

How to Select Appropriate Plants for Allergic Children

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Abbreviations: AAFA: Asthma and Allergy Foundation of America; CDC: Center for Disease Control; CO₂: Carbon Dioxide; P.p.m: Parts Per Million; OPALS: Ogren Plant Allergy Scale; PCI: Pollen Contribution Index

ABSTRACT

Pollen-related respiratory allergy has a significant impact on global public health, as it involves around one-quarter of the general population. On the other hand, green areas are of pivotal importance in improving the quality of life through a multitude of effects. Therefore, adequately selecting plants for the urban and country landscape represents an important preventive measure to reduce the burden of the disease. This review aims to summarize the characteristics of the allergenic plants and the measures that can be taken to reduce their impact on public health. The degree of allergenicity of plants can be predicted according to various tools, e.g. the Ogren Plant Allergy Scale (OPALS) and the criteria by the American Academy of Allergy, Asthma & Immunology. In brief, non-invasive, non-toxic, entomophilous plants (i.e. insect-pollinated flowers) should be the preferred ones. Interventions aimed at reducing the impact of pollen allergy should include both a correct selection of plants and simple individual preventive measures. In conclusion, better understanding how pollen-related respiratory allergy impacts on global public health and defining criteria to adequately choose plants for the landscape is of paramount importance to improve quality of life for children and adults with respiratory allergies.

Keywords: Allergy; Climate Change; Entomophilous; Landscape; Plants; Pollen

Introduction

Around 30% of the world population suffers from allergic pollen-related diseases [1], constituting an important clinical problem for affected individuals and carrying substantial costs for the healthcare system. In Europe, more than 150 million citizens have chronic allergic diseases, implying costs up to 151 billion euros per year [2] for the National Health Services. This is one of the main health issues at present, and will probably worsen exponentially in the next years, as a result of climatic change and growing urbanization, industrialization, and pollution [3]. Green areas are a qualifying element of urban environment and represent an added value, both in terms of health and economics, given its multiple effects [4]: the regulation of the microclimate through increased evaporation and perspiration, the protection from landslides and the control of river banks, and last but not least the possibility of creating a meeting and association area. The amount of green per capita is an important index to define the quality of life in a city. Green can also improve the physical and psychological well-being of people [5]. However, on the other hand, green can have negative effects, as it happens for patients with pollen allergy.

The prevention of respiratory allergic diseases is therefore an important goal and also a challenge for the scientific community. Complex and still inconclusive studies are being carried out aimed at identifying primary and secondary preventive