE relativa alla commercializzazione dei materiali forestali di moltiplicazione
[52]Determinazione n. 502 del 20 marzo 2014 Attuazione art. 10 del D.Lgs. n. 386/2003: istituzione del registro regionale dei materiali di base della Regione Sardegna.
[53]Decreto Ministeriale 22 dicembre 1992.Metodi ufficiali di analisi per le sementi.

illustrates in detail the methods for sampling, analysis for purity, germination tests, the determination of seed viability with biochemical tests, the calculation of seed humidity, determination of weight of a 1,000 seeds, and various other tests.

Production and trade of exotic species in Italy are somehow regulated by the Decree 214/2005[54]. This law prohibits the production or import of any "harmful organism", including "any species, strain or biotype of plant injurious to plants or plant products".

Complementary to the laws that enforce forest materials for propagation, Italy is elaborating a "national plan on biodiversity", which has not been approved yet, but aims to regulate the production, storage, trade, distribution, and the use of any kind of material for propagation and conservation of all the genetic diversity of wild and domesticated life in Italy. There was a work completed by the commission in 1997[55], which resulted in 2010 in a "national strategy for the biodiversity", with diverse targets for 2020. However, this strategy is almost disregarded, as still requires that Italy as a nation define the strategy, and then the regions, which have direct competence in environmental matters, adopt it and implement it at the regional level.

Lebanon - Lebanon signed on February 2012, one International protocol; the Nagoya Protocol[56] on the "Access to genetic resources and the fair and equitable sharing of benefits arising from their utilization". A draft law to ratify this protocol was prepared in the ministry of environment[57].

In terms of forest seed collection, propagation, storage, etc. (topics 1, 2, 4, 5, 6) there is not a national seed policy to guide the development of seed industry. However, in various research development institutions and in the private sector, the organization of seed production and supply is established on the ad hoc basis[58].

For native species, just two ministerial decisions have been established. The decision 38/1[59] dated on 7 April 1982 bans the export of all trees products whether forest or fresh water trees and of charcoal of Lebanese origin (topic 2). The decision Nbr 108/1edar 5 interdicts the import of any cestablished on September 199[60] seeds, seedlings and plants. This decision intends to prevent the genetic pollution of *Cedrus libani* (topics 2, 3).

Seeds for agricultural purposes have received the bigger attention in Lebanon in term of laws, although the species regulated are outside the scope of this Manual. For example, the decree N.143[61] , regulates seeds

[54] Decreto Legislativo 19 agosto 2005, n. 214. Attuazione della direttiva 2002/89/CE concernente le misure di protezione contro l'introduzione e la diffusione nella Comunità di organismi nocivi ai vegetali o ai prodotti vegetali.
[55] http://www.parks.it/federparchi/biodiversita/
[56] https://www.cbd.int/abs/nagoya-protocol/signatories/
[57] http://www.undp.org.lb/communication/publications/downloads/TNA_Book.pdf
[58] http://www.fao.org/docrep/012/al310e/al310e03.pdf
[59] قرار رقم ١/٣٨ منع تصدير جميع منتوجات الأشجار الحرجية والمائية والفحم ذات المنشأ اللبناني
[60] قرار ١/١٠٨، الصادر بتاريخ ١٩٩٥/٩/١٢، منع إستيراد وإدخال بذور وشتول الأرز على انواعها إلى لبنان، وزارة الزراعة.
[61] المرسوم الاشتراعي رقم ١٤٣، الصادر بتاريخ١٩٥٩/٦/١٢، صلاحيات و نظام مكتب القمح، وزارة الإقتصاد والتجارة.

of sugar beets and cereals (wheat, barley and maize), the Decision 781/1[62] regulates the import of seeds for planting except for potato seeds, and the Decision 986/1[63] that exclusively regulates potato seeds.

Regarding the certification of origin and quality, Sanitary and Phyto-sanitary Measures Law 778[64], issued on 28 of November 2006 intend to prevent the entrance of plant materials which could carry diseases or problems related to the safety of plants. In addition, the article 14 of this Law prohibited the entrance of genetically modified seeds to Lebanon.

Nowadays, the Ministries are more aware about the importance of developing a policy to regulate and protect the Lebanese native seed/seedling. Thus, a draft law regulating access to Lebanon genetic resources was prepared but not endorsed yet.

Spain **-** In Spain, the Law 42/2007 of natural heritage and biodiversity[65] is the current law in force establishing the basic legal framework for the conservation, sustainable use, improvement and restoration of Spanish natural heritage and biodiversity. This law abrogated the Law 4/1989, which consolidated the process initiated in the early eighties of the last century through the ratification of multilateral conventions such as CITES, Bern and Barcelona Convention, and because of the incorporation of the acquis communautaire by reason of the entry of Spain into the European Community on January 1, 1986. Equally, it involves the rules and recommendations developed over the past years by international agencies and environmental regimes such as the Council of Europe and the Convention on Biological Diversity, and also has been complemented by the incorporation of the Habitat Directive 92/43/EEC. The Spanish law states the prohibition for collection, tenancy, trade and exchange of certain native species (topics 1, 2): these ones are included in the list of species under special protection (further developed in Royal Decree 139/2011[66]), which hosts the Spanish catalogue of threatened species, with different limitations depending on the category (vulnerable, threatened with extinction, etc.). The different regions of Spain may establish their own catalogues and additional provisions, provided they do not contradict the Spanish norm. In the Valencian region the Decree 70/2009[67] (further amended by the Order 6/2013[68]), establishes the list of protected flora species and the Valencian catalogue of threatened flora species, stating the general avoidance for the collection, cutting, trade and other activities (topics 1, 2).

Perhaps, the only regulations in a more strict sense, not only through the avoidance of certain activities, but by setting up the conditions for collection, production and marketing (in a wide sense) (topics 1, 2), regarding origin and quality of the reproductive materials (topic 4), are the Spanish Royal Decree 289/2003[69] and the

[62] قرار ١/٧٨١، الصادر بتاريخ ٢٠١١/٨/٢٦، إستيراد البذورالمخصصة للزرع ما عدا البطاطا، وزارة الزراعة.
[63] قرار ١/٩٨٦، تحديد شروط إستيراد بذارالبطاطا لموسم ٢٠١٣-٢٠١٤، وزارة الزراعة.
[64] قانون رقم ٧٧٨، الصادر بتاريخ ٢٠٠٦/١١/٢٨، الحجر النباتي وتدابير الصحة النباتية، مجلس النواب.
[65] Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad.
[66] Real Decreto 139/2011, de 4 de febrero, para el desarrollo del Listado de Especies Silvestres en Régimen de Protección Especial y del Catálogo Español de Especies Amenazadas.
[67] Decreto 70/2009, de 22 de mayo, del Consell, por el que se crea y regula el Catálogo Valenciano de Especies de Flora Amenazadas y se regulan medidas adicionales de conservación.
[68] Orden 6/2013, de 25 de marzo, de la Conselleria de Infraestructuras, Territorio y Medio Ambiente, por la que se modifican los listados valencianos de especies protegidas de flora y fauna.
[69] Real Decreto 289/2003, de 7 de marzo, sobre comercialización de los materiales forestales de reproducción

Valencian Decree 15/2006[70]. Both regulations aimed at forest species widely used for restoration purposes implemented the Directive 99/105/EC. There are not regulations establishing official methods, nor for forest species neither other native species, for germination, multiplying or storage of reproductive materials (topics 5, 6), other than those explained above within topic 4.

The Law 42/2007 also prohibits, in a generic way, the collection in the "Natural Reserves" (topic 1), which are a kind of Protected Area considered especially valuable. But the different regions of Spain should establish the scope and limitations in their legislations for their protected areas. In this sense, in the Valencian Region, the current general regulation is Law 11/1994[71], which states the prohibition to alter the conditions of the protected area through several activities, among them, the collection of materials (topic 1). Other activities may be regulated by specific planning instruments.

Collection, production and trade of exotic invasive species (topic 3) are regulated by Royal Decree 630/2013[72], statewide, and the Valencian Region Decree 213/2009[73], both developing national and regional catalogues. The species listed in the catalogues as quarantine organisms are governed by other regulations related to plant health, being Law 43/2002[74], the main Spain - statewide instrument, which implements, among others, the European Directive 2002/89/EEC.

Tunisia **-** Tunisia has signed the Nagoya Protocol of the CDB on May 2011 that was developed to advance "the objective of the convention on the fair and equitable sharing of benefits arising from the utilization of genetic resources by providing greater legal certainty and transparency for both providers and users of genetic resources".

The Law 88-20[75], as modified by the Law 2005-13[76], relating to revision of recasting the Forest Code, is the ratification of the international conventions made by Tunisia (e.g. CITES, Barcelona Convention). This law includes the set of special rules applicable to forests, esparto surfaces, pasture land, forest-occupied land, national parks and reserves, wild fauna and flora, in an effort to ensure their protection, conservation and rational exploitation as well as to guarantee that the users legally exercise their rights (topics 1, 2). The law says that "the species of wild fauna and flora and products thereof protected by the international conventions ratified by Tunisia may only be purchased, imported, offered for sale, exported or owned in accordance with the provisions set forth by those conventions". It is prohibited to destroy rare or critically endangered plant species, to cut, mutilate, pull up, pick, remove, load, transport, give away, offer for sale or buy rare or endangered plant species. The same prohibition applies to the fruit of such species, whether whole or in

[70]Decreto 15/2006, de 20 de enero, del Consell de la Generalitat, por el que se regula la producción, comercialización y utilización de los materiales forestales de reproducción.
[71]Ley 11/1994, de 27 de diciembre, de Espacios Naturales Protegidos de la Comunidad Valenciana
[72]Real Decreto 630/2013, de 2 de agosto, por el que se regula el Catálogo español de especies exóticas invasoras.
[73] Decreto 2013/2009, de 20 de noviembre, del Consell, por el que se aprueban medidas para el control de especies exóticas invasoras en la Comunitat Valenciana.
[74]Ley 43/2002, de 20 de noviembre, de sanidadvegetal.
[75]La loi n° 88-20 du 13 Avril 1988 portant promulgation du code forestier.
[76]La loi n° 88-20 du 13 Avril 1988 modifiée et complétée par les textes subséquents et notamment la loi n° 2005-13 du 26 Janvier 2005.

pieces. Criminal proceedings will be initiated against those infringing these provisions, and specimens of plant species held illegally may be confiscated.

In addition, the order of the Minister of Agriculture and Water Resources of 19 July 2006[77] establishes the list of the rare and critically endangered species of fauna and flora that implements the CITES by regulating trade in certain plant species that are or may be threatened by trade.

In Tunisia, there is the Law 99-42[78] on seed, seedlings and new plant varieties which lays down the conditions for the production, propagation, import, marketing and the protection of the relevant rights of all seed, seedlings and new plant varieties used in the production of plants (topics 4, 5, 6). Article 12 specifies that "seeds and seedlings marketed shall meet the general standards of storage, packaging and labelling, which shall be fixed by decree". Article 8 of this law also establishes the procedures for the control and the production of seed and seedlings against the diseases and insects. The nurseries and production and propagation fields shall also be subject to supervision by the competent authority to ensure that they are unharmed by quarantine organisms and all other plant diseases, and to guarantee the purity and originality of the variety. In addition, the minister in charge of agriculture may, by decree and whenever needs dictate, prescribe special methods for the production of certain seeds and seedlings, according to their nature and the degree to which they are affected by their production environment. The rules for the inspection of seed and seedlings are specified in articles 13 and 14.

In chapter four of the ministerial order for agriculture of 24 June 200079, a list of genera and species eligible for protection was established as well as the time limit for filling applications for protection and the required quantities of propagating material. E.g. *Phoenix dactylifera* has a period of protection of 30 years and the quantity of production or propagation material to be supplied is five young plants.

Tunisia has currently comprehensive legislation that should allow the rational exploitation of biological resources and contribute to the conservation of biodiversity. Such measures are constantly reviewed and updated, supplemented and/or enhanced by new provisions for the sustainable management of natural resources and biodiversity. In addition, the following measures have enhanced:

• Decree No. 1748 of 11 August 2003[80] establishing the National Gene Bank, which its mission is to assess, preserve and assign values to local genetic resources.

• Decree No. 2005-1747 of 13 June 200581 establishing a national council to combat desertification, pursuant to the provisions of the UNCCD.

• Decree No. 2006-1431 of 22 May 2006[82] establishing the Regional Centre of Research on Oasis Agriculture, its organization and manner of operations.

[77]Arrêté du ministre de l'agriculture et des ressources hydrauliques du 19 Juillet 2006 fixant la liste des espèces de la faune et de la flore sauvages rares et menacées d'extinction.
78Loi n° 99-42 du 10 mai 1999, relative aux semences, plants et obtentions végétales.
79Arrêté du ministre de l'agriculture du 24 juin 2000, fixant la liste des plantes susceptibles d'être protégées, les données et la méthode d'inscription des demandes et des certificats d'obtentions végétales sur le catalogue national des obtentions végétales.
80Décret n° 2003-1748 du 11 Août 2003, relatif à la création d'une banque nationale de gènes.
[81]Vu le décret n° 2005-1747 du 13 juin 2005, portant création du conseil national de lutte contre la désertification.
82Décret n° 2006-1431 du 22 Mai 2006, portant création du centre régional des recherches en agriculture oasienne et fixant son organisation et les modalités de son fonctionnement.

1.5 Seeds management

The identification of the target species to sample is based on biological and technical criteria for ecological restoration in the Mediterranean Region that are detailed along the *Guide of Good Restoration Practices for Mediterranean Habitats* edited by the ECOPLANTMED project. Once the species have been selected, they need to be propagated. Because it is easier to capture and preserve a large genetic diversity with seeds than with vegetative propagation, it will be preferable that propagation is performed from seeds (see chapter 1.6). The availability of seeds for habitat restoration is often regulated by international and/or local laws (see chapter 1.4), and in some cases, clean seeds of high quality for plant production will (or can) be distributed by authorized entities [e.g. the "Corpo Forestale dello Stato" of Italy distributes in some Regions seeds for forest restoration works, the BG-SAR (Sardinian Germplasm Bank) of CCB (Centre for the Conservation of Biodiversity) in Sardinia is the only official institution authorized to collect and store germplasm from the species included in the Habitat Directive 92/43/EEC by the national ministry of protection of the environment[83]]. When there are not strict regulations, and the plant producers prefer to collect and manage its own seed stock, it is mandatory to follow the good practices detailed along this chapter.

1.5.1 Collection

Seeds harvest is the first step in producing a high-quality seed lot. The time of collection is important because only when seeds are mature they reach their maximum viability and vigour. The plants must have ripe fruits (with mature seeds), preferably still attached to the parent plant itself and ready for dispersal, and not physically damaged or eaten by predators (e.g. Fig. 15).

Figure 15. Mature fleshy fruits of *Ribes multiflorum* subsp. *sandalioticum* and *Taxus baccata*, and mature dry fruits of *Ptilostemon casabonae* and *Thapsia garganica* (Photos: M. Porceddu, G. Bacchetta).

To conduct an optimal collection, the collectors must:

1) Evaluate the information on the environmental characteristics of the collection area, distribution of the target species, and timing of their phenological phases.

2) Collect from indigenous, wild and self-sown populations, and not from plants planted or originating from cultivation.

[83] Ministero dell' Ambiente e della Tutela del Territorio N° DMP-5D-2005-2 6104, 17.10.2005

Whenever possible, not less than ten populations should be sampled for a homogenous ecogeographical area.

3) If doable, sample about 50% of the individuals in every population, but do not collect more than 20% of seeds available on the day of the fieldwork to avoid over collection and negative impacts on the natural population.

4) Sample randomly, but keep collection from metapopulations separated if the habitat is distinctly heterogenous.

5) Sample seeds or vegetative material in sufficient quantities to ascertain satisfactory representation. E.g., at least 10,000 to 20,000 seeds per population should be collected, for species with conservation interests, although in the case of small population, the number of seeds to be collected can be reduced.

6) Randomise the collection and indicate on the collection field maps/schedule the methodology followed (central collection, diagonal line, marginal collection, etc.).

7) In the case of fleshy fruits (e.g. *Arbutus unedo*, *Prunus spinosa*, *Vitis sylvestris*), collect the seeds with the fruit that contains them in order to avoid interrupting the physiological maturation of seeds. Fleshy fruits must be immediately stored in bags with adequate aeration.

Seed collection foresees the acquisition of information and data. In addition, the initial seed quality must be assessed to avoid collecting seeds that are empty, malformed, or damaged. More information of procedures for collection and seed quality analysis can be found, for example, in the standards produced by the International Seed Testing Association-ISTA (www.seedtest.org), in technical publications and specialized websites[84,85,86,87], or sometimes are detailed in local regulations (see chapter 1.4, e.g. *Decreto Ministeriale* of 22/12/1992 of Italy).

1.5.2 Cleaning

Seed samples collected in the field must be kept in a cool (about 15-20°C), dry (relative humidity < 50%), and well-shaded location up to cleaning. Fully mature seeds enclosed in desiccated fruits/capsules may be manually extracted rapidly and completely, while in the fleshy fruits, the pulp must be removed from seeds rapidly. For all material collected is highly recommended a quarantine period; such procedures permit the evaluation of the phytosanitary state of the collected material and identify the presence of fungal infections and/or phytophagous insects or other damaging parasites.

[84] Bacchetta G, Fenu G, Mattana E, Piotto B, Virevaire M (Eds). 2006. Manuale per la raccolta, studio, conservazione e gestione ex situ del germoplasma. Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici (APAT), Rome.
[85] Bacchetta G, Bueno Sánchez Á, Fenu G, Jiménez-Alfaro B, Mattana E, Piotto B, Virevaire M (Eds). 2008. Conservación ex situde plantas silvestres. Principado de Asturias/La Caixa, Gijón.
[86] http://www.genmedoc.org/
[87] http://ensconet.maich.gr/

There is a large range of mechanical instruments for the cleaning of large quantities of seeds that can be acquired from specialized distributors. Usually these instruments are designed for the cleaning of specific agronomical[88,89] or forestry[90] species. Often, these instruments work on a gravitational basis, making use of an air current or a vibrational belt that can be regulated to select the seeds. However, in some cases, the use of mechanical techniques damages the seeds, leads to deterioration of the seed coat, and exposes them to fungal infections. Manual intervention, although being particularly wasteful in terms of time, is necessary to separate and disarticulate fruits or infructescences[84,85,86]. Processing of modest quantities of seed is normally executed with small machines also available from specialized distributors or manually (Fig. 16).

Figure 16. Large mechanical seed separator and small blowing instrument (Photos: D. Ballesteros, M. Porceddu).

The plant producer that desires to collect and prepare its own seed stock needs to find the most appropriate cleaning techniques for the species of its interest, as well as should regulate and choose the features of the materials and machines to be used (for instance, the speed of the beaters or the suitable passing sieve size)[91]. As an aid, common cleaning methods for diverse Mediterranean species are reported in the following table:

Method	**Description**	**Additional tools**	**Common *taxa* or families that is used for**
Blowing instruments	- Air separates the particles (impurities or empty seeds) that are either lightest or heavier than the viable seeds; depending on	- Sieves	*Apiaceae, Gentianaceae, Malvaceae, Papaveraceae,*

[88]de Lucia M, Assennato D. 1994. Agricultural engineering in development. Post-harvest operations and management of food grains. FAO Agricultural Services Bulletin No. 93, Rome.
[89]Harmond JE, Brandenburg NR, Klein LM. 1968. Mechanical Seed Cleaning and HandlingUSDA Ag Handbook 354. Ag Research Service with Oregon Agricultural Experiment Station.
[90]Willan RL. 1987. A guide to forest seed handling. FAO, Rome.

	the size and weight, the viable seeds can fall, float or rise.		*Poaceae,* *Ranunculaceae,* etc.
Sieving	Seeds can then be separated from the chaff using interchangeable sieves of different mesh size.	- Sieving is often complementary to other mechanical methods	*Brassicaceae,* *Ranunculaceae,* and other *taxa* that need sieving.
Manual/microscopy	Manually using laboratory tools to separate seeds from the minute inflorescences.	- pliers - tweezers, - pointer, - stereo-microscope	*Orchidaceae,* *Plumbaginaceae*, and *Scophulariaceae*
Fleshy fruits	- Remove pulp manually and/or mechanically under a stream of water. - Better within 48 h after collection to limit fungal infections or any other processes that can damage the seeds. - Drain and dry seeds at room conditions for a 1 to 7 days.	- Sieves - pestle and mortar - beater or mixer - blot paper	*Arbutus* sp., *Ficus* sp., *Malus* sp., *Myrtus* sp., *Prunus* sp., *Pyrus* sp., *Rhamnus* sp., *Ribes* sp., *Rubus* sp., *Sorbus* sp., *Vitis* sp., etc.

1.5.3 Drying

Seeds, depending on their tolerance to drying and low temperatures are commonly classified as orthodox (i.e. tolerant to dehydration) or recalcitrant (i.e. dehydration sensitive). Orthodox seeds can be stored at low moisture content and temperatures with no damage, and include seeds of the majority of species with agronomical (e.g. pea, soybean, tomato, lettuce, etc.) or forestry interest (90% of mediterranean forest species such as *Arbutus* sp., *Ceratonia* sp., *Cistus* sp., *Myrtus* sp., *Pinus* sp., *Pistacia* sp., *Rosmarinus* sp., *Thymus* sp.), as well as wildest/native Mediterranean species. On the other hand, recalcitrant seeds (e.g. *Aesculus* sp., *Castanea* sp., *Quercus* sp.), are sensitive to desiccation, thus cannot be stored at temperatures inferior to zero, since this would result in substantial damage due to water freezing. Moreover, when conserved at high moisture levels and ambient temperature, germination is often promoted in short periods. A third category of seeds have been identified as “intermediate seeds”, and include seeds that tolerate dehydration better than recalcitrant but worse than orthodox seeds, and seeds that have the same

tolerance to dehydration as orthodox seeds but age very fast (e.g. *Abies* sp., *Cedrus* sp., *Fagus* sp., *Juglans* sp., *Laurus* sp., *Populus* sp., *Salix* sp.). Additionally, seeds that tolerate dehydration, but not temperatures below zero, are considered intermediate (e.g. coffee, papaya). Conservation of orthodox seeds is routinely done by seed desiccation and storage at low temperatures. Long-term conservation procedures of recalcitrant and, often, intermediate seeds envisage cryopreservation. Seed storage behaviour for diverse plant families can be found in the literature[85,86].

Desiccation - All seed samples should be dried to equilibrium in a controlled environment of 5–20 °C and 10-25 % of relative humidity, depending upon species[91]. The desiccation of a seed sample can be achieved via various methods. Seed banks often make use of specialized drying rooms (that use dehumidifiers and air conditioners to maintain a constant low relative humidity), which, although expensive, give optimal results. Materials destined for dehydration are arranged on open trays (sometimes seeds batches are also exposed to dehydration inside cardboard boxes, bags made from porous/breathable textiles). Humidity and temperature are controlled to avoid that the seed coats crack and/or wrinkle in the drying process. Desiccation in a drying room has a variable duration in relation to the seed type and varies from between few days to ca. 180 days.

Desiccation of small quantities of seeds can also be achieved via the use of artificial drying agents such as silica gel, which is placed in hermetic/sealed containers in close proximity of the seeds. Given its absorption property the internal humidity of the container is lowered to values that guarantee a proper desiccation of the seed batch. The quantity of silica gel employed varies according to the seed composition, the quantity of the material and the oil content. The general ratio of gel/seed is 1:1. For faster drying, some seed banks use higher gel/seed ratios such as 3:1.

Moisture content determination - Monitoring of the internal moisture of the seeds during dehydration is essential, and can be done with non-destructive methods, such as a Rotronic instrument (e.g. Fig. 17).

Figure 17. Rotronic instrument, balances and thermobalances in use at BG-SAR (Photos: M. Porceddu).

[91]FAO. 2014. Genebank Standards for Plant Genetic Resources for Food and Agriculture. Rev. ed. Rome.

In absence of this type of instrumentation, and if seed lots are large enough, moisture content can be monitored gravimetrically with the use of moisture balances or an oven and a balance. Full description of these and other methods can be found in international standards[85,86,88,92].

1.5.4 Storage and conservation

Packaging - As soon as the seeds have reached the desired moisture content, they should be packaged and stored within the dehydration room. After drying, seed moisture should be maintained using moisture-proof containers. Different types of containers can be used including glass, tin, plastic containers, and aluminium foils, each with their advantages and disadvantages[85,86,93,94]. In any case, either glass containers that are sufficiently thick to avoid breakage or laminate packaging with a metal foil layer of adequate thickness will maintain desired moisture levels for up to 40 years, depending on the ambient relative humidity at the seedbank location and the quality of the seal[93,94]. Transparent containers are recommended because they allow easy monitoring of moisture content inside the containers. Control of moisture is often done via an indicator. The most commonly used moisture indicator is the self-indicating silica gel granules which is capable of adsorbing excess water inside containers, by changing its colour during the process (Fig. 18).

Storage - After hermetically sealing the seeds batches, these must be stored to guarantee their conservation with an estimated viability of decades. According to the standards of the International Plant Genetic Resources Institute (IPGRI) and the Food and Agriculture Organization of the United Nations (FAO), most original samples and safety duplicate samples should be stored under long-term conditions (base collection) at a temperature of –18±3 °C and relative humidity of 15±3 %. Storage at such temperatures is done in a type of freezer as those commercially available or by using specialized freezing equipment. Banks of medium and large size, use freezing chambers which are made to measure with more sophisticated and dedicated freezing and controlling systems. For short/medium-term conditions (active collection), samples should be stored under refrigeration at 5–10 °C and relative humidity of 15±3 %.

All the explained above is applicable for orthodox seeds while, currently, it is difficult to guarantee long-term conservation of recalcitrant, and often, intermediate seeds. Cryopreservation has been indicated for the long-term storage and conservation of recalcitrant seeds, intermediate seeds, and for species that use vegetative propagation. Short-term storage (6 to 30 months) of some recalcitrant seeds that are not chilling sensitive can be achieved at high moisture conditions (between 30–50% of RH) and temperatures between 5-10°C (e.g. *Quercus* sp.)[95,96].

[92]Rao NK, Hanson J, Dulloo ME, Ghosh K, Nowell D and Larinde M. 2006. Manual of seed handling in genebanks. Handbooks for Genebanks No. 8. Bioversity International, Rome, Italy.
[93]Gómez-Campo, C. (2006) Erosion of genetic resources within seed genebanks: the role of seed containers. Seed Science Research 16, 291-294.
[94]Walters C. (2007) Materials used for seed storage containers: response to Gómez-Campo [Seed Science Research 16, 291-294 (2006)]Seed Science Research 17, 233-242
[95]Bonner FT. 2003. COLLECTION AND CARE OF ACORNS A Practical Guide for Seed Collectors And Nurserymen. U.S. Forest Service.

Figure 18. Silica gel microgranules and self-indicating strip to monitor humidity and, glass containers in use at BG-SAR (Photos: M. Porceddu)

[96]Bonner FT. Storage of Hardwood Seeds. In: FAO. 1978. FOREST GENETIC RESOURCES information - No. 7.

1.6 Germination requirements of wild seeds

Seed germination is a crucial stage in the life history of a plant species and it is the process by which a seed develops into a seedling. Seed germination involves the reactivation of the metabolic mechanisms that lead to growth and the emergence of the radicle and plumule. In laboratory conditions, the study of these mechanisms is conducted through germination tests of a relatively low number of seeds (usually four replicated of 25 seeds each), on paper or agar, and using germination chambers that control precisely temperature and photoperiod (Fig. 19). These experimental conditions allow to elaborate specific protocols for each investigated species. The aim of the germination tests is to determine the percentage of seeds capable of producing normal seedlings, virtually able to develop in normal plants, in favorable conditions of culture. In the nursery, results obtained during standard laboratory conditions will need to be adapted for germination of large number of seeds, often conducted in substrate, in the soil, or, if available, on thermo-regulated benches (Fig. 21B). The germination conditions will often be influenced or determined by the weather conditions of the diverse seasons, although some nurseries have cold or warm chambers that can be used for some pretreatments or to reach accurate temperatures for germination independently of the season of the year. Different factors to take into account are the depth of sowing (light/dark), the daily thermal variation between day and night (temperature), the soil composition (acid/basic), the amount of water in the substrate, etc. In this manual, germination conditions indicated have been prepared using germination tests in the laboratory which results have been adapted, when possible, to the habitual germination conditions of most nurseries.

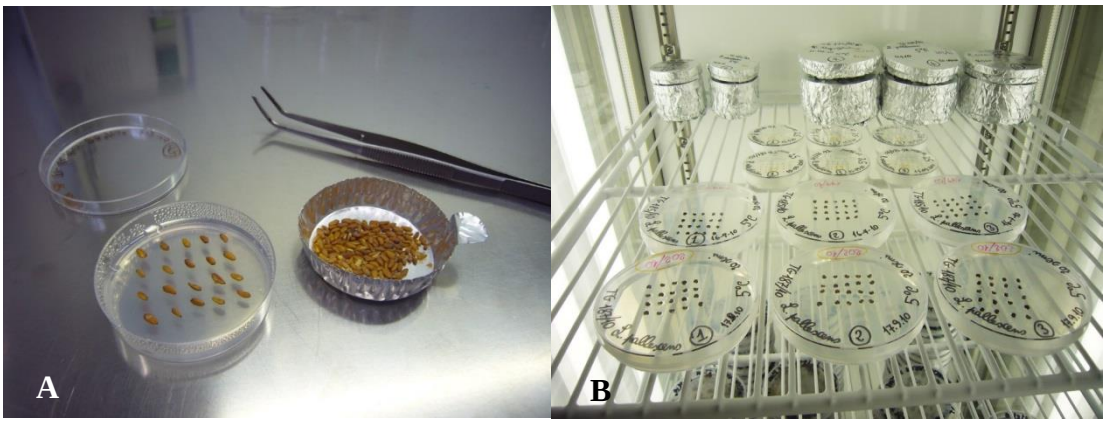


Figure 19. Germination of *Cakile maritima* seeds in the laboratory (A). Interior of a germination chamber that precisely controls temperature and light (photoperiod) (B) (Photos A. Santo).

1.6.1 Pre-treatments

Seed dormancy is the state in which a seed, despite of the favorable conditions for germination, is incapable to germinate. It may be due to the impermeable teguments of the seed, which prevent the imbibition of water necessary for the germination (physical dormancy), or depend on physiologic causes which involve the seed embryo (physiological dormancy). Different pre-treatments allow to alleviate seed dormancy, among the most used there are e.g. scarification, cold moist stratification, heat stratification, smoke, the use of plant hormones, etc. Detailed information on the biological, ecological and evolutionary basis for seed dormancy, the dormancy types and mixtures present in diverse species, and the methods commonly used in the

laboratory to break them can be found in specialized literature[97] and the diverse references used to write this chapter.

Scarification **-** Seeds of same species belonging to families with hard and impermeable seed coats (e.g. *Cistaceae*, *Convolvulaceae*, *Fabaceae*, *Malvaceae*, *Oleaceae*, etc.) need of abrasion through mechanic, chemical or physical treatments to break their seed dormancy. This type of pre-treatments is called scarification. In the wild, various biotic and abiotic factors can produce seed scarification, including extreme temperatures (e.g. fire or chilling), changes in the chemical environment (e.g. seed ingestion by frugivorous birds and passage through their digestive tract) and mechanical abrasion with rocks. Mechanical scarification (Fig. 20A, B) is made through drilling, cutting or chipping the seeds with scalpel or abrasion using sandpaper, to facilitate the thinning of the seed coat and the consequent imbibition of water, fundamental for the germination process. Several studies on various species showed enhancement of germination by mechanical scarification that could be attributed to the increase in water uptake and also reducing the mechanical resistance to the protrusion of the radicle. Chemical scarification (Fig. 15 C) is conducted for example by dipping the seeds in sulfuric acid (H_2SO_4 96%) for a time varying depending from the species and the thickness of the seed coat. After this pre-treatment the seeds must be washed with running water before the sowing for the germination test. The physical scarification is conducted through the immersion of the seeds in boiling water and consequent soaking per 12-24 hours to soften the seed coat.

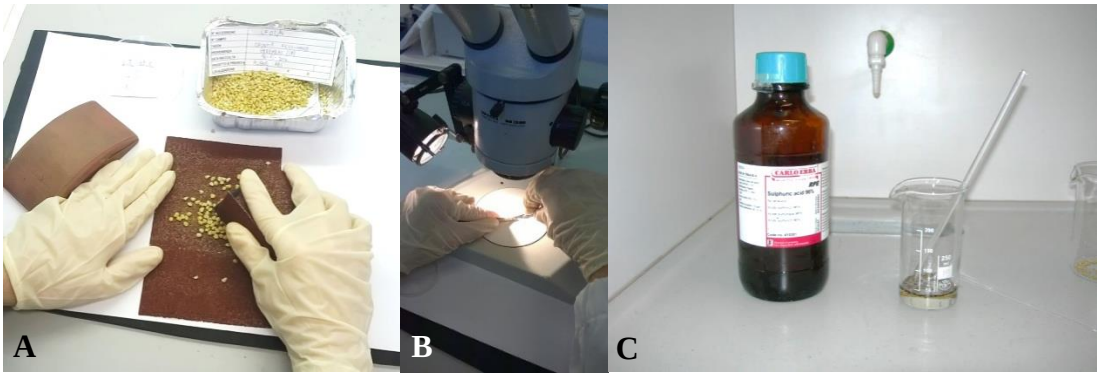


Figure 20. Mechanical (A, B) and chemical (C) scarification of seeds in the laboratory (Photos A. Santo)

Storing seeds in dry conditions (after-ripening)

After-ripening is the process of gradual dormancy release in seeds that had been stored for several months in a dry environment and room temperature, immediately after dispersion. After-ripening is a widespread phenomenon and has been documented in several species and mainly crops such as wheat, oat, barley, rye, rice, sunflower etc. Other researchers use the term 'dry after-ripening' to describe the release of the primary physiological dormancy during the summer in the hot and arid environment of desert areas. The need for after-ripening has been observed in the germination of many indigenous plants of Greece.

[97] Baskin CC, Baskin JM. 2014. Seeds: Ecology, Biogeography, and, Evolution of Dormancy and Germination (Second Edition). Academic Press, San Diego.

The time required to break the dormancy depends on the storage temperature. For example, dormancy in cereals remains for a relatively long period of time (5-10 years) when stored at (-18 °C), while at 30 °C dormancy release is observed in about one month. Moreover, some species require a few weeks of after-ripening (e.g. barley) or in some cases, more than 60 months (*Rumex crispus*). It has been observed that dormancy release in Mediterranean species in room conditions can take from two up to several months.

Pre-chilling or cold/moist stratification - To break one of the most common physiological dormancy of a seed before germination, seeds may be exposed to apposite pre-treatments with different temperatures. With the term pre-chilling (or cold/moist stratification), dormant seeds are exposed to variable temperatures from 0°C to + 5°C in moist conditions, depending on the species. This pretreatment simulates the action of the winter season on seeds. There are two types of cold/moist stratification: natural and artificial. Natural stratification consists in simply sowing seeds in vases with substrate (topsoil) in winter allowing them to spend the time at cold temperature during winter (vases must be shelter from rains to avoid the loss of many seeds). With this method, many species germinate during spring. Artificial stratification is used in regions where the winter is not too cold, therefore the method consists to envelop seeds in a wet gauze (or agar if the pretreatment is conducted in laboratory) and put them in a fridge per 2-4 months, to simulate the action of the winter. After this period seeds must be sown in vases with topsoil. The nursery has to select how to perform cold/mist stratification depending on their location and climatic conditions.

Heat stratification - On the contrary, the pre-heating (heat stratification or warming) consists in the exposition of the seeds to temperatures not higher than 30-35°C (generally 15-25°C) and it simulates the effect of the summer on seeds. Sometimes to break the seed dormancy in some species it is necessary to combine the two pre-treatments and to have a sequence of themselves, in this case normally the pre-heating must precede the pre-chilling.

Smoke - In some species associated to fire events, to facilitate the seed germination, in addition to a thermic treatment it may be useful the seed smoking (e.g. in the family *Ericaceae*). This pre-treatment consists in adding in the germination substrate a combination of natural chemical substances which are normally released during the fire events (they are available from diverse trademarks). The response of seeds of a plant species to the smoking pre-treatment depends both on the quantity of active substance in the smoke and the time of exposition. The effect of the fire on natural vegetation is particularly complex because it affects light, humidity, pH and nutrients availability, however the smoke is to be considered one of the determinant factors in the dormancy breaking in wild species of Mediterranean ecosystems.

Plant hormones - Another method used to facilitate seed germination, especially in seeds that require long germination time, is the use of plant hormones, as gibberellins. Gibberellins regulate growth and influence various developmental processes, including stem elongation, embryo development, germination, dormancy, flowering, sex expression, enzyme induction, and leaf and fruit senescence. One of the most used gibberellin is the gibberellic acid (GA_3). This latter plays a fundamental role because it is demonstrated that GA_3 treatments may promote germination of seeds that require pre-chilling, pre-warming, smoking, or others (e.g. *Ribes multiflorum* subsp. *sandalioticum*). Gibberellins can be found in diverse chemical companies.

1.6.2 Temperature

Temperature has important effects on germination and dormancy release (e.g. *Ribes multiflorum* subsp. *sandalioticum* and *Rhamnus persicifolia*). In seasonal climates, temperature is of course a good indicator of the time of year and it is therefore strongly implicated in determining the timing of germination. In a series of studies on geographical variation in germination temperature in Europe, it is asserted that both minimum and maximum temperatures for germination varied consistently along a north-south gradient; both were lower in Mediterranean species compared with those from northern Europe, a feature that is known as the Mediterranean germination syndrome. Indeed, some studies have investigated germination of Mediterranean coastal species, and their key feature is a rather low optimal temperature for germination[98,99]. The typical optimal temperature range of germination of Mediterranean coastal plants is generally between 5°C and 20°C (e.g. *Phleum sardoum*, *Silene badaroi*, *Lavatera triloba, Glaucium flavum, Dianthus morisianus, Allium staticiforme, Cakile maritima, Achillea maritima*). This may correspond to a field germination in the autumn-winter period, when water availability in the soil is high and temperatures are not prohibitive and it represent an advantageous ecological adaptation for seedling establishment towards the unpredictable Mediterranean rainfall pattern. However, some Mediterranean coastal plants (e.g. *Brassica insularis*, *Rouya polygama*, etc.) germinate in a wide temperature range, showing as their field germination may occur in any month of the year.

In contrast to Mediterranean coastal plants, some high mountain Mediterranean plant species (e.g. *Allium schoenoprassum, Hieracium vahlii* subsp. *myriadenum, Jasione crispa* subsp. *centralis, Minuartia recurva* subsp. *bigerrensis, Silene boryi* subsp. *penyalarensis, Senecio pyrenaicus* subsp. *carpetanus*) show higher optimum germination temperature values (e.g. 20-25°C)[100]. Species of wide geographical distribution generally show the same intra-specific trend as that found between species. In the Mediterranean (except in high altitudes), by far the least dangerous season for seedlings is the damp, cool but mostly frost-free winter.

In many species, germination is reduced, or does not occur at all, at constant temperatures, while it may frequently be increased by both the number and the amplitude of temperature alternations. Temperature alternations can be produced in germination chamber, but also in natural conditions through day/night temperature changes. It is important to indicate, that day/night temperature alternations are known to decline with depth in soil and also to be much lower beneath an established canopy of insulating vegetation. Seeds that are buried deeply or planted under a deep cover of insulating vegetation will respond to the natural alternating temperature inexactly.

1.6.3 Light conditions

The responses of seeds to light are important for preventing the occurrence of germination in places and at times that are unfavorable to seedling establishment. The ability to detect different aspects of the light

[98] Thanos CA, Georghiou K, Skarou F. 1989. Glaucium flavum seed germination - an ecophysiological approach. Annals of Botany, 63: 121-130.
[99] Thanos CA, Georghiou K, Douma DJ, Marangaki CJ. 1991. Photoinhibition of Seed Germination in Mediterranean maritime plants. Annals of Botany, 68: 469-475.
[100] Gimenez-Benavides L, Escudero A, Perez-Garcia F. 2005. Seed germination of high mountain Mediterranean species: altitudinal, interpopulation and interannual variability. Ecol. Res., 20: 433–444.

environment enables the seed to have at least some control over where and when germination takes place. The chances of successful establishment may be determined by whether the germinating seed is buried in the soil or on the surface. If it is buried, then the precise depth is crucial for emergence. If it is on the surface, then the degree of shade (especially from surrounding vegetation) can be decisive. In some cases, day length plays a part in determining the timing of germination. These parameters will need to be controlled in the nursery (e.g. Fig. 21) depending on the light conditions indicated in the species cards.

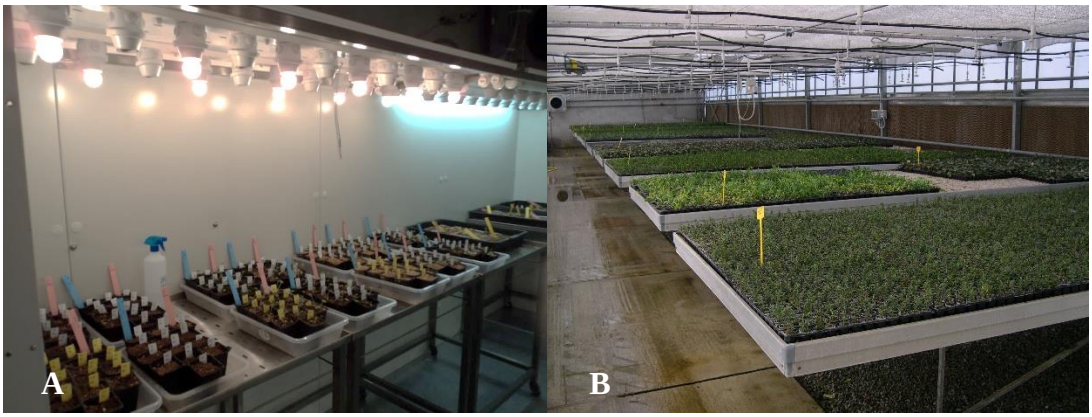


Figure 21. Seedlings growing under controlled light and temperature conditions in CIEF's research facilities and nursery (A) or a private nursery (B) (Photos A. Santo, G. Bacchetta).

In all these situations, the ability to detect the intensity, quality or periodicity of the light provides the seed with information it requires about its environment. If a seed that is lying in darkness below the soil surface germinates, then its shoot may not be able to reach the surface. This hazard is greatest for small seeds, so the ability to detect light (or its absence) is of great survival value. Near the surface, the amount of light received diminishes rapidly with depth. Measurable quantities of light seldom penetrate more than a few millimeters, though the presence of a high proportion of translucent particles such as quartz grains in sand may transmit light a little deeper. Not surprisingly, many small-seeded species require light for germination or are inhibited significantly by darkness (e.g. *Taraxacum officinale* group, *Sonchus oleraceus*, *Lactuca serriola*, *Chenopodium album*, *Poa annua*). On the contrary, several Mediterranean coastal species are photoinhibited by light for their germination (e.g. *Crucianella maritima*, *Allium staticiforme*, *Brassica tournefortii*, *Cakile maritima*, *Achillea maritima*).

In addition to the ability to detect the quantity and quality of light, the seeds of some species are sensitive to the photoperiod, i.e. the relative lengths of the light and dark periods corresponding to day and night (e.g. *Chenopodium* spp.). Day-length detection is often highly dependent on the temperature regime, especially chilling. Photoperiod sensitivity is likely to increase in importance with latitude because of the large seasonal variation in day length. Few wild species have been tested for sensitivity to day length, and its occurrence may be more widespread than the sparse literature would suggest. The published experiments do not always distinguish between the effects of total quantity of light received and the specific effect of the photoperiod. Some studies seem to indicate that elements of both light quantity and photoperiod are involved at the same time.

1.6.4 Water availability

A seed may become fully imbibed but remaining un-germinated indefinitely if its dormancy-breaking or germination-inducing requirements do not meet. Germination may take many days or weeks, during which time the seed is likely to encounter a number of wet and dry periods. Numerous experiments have been carried out to determine the effect of cycles of hydration and dehydration on germination and the response varies with species. The length of the dry period has been found to reduce viability and germination speed in annual pasture legumes (*Trifolium* spp.), but in other cases it has little or no effect. The response of seeds of different species to the pattern of rainfall at the time of germination may determine which species will be established. A fast response to rain may be advantageous providing that the wet period is sufficiently long to allow the seedlings to grow to a size that enables them to withstand the subsequent dry period. A slow response, in which germination can occur cumulatively even if interrupted by periods of drought, can be of advantage where the rain events are short-lasting. In the Mediterranean, the least dangerous season for seedlings is the damp, cool but mostly frost-free winter, thus a large number of species will germinate in the moist and fresh autumn.

2

Species propagation cards

2.1. Cards of selected Mediterranean plant species

The cards presented in this *manual* are a selection of protocols of seed management and germination for diverse Mediterranean plant species that are suitable to be used in restoration ecology and gardening in different areas of the Mediterranean Region. These species have been selected attending to some criteria explained in chapter 1.3. Cards have been prepared in an easy reading and graphical format to read and graphical format with the aim to encourage the readers to use them in their workstations.

The species presented are native to, at least, natural territories of the country of the partner that has prepared the card (see top left section of the card). The reader will find some cards of species that are endemic to territories of a particular country. On the other hand, other species presented have wider distribution and could be suitable for their growth in other areas along the Mediterranean Basin (see card's section *Growth conditions in the wild*). However, before germinating, growing, and planting any of these species, it is imperative to take into account some important considerations:

(1) During the selection of species for the restoration of a given habitat in a given place, it is **critical** to take into account the **local flora**, not only native species of a particular country, but also species that **grow locally**. More information about this point can be found in the *Guide of Good Restoration Practices for Mediterranean Habitats*, also edited by ECOPLANTMED.

(2) Seeds (or vegetative materials) used to reproduce a particular native species, **must** be **collected locally**. Seeds of a particular species collected in parts of the country that are distant from the region where the species is planned to be used, may not be suitable attending to criteria of genetic diversity and compatibility. Furthermore, seeds of a particular species present in a country collected in other countries (even if they are neighbour countries or other countries of the Mediterranean Basin) will not be (in most cases) suitable for their use (e.g. native Mediterranean species growing in Spain are not suitable to be planted in Lebanon). The information contained in each card of this *manual* has been prepared by one of the partners of the ECOPLANTMED project. Some species are repeated because they have been prepared by diverse partners. The reason to allow this duplicity is that the germination and seed management protocols have been prepared locally, with seeds collected in the territories of the country of the partner that has prepared the card, thus adapted to the particular ecological conditions of these territories. Sometimes a species can show wide ecophysiological responses and the protocols developed can be used broadly. However, the reader should take into account that, when using germination protocols prepared in other country, some modifications to the protocols may be needed to adapt them to the local conditions.

2.2. Example of the species propagation card

All the species cards follow the same scheme, where **colours**, **symbols**, and **small texts** describe the characteristics, protocols, and particularities for each species (Fig. 22).

The most characteristic ecosystem where the species **grow in natural conditions**, is indicated by the **colour of the card**. Green refers to **forest** habitats, blue refers to habitats closely related to **freshwaters**, orange refers to **coastal** habitats, and red refers to **arid lands, grasslands, shrub-lands**, etc. We have selected four ecosystem types in concordance to those presented in the *Guide of Good Restoration Practices for Mediterranean Habitats*, edited by the ECOPLANTMED project, which are also described in chapter 1.2 of this *Manual*. Some habitats within these ecosystems are summarized in Annex 1. Further descriptions of distribution and ecology of the species within the card can be found in the section describing "*Growth conditions of the plant in the wild*".

Other sections and information presented in each species card are summarized in Fig. 22:

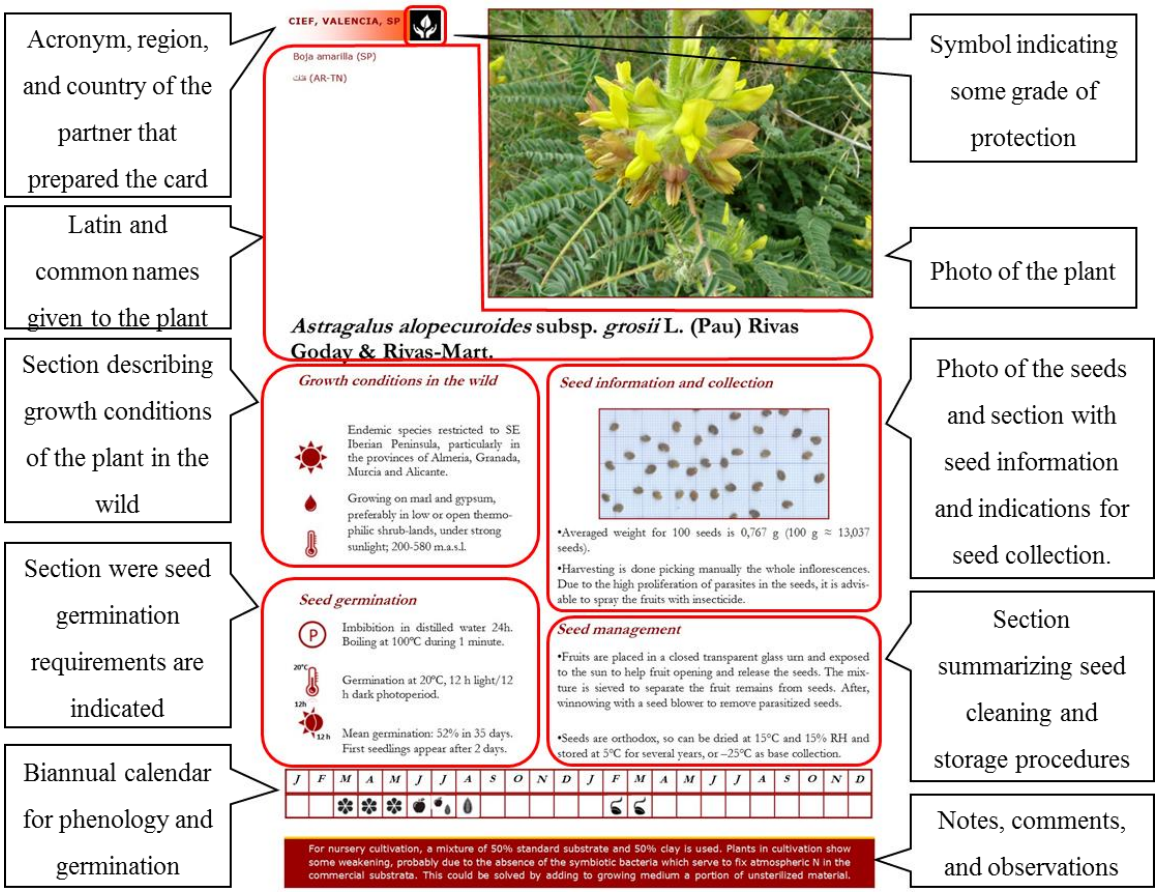
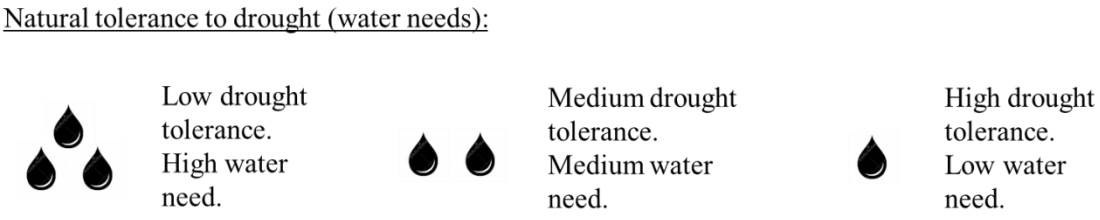


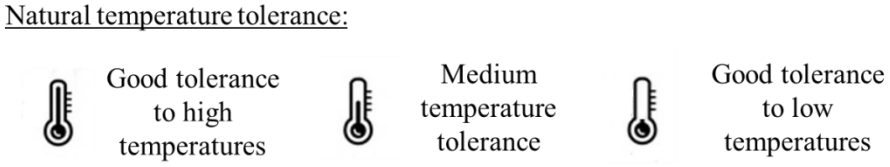
Figure 22. Different sections and information presented in each species card.

The species card have been designed with the aim to be practical and facilitate its use in the workstations of private and public nurseries. In addition, we expect that these cards will be useful to other potential readers of the *manual*, such as public authorities, architects and engineers that aim to use native species in their parks and gardens. For this reason, the main information on growth conditions of the plant in the wild and germination/propagation requirements are indicated by a few, and intuitive symbols detailed below:

Grade of protection: The symbol is included in the card only if the species has a "legal grade of protection" that limit seed collection and production, such as CITES, local laws, etc. (chapter 1.4). Details on the grade of protection will be indicated in the section "*seed information and collection*".

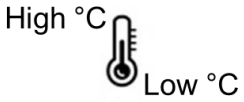
***Growth conditions of the plant in the wild*:** They will be summarized by three symbols indicating the high, medium or low natural tolerance to **sun**, **drought** and **temperature**:





Seed germination: **Temperature** and **light** symbols will be specified for all the species. They will also provide numerical values of the high and low optimal germination temperature ranges (in °C, only one number will be indicated for species that require constant temperatures), and light/dark hours of photoperiod (e.g. 12 / 12 h, or 0 / 24 h for darkness). **Pretreatment(s)** symbol will only be indicated if any pretreatment is needed to break dormancy (the particular pretreatment will be briefly explained in the text). The symbol for

vegetative propagation will be included if the information is available in the literature or from the experience of the partner that prepared the card.

Temperature: 

Light: 

Pretreatment(s): 

Vegetative propagation: 

***Biannual calendar for phenology and germination*:** it includes symbols to represent **flowering** and **fructification** periods (thus when could be possible to proceed to seed collection). Also it includes symbols to indicate when (months) would be the best moment for **sowing or start pretreatments** (this is due as most nurseries do not have germination chambers and sow directly on soil), and a symbol to indicate when **germination and seedling emergence** usually occur. The last two symbols will only be represented if this information is available from the ecophysiology of the species and the knowledge acquired from the germination experiments. If this information is not available, the plant grower will have to adapt the germination protocol from the germination conditions exposed in the card.

Flowering:  Fructification:  Pretreatments/Sowing:  Germination: 

Acronyms and abbreviations used in the species cards:

MAICh	Mediterranean Agronomic Institute of Chania
CCB	Centro Conservazione Biodiversità
USJ	University Saint Joseph
CIEF	Centro para la Investigación y Experimentación Forestal
INRGREF	Institut National de Recherches en Génie Rural, Eaux et Forêts
EN	English
IT	Italy, Italian
SP	Spain, Spanish
FR	French
GR	Greece, Greek

LB	Lebanon
TN	Tunisia
AR-LB	Arabic from Lebanon
AR-TN	Arabic from Tunisia
IP	Iberian Peninsula
N, S, E, W	North, South, East, West
m.a.s.l	Meters above sea level
FRM	Forest Reproductive Materials

CIEF, VALENCIA, SP

Montpellier Maple (EN)

Acero minore (IT)

Arce de Montpellier (SP)

Érable de Montpellier (FR)

Σφεντάμι (GR)

قيقب مونبلييه (AR-LB)

Acer monspessulanum L. subsp. *monspessulanum*

Growth conditions in the wild

Mediterranean region, Caucasus, north of Persia and Turkestan.

Mixed with sclerophyllous, deciduous and sub-sclerophyllous, or conifer species, in mountain areas of meso- and supra-Mediterranean levels, mainly on calcareous but also on siliceous substrata; common also on stony ground and even in rock crevices; 600 -1200 (1600) m. a.s.l.

Seed germination

Imbibition in distilled water (24 h).

Germination at 4ºC in sand and vermiculite. No light (24 h dark).

First seedlings may be observed in 3 months. Total test lenght: 4 ½ months.

Average germination: 66%.

Seed information and collection

•Averaged weight for 100 seeds is 3.195 g (100 g = 3,129 seeds).

•Harvesting is done manually from the ground or using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species. However, collection, production, trade and use of "Forest Reproductive Material" is regulated under Valencian normative.

Seed management

•Manually remove the remains of leaves and branches. Breaking the wing of the fruit with a scarifying-brushing machine to separate the nutlets from the wings. Separate empty seeds and remains of wings using a gravity table.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
			✿	✿			●	●	●	●	●			●									

Seed production is usually plentiful, but seed quality from year to year is very heterogeneous. Vegetative propagation is quite difficult and plants obtained have low vigour, so its use is discouraged. Cultivated as ornamental.

USJ, BEIRUT, LEB

Syrian Maple (EN)

Acero di Siria (IT)

Erable de Syrie (FR)

قيقب سوري (AR-LB)

قيقب سوري (AR-TN)

Acer syriacum Boiss. & Gaill.

Growth conditions in the wild

Native of Syria, Lebanon, Palestine, and Cyprus.

It is found on limestone substrata. It occurs frequently in forests.

It is located in a wide altitudinal range, from ca. 0 to 1300 m. a.s.l.

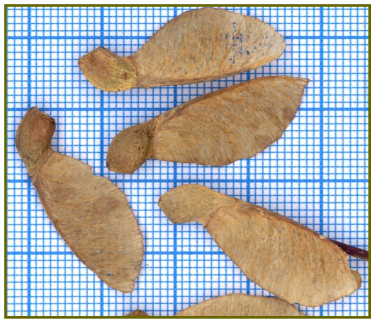
Seed germination

Pre-treatments: Imbibition in distilled water (2 h). Cold/moist stratification at 4ºC on peat with no direct light for 3 months (some seeds may germinate during stratification).

Germination at 20°C, 12 h light / 12 h dark.

Average germination: 49%.

Seed information and collection



•Averaged weight for 100 seeds is 3.167 g (100 g = 3,157 seeds).

•Fruits must be collected when they are fully dried and have a brown colour. Harvesting is done manually from picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cleaning is very easy. Remove the wings of the seeds after drying them.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	❀	❀						●	●			▮		❧	❧	❧							

CCB, SARDINIA, IT

Cottonweed (EN)

Santolina delle spiagge (IT)

Algodonosa (SP)

Achillée maritime (FR)

اذنية بحرية (AR-TN)

Achillea maritima (L.) Ehrend. & Y.P. Guo subsp. *maritima*

Growth conditions in the wild

Native to the Balkan Peninsula, British Isles, Canary Islands, France, Iberian Peninsula, Italy, Morocco and Turkey.

Pioneering, perennial, growing typically on embryonic shifting dunes subjected to rearrangement through the action of wind and occasionally reached by marine water spray. It occurs from 0 to ca. 30 m. a.s.l.

Tolerant to salinity, constant winds and the lack of soil moisture.

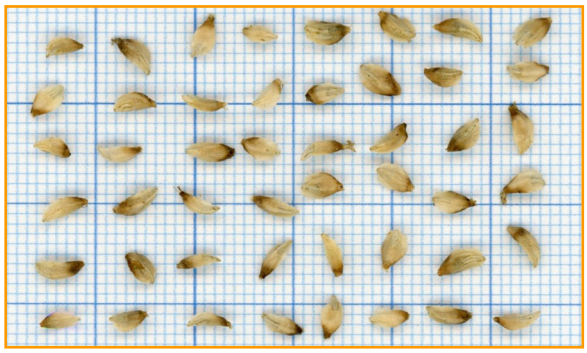
Seed germination

Imbibe on wet sand for 8 weeks at 5°C; germinates in sand, light (8 h light /16 h dark), at 20°C.

Same results if sown in 1% agar, light (8 h light /16 h dark), at 25/10°C.

High percentages of germination, often up to 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.08 g (100 g = 125,000 seeds).

•Seeds are white-brownish achenes without the coma (hairy part). Their collection can be conducted by hand from July to September.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds can be cleaned by separating them from the inflorescence and selecting them through differently sized metallic sieves.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is able to exercise a stabilizing action on the substrate through its root system. Aromatic herb, used in traditional medicine for treatment of toothache, asthmatic bronchitis, dysentery and inflammation of the urinary bladder.

CIEF, VALENCIA, SP

Milenrama algodonosa (SP)

Achillea santolinoides Lag.

Growth conditions in the wild

Ibero-northafrican species.

In the Iberian Peninsula it is only known in the SE part (Valencia, Alicante, Murcia and Almería).

Living in areas of clay or gypsum marl soils in temporarily flooded soils.

Salinity tolerant species.

Seed germination

Imbibition in distilled water 24 h.

Germination at alternant day/night temperatures (15°/20°C), with 12 h dark /12 h light photoperiod.

Germination: 75% in 24 days. First seedling after 3 days.

Growth vegetatively from branch cutting or plant division.

Seed information and collection

•Averaged weight for 100 seeds is 0.009 g (100 g = 1,100,000 seeds).

•Seed maturation coincides with the senescence of the aerial part of the plant. Whole flower heads are harvested when they are dry to the touch, brittle and separable from the plant with little resistance.

• Valencian Protected species; collection regulated.

Seed management

•Flower heads are dried in the drying room for about two months and then crushed gently with your fingers to release the seeds. Then impurities should be removed manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

The scientific name of taxon comes from its external resemblance to the species of the genus Santolina, from which is differenciated by being less woody, smaller size, tendency to expand via rhizomatous and smaller flower heads.

CIEF, VALENCIA, SP

Snowy mespilus (EN)

Pero corvino (IT)

Guillomo (SP)

Amélanchier à feuilles ovales (FR)

زعروريه (AR-LB)

Amelanchier ovalis Medik. s.l.

Growth conditions in the wild

W, C and S Europe, Africa NW and SW Asia.

In the Mediterranean area it occurs in the mountain ranges and more precisely in the supra- and oromediterremamean belt.

Not very dense forests and scrubs, woodland borders and crag crevices; mainly in rocky terrains, preferably on limestone; (100) 300-2500 m. a.s.l.

Seed germination

Imbibition into distilled water during 24 h.

4°C

Germination at 4ºC in sand and vermiculite substrate. No light (24 h dark).

0 h

24 h

First seedling may be observed after 18 weeks. Total test lenght: 6 months.

Average germination: ca. 78%.

Seed information and collection

•Averaged weight for 100 seeds is 0.51 g (100 g = 19,455 seeds).

•Fruit collection should be done from the end of July, once the fruit is ripe, to avoid predation by birds and mammals.

•Harvesting is done manually from the ground, picking the mature fruits directly from the branches.

•Non-protected species; collection, production, trade and use of FRM regulated under Valencian normative.

Seed management

•Soak the fruits during 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dry during 2 days, slighltly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿		●	●		▮	▮			▮	▮									

There is great variability in the seed dormancy among populations and between years, which may influence results in germination. Like many other Rosaceae, it is able to re-sprout from strain after cutting or burning.

MAICh, CRETE, GR

European marram (EN)

Sparto pungente (IT)

Barrón (SP)

Oyat du midi (FR)

Ψάθα (GR)

سبط قصبي (AR-LB)

Ammophila arenaria (L.) Link subsp. *arundinacea* H. Lindb.

Growth conditions in the wild

Wide Euro-Mediterranean distribution, including Algeria, Egypt, Morocco, Cyprus, Israel, Lebanon, Syria, Turkey, Albania, Bulgaria, Croatia, Greece, Italy, Romania, Serbia, France, Portugal, and Spain.

Light-demanding plant, in well lit places but not in very insolation rich sites. It grows in dry to fresh sites. Plants of fairly hot to hot sites. It occurs from 0 to 150 m. a.s.l. In Crete it is distributed at lower altitudes, from 0 to 25 m. a.s.l.

Seed germination

Pre-treatment: Dry storage (Relative Humidity < 20% and room temperature) for approx. 6 months.

Best germination conditions: 15 and 20°C. No light (24 h dark).

Seedlings visible after approximately 10 days.

Average germination: 100%.

Seed information and collection

•Averaged weight for 100 seeds is 0.397 g (100 g = 25,189 seeds).

•When collecting seeds, special care is required, due to the fact that the infructescence is dry and fragile and can easily fall apart.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is relatively difficult. Seeds can break easily if pressure is applied on them, due to the high percentage of starches in the seed.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is a species that can be used for sand dune stabilization.

CCB, SARDINIA, IT

Jupiter's beard (EN)

Vulneraria barba di Giove (IT)

Barbajove (SP)

Barbe-de-Jupiter (FR)

Πώγων του Διός (GR)

النفلة (AR-TN)

Anthyllis barba-jovis L.

Growth conditions in the wild

Native to Algeria, Croatia, France (Provence, Hyres Islands and Corsica), Italy (Tuscany, Apulia and Sardinia) and Tunisia.

Coastal rocky cliffs predominantly calcareous and coastal garigues, the species is able to tolerate salinity, direct exposure to the sun, constant winds and the lack of moisture. It occurs from 0 to 100 m. a.s.l.

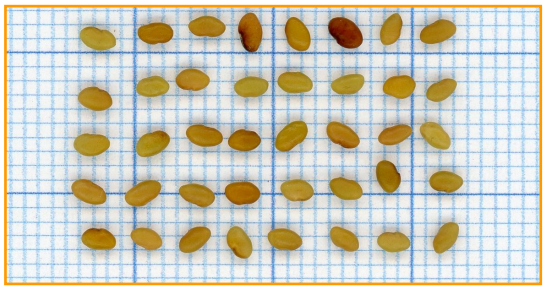
Seed germination

Scarification with sulphuric acid (96%) for 15 min.; light (12 h light / 12 h dark), at 20°C. Also good results at 25/10°C or 15°C.

Abrasive sand paper can alternatively be used for scarification.

Average germination: 85%.

Seed information and collection



•Averaged weight for 100 seeds is 0.3 g (100 g = 33,300 seeds).

•Collection by hand from July to September. It is collected the legume, generally retained inside the dry flower remains.

•Non-protected species in Sardinia, except inside protected areas where collection is regulated. Considered threatened in other regions of Italy. Collection and selling are prohibited in France and Croatia.

Seed management

•Fruits are cleaned by rubbing them between two rubber sheets and separating them through sieves of different size; pods are opened during this process, or can be opened individually with a blade.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
		✿	✿	✿	✿	●	●	●	▮	▮			❧	❧									

The species is frequently used in gardening.

MAICh, CRETE, GR

Yellow Kidney Vetch (EN)

Vulneraria di Hermann (IT)

Anthyllide d'Hermann (FR)

Αλογοθύμαρο, Σάρωμα (GR)

Anthyllis hermanniae L. subsp. *hermanniae*

Growth conditions in the wild

It is widespread in the central and eastern Mediterranean area. This particular subspecies is found in Greece (including Crete) and Turkey.

Light-demanding plant, in well lit places but not in very insolation rich sites. It grows in dry sites. Plants of fairly hot to hot sites. In Crete it occurs from 0 to 1100 m. a.s.l.

Seed germination

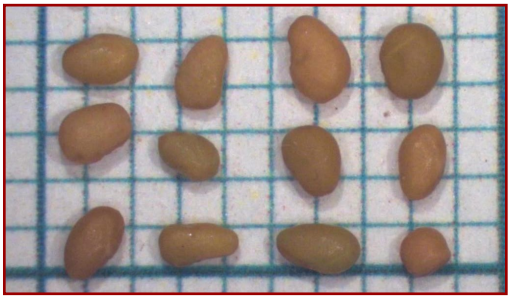
Pre-treatment: Immersion for 20 seconds in boiling water.

Best germination conditions: 10, 15 and 20°C, light (12 h light / 12 h dark).

Seedlings visible 25 days after sowing.

Average success of seed germination: 90-100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.235 g (100 g = 42,553 seeds).

•The entire seed pods are collected and placed inside cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is done very easily, by simply opening the dry seed pods with a rubber tool.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿		●	●			●	●	●	●										

Within *A. hermanniae*, seven subspecies are recognized: *hermanniae* (NE Mediterranean area), *melitensis* (Malta), *sicula* (Sicily, IT), *brutia* (Calabria, IT), *japygica* (Apulia, IT), *ichnusae* (Sardinia, IT), and *corsica* (Corsica, FR).

MAICh, CRETE, GR

Greek Strawberry Tree (EN)

Corbezzolo greco (IT)

Madroño oriental (SP)

Arbousier de Chypre (FR)

Αγριοκουμαριά, Γλυστροκουμαριά (GR)

Arbutus andrachne L.

Growth conditions in the wild

It occurs in the eastern Mediterranean region, ranging from the Balkans (Croatia, Albania, FYROM and Bulgaria), to Cyprus, Georgia, Greece, the Middle East (Israel, Lebanon, Jordan and Syria) and Turkey.

Regarding natural sun exposure, the ecological behaviour of the species is unclarified. It grows on fresh sites, in mesophilous forests and maquis from 100 to 1400 m. a.s.l. In Crete it is distributed at lower altitudes, from 0 to 700 m. a.s.l. Plants of fairly hot sites.

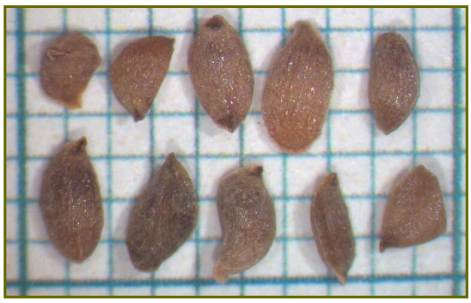
Seed germination

Best germination conditions: no pre-treatment, 10, 15 and 20°C, light (12 h light/12 h dark).

Seedlings visible 30 days after sowing.

Average success of seed germination: 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.16 g (100 g = 62,500 seeds).

•Collect mature fruits (of red color) in cloth bags place them on absorbent paper.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

• Cleaning is relatively difficult. Seeds are placed under running water, while mechanically cleaned in a sieve, using a rubber tool to remove the fruit parts. After that seeds are placed on absorbent paper to dry and then cleaned once again.

• Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿						●	●													

According to Theophrastus, the wood was used as fuel and for the construction of looms.

CCB, SARDINIA, IT

Tree Wormwood (EN)

Assenzio aromatico (IT)

Ajenjo marino (SP)

Armoise arborescente (FR)

Αψιθιά (GR)

ذقن شيخ (AR-LB)

Artemisia arborescens (Vaill.) L.

Growth conditions in the wild

Native to Atlantic and Mediterranean coasts. Can be found in Algeria, Corse, Croatia, Greece, Spain, Israel, Italy, Jordan, Lebanon, Lybia, Syria, Portugal, Morocco, Tunisia, Turkey.

Grows preferently on limestone substrata in coastal cliffs, rocks near the sea, and garrigues, from 0 to 1000 m. a.s.l.

High natural tolerant to salt, drought and sun.

Seed germination

Best germination condition: light (12 h light / 12 h dark), at 15°C.

Average germination: ca. 70%.

Suggestion for the nursery: Sow seeds on the surface of a well drained seed sowing mix at about 17°C (seed germination requeres light). Seeds usually germinate in 30-60 days.

Seed information and collection

•Averaged weight for 100 seeds is 0.015 g (100 g = 660,000 seeds).

•Seed collections do not need particular precautions, fruits may be cutted with the whole head and achenes subsequently extracted through cleaning.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seed were cleaned using sieves to separate the seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It contains essential oils with anti-inflammatory, antiviral, antihistaminic properties. It is used in perfumery and as repellent for mice and moths.

CIEF, VALENCIA, SP

Boja amarilla (SP)

قتات (AR-TN)

Astragalus alopecuroides L. subsp. *grosii* (Pau) Rivas Goday & Rivas Mart.

Growth conditions in the wild

Endemic species restricted to SE Iberian Peninsula, particularly in the provinces of Almeria, Granada, Murcia and Alicante.

Growing on marl and gypsum, preferably in low or open thermophilic shrub-lands, under strong sunlight; 200-580 m. a.s.l.

Seed germination

Imbibition in distilled water 24 h. Boiling at 100ºC during 1 minute.

Germination at 20ºC, 12 h light / 12 h dark photoperiod.

Average germination: 52% in 35 days. First seedlings appear after 2 days.

Seed information and collection

•Averaged weight for 100 seeds is 0.767 g (100 g = 13,037 seeds).

•Harvesting is done picking manually the whole inflorescences. Due to the high proliferation of parasites in the seeds, it is advisable to spray the fruits with insecticide.

•Valencian protected species; collection regulated.

Seed management

•Fruits are placed in a closed transparent glass urn and exposed to the sun to help fruit opening and release the seeds. The mixture is sieved to separate the fruit remains from seeds. After, winnowing with a seed blower to remove parasitized seeds.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
		✿	✿	✿	●	●	▮						❧	❧									

For nursery cultivation, a mixture of 50% standard substrate and 50% clay is used. Plants in cultivation show some weakening, probably due to the absence of the symbiotic bacteria which serve to fix atmospheric N in the commercial substrata. This could be solved by adding to growing medium a portion of unsterilized material.

USJ, BEIRUT, LEB

Lebanon Barberry (EN)

Crespino del Libano (IT)

Berberis du Liban (FR)

بربريس لبنان (AR-LB)

Berberis libanotica Ehrenb. ex C.K. Schneid.

Growth conditions in the wild

Endemic to Lebanon and could be present on the Syrian side of Anti-Liban.

It is found on limestone substrata. It occurs frequently in orophilous sands in degraded lands.

It is located in a wide altitudinal range, from ca. 1200 to 2200 m. a.s.l.

Seed germination

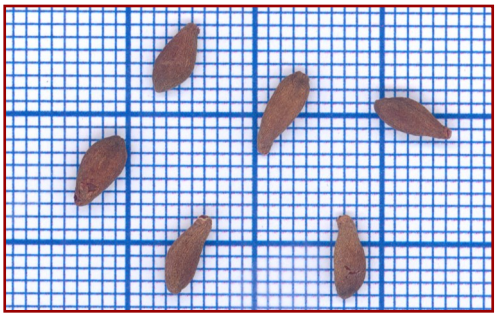
Cold stratification for 6 months at 4°C.

Germination at 4ºC on filter paper with no direct light.

First seedlings may be observed in 4 months. Total test lenght: 9 months

Average germination: 75%.

Seed information and collection



•Averaged weight for 100 seeds is 1.47 g (100 g = 6,817 seeds).

•Fruits must be collected when they have a blue-dark colour.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cover the blade of a blender with a rubber material. Place the ripe fruits in the blender and turn it on for 1 min. Separate the seeds from the dirt using a sieve.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

MAICh, CRETE, GR

Furrowed throny broom (EN)

Sparzio villoso (IT)

Aulaga (SP)

Calicotome velu (FR)

Ασπάλαθος (GR)

قندول مقلم الساق (AR-LB)

قندول (AR-TN)

Calicotome villosa (Poir.) Link

Growth conditions in the wild

It is distributed across the Mediterranean, ranging from Algeria, Morocco, Portugal, Spain and Tunisia in the east, to Cyprus, Greece, Italy, Middle East and Turkey in the west.

Regarding the natural temperature tolerance the species shows indifferent behaviour. Light plant, generally in well lit places. It is an indicator of dry sites. It occurs from 0 to 600 m. a.s.l., and in Crete up to 1600 m. a.s.l.

Seed germination

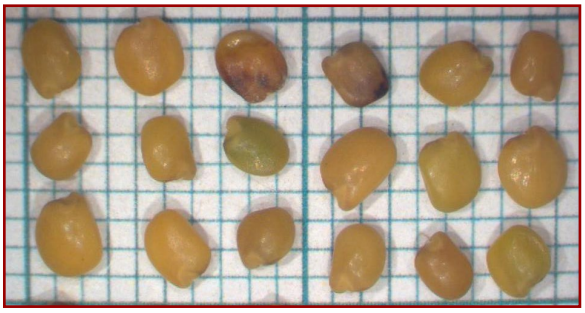
Pre-treatment: Immersion for 20 seconds in boiling water.

Best germination conditions: 15 and 20°C, light (12 h light / 12 h dark).

Seedlings visible 20 days after sowing.

Average success of seed germination: 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.649 g (100 g = 15,400 seeds).

•Collect mature seed pods inside a cloth bag. This is a very spiny plant, so the use of thick gloves is recommended.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is very easy. Seeds fall apart after fruit dehiscence, just remove the mature dry seed pod parts.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿			●				𝅘𝅥𝅯	𝅘𝅥𝅯	𝅘𝅥𝅯	𝅘𝅥𝅯										

The overground part of the plant is used in aromatotherapy. The plant is poisonous for ruminants.

USJ, BEIRUT, LEB

Furrowed throny broom (EN)

Sparzio villoso (IT)

Aulaga (SP)

Calicotome velu (FR)

Ασπάλαθος (GR)

قندول مقلم الساق (AR-LB)

قندول (AR-TN)

Calicotome villosa (Poir.) Link

Growth conditions in the wild

It is distributed across the Mediterranean, ranging from Algeria, Morocco, Portugal, Spain and Tunisia in the east, to Cyprus, Greece, Italy, Middle East and Turkey in the est.

It is found both on limestone and siliceous substrate. It occurs frequently in scarps and roadsides and can be found in landfill mining (mainly screes).

It is located in a wide altitudinal range, from ca. 100 to 1200 m. a.s.l.

Seed germination

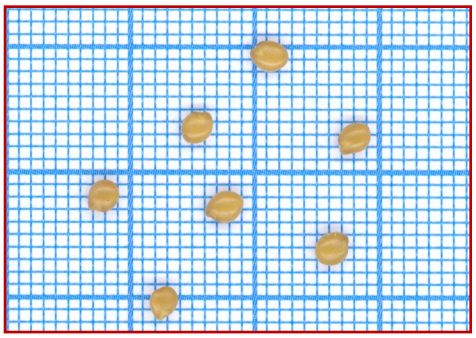
Hot scarification in boiling water for 20 sec.

Germination at 20ºC on agar with no direct light.

First seedlings may be observed in 1 week. Total test length: 2 months.

Average germination: 96%.

Seed information and collection



•Averaged weight for 100 seeds is 0.667 g (100 g = 14,993 seeds).

•Fruits must be collected when they are dried and have a brown colour.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cleaning is very easy. Dried fruits must be cut in the middle and seeds will be removed easily.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
✿	✿	✿	✿					●	●	●				●	●								

INRGREF, TUNISIA, TN

Caper (EN)

Cappero (IT)

Alcaparro (SP)

Câprier (FR)

كبّار (AR-TN)

κάππαρη (GR)

كبر وير (AR)

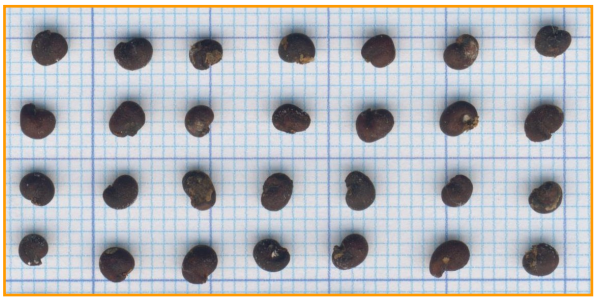
Capparis spinosa L. s.l.

Growth conditions in the wild

Caper is found in almost all the Mediterranean regions. It is uncertain if it is indigenous to all the Mediterranean regions.

In Tunisia, caper is characterized by a wide geographical distribution.

Seed information and collection



•Averaged weight for 100 seeds is 0.83 g (100 g = 13,600 seeds).

•Fruit collection should be done as soon as the fruit is ripe (July-August). Harvesting is done manually by picking the mature fruits directly from the branches.

•Non-protected species.

Seed germination

25°C

Pre-treatment: Soak in H_2SO_4 98% during 20 min.

12 h

12 h

Best germination conditions in peat, 12 h light /12 h dark at 25°C.

Average germination: 51%.

Seed management

•Cleaning is done manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
				✿	✿	✿	✿						❧	❧									

It is one of the most commonly found aromatics in the Mediterranean Basin. The flower buds are stored in vinegar or brined and eaten pickled.

INRGREF, TUNISIA, TN

Carob (EN)

Carrubo (IT)

Algarrobo (SP)

Caroubier à siliques (FR)

Χαρουπιά (GR)

الخروب (AR-LB)

خرّوب (AR-TN)

Ceratonia siliqua L.

Growth conditions in the wild

Native to Turkey, Cyprus, Syria, Lebanon, Palestina, southern of Jordan, Egypt, Tunisia and Libya. It has been probably introduced to Greece, Italy, France, Spain and Portugal. It is cultivated for the edible legume beans, as ornamental tree and for restoration of degraded arid areas.

Carob tree is an evergreen sclerophyllous species and it occurs notably in maquis and forests. It shows indifferent edaphic behaviour and grows from 0 to 600 m. a.s.l.

Seed germination

Soaking in water (48 h) or in H_2SO_4 98% during 30 min.

20°C

Germination at 20ºC in 1% agar or in peat. No light (24 h dark).

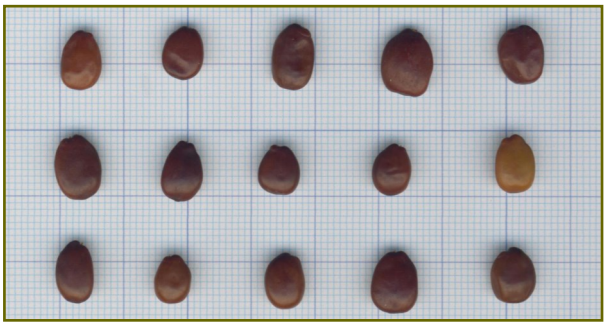
0 h

24 h

First seedlings in peat may be observed in 3 days.

Average germination: 100%.

Seed information and collection



•Averaged weight for 100 seeds is 14.8 g (100 g = 800 seeds).

•Fruit collection is done manually as soon as the fruit is ripe (August-September) from the ground or from the tree using a pruning shear.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seed extraction is done manually from fresh pods or mechanically using a blender. Seeds are separated from pulp using different sives.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

Carob flour is used as thikening agent (E410) in agroalimentary industry. In Tunisia carob is used for manufacturing soda drinks and sirops.

USJ, BEIRUT, LEB

Carob (EN)

Carrubo (IT)

Algarrobo (SP)

Caroubier à siliques (FR)

Χαρουπιά (GR)

الخروب (AR-LB)

خرّوب (AR-TN)

Ceratonia siliqua L.

Growth conditions in the wild

Native to Turkey, Cyprus, Syria, Lebanon, Palestina, southern of Jordan, Egypt, Tunisia and Libya. It has been probably introduced to Greece, Italy, France, Spain and Portugal.

It is found both on limestone and siliceous substrata. It occurs frequently in forest land cover and sands.

It is located in a wide altitudinal range, from ca. 0 to 1000 m. a.s.l.

Seed germination

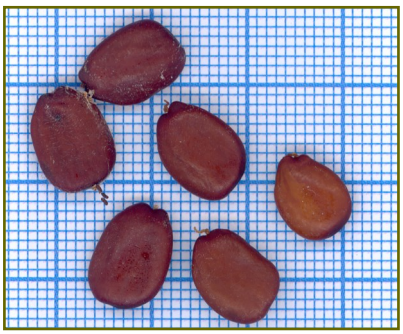
Chemical scarification with a concentrated solution of H_2SO_4 for 20 minutes.

Germination at 20ºC on agar without light.

First seedlings may be observed in 2 weeks. Total test length: 1 month.

Average germination: 83%.

Seed information and collection



•Averaged weight for 100 seeds is 20.9 g (100 g = 478 seeds).

•Fruits must be collected when they are fully black and dried. Harvesting is done manually from the ground or using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Dried pods can be cut in the middle to remove the seeds.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

The seeds contain galactomannan carob bean gum (CBG) or locust bean gum which is extracted and used as food additive for a wide range of purposes, and the potds provide a health food chocolate substitute.

USJ, BEIRUT, LEB

Cretan rockrose (EN)

Cisto di Creta (IT)

Estepa menorquina (SP)

Ciste de crète (FR)

Λαδανιά (GR)

لاذن أحمر (AR-LB)

تاي العرب (AR-TN)

Cistus creticus L. subsp. *creticus*

Growth conditions in the wild

Native to North Africa, Italy and Eastern Mediterranean.

It is found on limestone substrata. It occurs frequently in garrigues and roadsides and can be found in land-fill mining (mainly screes).

It is located in a wide altitudinal range, from ca. 0 to 1600 m. a.s.l.

Seed germination

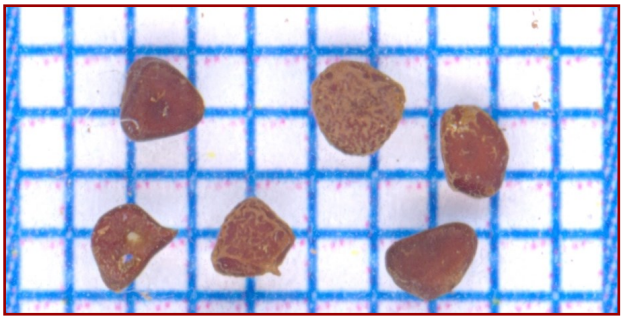
Hot scarification in boiling water for 20 sec.

Germination at 20ºC on agar without light.

First seedlings may be observed in 1 week. Total test length: 2 months.

Average germination: 78%.

Seed information and collection



•Averaged weight for 100 seeds is 0.1 g (100 g = 100,000 seeds).

•Fruits must be collected when they are dried and have a brown colour.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Open the fruits from above to remove the seeds, then shake them in a sieve to separate the seeds from the dirt.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
	✿	✿	✿																				

In the Western area it occurs *Cistus creticus* L. subsp. *eriocephalus* while in Sardinia and Corsina it is found the *Cistus creticus* L. subsp. *Corsicus.*

CCB, SARDINIA, IT

White Rockrose (EN)

Cisto di Montpellier (IT)

Estepa negra (SP)

Ciste de Montpellier (FR)

Βούκιθο (GR)

الملية (AR-TN)

Cistus monspeliensis L.

Growth conditions in the wild

Distributed along all the Mediterranean Basin and Canary Islands.

Occurs on poor soils (especially on siliceous substrata). Typical element of Mediterranean garrigues, dry scrubs or open woodlands, both in the inland and in coastal areas. It forms dense populations, especially in areas subjected to repeated fires.

It is a nanophanerophyte that grows at altitude ranging from 0 to 2000 m. a.s.l. Sun-tolerant, resistant to wind, dryness and salt stress.

Seed germination

It requires scarification: usually chipped with scalpel or other mechanical methods (e.g. sand paper).

16°C

12 h

12 h

Light (12 h light / 12 h dark), at 16°C.

It reaches high germination percentages, up to 100%.

Seed information and collection

•Averaged weight for 100 seeds is 0.09 g (100 g = 111,000 seeds).

•Collect capsules (about 12 seeds per capsule) by hand between July and October.

•Non-protected species, except inside protected areas where collection is regulated. The species is protected in Malta where it

Seed management

•Seeds can be separated from fruits and impurities by hand or mechanically using rubber tools, sieves of different size, and a blowing instrument.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

It has antioxidant, antibacterial, and anti-inflammatory effects. The resin that is derived from this plant is used in cosmetics. In the wild, seed germination increases significantly after the passage of fire.

MAICh, CRETE, GR

Cisto a fiori piccoli (IT)

Αγκίσαρος, Κίστος ο μικρανθής (GR)

Cistus parviflorus Lam.

Growth conditions in the wild

It occurs in the eastern Mediterranean Basin: Cyprus, Greece, Italy and Libya.

Light-demanding plant, in well lit places but not in very insolation rich sites. It occurs in very dry to dry sites. It is distributed from 0 to 550 m. a.s.l., and in Crete up to 1150 m. a.s.l. Plants of fairly hot to hot sites.

Seed germination

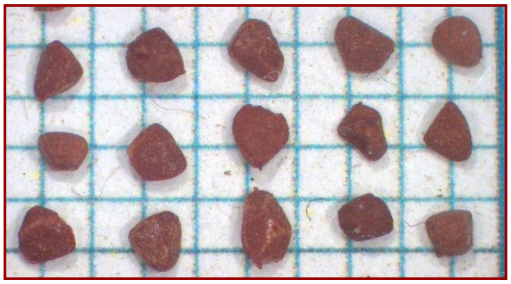
Pre-treatment: Seed immersion for 20 seconds in boiling water.

Best germination conditions: 10, 15 and 20°C, light (12 h light / 12 h dark).

Seedlings visible 30 days after sowing.

Average success of seed germination: 75-90%.

Seed information and collection



•Averaged weight for 100 seeds is 0.055 g (100 g = 181,818 seeds).

•Collect the seed pods in cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•The seed pods were cleaned mechanically using a rubber tool, and subsequently an seed aspirator (blowing instrument) was used to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿	✿		🍎	🍎			🍃	🍃	🍃	🍃										

It is used for ornamental purposes in gardens. The *Cistus* plants are known from ancient Greece with the common name κίστος.

CIEF, VALENCIA, SP

Evergreen clematis (EN)

Clematide (IT)

Clemátide (SP)

Clématite des haies (FR)

Αγράμπελη (GR)

ياسمين البر (AR-LB)

Clematis vitalba L.

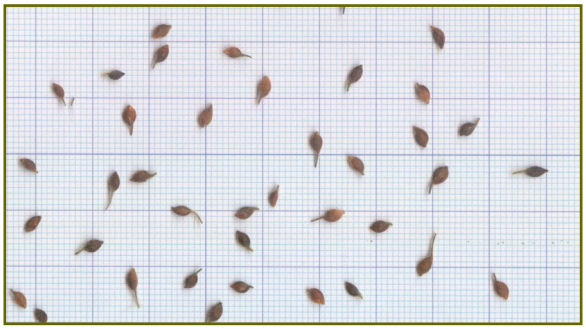
Growth conditions in the wild

Mediterranean region, W and C Europe.

Dispersed throughout the mesophilaw forests, hedges and scrubs; 0-1500 m. a.s.l.

Indifferent to edaphic factors.

Seed information and collection



•Averaged weight for 100 seeds is 0.267 g (100 g = 37,453 seeds).

•Harvesting is done manually picking the mature fruits directly from the branches.

Seed germination

Remove external coat. Imbibition into distilled water during 24 h. with 0.1% tween-20. Cold stratification (4ºC) during 2 month.

20°C 10°C

Alternant day/night temperature: 20/10°C. No light (24 h dark).

0 h 24 h

First seedlings after 10 days. Total test lenght (excluding pretreatment): 1 month.

Average germination: ca. 92%.

Seed management

•Fruits should be dried during 3-4 days. After, they should be slightly rubbed against a sieve to separate seeds from fruits and then winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
					✿	✿	✿		●	●	●			𝅘𝅥𝅮	𝅘𝅥𝅮								

Crushed fresh stems and leaves are extremely irritating. The beggars used them produce sores in their skins to cause sympathy. Nowadays the leaves are used to treat neuralgia and rheumatism.

INRGREF, TUNISIA, TN

Hairy broom (EN)

Citisio trifloro (IT)

Cytise velu (FR)

هذبان(AR-TN)

κὐτισος (GR)

Cytisus triflorus Lam.

Growth conditions in the wild

The genus Cytisus is distribuited from N Africa to S, W and central Europe, reaching Germany and Poland to the N, and W Russia, the Black Sea and Turkey to the East. The highest species diversity is observed around the Mediterranean Sea.

In Tunisia, the hairy broom is found in the kouk oak forests with siliceous substrata. It occurs from 200 to 800 m. a.s.l.

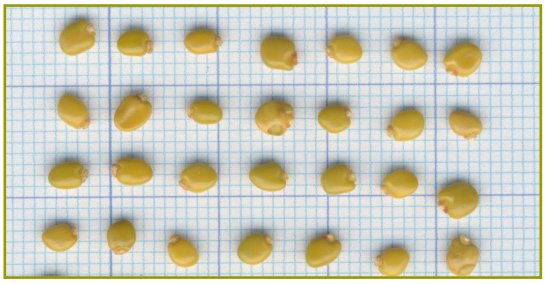
Seed germination

Soaking in H_2SO_4 98% during 30 min.

Best germination conditions in 1% agar, dark at 25°C.

Average germination: 80%.

Seed information and collection



•Averaged weight for 100 seeds is 0.82 g (100 g = 12,800 seeds).

•Harvesting is done manually as soon as the fruit is ripe from the tree.

•Non-protected species.

Seed management

•Cleaning is very easy. Seed extraction from pods is done manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
				✿	✿	●	●							𝅘𝅥𝅮	𝅘𝅥𝅮								

It is used in traditional medicine for treating abdominal pain, wound healing and as haemostatic.

MAICh, CRETE, GR

Garou (FR)

Χολόχορτο, Χολοκούκκι (GR)

Daphne gnidioides Jaub. & Spach

Growth conditions in the wild

The species is found in Greece, Lebanon, Syria and Turkey.

Semi-light plant, generally in well lit places, but also in moderate shade. It occurs in very dry to dry-sites. In Crete it is distributed from 5 to 150 m. a.s.l. Plants of fairly hot to hot sites.

Seed germination

15 °C

12 h

12 h

Best germination conditions: No pre-treatment, 15°C, light (12 h light / 12 h dark).

Seedlings visible 90 days after sowing.

Average success of seed germination: 95%.

Seed information and collection

•Averaged weight for 100 seeds is 1.667 g (100 g = 6,000 seeds).

•Collect mature seeds (of bright red color) in cloth bags and place them on absorbent paper.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

• Cleaning is relatively difficult. Seeds are placed under running water, while mechanically cleaned inside a sieve, using a rubber tool to remove the fruit parts. After that seeds are placed on absorbent paper to dry and then cleaned once again.

• Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

It is a medicinal plant.

USJ, BEIRUT, LEB

Olive-like Daphne (EN)

Dafne spatolata (IT)

Torvisco de monte (SP)

Daphné Faux-olivier (FR)

Χαμολιά (GR)

دفنة زيتونية (AR-LB)

Daphne oleoides Schreb. s.l.

Growth conditions in the wild

Native to Syria, Lebanon and the Mediterranean Basin.

It is found on limestone substrate. It occurs frequently in a degraded lands.

It is located in a wide altitudinal range, from ca. 1000 to 1900 m. a.s.l.

Seed germination

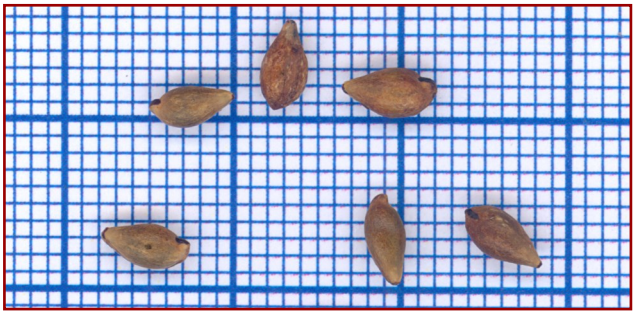
Warm stratification 20ºC for 10 weeks and cold stratification for 3 months 4ºC.

Germination at 4ºC on agar with not direct light.

First seedlings may be observed in 6 months. Total test length: 1 year.

Average germination: 58%.

Seed information and collection



•Averaged weight for 100 seeds is 1.18 g (100 g = 8,439 seeds).

•Fruits must be collected when they have an orange colour and well ripped.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cover the blade of a blender with a rubber material. Place the ripe fruits in the blender and turn it on for 1 min. Separate the seeds from the dirt using a sieve.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

CCB, SARDINIA, IT

Sardinian Purple Foxglove (EN)

Digitale purpurea (IT)

Digitale pourpre de Corse (FR)

Digitalis purpurea var. *gyspergerae* (Rouy) Fiori

Growth conditions in the wild

Endemic to Corsica and Sardinia. It is found at the margin of different oak woods, in screes but it can be located also on orophylous scrubs and soil disturbed by morphology dynamics.

It is a biennial or perennial herb. It grows mainly on siliceous substrata at a variable altitude from ca. 200 to 1800 m. a.s.l.

Seed germination

20°C

12 h

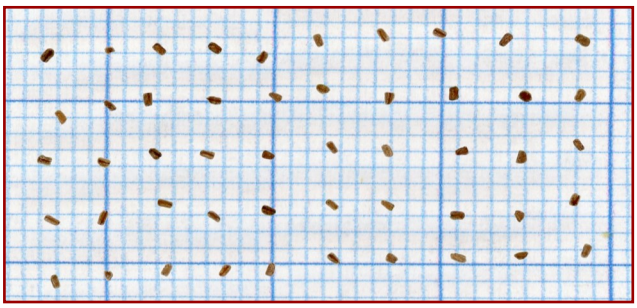
12 h

Best germination conditions: no pre-treatment, light (12 h light / 12 h dark), at 20°C.

Similar results were obtained when seeds were treated with GA_3.

Average germination: very high, up to 98%.

Seed information and collection



•Averaged weight for 100 seeds is 0.006 g (100 g = 1,660,000 seeds).

•The fruit is a capsule and when reaches maturity, it opens releasing numerous tiny seeds. When collecting seeds, cut the capsules and put them in paper bags.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds were cleaned mechanically, using a rubber tool to break the capsules; then sieves were used with different mesh sizes to separate and select the material from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is a common ornamental and useful plant for the treatment of heart disease.

CCB, SARDINIA, IT

Sand couch grass (EN)

Gramigna delle spiagge (IT)

Grama de la arena (SP)

Chiendent des sables (FR)

Elytrigia juncea (L.) Nevski subsp. *juncea*

Growth conditions in the wild

It is distributed along the Mediterranean coasts and the European and Moroccan Atlantic.

It grows on coastal dunes and sandy shores. It occurs on the first embryo dunes up to 100 m. a.s.l.

Seed germination

20°C

12 h

12 h

Best germination condition: no pretreatment, light (12 h light / 12 h dark), at 20°C.

Average germination: ca. 90%.

Seed information and collection

•Averaged weight for 100 seeds is 0.910 g (100 g = 10,900 seeds).

•During collecting cut the inflorescences and put them in paper bags.

•Non-protected species, except inside protected areas where

Seed management

•Seeds were cleaned manually, separating the caryopses from the glume with the help of a rubber tool.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿	✿	●	●	●													♪	♪	

CCB, SARDINIA, IT

Sea holly (EN)

Calcatreppola marina (IT)

Cardo de mar (SP)

Panicaut maritime (FR)

Γαλανόχορτο (GR)

شنداب بحري (AR-LB)

شوك بحري (AR-TN)

Eryngium maritimum L.

Growth conditions in the wild

Mediterranean region, from Morocco to Asia Minor, Syria, Israel and the Black Sea coast, western Portugal up to Scandinavia and the Baltic Sea.

Pioneer species of dunes and sandy beaches, especially on the front dune closest to the sea.

Seed germination

20°C

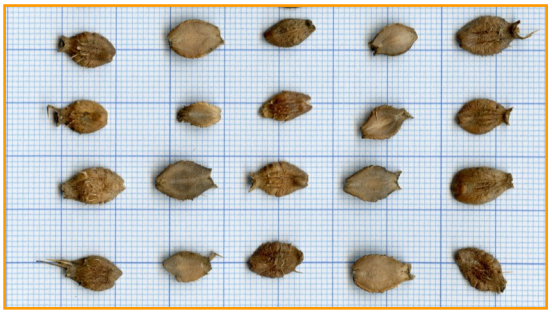
12 h

12 h

Best germination condition: light (12 h light / 12 h dark), at 20°C.

Average germination: 78%.

Seed information and collection



•Averaged weight for 100 seeds is 1.87 g (100 g = 5,300 seeds).

•Use gloves for the seed collection due the thorns presence on the fruits. Period of collecting during late summer (August, September).

•Non-protected species, except inside protected areas where

Seed management

•Seeds cleaned manually using gloves. Crush fruits with swab and select seeds using tweezers.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿	✿	✿	✿	●						𝅗𝅥	𝅗𝅥									

In Sardinia the plant is used as an analgesic, for rheumatic pains and for renal affections. In Elizabethan times in England, this plant was believed to be a strong aphrodisiac.

CIEF, VALENCIA, SP

Sea holly (EN)

Calcatreppola marina (IT)

Cardo marino (SP)

Panicaut maritime (FR)

Γαλανόχορτο (GR)

شنداب بحري (AR-LB)

شوك بحري (AR-TN)

Eryngium maritimum L.

Growth conditions in the wild

Mediterranean region, from Morocco to Asia Minor, Syria, Palestine and Black Sea. Western coasts of Europe, from Portugal to the S Scandinavia and the Baltic Sea.

Coasts of the Iberian Peninsula and Balearic Islands.

Maritime dunes and island sandy areas. It occurs from 0 to 300 m. a.s.l.

Seed germination

Remove external coat. Disinfection with 1% NaClO 15 min. Imbibition into distiled water 4 hours. Cold stratification (4ºC): 1 month.

20°C

Germination at 20ºC, no light.

0 h

24 h

First seedlings are observed in 4-5 days. Total test lenght (excluding pretreatment): 7-8 weeks.

Average germination: 55% (min 32%-max 85%).

Seed information and collection

•Averaged weight for 100 seeds is 1.671 g (100 g = 5,981 seeds).

•As it is a thorny plant it is recommended to use gloves while harvesting, and cut with scissors the stems holding infructescences. Smaller infructescences often contains few good-condition seeds, so it is advisable to collect only the larger ones.

Seed management

•Seeds are extracted from fruits manually, with laboratory tweecers, and using globes to avoid pricking. Additionally, the seeds may be sieved to remove its thorny extensions, that will allow to work easily with them.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is used to revegetate the leeward dune areas. Viability of seed lots is highly variable, which leads to different germination sucess. For restoration purposes, seeds, seedlings or roots may be used.

INRGREF, TUNISIA, TN

Fennel (EN)

Finocchio (IT)

Hinojo (SP)

Fenouil (FR)

Μάραθο (GR)

بسباس (AR-TN)

Foeniculum vulgare Mill. s.l.

Growth conditions in the wild

Fennel plant is native to S Europe and the Mediterranean region.

F. vulgare tolerates sandy dry soil better than fertile loam, and it seems to prefer acid rather than alkaline soil.

Seed germination

20°C

Best germination conditions in 1% agar, no pretreatment, dark at 30°C.

0 h

24 h

Average germination: 80%.

Seed information and collection

•Averaged weight for 100 seeds is 0.21 g (100 g = 67,000 seeds)

•Seed harversting is done using a pair of scissors to cut the flower heads inside a plastic bag, in order to avoid the wind dispersion of the material.

•Non-protected species.

Seed management

•Cleaning is done manually by rubbing the flowers.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
						✿	✿		●	●				❧									

Fennel is an aromatic and edible plant with soft, feathery, almost hair-like foliage. Seeds infusion is used particularly in folk medicine for intestinal gas treatment.

INRGREF, TUNISIA, TN

Slender broom (EN)

Ginestra cenerina (IT)

Genêt cendré (FR)

رتم رمادي (AR-TN)

Genista cinerea (Vill.) DC.

Growth conditions in the wild

It occurs in Algeria, France, Italy and Spain. In Tunisia, it is present from the thermomediterranean to the mesomediterranean belt.

It is found on rocks and mountain slopes. It occurs from 100 to 800 m. a.s.l.

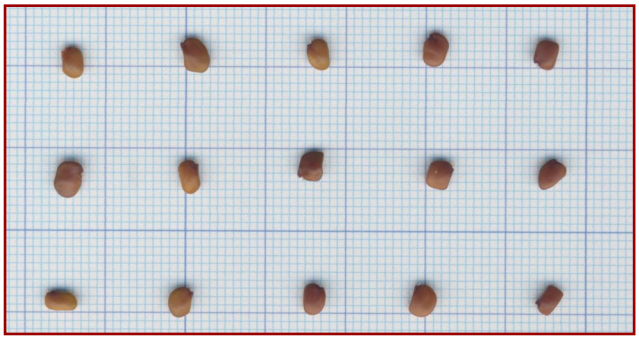
Seed germination

Pre-treatment: soak in H_2SO_4 98% during 30 min.

Germination at 20°C in 1% agar or in peat. Light conditions (16 h light, 8 h dark).

Average germination: 90%.

Seed information and collection



•Averaged weight for 100 seeds is 1.231 g (100 g = 8,200 seeds).

•Seed harvesting is done using a pair of scissors.

•Non-protected species.

Seed management

•Seed extraction is done manually from pods or by rubbing pods against a sieve.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

The branches are used for heating and making brooms.

CCB, SARDINIA, IT

Cat's Head Rockrose (EN)

Eliantemo a testa di micio (IT)

Jarilla de cabeza de gato (SP)

Hélianthème tête de chat (FR)

Helianthemum caput-felis Boiss.

Growth conditions in the wild

It is distributed along the SW Mediterranean Basin. It is found in small populations in Spain (Alicante, Balearic Islands), Italy (Sardinia), Morocco and Algeria.

It occurs mainly on carbonate substrata, compact or sandy, on marly limestones or on sandstone, from ca. 5 to 150 m. a.s.l.

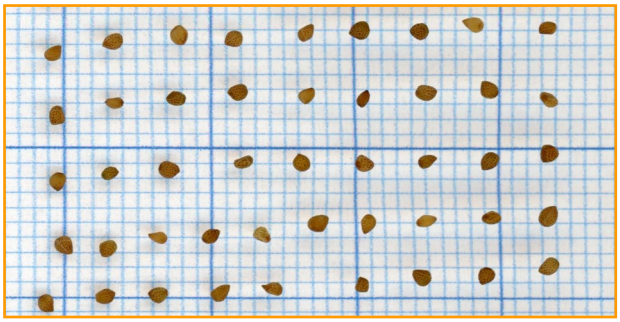
Seed germination

Before germination, seeds need a prestorage for 3 months on silica gel at 25°C (Dry After Ripening — DAR). Then, scarification is needed: seeds were chipped with scalpel before sowing.

Best germination conditions: light (12 h light / 12 h dark), at 20°C.

Average germination: up to 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.07 g (100 g = 142,000 seeds).

•For seed collection, cut capsules and put them in paper bags.

•Protected species. It is included in the Berne Convention, and protected by the Habitats Directive 92/43/EEC. It is categorized as "Critically Endangered, CR" in the Italian Regional Red

Seed management

•Seeds cleaned mechanically using a rubber tool, and sieves with different mesh sizes to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	✿	✿	✿	✿		●	●														)	)	

CCB, SARDINIA, IT

Tyrrhenian Curry Plant (EN)

Elicriso tirrenico (IT)

Immortelle Tyrrhenienne (FR)

Siempreviva tirrenica (SP)

Helichrysum microphyllum Cambess. subsp. *tyrrhenicum* Bacch., Brullo & Giusso

Growth conditions in the wild

Endemic to Sardinia, Corsica and Balearic Islands.

It is found on different substrata. It grows frequently in dry and stony places in arid grasslands, garrigues and maquis.

In Sardinia is widespread from sea level up to 1500 m. a.s.l.

Seed germination

20°C

12 h

12 h

Best germination conditions: no pretreatment, light (12 h light / 12 h dark), at 20°C.

Seeds treated with GA_3 germinated similarly when incubated at 20°C.

Average germination: up to 95%.

Seed information and collection

•Averaged weight for 100 seeds is 0.006 g (100 g = 1,660,000 seeds).

•When collecting seeds, cut the flower heads inside a paper bags in order to avoid the dispersion of the material due to wind.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds fall apart after fruit dehiscence, just remove manually the coma (hairy part) of the seed.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿	✿	✿	●																

Is used in Sardinian traditional medicine to nurse cough, burns and as antirheumatic and analgesic.

MAICh, CRETE, GR

Dwarf curry plant (EN)

Elicriso microfillo (IT)

Siempreviva del monte (SP)

Immortelle à petites feuilles (FR)

Λαγοκοιμηθιά (GR)

Helichrysum microphyllum (Willd.) Cambess subsp. *microphyllum*

Synonym: *Helichrysum italicum* (Roth) G. Don. subsp. *microphyllum* (Willd.) Nyman

Growth conditions in the wild

The species is distributed only in Greece.

It is a light-demanding plant, in well lit places but not in very insolation rich sites. It occurs in dry to fresh sites. Regarding natural temperature tolerance, the species is indifferent; wide ecological amplitude or different behaviour in different areas. It is distributed from 700 to 2100 m. a.s.l., in Crete it can be find also at lower altitudes, specifically from 300 m. a.s.l.

Seed germination

20 °C

12 h

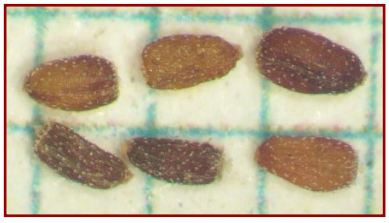
12 h

Best germination conditions: No pre-treatment, 10, 15 and 20°C, light (12 h light / 12 h dark).

Seedlings visible 15 days after sowing.

Average success of seed germination: 90-100%.

Seed information and collection



• Averaged weight for 100 seeds is 0.005 g (100 g = 1,925,134 seeds).

•When collecting seeds, it is useful to bring a pair of scissors to cut the flower heads inside a cloth bag, in order to avoid the dispersion of the material due to wind.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Seeds were cleaned mechanically using a rubber tool, and subsequently an seed aspirator (blowing instrument) was used to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿	✿	✿	✿															

Medicinal plant that can also be used as ornamental.

MAICh, CRETE, GR

Αγούδουρας (GR)

الحمراء (AR-TN)

Hypericum empetrifolium Willd. subsp. *empetrifolium*

Growth conditions in the wild

The species occurs in Albania, Greece (including Crete), Cyprus, Turkey and Libya.

Semi-light plant, generally in well lit places, but also in moderate shade. It occurs widely in woodland, maquis and garrigues. It is distributed from 0 to 1200 m. a.s.l. Plants of fairly hot sites.

Seed germination

Pre-treatment: Dry storage (Relative Humidity < 20% and room temperature) for approx. 6 months.

20 °C

Best germination conditions: 15 and 20°C, light (12 h light / 12 h dark).

12 h

12 h

Seedlings visible 35 days after sowing.

Average success of seed germination: 95%.

Seed information and collection

•Averaged weight for 100 seeds is 0.011 g (100 g = 909,100 seeds).

•Seed pods are cut with scissors and placed inside cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is difficult. Seeds were cleaned mechanically using a rubber tool, and subsequently a seed aspirator was used to separate the seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

Can be used as ornamental and may have medicinal properties, as all *Hypericum* species.

MAICh, CRETE, GR

Stinking tutsan (EN)

Iperico ircino (IT)

Androsemo cabruno (SP)

Millepertuis (FR)

Υπέρικο (GR)

Hypericum hircinum L. *albimontanum* (Greuter) N. Robson

Growth conditions in the wild

The species occurs in many Mediterranean countries, either as native (Cyprus, Greece (including Crete), Israel, Jordan, Lebanon, Syria and Turkey or as cultivated (Portugal, Spain, Switzerland and UK).

Semi-shade plant. It is an indicator of wet and of fairly hot sites. It occurs up to 1000 m. a.s.l.

Seed germination

20 °C

12 h 12 h

Best germination conditions: no pre-treatment, 15 and 20°C, light (12 h light/12 h dark).

Seedlings visible 20-30 days after sowing.

Average success of seed germination: 80-100%.

Seed information and collection

•Averaged weight for 100 seeds is 0.0076 g (100 g = 1,315,789 seeds).

•Seed pods are cut with scissors and placed inside cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is difficult. Seeds were cleaned mechanically using a rubber tool, and subsequently a seed aspirator (blowing instrument) was used to separate the seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
					✿	✿			●					𝅘𝅥𝅯	𝅘𝅥𝅯								

Can be used as ornamental and may have medicinal properties, as all *Hypericum* species.

CCB, SARDINIA, IT

Somerset Rush (EN)

Giunco foglioso (IT)

Junco o candilejo (SP)

Jonc (FR)

Βούρλο (GR)

السمار (AR-TN)

Juncus subulatus Forssk.

Growth conditions in the wild

Is distributed in the Southern Mediterranean areas. In Italy it occurs in Tuscany, Lazio, Molise, Puglia, Basilicata, Calabria, Sicily and Sardinia, where it is widespread in wetlands.

It is a rhizomatose geophytes; it occurs in brackish marshes, and only rarely more internally; from 0 to 10 m. a.s.l.

Seed germination

25°C

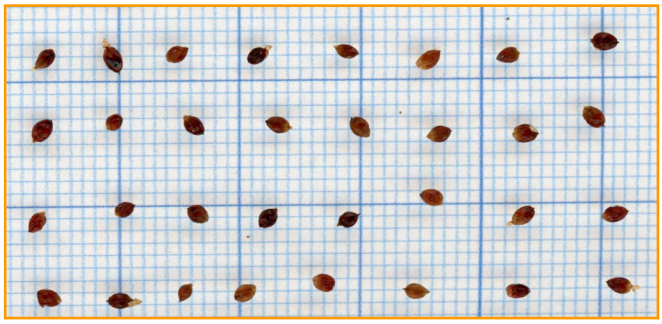
12 h

12 h

Best germination condition: no pre-treatment, light (12 h light / 12 h dark), at 25°C.

Average germination: ca. 80%.

Seed information and collection



•Averaged weight for 100 seeds is 0.004 g (100 g = 2,500,000 seeds).

•During collecting cut the inflorescences and put them in paper bags.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds cleaned mechanically using a rubber tool and sieves with different mesh sizes (it is useful the 0.250 µm sieve). Finally, the material was positioned in the airstream to separate and select the seeds from residual impurities.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
				✿	✿																		

The tender leaf is used to weave baskets and for drawstrings production.

CCB, SARDINIA, IT

Phoenicean juniper (EN)

Ginepro fenicio (IT)

Sabina marina (SP)

Genévrier Phénicie (FR)

العرعار (AR-TN)

Juniperus phoenicea L. subsp. *turbinata* (Guss.) Nyman

Growth conditions in the wild

Distribuited along the western Mediterranean coasts: Algeria, Dalmazia coast, France (Corsica and mainland Provence coast), Greece, Italy (Tyrrhenian coasts and islands, Sardinia, Sicily), Morocco, Portugal (Algarve), Spain (Baleares and eastern-coast), Tunisia.

It is a phanerophyte that grows in the lowlands behind the dunes and is a characteristic plant of the priority habitat "Coastal dunes with *Juniperus* spp." of the Habitats Directive 92/43/EEC.

Seed germination

Best germination condition: seeds are pre-chilled for 3 months at 5°C. Light (12 h light / 12 h dark), at 20°C.

20°C

12 h

12 h

In nurseries, sowing occurs in seedbeds in October (germination may begin after 5-6 weeks), transplanting the seedlings the following March.

Average germination: very variable, usually between 30-60%.

Seed information and collection

•Averaged weight for 100 seeds is 2.192 g (100 g = 4,500 seeds).

•During collection take the cones and put them in paper bags. It is a dioecious plant: the seeds are produced only on female trees.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds are cleaned manually, opening the cones and extracting the seeds with tweezers. If the cones are particularly resistant, it could be useful to hydrate the cones for a couple of hours and only later start the cleaning. They can also be cleaned mechanically for large-scale plant production, using a seed depulper.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

In the traditional medicine infusion of the cones was used as an antiseptic and vermifuge.

INRGREF, TUNISIA, TN

Fringed lavender (EN)

Spigonardo (IT)

Alhucema rizada (SP)

Lavande (FR)

Λεβάντα (GR)

خزامى مسننة (AR-TN)

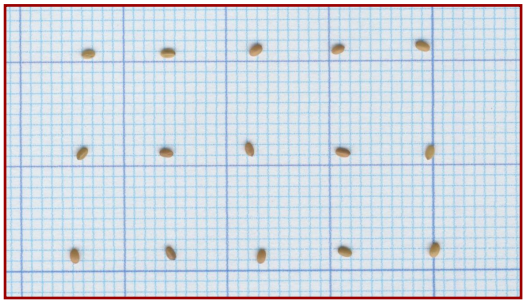
Lavandula dentata L.

Growth conditions in the wild

It is distributed from the Canary, Cape Verde Islands and Madeira, across the Mediterranean Basin, North Africa, South, West Asia and the Arabian Peninsula.

It is a small evergreen shrub, having aromatic foliage and flowers. Its native habitat includes low hills, garrigues and maquies with limestone substrates amidst other shrubs. It occurs from 0 to 1000 m. a.s.l.

Seed information and collection



•Averaged weight for 100 seeds is 0.06 g (100 g = 202,000 seeds)

•Seed harvesting is done using a pair of scissors, cutting the inflorescences and putting them in paper bags.

•Non-protected species.

Seed germination

30°C

16 h

8 h

Germination at 30ºC in peat 16 h light /8 h dark.

Average germination: 92%.

Seed management

•Seeds fall after fruit dehiscence.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

The species is of great interest due to their content of essential oil, which is important in the perfume, cosmetic, flavoring, and pharmaceutical industries.

MAICh, CRETE, GR

French or Spanish lavender (EN)

Lavanda selvatica (IT)

Cantueso (SP)

Lavande à toupet (FR)

Ἀγρια λεβάντα (GR)

لاوند (AR-LB)

الخلال (AR-TN)

Lavandula stoechas L. subsp. *stoechas*

Growth conditions in the wild

It is distributed throughout the Mediterranean, in Algeria, Cyprus, France, Greece (including Crete), Israel, Italy, Jordan, Lebanon, Morocco, Portugal, Spain, Syria, Tunisia an Turkey.

Light plant, generally in well lit places and in dry sites. It grows mainly on siliceous substrata and it occurs from 0 to 1000 m. a.s.l. In Crete it is distributed up to 800 m. a.s.l. Plants to fairly hot to hot sites.

Seed germination

20 °C

12 h

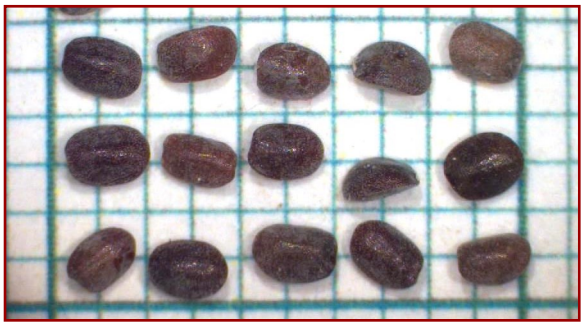
12 h

Best germination conditions: No pretreatment, 10, 15 and 20°C, light (12 h light/12 h dark).

Seedlings visible 10 days after sowing.

Average success of seed germination: 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.082 g (100 g = 122,500 seeds).

•Collect the entire infructescence in cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Seeds were cleaned mechanically using a rubber tool, and subsequently a seed aspirator (blowing instrument) was used to separate the seeds from residual impurities.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿		●	●					❧	❧	❧										

Plant used as ornamental, as bee plant and was also used as medicinal in the ancient times.

CIEF, VALENCIA, SP

Etruscan honeysuckle (EN)

Caprifoglio etrusco (IT)

Madreselva etrusca (SP)

Chèvrefeuille d'Étrurie (FR)

Αγιόκλημα (GR)

سلطان الجبل (AR-LB)

Lonicera etrusca Santi

Growth conditions in the wild

Mediterranean region, SW Asia and Macaronesia (Azores, Madeira and the Canary Islands).

Clearings and fringe communities of oak, pyrenean oak and gall oak forests in Mediterranean or sub-Mediterranean climate, on all sub-strata; 0-1600 (1800) m. a.s.l.

Seed germination

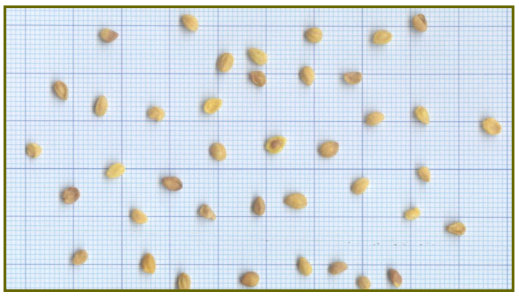
Imbibition in distilled water during 2 h.

Germination at alternant day/night temperature: 20/10°C. No light (24 h dark).

First seedling after 23 days. Total test lenght: 6 weeks.

Germination: 93%.

Seed information and collection



•Averaged weight for 100 seeds is 0.833 g (100 g = 12,006 seeds).

•Fruit collection should be done as soon as the fruit is ripe (August-September) to avoid predation by fauna.

•Harvesting is done manually picking the mature fruits directly from the branches.

Seed management

•Soak the fruits during 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dry during 2 days, slighltly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿	✿																	

- It is a species often cultivated as ornamental. The ornamental value of *Lonicera etrusca* lies especially in its fragrance.

CIEF, VALENCIA, SP

Minorca honeysuckle (EN)

Caprifoglio mediterraneo (IT)

Madreselva mediterránea (SP)

Chèvrefeuille entrelacé (FR)

Αγιόκλημα (GR)

Lonicera implexa Aiton. subsp. *implexa*

Growth conditions in the wild

Mediterranean region, SW Asia and Macaronesia (Azores).

Scrubs, forest clearings and borders, in mediterranean environment; 0 - 900 (1300) m. a.s.l.

Indifferent to edaphic factors.

Seed germination

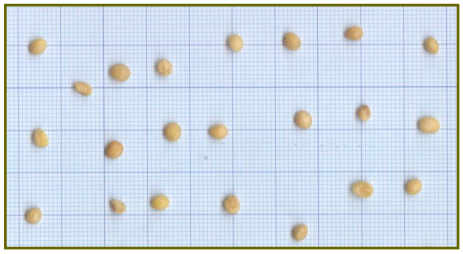
Imbibition in distilled water during 2 h.

Germination at alternant day/night temperature: 20/10°C. No light (24 h dark).

First seedling after 22 days. Total test lenght: 2 months.

Average germination: 85%.

Seed information and collection



•Averaged weight for 100 seeds is 1.231 g (100 g = 8,123 seeds).

•Fruit collection should be done as soon as the fruit is ripe (September-October) to avoid predation by fauna.

•Harvesting is done manually picking the mature fruits directly from the branches.

Seed management

•Soak the fruits during 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dry during 2 days, slightly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿	✿	✿																	

It is a species often cultivated as ornamental. Plant cultivation may be performed in 200 cm^3 forest containers, sowing in early autum-winter.

CIEF, VALENCIA, SP

Dwarf honeysuckle (EN)

Caprifoglio peloso (IT)

Madreselva pilosa (SP)

Chèvrefeuille à balais (FR)

Αγιόκλημα (GR)

Lonicera xylosteum L.

Growth conditions in the wild

Most of Europe states, Caucasus, Pontic region and W Siberia.

Mountainous areas of the northern half of the Iberian Peninsula, much rarer in the South.

Clearings and fringe communities of deciduous forests, thorn thickets and hedges, preferably in calcareous soils, in mountainous sub-humid environments; 300-1500 (1800) m. a.s.l.

Seed germination

Imbibition in distilled water during 2 h.

Germination at alternant day/night temperature: 20/10°C (24 h dark).

First seedling after 15 days. Total test lenght: 6 weeks.

Germination: 93%.

Seed information and collection

•Averaged weight for 100 seeds is 0.340 g (100 g = 29,378 seeds).

•Fruit collection should be done as soon as the fruit is ripe (August-September) to avoid predation by fauna.

•Harvesting is done manually picking the mature fruits directly from the branches.

Seed management

•Soak the fruits during 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dry during 2 days, slighltly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is a species often cultivated as ornamental. The fruits are irritating to the mucous membranes and skin.

INRGREF, TUNISIA, TN

Magydaris (EN)

Basilisco (IT)

Magydaris (FR)

تفيفرة (AR-TN)

Magydaris pastinacea (Lam.) Paol.

Growth conditions in the wild

It is a biannual plant which originated from Mediterranean region. It is widespread especially in Algeria, Morocco, Sardinia, Sicily and Lampedusa.

Magydaris is cultivated in the Northern of Tunisia and it is found on humid ravines and edges of rivers. It occurs from 0 to 400 m. a.s.l.

Seed germination

22°C

Pre-treatment: soak in NaOCl 32% during 15 min.

0 h 24 h

Best germination conditions in peat, dark at 22°C.

Average germination: 90%.

Seed information and collection

•Averaged weight for 100 seeds is 4.55 g (100 g = 2,500 seeds).

•Seed harversting is done using a pair of scissors to cut the umbels inside a plastic bag.

•Non-protected species.

Seed management

•Cleaning is done manually by rubbing the umbels.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
			✿	✿	●	●								♪	♪								

It is valued for its aroma, medicinal and therapeutic properties. In Tunisia, the fruits are used in rituels (fumigation).

USJ, BEIRUT, LEB

Tree-lobed apple (EN)

Melo trilobo (IT)

Manzano trilobulado (SP)

Pommier trilobé (FR)

تفاح الجبل (AR-LB)

Malus trilobata (Labill. ex Poir.) C.K. Schneid.

Growth conditions in the wild

Endemic to Lebanon.

It is found both on limestone and siliceous substrata. It occurs frequently in woods and clearing of forest and bushes.

It is located in a wide altitudinal range, from ca. 900 to 1700 m. a.s.l.

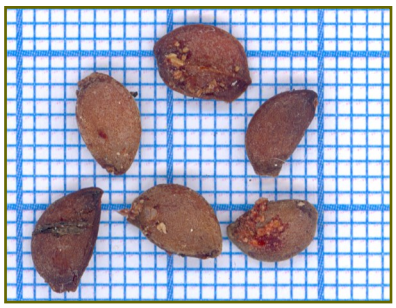
Seed germination

Cold/moist stratification for 90 days at 4°C on sand with no direct light. All seeds germinated during stratification.

First seedlings may be observed in 2 months. Total test length: 4 months.

Average germination: 89%.

Seed information and collection



•Averaged weight for 100 seeds is 2.4 g (100 g = 4,082 seeds).

•Fruits must be collected when they have a yellow-green colour and well ripped. Harvesting is done manually from the ground or using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cut the fruit in the middle and recover the seeds.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿			●	●					▮	▮		▮	▮					

The fruits are edible and are characterized by their sweetness.

INRGREF, TUNISIA, TN

Moon trefoil (EN)

Erba medica arborea (IT)

Alfalfa arbórea (SP)

Luzerne arborescente (FR)

Μηδική (GR)

شجيرة الفصّة (AR-TN)

Medicago arborea L.

Growth conditions in the wild

It is a woody shrub native to the islands and areas around the Mediterranean Sea. It is a leguminous grows in xerophilous garrigues and maquis.

It is highly salt tolerant and is widely adapted to southern Tunisia farming regions. It occurs from 0 to 300 m. a.s.l.

Seed germination

25°C

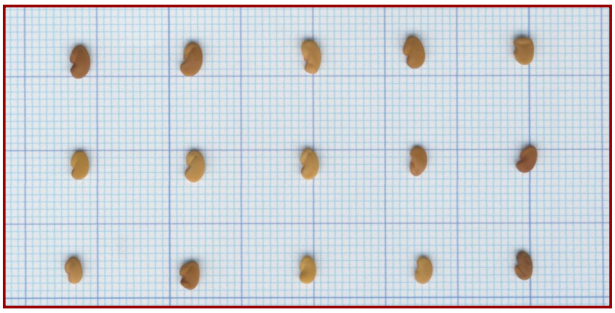
Germination at 25ºC in 1% agar, No light (24 h dark).

16 h / 8 h

Germination at 30ºC in peat, 16 h light /8 h dark.

Average germination in agar/peat: 92% / 90%.

Seed information and collection



•Averaged weight for 100 seeds is 0.89 g (100 g = 13,362 seeds).

•Seed harvesting is done using a pair of scissors. Cut pods from the plant and put in paper bags.

•Non-protected species.

Seed management

•Seed cleaning is done manually from fresh pods or mechanically using a blender. Seeds are separated from pulp using different sieves.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			❀	❀		🍎	🍎						𝅘𝅥𝅯	𝅘𝅥𝅯									

Species of the genus *Medicago* have agronomic interest due to their ability to the symbiotic nitrogen fixation, allowing an abundant production of plant proteins. The moon trefoll is the most important fodder crop in Tunisia.

CIEF, VALENCIA, SP

Coastal Medick (EN)

Erba medica marina (IT)

Carretón de playa (SP)

Luzerne marine (FR)

Αρμυρίθρα του πελάγου (GR)

فصة بحرية (AR-LB)

Medicago marina L.

Growth conditions in the wild

Mediterranean region, Black Sea coasts and Canary Islands.

Coasts of the Iberian Peninsula and Balearic Islands.

Coastal dunes and gravels, characteristic of first dune fringe; 0-50 m. a.s.l.

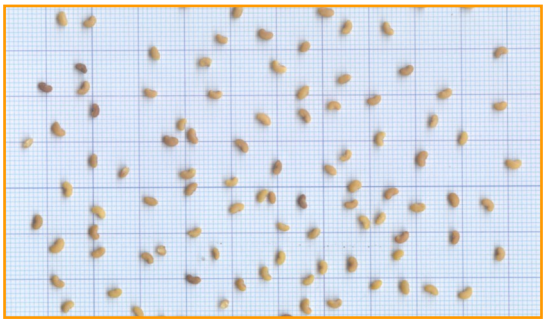
Seed germination

Scarification with concentrated H_2SO_4 for 20 min and rinse profusely. Imbibition into distiled water until the seeds are swollen. Germination at 20ºC, no light.

First seedlings are observed in 1 day. Total test lenght: 10 days.

Average germination: 95%.

Seed information and collection



•Averaged weight for 100 seeds is 0.424 g (100 g = 23,594 seeds).

•Harvesting is done manually picking the mature fruits directly from the branches.

Seed management

•To release the seeds, dried fruits should be introduced in a modified mincer (with protected or worn blades, to avoid breaking of seeds) for few seconds. After, the mixture should be sieved and winnowied with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿	●	●																		

It is used to revegetate the windward and the crest dune area. For restoration purposes, seeds instead of seedlings may be used, planting in autumn, while raining preferably

INRGREF, TUNISIA, TN

Myrtle (EN)

Mirto (IT)

Mirto (SP)

Myrte (FR)

Μυρτιά (GR)

آس شائع (AR-LB)

ريحان (AR-TN)

Myrtus communis L.

Growth conditions in the wild

It is wide spread in the Mediterranean region. It is widely distributed in coastal habitat particularly on siliceous substrata.

Thermophilous and humid shrub at altitude ranging from 0 to 600 m. a.s.l.

Seed germination

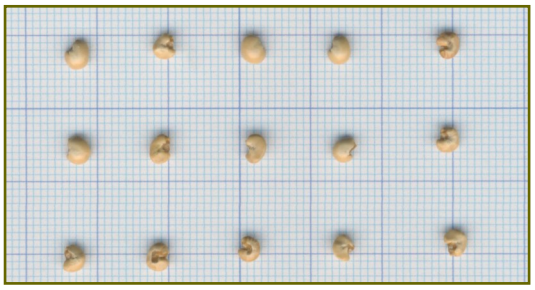
25°C

Germination at 25ºC on filter paper. 12 h light/12 h dark.

12 h 12 h

Average germination: 65%.

Seed information and collection



•Averaged weight for 100 seeds is 0.95 g (100 g = 12,000 seeds).

•Fruit collection should be done as soon as the fruit is ripe. Harvesting is done manually by picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds were cleaned manually removing carefully the pulp under water and then allowed to dry above sheets of paper.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
						✿	✿			●	●			𝅘𝅥𝅮	𝅘𝅥𝅮								

Essential uses of myrtle of Tunisia are perfumery, cosmetic, aromatherapy and food flavoring.

USJ, BEIRUT, LEB

Myrtle (EN)

Mirto (IT)

Mirto (SP)

Myrte commun (FR)

Μυρτιά (GR)

آس شائع (AR-LB)

ريحان (AR-TN)

Myrtus communis L.

Growth conditions in the wild

It is wide spread in the Mediterranean region.

It is widely distributed in coastal habitat particularly on siliceous substrata.

Thermophilous and humid shrub at altitude ranging from 0 to 1400 m. a.s.l.

Seed germination

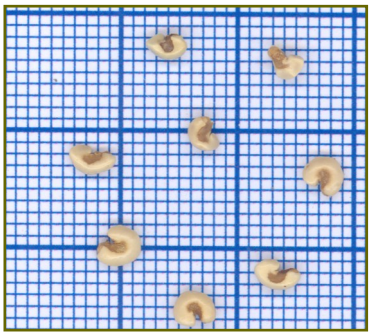
Cold/moist stratification for 3 months at 4°C.

Germination at 20°C on filter paper with no direct light.

First seedlings may be observed in 3 months. Total test length: 4 months.

Average germination: 90%.

Seed information and collection



•Averaged weight for 100 seeds is 0.6 g (100 g = 16,667 seeds).

•Fruits must be collected when they have a dark purple colour and well ripped. Harvesting is done manually using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds were cleaned manually removing carefully the pulp under water and then allowed to dry above sheets of paper.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿	✿				●	●	●											

The fruits are edible either raw or cooked.

CCB, SARDINIA, IT

Sardinian catmint (EN)

Gattaia di Sardegna (IT)

Calamento de Cerdeña (SP)

Népète de Sardaigne (FR)

Nepeta foliosa Moris

Growth conditions in the wild

This herbaceous perennial plant is endemic to Sardinia. It grows exclusively on the Supramonte Massif, in limestone substrate.

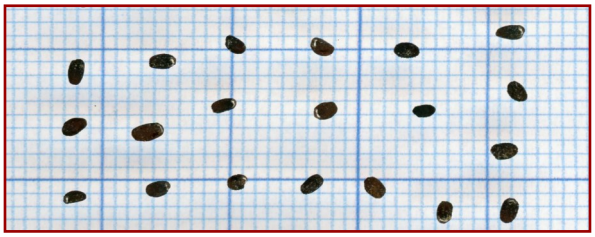
It is found from 700 to 1460 m. a.s.l. and it forms garrigues and frequently participates in maquis.

Seed germination

Best germination conditions: Incubate seeds with GA_3 (250 mg/L), light (12 h light / 12 h dark), at 20 and 25°C.

Average germination: 85%.

Seed information and collection



•Averaged weight for 100 seeds is 0.071 g (100 g = 140,000 seeds).

•During collecting, take the fruits (achenes) and put them in paper bags.

•Non-protected species, except inside protected areas where collection is regulated. It is included in the SIC " Supramonte di Oliena, Orgosolo e Urzulei-Su Sercone". The species is considered as "*Vulnerable*, VU" according the IUCN in the Italian Regional Red Book (Congiu *et al.,* 2014).

Seed management

•Seeds were cleaned mechanically using a rubber tool and then manually using a pair of tweezers to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

It is associated with other endemic species and helps to form a particular feature of the mountain scrubland on limestone substrate.

CIEF, VALENCIA, SP

Sea daffodil (EN)

Giglio di mare (IT)

Azuzena marina (SP)

Lis maritime (FR)

Κρίνος της θάλασσας (GR)

نرجس البحر (AR-LB)

Pancratium maritimum L.

Growth conditions in the wild

Coastline of the entire Mediterranean Basin, European Atlantic coasts and Morocco.

Coastal dunes; 0-50 m. a.s.l.

Seed germination

Imbibition into distiled water during 3 hours.

Germination at 20ºC. No light (24 h dark).

First seedlings are observed in 8 days. Total test lenght: 1 month.

Average germination: 91%.

Seed information and collection

•Averaged weight for 100 seeds is 3.209 g (100 g = 3,116 seeds).

•Harvesting is done manually picking the mature fruits (capsules) directly from the plant, preferably when capsules start to open, when they are full of seeds.

Seed management

•Dry the capsules in dry room to reach complete fruit opening (around 1 week); then it is easy to shell the seeds and remove fruit remains manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

It is used to revegetate the leeward dune. It is a bulbous plant species, so seedlings or bulbs may be used for restoration purposes; in the latter case, bulb should be devoid of leaves and be buried at 25-30 cm depth.

INRGREF, TUNISIA, TN

Wolfbane (EN)

Periploca minore (IT)

Cornical (SP)

Périploque (FR)

Περικοκλάδα (GR)

الحلاّب (AR-TN)

Periploca laevigata subsp. *angustifolia* (Labill.) Markgr.

Growth conditions in the wild

Distributed along the North of Africa, SE of Spain, Italy (Sicily), Malta, Greece (Crete), and Syria.

It is adapt to extremely varied hydric conditions. It is found on the driest and poorest soils. It occurs in thermophilous guarrigues and maquis, from 0 to 400 m. a.s.l.

Seed germination

30°C

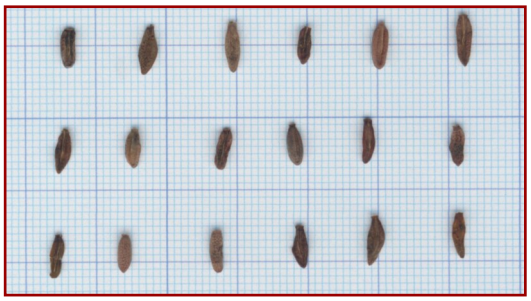
16 h

8 h

Best germination conditions: no pretreatment, in peat, light conditions (16 h light / 8 h dark), 30°C.

Average germination: 77%.

Seed information and collection



•Averaged weight for 100 seeds is 0.56 g (100 g = 25,000 seeds).

•When collecting seeds, it is usefull to bring a pair of scissors to cut the flower heads inside a cloth bag, in order to avoid the dispersion of the material due to wind.

•Non-protected species.

Seed management

•We suggest manual harvesting of fruits and seeds. For the follicles that are not fully ripened, they can be dried in open air. This method of drying prevents putrefaction of seeds and seed dispersal after the opening of the follicles.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

It has became infrequent, it is sought for its traditional medicinal virtues and for its pastoral and anti-erosion interest. In some regions in the South of Tunisia the latex is used as a masticatory.

USJ, BEIRUT, LEB

Intermediate phillyrea (EN)

Fillirea (IT)

Labiérnago de hoja ancha (SP)

Philaria intermédiaire (FR)

Φιλλύκι (GR)

برزة (AR-LB)

قطم (AR-TN)

Phillyrea latifolia L.

Growth conditions in the wild

Native to the whole Mediterranean Basin.

It is found both on limestone and siliceous substrata. It occurs frequently in sclerophyllous woods and sands.

It is located in a wide altitudinal range, from ca. 0 to 800 m. a.s.l.

Seed germination

Chemical scarification: soak the seed in a concentrated solution of H_2SO_4 for 30 minutes.

10°C

Germination at 10ºC on sand with no direct light.

12 h

12 h

First seedlings may be observed in 1 month. Total test length: 2 months.

Average germination: 75%.

Seed information and collection

•Averaged weight for 100 seeds is 4.1 g (100 g = 2,439 seeds).

•Fruits must be collected when they have a dark blue colour and well ripped. Harvesting is done manually or using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cover the blade of a blender with a rubber material. Place the ripe fruits in the blender and turn it on for 1 min. Separate the seeds from the dirt using a sieve.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
	✿	✿						●	●	⬮	⬮			𝅘𝅥𝅯	𝅘𝅥𝅯	𝅘𝅥𝅯							

In many Mediterranean places it is used for charcoal production.

INRGREF, TUNISIA, TN

Maritime pine (EN)

Pino marittimo (IT)

Pino rodeno o resinero (SP)

Pin maritime (FR)

صنوبر بحري (AR-TN)

Pinus pinaster Aiton s.l.

Growth conditions in the wild

Native to Algeria, France (Corse), Gibraltar, Italy (Sardinia, Sicily); Monaco; Morocco; Portugal; Spain (Baleares); Tunisia.

This long lived species dominates different landscapes and can withstand severe environmental conditions. The soil conditions are variable; mainly in acid soils, but also in basic soils and even in sandy and poor soils.

Seed germination

30°C

16 h 8 h

Germination at 30ºC in peat, 16 h light / 8 h dark.

First seedlings in peat may be observed in 2 weeks.

Average germination: 100%.

Seed information and collection

•Averaged weight for 100 seeds is 5.148 g (100 g = 1,900 seeds).

•Cones are collected manually or using a pruning shears before their opening.

•Non-protected species.

Seed management

•Cones are left immediately at the sun to open or exposed to the heat in an oven.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿			●	●					♪	♪								

Maritime pine is one of the most important species in the Mediterranean region for its ecology and wood productiveness. It is a major resin producing species.

CCB, SARDINIA, IT

Thorny burnet (EN)

Poterio spinoso (IT)

Pimpinela espinosa (SP)

Pimprenelle épineuse (FR)

Αφάνα (GR)

بلان شائك (AR-LB)

Poterium spinosum L.

Growth conditions in the wild

Native to Albania, Dalmazia, Greece, Israel, Italy (Sicily, Sardinia, Calabria, Basilicata, Apulia), Lebanon, Malta, Syria, Tunisia (Djerba), Turkey.

It is a nanophanerophite that grows mainly on limestones substrata. It is a characteristic species of phrygana and garrigue, at altitude from 0 to 1800 m. a.s.l.

Seed germination

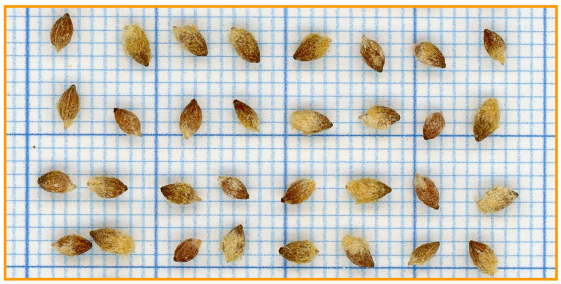
20°C 15°C

12 h 12 h

Best germination conditions: no pre-treatment, light (12 h light / 12 h dark), at 15 and 20°C.

Average germination: ca. 75%. High inter-population variability in seed germination.

Seed information and collection



•Averaged weight for 100 seeds is 0.72 g (100 g = 13,800 seeds).

•For the fruit collection is recomended the use of gloves, due the plant thorns. The optimal period to collecting seeds is during summer (July and August).

•Non-protected species, except in Malta and inside protected areas where collection is regulated. However, the species is considered endangered (EN) according the IUCN criteria at a regional level in Italy.

Seed management

•Extract seeds from the fruits manually and using metallic sieves.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿	✿	●	●	●		▮	▮			▮	▮									

Used in traditional medicine for the prevention of diabetes and the treatment of disorders related to blood sugar.

CCB, SARDINIA, IT

Fishbone thistle (EN)

Cardo di Casabona (IT)

Cardo de Casabona (SP)

Chardon de Casabona (FR)

Ptilostemon casabonae (L.) Greuter

Growth conditions in the wild

Endemic species of Sardinia, Corsica, Elba island and Hyères islands.

It grows both on limestone and siliceous substrata. It occurs frequently in scarps and roadsides and can be found in landfill mining (mainly screes).

It is a perennial macrocarpic herb. It is located in a wide altitudinal range, from ca. 100 to 1300 m. a.s.l.

Seed germination

15°C

12 h

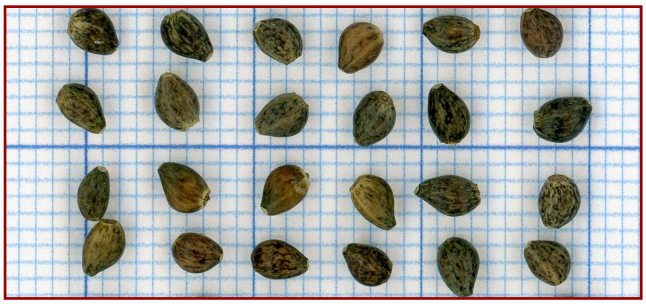
12 h

Best germination conditions: no pretreatment, light (12 h light / 12 h dark), at 15°C.

Similar results were obtained when seeds were treated with GA_3 or prestored at 25°C for 3 months on silica gel (Dry After Ripening - DAR).

Average germination: up to 100%.

Seed information and collection



•Averaged weight for 100 seeds is 0.071 g (100 g = 140,000 seeds).

•When collecting seeds, it is usefull to bring a pair of scissors to cut the flower heads inside a plastic bag, in order to avoid the dispersion of the material due to wind.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cleaning is very easy. Seeds fall apart after fruit dehiscence, just remove manually the coma (hairy part) of the seed.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

Flowers and shoots are cooked in some areas of Sardinia (Atzei AD 2003).

MAICh, CRETE, GR

Shrubby knapweed (EN)

Ptilostemon chamaepeuce (L.) Less.

Growth conditions in the wild

It is distributed in the East Mediterranean, namely Albania, Greece (including Crete), Cyprus, Turkey, Syria, Lebanon and Israel.

Semi-light plant, grows, generally in well lit places, but also in moderate shade. It is an indicator of damp and fairly hot sites. It occurs from 0 to 850 m. a.s.l.

Seed germination

15 °C

12 h

12 h

Best germination conditions: no pre-treatment, 10 and 15°C, light (12 h light / 12 h dark).

Seedlings visible 10 days after sowing.

Average success of seed germination: 100%.

Seed information and collection

•Averaged weight for 100 seeds is 1.208 g (100 g = 8,300 seeds).

•When collecting seeds, it is useful to bring a pair of scissors to cut the flower heads inside a cloth bag, in order to avoid the dispersion of the material due to wind.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is very easy. Seeds fall appart after fruit dehiscence, just remove manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
			✿	✿	✿	●				❧	❧	❧	❧										

Can be used as ornamental.

USJ, LEB

Syrian pear (EN)

Pero della Siria (IT)

Poirier de la Syrie (FR)

اجاص بري (AR-LB)

Pyrus syriaca Boiss.

Growth conditions in the wild

Native to Turkey, Iraq, Syria, Lebanon and Palestine.

It is found both on limestone and siliceous substrata. It occurs frequently in oak woods, forest claring and borders.

It is located in a wide altitudinal range, from ca. 100 to 2000 m. a.s.l.

Seed germination

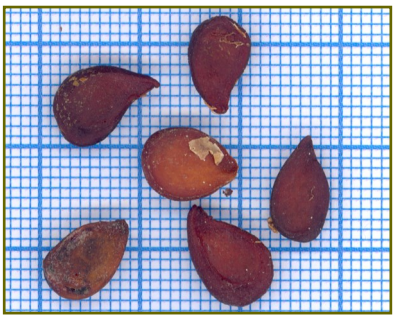
Imbibition in distilled water (2 h).

Cold/moist stratification at 10ºC on filter paper with no direct light.

All seeds germinated during stratification. First seedlings may be observed in 21 days. Total test length: 4 months.

Average germination: 80%.

Seed information and collection



•Averaged weight for 100 seeds is 9.2 g (1000 g = 10,870 seeds).

•Fruits must be collected when they have a dark green colour and well ripped. Harvesting is done manually or using stools or ladders, picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cut the fruit in the middle and recover the seeds.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	✿	✿	✿	✿				●	●	●	●		●	●	●								

The fruit is well known for its purgative properties.

INRGREF, TUNISIA, TN

Kermes Oak (EN)

Quercia spinosa (IT)

Coscoja (SP)

Chêne Kermès (FR)

الكشريد (AR-TN)

πρίνος (GR)

Quercus calliprinos Webb - synonym: *Quercus coccifera* L.

Growth conditions in the wild

It is one of the most common species throughout the Mediterranean maquis, thriving in a wide variety of often contrasting environments.

Kermes oak are abundant in Tunisian coastal-forestry regions.

It grows on a great variety of soil types. It occurs from 0 to 1000 m. a.s.l.

Seed germination

25°C

12 h

12 h

Germination at 25ºC in peat. 12 h light /12 h dark.

First seedlings in peat may be observed in 1 month.

Average germination: 78%.

Seed information and collection

•Averaged weight for 100 seeds is 650 g (100 g = 16 seeds).

•Fruit collection is done manually from the tree as soon as the fruit is ripe (November-December).

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cleaning is very easy and seed extraction is done manually.

•Seeds are recalcitrant, so they cannot be stored dry at 4 or –25°C as the other orthodox seeds. Short-term storage (a few months) is possible if they are stored in moist conditions and fresh temperatures (+5°C). Storage up to 4 years might be possible if they are dried to 45% moisture content and stored at positive temperature.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿						●	●				𝅘𝅥𝅮	𝅘𝅥𝅮							

It have been used as antiseptic, hemostatic and for the treatment of diarrhea. *It* is an important species for re-vegetation.

INRGREF, TUNISIA, TN

Broom (EN)

Ratama sferocarpa (IT)

Retama amarilla o chinastra (SP)

Retam à fruits globuleux (FR)

رتم كروية البذرة (AR-TN)

Retama sphaerocarpa (L.) Boiss.

Growth conditions in the wild

It is a leguminous shrub native to the Iberian Peninsula and North-West Africa that has generated interest for revegetation of dry Mediterranean habitats. In Tunisia, this shrub plays an important ecological role, it is widely used in dune stabilisation and soil fixation.

The species is able to tolerate salty soil, high temperatures, and low levels of soil nutrients and humidity.

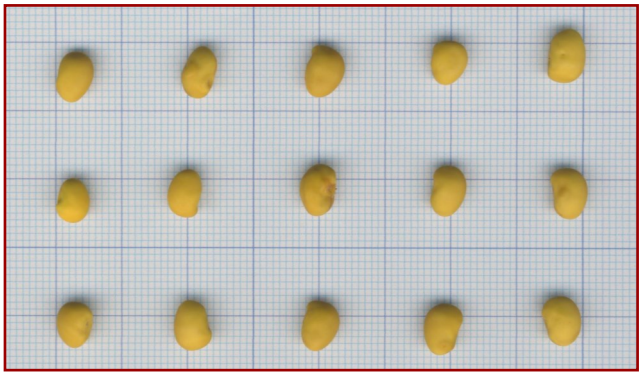
Seed germination

Soaking in H_2SO_4 98% during 30 min .

Germination at 20°C in 1% agar or in peat, 24 h dark.

Average germination: 80%.

Seed information and collection



•Averaged weight for 100 seeds is 7.49 g (100 g = 1,400 seeds).

•Harvesting is done manually as soon as the fruit is ripe (June-July) from the tree.

•Non-protected species.

Seed management

•Seed extraction from pods is done manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿		●	●							❧	❧									

- Pastoral and medicinal use.
- The species may be used to restore or increase fertility of degraded and eroded soils.

CCB, SARDINIA, IT

Mediterranean Buckthorn (EN)

Alaterno (IT)

Aladierno (SP)

Nerprun alaterne (FR)

Κιτρινόξυλο (GR)

زفرين الجرد (AR-LB)

القيص (AR-TN)

Rhamnus alaternus L. subsp. *alaternus*

Growth conditions in the wild

Distributed along the Mediterranean Basin, e.g. France, Portugal, Spain, ex-Yugoslavia, Albania, Greece, Italy, Turkey, Israel, Libya, Tunisia, Algeria, Morocco e Ukraine.

Common in shrub-lands and oak woods, but it also has the ability to survive in xeric environments. From sea level up to 700 m. a.s.l.

Seed germination

20°C

12 h

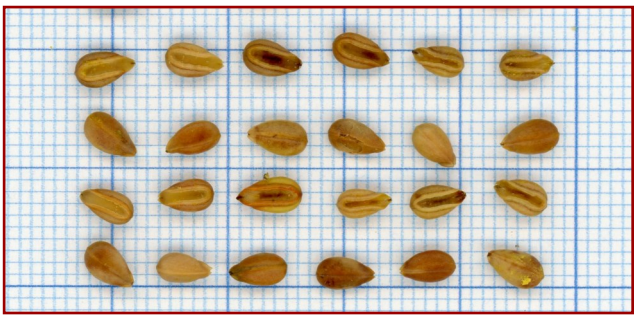
12 h

Best germination conditions: no pre-treatment, light (12 h light / 12 h dark), at 20°C.

Seeds treated with GA_3 germinated similarly when incubated at 20°C.

Average germination: 60%.

Seed information and collection



•Averaged weight for 100 seeds is 0.619 g (100 g = 16,100 seeds).

•Fleshy fruits, containing 2-3 seeds that are covered by an endocarp that opens when the fruit pulp is removed. During collection take the fruits and put them in paper or plastic bags.

•Non-protected species, except inside protected areas where

Seed management

•Seeds were cleaned manually removing carefully the pulp under water and then allowed to dry above sheets of paper.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
❀	❀	❀					🍎	🍎	🍎						🍃	🍃							

It is one of the species used in reforestation programs in the Mediterranean due to its fruit characteristics and ability to survive in xeric environments.

USJ, BEIRUT, LEB

Purgning Buckthorn (EN)

Spino cervino (IT)

espino cerval (SP)

Nerprun purgatif (FR)

λευκαγκάθα, λευκάγκαθο (GR)

زفرين مسهل (AR-LB)

Rhamnus cathartica L.

Growth conditions in the wild

Native to Lebanon and Syria. It is as well distribuited in all Europe, Iran and North Africa.

It is found on limestone substrata. It occurs frequently in a mountains places.

It is located in a wide altitudinal range, from ca. 900 to 2000 m. a.s.l.

Seed germination

Pre-treatments: imbibition in distilled water (2 h). Cold/moist stratification at 4ºC on Agar (1%) with no direct light for 3 months. Germination at 20°C, 12 h light / 12 h dark.

First seedlings may be observed in 3 months. Total test lenght: 6 months.

Average germination: 80%.

Seed information and collection

•Averaged weight for 100 seeds is 1.9 g (100 g = 5,263 seeds).

•Fruits must be collected when they have a blue-dark colour.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cover the blade of a blender with a rubber material. Place the ripe fruits in the blender and turn it on for 1 min. Separate the seeds from the dirt using a sieve.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿			●	●						●	●	●	●	●				

CIEF, VALENCIA, SP

Black hawthorn (EN)

Ranno simile alla spina santa (IT)

Espino negro (SP)

Nerprun faux olivier (FR)

Rhamnus lycioides L. subsp. *lycioides*

Growth conditions in the wild

W Mediterranean region, but also in eastern localities (Turkey, Cyprus and Greece). In the Iberian Peninsula it is spread throughout the east, central and south, and Pityuses islands.

In garrigues and scrubs, in environments of sclerophyllous forest and woods of pines, holm oaks and *Quercus coccifera*; usually on limestone, it is favored in rocky and dry lands, since it is a very hardy plant, 0-800 m. a.s.l.

Seed germination

Imbibition in distilled water 4h.

Germination at 20ºC. No light (24 h dark).

First seedlings after 5 days. Total test lenght: 20 days.

Average germination: 85%.

Seed information and collection

•Averaged weight for 100 seeds is 0.67 g (100 g = 14,815 seeds).

•Fruit collection should be done as soon as the fruit is ripe to avoid predation by fauna. Harvesting is done by gently shaking the plant with a stick; the fruits drop into nets placed on the ground.

•Non-protected species; collection, production, trade and use of FRM regulated under Valencian normative.

Seed management

•Soak the fruits 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dissinfect with diluted (0.4%) bleach solution 10 min and rinse. Dry 2 days, slighltly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
		✿	✿	✿																			

Sprouts vigorously after fire or felling, but its seeds can not resist the high temperatures of fire.

USJ, BEIRUT, LEB

Hairy Buckthorn (EN)

Nerprun ponctué (FR)

عجرم (AR-LB)

Rhamnus punctata Boiss.

Growth conditions in the wild

Native to Lebanon, Syria, Cyprus and Cilicia.

It is found on limestone substrat. It occurs frequently in a degraded lands.

It is located in a wide altitudinal range, from ca. 0 to 1400 m. a.s.l.

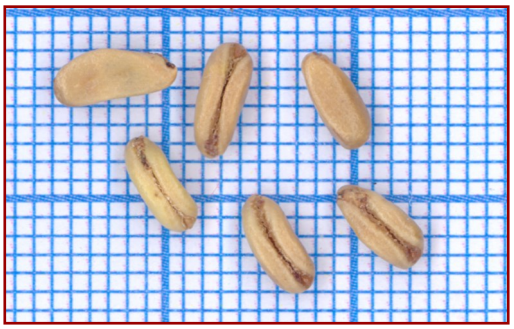
Seed germination

Pre-treatments: imbibition in distilled water (2 h). Cold/moist stratification at 4ºC on Agar (1%) with no direct light for 3 months. Germination at 20°C, 12 h light / 12 h dark.

First seedlings may be observed in 3 months. Total test lenght: 6 months.

Average germination: 80%.

Seed information and collection



•Averaged weight for 100 seeds is 1.35 g (100 g = 7,407 seeds).

•Fruits must be collected when they have a blue-dark colour.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cover the blade of a blender with a rubber material. Place the ripe fruits in the blender and turn it on for 1 min. Separate the seeds from the dirt using a sieve.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	✿	✿	✿					●	●	▮	▮			♪	♪	♪							

MAICh, CRETE, GR

Mountain or wild sage (EN)

Σγουρή φασκομηλιά, Μηλοσφακιά (GR)

النعمة (AR-TN)

Salvia pomifera L. subsp. *pomifera*

Growth conditions in the wild

South Greece and Aegean Islands. On Crete confined to the western half, often a more montane plant, ranging from 100 to 1350 m. a.s.l.

Semi-light plant, generally in well lit places, but also in moderate shade. The species is found in dry to fresh sites. Plants of fairly hot sites. It occurs in pine woodland, olive groves, scrubs, garrigues and rocky places.

Seed germination

Pre-treatment: Dry storage (Relative Humidity <20% and room temperature) for approx. 6 months.

15 °C

Best germination conditions: 15°C, light (12 h light / 12 h dark).

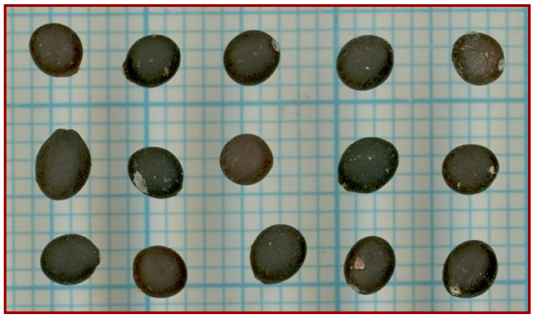
12 h

12 h

Seedlings visible 30 days after sowing.

Average success of seed germination: 90%.

Seed information and collection



•Averaged weight for 100 seeds is 0.864 g (100 g = 11,500 seeds).

•Collect the entire infructescence in cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is very easy. Seeds fall apart after fruit dehiscence, just remove manually.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

Medicinal and bee plant. Most probably it is the plant Σφάκος, according to Theophrastus.

CCB, SARDINIA, IT

Sardinian chamomilla (EN)

Crespolina di Sardegna (IT)

Santolina sarda (SP)

Santoline de Sardaigne (FR)

Santolina insularis (Gennari *ex* Fiori) Arrigoni

Growth conditions in the wild

Endemic to Sardinia. It is distributed mainly in the mountain areas in the south and central-eastern parts of Sardinia.

Populations show indifference to the edaphic factors. It is a nanophanerophyte and grows in arid slopes, garrigues and shrubs and degraded maquia, from sea level to the summit of M. Gennargentu (1834 m. a.s.l.).

Seed

Best germination condition: no pretreatment, light (12 h light / 12 h dark), and alternant day/night temperature: 25/10°C. Can be sowed directly in soil in fall (if winters are cold enough).

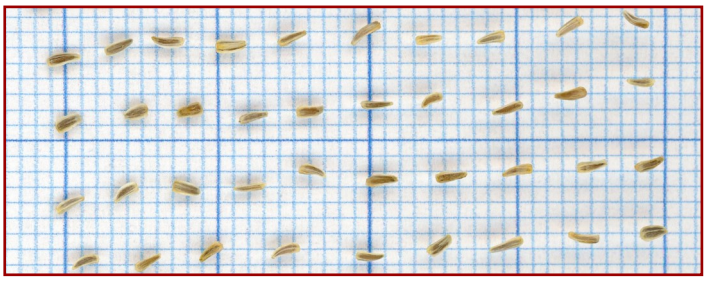
25°C 10°C

12 h 12 h

Seedlings visible 1 month after sowing. Average success of seed germination: 85-90%.

Vegetative growth from branch explants planted directly in soil.

Seed information and collection



•Averaged weight for 100 seeds is 0.048 g (100 g = 208,000 seeds).

•When collecting seeds, cut the flower heads and put them in paper bags.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Seeds were cleaned mechanically using a rubber tool, and subsequently was used a blowing instrument to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿	✿	●	●	⬮	⬮				⬭	⬭								

It is a medicinal plant whose essential oil has antiviral and antibacterial activities, potent and selective cytotoxic activity against carcinoma cell lines. However, is not commonly used in herbalist's shops.
The closest species *is Santolina corsica* that is found exclusively in Monte Albo.

CIEF, VALENCIA, SP

Common whitebeam (EN)

Sorbo montano (IT)

Serbal (SP)

Alisier blanc (FR)

Τροκκιά (GR)

العبيرة (AR-TN)

Sorbus aria (L.) Crantz s.l.

Growth conditions in the wild

N, C and W Europe, NW Africa, Tenerife and La Palma. Almost all IP, except in most SW-quadrant provinces and Mallorca.

Beech, deciduous oak and gall forests, groves of maples, holm oalk and pinus forests –often on clearings and forests limits-, bushes, rocky, etc.; 0-2200 m. a.s.l. Indifferent to edaphic factors, but prefers lime-rich substartes.

Seed germination

Imbibition in distilled water (24 h).

Germination at 4ºC in sand and vermiculite. No light (24 h dark).

First seedlings may be observed in 3 months. Total test lenght: 6 month.

Average germination: 80%.

Seed information and collection

•Averaged weight for 100 seeds is 2.04 g (100 g = 4,888 seeds).

•Collection must be done as soon as the fruit is ripe to avoid bird predation. Harvest fruits manually from the ground or using ladders, picking the mature fruits directly from the branches.

•Non-protected species; but collection, production and trade of "Forest Reproductive Materials" is regulated under Spanish and Valencian normatives.

Seed management

•Soak the fruits during 24 hours and crush with blade blender. Separate the seeds from the crushed pulp with proper sieve and water under pressure. Dry during 2 days, slighltly rub against a sieve to remove the pulp remains attached and winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
				✿	✿			●	●			◗	◗										

The fruits contains substances that inhibit the germination, so that the pulp should be removed as soon as possible and seeds should be washed several times before drying. *Sorbus aria* is able to resprout from strain.

USJ, BEIRUT, LEB

Fan-leaved service tree (EN)

Sorbier (FR)

Τροκκιά (GR)

غبيراء مروحية الورق (AR-LB)

Sorbus umbellata var. *taurica* (Zinserl.) Gabrieljan.

Growth conditions in the wild

Native to Turkey, Syria, Lebanon and Iran.

It is found both on limestone and siliceous substrate. It occurs frequently in forest and bushes.

It is located in a wide altitudinal range, from ca. 1400 to 2000 m. a.s.l.

Seed germination

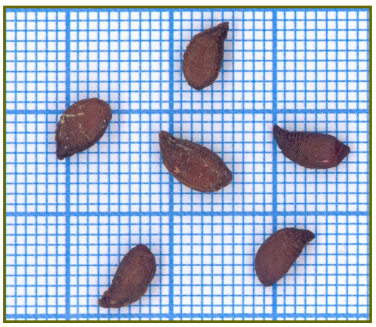
Cold Stratification for 3 months at 4°C.

Germination at 4ºC on peat without light.

First seedlings may be observed in 3 months. Total test length: 6 months.

Average germination: 91%.

Seed information and collection



•Averaged weight for 100 seeds is 1.3 g (100 g = 13,300 seeds).

•Fruits must be collected when they have a orange colour and well ripped. Harvesting is done manually picking the mature fruits directly from the branches.

•Non-protected species, except inside protected areas where collection is regulated.

Seed management

•Cut the fruit in the middle and recover the seeds.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
				✿	✿			●	●	●			∿	∿									

MAICh, CRETE, GR

Storax tree (EN)

Storace (IT)

Estoraque (SP)

Alibοufier (FR)

Αστύρακας (GR)

Styrax officinalis L. s.l.

Growth conditions in the wild

It occurs in Italy, Croatia, Greece (including Crete), Cyprus, Turkey, Syria, Lebanon, Jordan and Israel.

Regarding the natural sun exposure the species is indifferent, with wide ecological amplitude or different behaviour in different areas. It is found in damp to wet sites, from 50 to 600 m. a.s.l., in Crete up to 1100 m. a.s.l.

Plants of fairly hot to hot sites.

Seed germination

10 °C

0 h

24 h

Best germination conditions: no pre-treatment, 10°C and no light (24 h dark).

Seedlings visible 70 days after sowing.

Average success of seed germination: 90%.

Seed information and collection

•Averaged weight for 100 seeds is 46.5 g (100 g = 215 seeds).

•Fruit collection is done directly from the plant.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is very easy, seeds are just picked directly from the plant.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*
			✿	✿				●	●				●	●									

Resin was used in the ancient times as a medicinal substance.

INRGREF, TUNISIA, TN

Sulla (EN)

Sulla (IT)

Zulla (SP)

Sulla (FR)

سلّة (AR-TN)

Sulla coronaria (L.) Medik.

Growth conditions in the wild

Sulla is a biennial or short-lived perennial herbaceous plant from the western Mediterranean.

It is cultivated in Tunisia, grows in low fertile soils and even leave fixed nitrogen in the soil.

Seed germination

Good germination without pre-treatment.

25°C

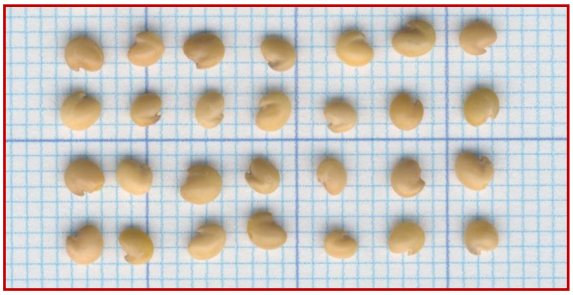
Germination at 25°C in 1% agar or in peat. Light conditions (16 h light, 8 h dark).

16 h

8 h

Average germination: 90%.

Seed information and collection



•Averaged weight for 100 seeds is 0.400 g (100 g = 29,800 seeds).

•Seed harvesting is done using a pair of scissors. Cut pods from the plant and put in paper bags.

•Non-protected species.

Seed management

•Seed cleaning is done mechanically using a blender and seeds are seperated from debris using different sieves.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	❀	❀		🍎	🍎																		

It is used as pastoral species in Tunisia. It produces high-quality forage that is well received by livestock.

MAICh, CRETE, GR

Shortleaf Germander (EN)

Camedrio brevifoliato (IT)

Τεύκριον το βραχύφυλλον (GR)

Teucrium brevifolium Schreb.

Growth conditions in the wild

Teucrium brevifolium is distributed in Morocco, Libya, Egypt, Turkey and Greece (including Crete).

It is a light-demanding plant, in well lit places but not in very insolation rich sites. It is an indicator of very dry to dry sites and of hot sites. It occurs from 0 to 400 m. a.s.l.

Seed germination

Pre-treatment: Dry storage (Relative Humidity <20% and room temperature) for approx. 6 months.

Best germination conditions: 15 and 20°C, light (12 h light / 12 h dark).

Seedlings visible 20 days after sowing.

Average success of seed germination: 80-90%.

Seed information and collection

•Averaged weight for 100 seeds is 0.291 g (100 g = 34,350 seeds).

•Collect the infructescence in cloth bags.

•A permit is required to collect any wild plant in Greece, for commercial and research purposes.

Seed management

•Cleaning is medium in difficulty. Infructescence was cleaned mechanically using a rubber tool, and subsequently an Agriculex seed aspirator was used to separate seeds from residual impurities.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
		✿	✿	●	●	▮	▮	▮			◡	◡	◡										

It can be used as an ornamental plant especially in dry areas, since it is tolerant to drought and high temperatures. Most probably it is the plant ελένιον αιγύπτιον, according to Dioskourides.

CCB, SARDINIA, IT

Cat Thyme (EN)

Camedrio maro (IT)

Tomillo de gato (SP)

Germandrée marum (FR)

الخيّاطة (AR-TN)

Teucrium marum L.

Growth conditions in the wild

Native to Balearic Islands, Corse, France (Island of Hyères), Italy (Sardinia, Tuscan Archipelago), Tunisia, Jugoslavia, Croatia (islet of Murter).

It is a fruticose chamaephyte and it occurs in garrigues, maquis, arid and stony environments, dry hills, scrubby landscapes, up to 1500 m. a.s.l.

Seed germination

Best germination conditions: light (12 h light / 12 h dark), at 15 and 20°C.

20°C 15°C

Average germination: 60%.

12 h 12 h

Suggestion for the nursery: Sow seeds in spring on the surface of soil and cover with plastic wrap. Germination in 25-30 days. Prick out the seedlings into individual pots when they are large enough to handle. Plant them out in the summer if they are large enough. Otherwise, grow them in a cold frame for the winter and plant them out in the following spring.

Seed information and collection

•Averaged weight for 100 seeds is 0.06 g (100 g = 158,000 seeds).

•Seed collections do not need particular precautions. During August and September take the dry fruits and put them in paper bags.

•Non-protected species, except inside protected areas where

Seed management

•Seeds cleaned manually. Crush fruits with swab and select seeds using tweezers.

•Seeds are orthodox, so can be dehydrated at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*

It contains a terpene component that causes sexual arousal in cats, hence the name of the Cat Thyme. The plant is used in homeopathy and has multiple uses in traditional medicine due to its astringent and stimulant properties.

CIEF, VALENCIA, SP

Piorno (SP)

Vella lucentina M.B. Crespo

Growth conditions in the wild

It is an exclusive endemic species of Valencian Region, restricted to semi-arid coastal mountains of the province of Alicante.

Inhabits inside open and sunny steppic scrubs, in deep soil and on clay-calcareous, rich in ferrous oxides substrates; 300-400 m. a.s.l.

Seed germination

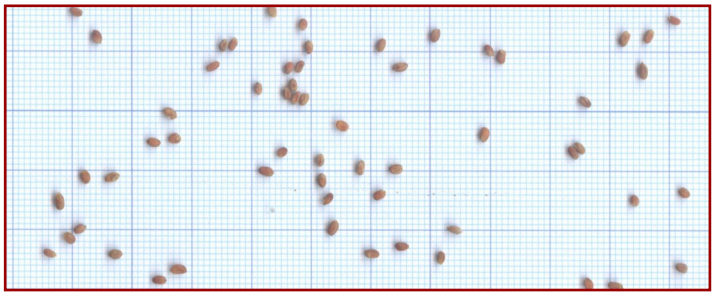
Imbibition in distilled water 24 h.

Germination at 20ºC, with 12 h dark / 12 h light photoperiod.

First seedling after 1 day. Total test lenght: 1 month.

Germination: 86%.

Seed information and collection



•Averaged weight for 100 seeds is 0.361 g (100 g = 27,700 seeds).

•Harvesting is done manually with some caution, since the fruits have a somewhat explosive dehiscence when they are in an advanced maturation state and under certain humidity conditions. It is advisable to wear gloves to collect the fruits, since their leaves have rigid, little-damaging, hairs.

• Valencian protected species; collection regulated.

Seed management

•Fruits desiccated for 1 month in dry-room are crushed gently with a wooden block on a hard surface to break them and then winnowing with a seed blower.

•Seeds are orthodox, so can be dried at 15°C and 15% RH and stored at 5°C for several years, or –25°C as base collection.

J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
		✿	✿		●	●	●																

Germinated seeds can be sowed in autumn or spring, in a mix of standard substrate with clay, under high luminosity and without overwatering. Seedlings have quick and vigorous growth.

3

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4

GLOSSARY

Achenes: is a type of simple dry fruit produced by many species of flowering plants. Achenes are monocarpellate (formed from one carpel) and indehiscent (they do not open at maturity).

Allelopathic substances: subset of biochemical substances produced by same species that influence, positively or negatively, the growth, survival and reproduction of others organisms.

Alluvial woods (or flooded forests): forests that grow in seasonally flooded areas (eg. wetlands, floodplains, etc.). The species of this habitats have established same adaptation strategies, for eg. grass and aquatic plants are able to grow during the flood stage and trees have developped a system of curved roots, resistant to strong pressure of the water in the wet season, and the ability to capture oxygen through special appendices radicals with respiratory functions ("pneumatophores").

Canopy: the aboveground portion of a plant community or crop, formed by plant crowns.

Caryopses: a dry one-seeded fruit in which the ovary wall is united with the seed coat, typical of grasses and cereals.

Chamaephyte: low-growing perennial plant, woody at the base, whose dormant buds are at or just above the surface of the ground (from two to 30 cm of height) (eg. Helichrysum italicum).

Chilling (**Cold stratification**): type of seed pre-treatement conducted at low temperatures (from +0°C to +5°C or from +2°C to +6°C), either in a controlled environment (eg. growth chamber, refrigerators, etc.) or in uncontrolled environments (eg. holes in the ground), with the aim to break the seed dormancy.

Clonal propagation (for plants): process of asexual reproduction by multiplication of genetically identical copies of individual (eg. cutting, grafting, micropropagation, etc.).

Deciduous: means "falling off at maturity" or "tending to fall off", and it is typically used in order to refer to trees or shrubs that lose their leaves seasonally (most commonly during autumn) and to the shedding of other plant structures such as petals after flowering or fruit when ripe.

Dioecious: is a characteristic of a species, meaning that it has distinct male and female individual organisms or colonies, meaning that a colony contains only either male or female individuals.

Ecophysiological features: characteristics of an organism which determine its response mechanisms to the surrounding physical, chemical and biological environments.

Ecosystem resilience: capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes.

Ecotypes: a group of organisms within a species that is adapted to particular environmental conditions and therefore exhibits behavioural, structural, or physiological differences from other members of the species.

Environmental restoration or habitat restoration: the practice of renewing and restoring degraded, damaged, or destroyed environments by active human intervention and action.

Evapotranspiration: process by which moisture is carried through plants from roots to small pores on the underside of leaves (stomata), where it changes to vapor and is released to the atmosphere.

Exotic plant: not native plant into the region in which it occurs.

Genetic pollution: it refers to the undesirable and uncontrolled gene flow from a domestic, feral, non-native or invasive species into wild populations in which such genes are not present.

Genotype: in a broad sense, it refers to the genetic makeup of a particular organism / group of organisms and describes its / their complete set of genes. In a narrower sense, the term can be used to refer to the alleles, or variant forms of a gene that are carried by an organism.

Gibberellins (Gibberellic acid or GA_3): hormones that regulate plant growth and influence various developmental processes, including stem elongation, germination, dormancy, flowering, sex expression, enzyme induction, and leaf and fruit senescence.

Glume: a basal, membranous, outer sterile husk or bract in the flowers of grasses (Poaceae) and sedges (Cyperaceae).

Halophytes: salt-resistant or salt-tolerant plants that thrive and complete their life cycles in soils or waters containing high salt concentrations (eg. species living in saline semi-deserts, mangrove swamps, marshes, seashores, etc.). The salt tolerance in these plants is assured to various physiological adaptations as the salt accumulation in the cells, the increase of osmotic pressure, the elimination salts through special epidermal structures, etc.

Heat stratification (Heat stratification or Warming): exposition of the seeds to temperatures not higher than 30-35°C (generally 15-20°C) with the aim to simulate the effect of the summer.

Heathland: shrubland habitat found mainly on free-draining, infertile and acidic soils, favoured where climatic conditions are typically warm and dry, particularly in summer. It is characterised by a open and low-growing woody vegetation.

Hermaphroditic individuals: organisms that produce both male and female reproductive organs during their life cycle.

Hetero specific pollen deposition: pollen deposition from multiple species during pollination.

Hotspot (diversity): region with an exceptional concentration of endemic species and an exceptional loss of habitat. With the aim to better assess plant conservation priorities Médail and Quézel (1999) have identified 34 Biodiversity hotspots in the world, the Mediterranean Basin is one of these.

Hybridization: in genetics it is the process through which cross different taxa to create a hybrid.

Imbibition: process through which an aqueous solution penetrates the seed coat and begins to soften the hard and dry tissues inside, causing the seed swell up. For non-dormant seeds, if the environmental conditions are appropriating, germination starts when a seed is imbibed, because the water presence activate the enzymes involved in the germination process and the seed increase its metabolic activities.

Inflorescence: part of the plant consisting in a group or cluster of flowers arranged on a stem that is composed of a main branch or of a complicated arrangement of branches.

Infructescence: part of the plant, derived from an inflorescence, that bears the fruits, including the bracts and branches, but excluding unmodified leaves.

Invasive alien species: naturalized exotic species with the tendency to spread, which is believed an agent of change and threatens for human health, economy and/or native biodiversity. In particular, their presence is considered as one of major causes of biodiversity loss in the world.

Mesophilous: it refers to species which are adapted to neither a particularly dry nor a particularly wet environment, therefore mesophyte species do not show any specific adaptations. The term can be also referred to types of vegetation or habitats (eg. Mesophilous woods).

Metapopulations: the concept, coined by Levins (1970), defines functional units consisting in a set of subpopulations, located within a geographical area, that interact through flows of individuals.

Morpho-type: in botany describes a group of individuals belonging to species or populations which are characterized by same distinctive morphological traits.

Nanophanerophyte: type of Phanerophyte where buds not exceeding two meters in height (eg. Rosmarinus officinalis).

Native plant species (autochthonous or indigenous species): species existing within its natural distribution and dispersion range.

Pappus (coma): is the modified calyx, the part of an individual floret, which surrounds the base of the corolla tube in flower heads of the plant family *Asteraceae*. The term is sometimes used in other plant families such as *Asclepiadaceae* (milkweeds), whose seeds have a similar structure attached, although it has not related to the calyx of the flower.

Phanerophyte: perennial woody plant that carries its dormant buds on branches above 30 cm of height (eg. Quercus sp.).

Phenological phase (see also Phenology in 1.1): specific stage of the life cycle of an organism identified by a morphological, physiological, behavioral and functional status induced by seasonal mutations of the environmental conditions, in particular those climatic.

Phenology: study of the periodic biological phenomena that occur in the life cycle of an organism (eg. germination, flowering, etc.), in relation to climatic conditions (humidity, temperature, photoperiod).

Physical dormancy: type of dormancy that is caused by an impermeable seed coat. This layer prevents the seed from taking up water or gases inhibiting seed germination.

Physiognomic features: set of functional and morphological attributes of a plant.

Physiological dormancy: type of endogenous dormancy associated with intrinsic features of the seed embryo and caused by a physiological inhibiting mechanism.

Phytophagous: organisms that feed on plants. Used especially for insects or other invertebrates.

Pioneer plant species: the first adaptable and vigorous flora to colonize disturbed or damaged ecosystems. These plants readily acclimate to bare soil, have the ability to grow and regenerate and respond vigorously to poor site conditions.

Plant communities: groups of plants that interact with each other and with their environment.

Plumule: the first bud in a plant embryo from which it will develop the stem and the leaves.

Sclerophyllous: typically shrubs and trees in which the leaves are evergreen, hard, thick, leathery and usually small with a little water content (eg. Pistacia lentiscus L.). These adaptations allow them to survive the hot and dry season of the Mediterranean climate.

Shrub: plant community dominated by shrubs, but also including grasses, herbs, and geophytes. It may be a mature vegetation type in a particular region characterized by regular natural disturbance, or a transitional community that occurs temporarily as the result of a human disturbance (eg. fire).

Seed coats: external tegument of the seed, equipped or not of outgrowths, hooks, hair, wings, etc. and having a role in its dissemination.

Seed dormancy: state, due to physical and / or physiological causes, that prevents seed germination, even in favorable environmental conditions. It is genetically or physiologically controlled and interacts in various ways with environmental factors.

Seedling establishment: period of a plant life cycle following the germination phase. In particular, the appearance of the radicle marks the end of germination and the beginning of seedling establishment. It is one of the most critical phases in the life of a plant because seedlings are very vulnerable to injury, disease and water stress.

Self-fertilization: fusion of male and female gametes (sex cells) produced by the same individual.

Steppes: although the true steppes are continental, in the Mediterranean Region the term refers to the herbaceous vegetation of sunny rocky slopes. This type of vegetation, dominated by xerophilous herbs (especially grasses), are widespread in the Mediterranean area up to 1000 m, and often represent the result of recurrent wildfires and / or grazing or the final stage of the Mediterranean shrub degradation.

Stomata (singular "stoma"): pores found in the epidermis of leaves, stems and other organs of the plants that are used to control gas exchanges (water vapor, carbon dioxide and oxygen) during the transpiration.

The pore consists of a pair of cells known as guard cells able to adjust the width of the opening by means of an osmotic process.

Succulence: feature of plants adapted to live in dry places. Succulent plants, although belonging to taxa distant from each, have developed similar morphological adaptations that mainly allow them an efficient water store (eg. acquisition of a parenchyma aquifer rich in mucilage, thickened epidermis, transformation of the leaves in thorns, presence of stems photosynthesizing, assumption of spherical shapes in order to limit the the transpiring surface, etc.).

Teguments (seed): consist in one or two layers around an ovule which ensure protection and isolation from the external environment. After fertilization they toughen and change their structure for a better protection of the seed embryo.

Thermophilous: it refers to warmth-loving species. In the Mediterranean Regions a typical example are the Sclerophyllous plants of the Mediterranean shrub. The term can be also referred to types of vegetation or habitats (eg. Thermophilous garrigues).

5

ANNEXES

Annex 1: Representative Mediterranean habitats

This annex does not pretend to be a complete and exhaustive list of all Mediterranean habitats for the whole Mediterranean Basin. Our intention is to show to the reader of this manual some of the most representative habitats found in the Mediterranean Basin attending to diverse ecosystems and based in the literature and information available. This annex is just an appetizer, a quick way to indicate to the reader of this manual the high diversity of habitats found in the Mediterranean Basin, that often are shared by different countries in the Mediterranean Basin, or other times are "endemic" to particular parts of the Mediterranean Basin. Each habitat indicated in this annex has a particular flora that characterize it. One example can be found in the "Interpretation Manual of European Union Habitats" (http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf).

However, we must highlight that the flora of these habitats may suffer small but significant changes depending on the place (i.e. area, region, country, etc.) where the habitat is located. Moreover, when the habitat can be found in different sites within the same place (e.g. within the same country or region in a country), there are differences in the genetic composition of the species that we must take into account. We expect that this annex will serve to highlight a concept repeated along this manual, which is the attention needed during the selection of species for the restoration of a given habitat in a given place, taking into account the use of native flora collected locally.

The annex is divided in two tables. Table 1 summarizes the diversity of habitats that are "exclusively and characteristically Mediterranean" and are present along the Mediterranean Basin. Table 2 serves as example of other habitats (excluded from table 1) that can be present in the Mediterranean Region but are usually characteristic of other biogeographical Regions.

For further information, references are provided in the annex or along the chapter 1.2.

Table 1: Representative habitat types only present in the Mediterranean biogeographical region. This table is based on the reports "Biogeographical regions in Europe: The Mediterranean biogeographical region – long influence from cultivation, high pressure from tourists, species rich, warm and drying. EEA (Ed.)"[1] and the "Mediterranean Terrestrial Region Reference List. ETC/DB"[2]. * indicates that the habitat is priority within the EU as in the Habitats Directive 92/43/EEC, Annex I. *p Indicates that the habitats have been proposed as priority habitat based on the EU's 2013 report "Natura 2000 Biogeographical Process in the Mediterranean Region"[3]. + indicates non-priority habitats in the EU included as proposed by the Lebanese partner (USJ) since they are representative for Lebanon and nearby areas[4].

Ecosystems	PAL.CLASS. code (EUNIS code)	Habitats Directive 92/43/EEC
Coastal	11.125, 11.22, 11.31, 11.333	1110*p Submerged sandbanks which are slightly covered by sea water all the time
	11.34	1120* Submerged *Posidonia* beds (*Posidonion oceanicae*)
	21	1150* Tidal Coastal lagoons
	11.24, 11.25	1170*p Submerged Reefs
	none	2110*p Dune Embryonic shifting dunes
	16.221 to 16.227, 16.22B	2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)
	16.224	2220 Dunes with *Euphorbia terracina*
	16.228	2230*p *Malcolmietalia* dune grasslands
	16.27, 64.613	2250* Coastal dunes with *Juniperus* spp.
	16.29 x 42.8	2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*
Forest	41.181, 41.185, 41.186	9210* Apennine beech forests with *Taxus* and *Ilex*
	41.186, 41.187	9220* Apennine beech forests with *Abies alba* and beech forests with *Abies nebrodensis*
	41.78	9250 *Quercus trojana* woods
	41.1B	9280 *Quercus frainetto* woods
	42.A1 (G3.9)	9290 *Cupressus* forests (*Acero-Cupression*)
	41.735	9310 Aegean *Quercus brachyphylla* woods
	45.1	9320*p *Olea* and *Ceratonia* forests
	45.2 (G2.1)	9330*p *Quercus suber* forests

	45.3 (G2.1)	9340*[p] *Quercus ilex* and *Quercus rotundifolia* forests
	41.79	9350 *Quercus macrolepis* forests
	45.7	9370* Palm groves of *Phoenix*
	45.48 (G2.1)	9390* Scrub and low forest vegetation with *Quercus alnifolia*
	45.46 (G2.1)	93A0[+] Woodlands with *Quercus infectoria*
	42.4	9430 Subalpine and montane *Pinus uncinata* forests (* if on gypsum or limestone)
	41.1A (G3.1)	9270[+] Hellenic beech forests with *Abies borisii-regis*
	42.19 (G3.1)	9520[+] *Abies pinsapo* forests
	42.61 to 42.66	9530* (Sub-)Mediterranean pine forests with endemic black pines
	42.8	9540*[p] Mediterranean pine forests with endemic Mesogean pines
	42.A2 to 42.A5 and 42.A8 (G3.9)	9560* Endemic forests with *Juniperus* spp.
	42.A6 (G3.9)	9570* *Tetraclinis articulata* forests
	42.A72, 42.A73 (G3.9)	9580* Mediterranean *Taxus baccata* woods
	42.B2 (G3.9)	9590* *Cedrus brevifolia* forests (*Cedrosetum brevifoliae*)
	42.7 (G3.6)	95A0[+] High oro-Mediterranean pine forests
Freshwater	22.34	3170* Mediterranean temporary ponds.
	24.16, 24.53	3290*[p] Intermittently flowing Mediterranean rivers of the *Paspalo-Agrostidion*.
	53.3	7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
	44.3, 44.2, 44.13	91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)
	44.141, 44.162, 44.6	92A0*[p] *Salix alba* and *Populus alba* galleries
	44.52, 44.54	92B0 Riparian formations on intermittent Mediterranean water courses with *Rhododendron ponticum*, *Salix* and others
	44.81 to 44.84	92D0*[p] Southern riparian galleries and thickets (*NerioTamaricetea* and *Securinegion tinctoriae*)
Grassland, Heaths & Scrubs	15.8	1510* Mediterranean salt steppes (*Limonietalia*)
	15.9	1520* Iberian gypsum steppes (*Gypsophiletalia*)
	32.2B	5140* *Cistus palhinhae* formations on maritime wet heaths
	32.17	5220* Arborescent matorral with *Zyziphus*

	32.18	5230* Arborescent matorral with *Laurus nobilis*
	32.216	5310 *Laurus nobilis* thickets
	32.217	5320 Low formations of *Euphorbia* close to cliffs
	32.21G1, 32.22 to 32.26, 32.441p	5330*p Thermo-Mediterranean and pre-desert scrub.
	33.1	5410 West Mediterranean clifftop phryganas (*AstragaloPlantaginetum subulatae*)
	33.3	5420 *Sarcopoterium spinosum* phryganas
	33.4 to 33.A	5430 Endemic phryganas of the *Euphorbio-Verbascion*
	34.11	6110* Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi*
	34.31 to 34.34	6210*p Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)
	34.5	6220* Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*
	none	62B0* Serpentinophilous grassland of Cyprus
	32.11 x 91.2	6310*p Dehesas with evergreen *Quercus* spp.
	none	6460* Peat grasslands of Troodos
	61.4, 61.5	8140 Eastern Mediterranean screes

[1]http://www.eea.europa.eu/publications/report_2002_0524_154909/biogeographical-regions-in-europe/mediterranean_biogeografical_region.pdf.

[2]http://ec.europa.eu/environment/nature/natura2000/sites_hab/biogeog_regions/docs/Mediterranean_ref_list.pdf

[3]http://ec.europa.eu/environment/nature/natura2000/platform/knowledge_base/135_mediterranean_region_en.htm

[4]EEA Technical report No 9/2006. European forest types nomenclature: category and types descriptions

Table 2: Non-Mediterranean habitats present in along the Mediterranean biogeographical Region with local significance due to their relict character, particular flora, and conservation importance. * indicates that the habitat is priority within the EU. *p Indicates that the habitats have been proposed as priority habitat based on the EU's 2013 report "Natura 2000 Biogeographical Process in the Mediterranean Region"[1].

Ecosystems	PAL.CLASS. code	Habitats Directive 92/43/EEC
Coastal	15.1	1310*p *Salicornia* and other annuals colonizing mud and sand
Forest	41.4	9180* *Tilio-Acerion* forests of slopes, screes and ravines
	41.7373, 41.7374	91H0* Pannonian woods with *Quercus pubescens*
	41.86	91B0 Thermophilous *Fraxinus angustifolia* woods
	41.9	9260*p *Castanea sativa* woods
	42.15	9510* Southern Apennine *Abies alba*
Freshwater	53.3	7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
	54.12	7220* Petrifying springs with tufa formation (*Cratoneurion*)
	54.2	7230 Alkaline fens
Grassland, Heaths, Scrubs & arid lands	31.2	4030 European dry heaths .
	34.12	6120* Xeric sand calcareous grasslands
	35.1, 36.31	6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)
	37.31	6410 *Molinia* meadows on calcareous, peaty or clayey-siltladen soils (*Molinion caeruleae*)
	37.7, 37.8	6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

[1]http://ec.europa.eu/environment/nature/natura2000/platform/knowledge_base/135_mediterranean_region_en.htm

Annex 2: Indications for the collection, conservation and sown of common Mediterranean spontaneous trees and shrubs.

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Abies alba* Mill., *A. cephalonica* Link., *A. nordmanniana* Spach., *A. pinsapo* Boiss.**	Summer	Early autumn	The resinaction of the cones indicates the moment in which is possible to start the collecting	Orthodox	Autumnal sowing mulched or in spring with pre-chilled seeds	Cold/moist stratification per 3 - 4 weeks.
***Acer campestre* L.**	Early autumn	Autumn	The change of seed color in brown indicates the moment to start the collecting	Difficult conservation	Autumnal sowing or in spring if seed is treated	Heat stratification per 0-8weeks followed by cold/moist stratification per 12-24 weeks.
***Acer monspessulanum* L.**	Early autumn	Autumn	An abundant fruiting does not always indicate quality, sometimes many seeds are empty	Difficult conservation	As above	Cold/moist stratification per 8-12 weeks
***Acer opalus* Mill.**	Early autumn	Autumn	As above	Difficult conservation	Autumnal sowing or in spring if seed is treated	Heat stratification per 0-12 weeks followed by cold/moist stratification per 4-12 weeks.
***Acer platanoides* L.**	Early autumn	Autumn	A change of seed color to brown indicates the moment to start the collection	Difficult conservation	As above	Cold/moist stratification per 4-6 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Acer pseudoplatanus* L.**	Early autumn	Autumn	As above	Difficult conservation	as above	Cold/moist stratification per 4-10 weeks
***Acer sempervirens* L.**	Autumn	Autumn		Orthodox	November at high altitudes	The species needs low temperatures 5– 10 °C for germination. The germination is completed after approx. 3 months.
***Alnus cordata* (Loisel.) Loisel., *A. glutinosa* (L.) Gaertn., *A. incana* (L.) Moench, *A. viridis* (Chaix) DC.**	Early autumn	Autumn	Small pseudo-strobilous must not be opened	Orthodox	Sowing by February or in spring with pre-chilled seeds	Cold/moist stratification per 4-6 weeks
***Amelanchier ovalis* Medik.**	Summer	Summer	Predation by birds is frequent	Orthodox	Autumnal sowing immediately after the collecting or in spring with pre-chilled seeds	Cold/moist stratification per 8-12 weeks
***Arbutus unedo* L.**	Autumn	Autumn	Maturation is scalar and protracted in time	Orthodox	Autumnal or spring, eventually with pre-chilled seeds	Cold/moist stratification per 0-8 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Berberis vulgaris* L.**	Summer	Autumn		Orthodox	Autumnal or spring with pre-chilled seeds	Cold/moist stratification per 6-13 weeks (previous estivation may be positive)
***Betula pendula* Roth**	Summer	End of summer		Orthodox	Autumnal or spring with pre-chilled seeds	Cold/moist stratification per 4-8 weeks
***Buxus sempervirens* L.**	Summer	Summer		Orthodox	Autumnal or spring with pre-chilled seeds	
***Carpinus betulus* L.**	Autumn	Autumn		Orthodox	Presence of complex dormancy. Sowing in late summer of green seeds or spring with mature treated seeds	Heat stratification per 2-8 weeks followed by cold/moist stratification per 12-14 weeks
***Carpinus orientalis* Mill.**	Autumn	Autumn		Orthodox	Spring sowing with seeds subjected to estivation + cold/moist stratification	Heat stratification per 3-6 weeks followed by cold/moist stratification per 12-15 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Castanea sativa* Mill.**	Autumn	Autumn		Recalcitrant	Spring of autumnal sowing with pre-chilled seeds, generally outdoors, from the collecting	
***Cedrus* sp. pl.**	Autumn	Winter	At the moment of collecting there are both mature and immature cones	Difficult conservation	Sowing by February or in spring with pre-chilled seeds	Cold/moist stratification per 3-6 weeks
***Celtis australis* L.**	Autumn	Autumn		Orthodox	Sowing by February or in spring with pre-chilled seeds	Cold/moist stratification per 8-12 weeks
***Ceratonia siliqua* L.**	Summer	Late summer		Orthodox	Spring sowing with scarified seeds	Mechanical scarification
***Cercis siliquastrum* L.**	Autumn	Late summer		Orthodox	Spring sowing with scarified seeds (a short cold/moist stratification after scarification may be useful in some cases)	Mechanical scarification
Chamaecytisus spinescens* (C. Presl) Rothm. *subsp. creticus (Boiss. & Heldr.)	Summer	Summer		Orthodox	Winter sowing with scarified seeds	Mechanical scarification, or immersion of the seeds in boiling water for 20 sec

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
K.l.Chr.						
***Colutea arborescens* L.**	Summer	Summer		Orthodox	Spring sowing with scarified seeds	Mechanical scarification
***Coriaria myrtifolia* L.**	Autumn	Autumn			Spring sowing with pretreated seeds. Alternate temperatures promotes germination of non-dormant seeds	Application of solutions of gibberellic acid ($2,6 \times 10^{-3}$)
***Cornus mas* L.**	Summer	Late summer	Predation by birds is frequent	Orthodox	Presents seed dormancy very complex. Autumnal sowing (germination occurs in late spring) or in spring with seeds after Heat stratification followed by cold/moist stratification; may be useful the scarification before of Heat stratification	Heat stratification per 16 weeks followed by cold/moist stratification per 4-16 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Cornus sanguinea* L.**	Autumn	Autumn	Predation by birds is frequent	Orthodox	Autumnal or spring sowing with seeds subjected to heat stratification + cold/moist stratification; only cold/moist stratification may be sufficient	Cold/moist stratification per 12-18 weeks (eventually preceded by estivation 0-8 weeks)
***Emerus majus* Mill.**	Summer	Summer		Orthodox	Spring sowing with mechanical scarified seeds or soaked in hot water per 12-14 hours	Mechanical scarification
***Corylus avellana* L.**	Late summer	Early autumn	Various types of predation	Sub- orthodox	Seeds do not tolerate the dehydration. Sow in autumnal or spring, in both cases with pre-chilled seeds, often in outdoor, from the collecting	Cold/moist stratification

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Cotinus coggygria* Scop.**	Summer	Summer		Orthodox	Spring sowing with mechanical or chemical scarified seeds and after pre-chilling	Mechanical or chemical scarification (sulfuric acid 30-45 minutes) followed by 4-8 (or more) weeks of cold/moist stratification in relation to the provenance
***Crataegus* sp. pl.**	Autumn	Autumn		Difficult conservation	Sowing at the end of winter – early spring with seeds after heat stratification + cold/moist stratification, eventually after scarification	Heat stratification per 4-16 weeks followed by cold/moist stratification per 12-20 weeks
***Cytisus* sp.pl.**	End of summer	Autumn		Orthodox	Spring sowing with scarified seeds	Mechanical or chemical scarification
***Ebenus cretica* L.**	Summer	Summer		Orthodox	Winter to Spring	Mechanical scarification, or immersion of the seeds in boiling water for 20 sec.
***Erica arborea* L.**	End of spring	Summer		Orthodox	Winter to spring. The seeds need light to germinate, which means that they must be sown near the soil	

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
					surface	
***Erica arborea* L.**	Summer	Summer		Orthodox		
***Euonymus europaeus* L.**	Autumn	Autumn		Orthodox	Autumnal or in early spring sowing with seeds after heat stratification + cold/moist stratification	Heat stratification per 8-12 weeks followed by cold/moist stratification per 8-16 weeks
***Fagus sylvatica* L.**	Autumn	Autumn		Orthodox	Sowing in autumn or in late winter – early spring with pre-chilled seeds. Must be avoided sowing in late spring because high temperatures in the soil may cause secondary dormancy in seeds	Cold/moist stratification per 3-12 weeks (average of 8)
***Frangula alnus* Mill., *F. rupestris* (Scop.) Schur.**	Summer	Summer *(F. rupestris)*, end of summer - early autumn	Scalar maturation (*F. alnus*)	Orthodox		

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
		(*F. alnus*)				
***Fraxinus angustifolia* Vahl**	Autumn	Autumn - winter		Orthodox	Sowing in autumn or in late winter – early spring with seeds subjected to pretreatment to break seed dormancy	Possible pretreatments: Heat stratification (4 weeks) + cold/moist stratification (4-8 weeks) or only cold/moist stratification per 8-16 weeks
***Fraxinus excelsior* L.**	Autumn	Autumn		Orthodox	Presence of complex dormancy. Sowing in autumn or in spring with pretreated seeds	Heat stratification (8-16 weeks) + cold/moist stratification (8-16 weeks)
***Fraxinus ornus* L.**	Autumn	Autumn		Orthodox	Sowing in autumn or in late winter – early spring with pretreated seeds	Heat stratification (2-8 weeks) + cold/moist stratification (8-15 weeks)

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Genista pilosa* L., *G. radiata* (L.) Scop., *G. tinctoria* L.**	Summer	Summer		Orthodox	Spring sowing with scarified seeds	Mechanical or chemical scarification (immersion in acid with variable times)
***Helianthemum stipulatum* (Forssk.) C.Chr.**	Spring	Late spring		Orthodox	Winter	Mechanical scarification, or immersion of the seeds in boiling water for 20 sec
***Hippophae rhamnoides* L.**	summer	End of summer		Orthodox	Autumnal sowing or in spring with pre-chilled seeds	Cold/moist stratification per 4-12 weeks
***Ilex aquifolium* L.**	Autumn	Winter		Difficult conservation	Autumnal sowing or in spring with pretreated seeds	Seed dormancy is complex and connected to dispersion by birds, and it is not easy to remove. Long periods of Heat stratification are suggested (up to 40 weeks) followed by cold/moist stratification (up to 24 weeks)

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Juglans regia* L.**	Autumn	Autumn		Sub-orthodox	Seeds do not tolerate high dehydration. Sowing in autumn or in spring with pre-chilled seeds, generally in outdoor, during all the winter	
***Juniperus communis* L., *J. oxycedrus* L. subsp. *macrocarpa* (Sibth. *et* Sm.) Neirn.**	End of summer	Autumn	Coexistence of fruits of different ages and maturation at the collecting	Orthodox	Sowing in autumn or in late winter – early spring with treated seeds	Very complex seed dormancy may be removed by heat stratification followed by cold/moist stratification, in some cases may be sufficient only cold/moist stratification
***Juniperus phoenicea* L.**	All over the year	All over the year	Usually monoecious plants, female trees produce fruits. Difficult to separate the sound seeds from the empty ones without cutting.	Orthodox	Autumn or winter. Seeds need 60-80 days to germinate at temperatures between 10-20 °C. Seeds germinate better when sown near the soil surface	The seeds must be cleaned with alcohol and hot water in order to remove the resin from the seed coat.
***Laburnum alpinum* (Mill.) Bercht. *et* J. Presl, *L. anagyroides* Medik.**	Autumn	Autumn *(L. alpinum)*, autumn-winter		Orthodox	Sowing in spring with scarified seeds	Mechanical or chemical scarification

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
		(L. anagyroides)				
***Larix decidua* Mill.**	Autumn	Winter	The risk is to collect also old cones	Orthodox	Sowing in autumn mulched or in spring, preferably with pre-chilled seeds	Cold/moist stratification per 3 - 8 weeks
***Laurus nobilis* L.**	Autumn	Winter	Predation by birds is frequent	Recalcitrant, difficult conservation	Sowing in autumn immediately after the collecting (seeds lose their vitality very quickly) or in spring with pre-chilled seeds during winter	Cold/moist stratification per 8-12 weeks
***Ligustrum vulgare* L.**	Summer	Autumn	Predation by birds is frequent	Orthodox	Sowing in autumn or in spring with pre-chilled seeds	Cold/moist stratification per 4-12 weeks
***Lonicera alpigena* L., *Lonicera etrusca* Santi, *Lonicera nigra* L., *Lonicera xylosteum* L.**	Summer	Summer (*L. etrusca*), summer-autumn (*L. nigra* and *L. xylosteum*)	Predation by birds is frequent	Orthodox	There is a lack of information on seeds propagation; generally sowing in spring with pre-chilled seeds	Cold/moist stratification per 12 weeks (at times preceded from heat stratification per 8 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
		autumn (*L. alpigena*)				
***Malus sylvestris* (L.) Mill.**	Autumn	Autumn	Predation by birds is frequent	Orthodox	Sowing immediately after seed collecting or in spring with treated seeds	Heat stratification (2-4 weeks) + cold/moist stratification (12-16 weeks)
***Myrtus communis* L.**	End of summer	Autumn	Predation by birds is frequent	Orthodox	Sowing in late autumn or in spring with pre-chilled seeds	Cold/moist stratification per 3-6 weeks
***Ostrya carpinifolia* Scop.**	End of summer	Autumn-winter		Orthodox	Sowing at the end of the winter – early spring with seeds subjected to Heat stratification + cold/moist stratification	Heat stratification per 4-8 weeks followed by cold/moist stratification per 16-20 weeks
Periploca angustifolia Labill.	End of spring	End of spring	This species produce many empty seeds	Orthodox	Autumn and spring. The seeds must be shown deep in the soil. The light inhibits germination	

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Phillyrea angustifolia* L., *P. latifolia* L.**	Early autumn	Autumn	Predation by birds is frequent	Orthodox	Sowing in autumn or in spring, in both cases is preferable to use scarified seeds	Mechanical or chemical scarification (sulfuric acid 30 minutes)
***Phlomis cretica* C. Presl**	End of spring	End of spring beginning of the summer	This species produces many empty seeds		Autumn and winter	
***Phoenix theophrasti* Greuter**	Autumn	Autumn - winter		Orthodox	Autumn, early spring	
***Picea abies* (L.) H. Karst.**	Early autumn	Autumn		Orthodox	Sowing in spring with seeds soaked in cold water per 24-48 hours or pre-chilled	Cold/moist stratification per 2-3 weeks
***Pinus* sp. pl.**	Summer (autumn for *P. nigra* and *P. sylvestris*)	From december to June *P. halepensis* From		Orthodox	For Mediterranean *Pinus* sowing in spring without pretreatments, for others sowing in spring with seeds pre-chilled per 4-10 weeks.	

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
		november to may *P. pinea* From october to june *P. pinaster* Summer *P. mugo*, autumn *P. cembra* e *P. nigra*, autumn-winter *P. sylvestris*				
***Pistacia lentiscus* L.**	End of summer	Autumn		Orthodox	Sowing in autumn or in spring with vernalized seeds (2-3 weeks). Alternatively sowing in spring with seeds scarified manually	Cold/moist stratification or scarification (see sowing period)
***Pistacia terebinthus* L.**	End of summer	Autumn	In some years the production of empty seeds is very high	Orthodox	Autumnal sowing or during spring with pre-chilled seeds	Cold/moist stratification per 12 weeks

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Platanus orientalis* L.**	Summer	Autumn		Orthodox	Sowing immediately after collecting (winter) or in spring with pre-chilled seeds	Cold/moist stratification per 6-8 weeks
***Prasium majus* L.**	Early spring	Middle of spring	The seeds ripen gradually and are dispersed quickly.	Orthodox	Late winter	Dry storage for 6-7 months in room temperature before sowing
***Prunus amygdalus* Stokes, *P. avium* L., *P. brigantina* Vill., *P. cerasifer* Ehrh., *P. cerasus* L., *P. laurocerasus* L., *P. mahaleb* L., *P. padus* L., *P. spinosa* L.**	Spring (summer for *P. spinosa*)	Summer for all except *P. mahaleb* (early summer) e *P. spinosa* (end summer - autumn)	May be predation by birds, in particular *P. avium* e *P. mahaleb*	Orthodox	Sowing at the end of the winter – beginning of spring (germination is favored from the alternation of temperatures in the soil) with seeds subjected to pretreatments to break seed dormancy	Heat stratification (2-6 weeks) + cold/moist stratification (4-18 weeks), depending from the species. For *P. avium* is suggested 6 weeks cold/moist + 2 weeks heat + 2 weeks cold/moist + 2 weeks heat + 12 weeks cold/moist; germination is highly favored by the alternating of temperatures (3°C in the night, 20°C during the day)

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
Pyrus spinosa **Forssk.,** ***P. pyraster*** **Medik.**	Autumn	Autumn	Predaction by birds is frequent	Orthodox	Sowing at the end of the winter – beginning of spring (germination is favored from the alternation of temperatures in the soil) with seeds subjected to pretreatments to break seed dormancy	Heat stratification (2-4 weeks) + cold/moist stratification (12-18 weeks)
Quercus **sp. pl.**	End of summer	Autumn		Recalcitrant	Seeds do not tolerate dehydration. Sow in autumn after seed collection, or in spring with pre-chilled seed stored in wet conditions, generally outdoor.	
Rhamnus **sp. pl.**	Summer	Generally end of summer-early autumn	Various predations. In some years the production of empty seeds is very high.	Orthodox	*Rhamnus* showed seed dormancy very complex which may vary with the year and the provenance. Sowing in autumn or in spring with pretreated	For *Rhamnus alpinus* are suggested 12-16 weeks of cold/moist stratification

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
					seeds.	
***Rosa* sp. pl.**	End of summer	Autumn		Orthodox	Sowing at the end of winter – beginning of spring with seeds subjected to heat stratification + cold/moist stratification. The addition of substances used as starter of composting in the substrate of stratification reduce the length of the treatment because they degrade the fleshy endocarp. These treatments are not always effective	Heat stratification (8-24 weeks) + cold/moist stratification (8-24 weeks)

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Ruscus aculeatus* L.**	Winter	Winter-spring		Orthodox	This species demonstrates very complex seed dormancy and at date effective methods to break seed dormancy are unknown. Sowing in spring with seeds subjected to heat stratification (also many cycles)	Heat stratification (4-8 weeks) + cold/moist stratification (8-12 weeks)
***Sambucus* sp. pl.**	Summer	Summer	Predation by birds is frequent (in particular *S. nigra)*	Orthodox	Autumnal sowing with non-treated seeds or during spring with treated seeds	For *S. nigra* cold/moist stratification (8-9 weeks), it like 20°C of temperature to germinate For *S. racemosa* cold/moist stratification (12-24 weeks) prefers alternating temperatures for germination

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Securigera globosa* (Lam.) Lassen**	Summer	Summer		Orthodox	Autumn or winter sowing with scarified seeds	Mechanical scarification, or immersion of the seeds in boiling water for 20 sec
***Sorbus* sp. pl.**	Summer	End of summer - autumn (*S. aria, S. domestica*), autumn (*S. aucuparia, S. torminalis)*	Various predations (in particular on *S. aucuparia* e *S. torminalis*)	Orthodox	Sowing immediately after seed collecting or at the end of the winter – beginning of spring (the daily alternation of temperatures favors germination, while the constant temperatures induce secondary dormancy) with seeds subjected to heat stratification + cold/moist stratification (or only cold/moist stratification)	Heat stratification (0-4 weeks + cold/moist stratification (12-16 weeks)
***Spartium junceum* L.**	Summer	Summer-autumn		Orthodox	Sowing during spring with scarified seeds	Scarification

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Staphylea pinnata* L.**	Autumn	Autumn		Orthodox	Sowing immediately after seed collecting or in spring with seeds subjected to heat stratification + cold/moist stratification	Heat stratification (12 weeks) + cold/moist stratification (12 weeks)
***Taxus baccata* L.**	End of the summer	End of summer – beginning of autumn		Difficult conservation	Sowing in autumn (germination occur during the second spring) or in spring with seeds subjected to treatment (not always effective)	Heat stratification (12-28 weeks) + cold/moist stratification (8-16 weeks)
***Tilia* sp. pl.**	Autumn	Autumn or end of the autumn		Difficult conservation	Presents complex seed dormancy. If seeds untreated are used, germination lasts three years Sowing in spring with treated seeds (heat stratification + cold/moist stratification)	Heat stratification (16 weeks) + cold/moist stratification (14-18 weeks)

Scientific name	Period in which to estimate the extent and quality of fruiting	Collection period	Elements to consider before proceeding to seed collection	Seed storability	Sowing period	Pre-treatments (if it is necessary to remove seed dormancy)
***Ulmus* sp. pl.**	Spring	Spring		In wild they lose quickly the viability; difficult conservation	Seeds are non-dormant. Sowing immediately after seed collection (spring)	
***Viburnum* sp. pl.**	Summer (*V. lantana* e *V. opulus)*, autumn (*V. tinus)*	End of the summer - autumn		Orthodox	Sowing in autumn or in spring with seeds subjected to heat stratification + cold/moist stratification	Heat stratification (16 weeks) + cold/moist stratification (14-18 weeks)
Zelkova abelicea (Lam.) Boiss.	Early autumn	Autumn	This species seems to have a three-year-cycle of high fruit production. At the 'productive years' the 50% of the seeds are empty. On the contrary on 'no productive years' this percentage is very low, less than 5%	Orthodox	Early spring	Cold stratification for 3 months

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Unpublish data from the Seed Bank of MAICh from various reports from the projects (Junicoast, Cretaplant, MAVA).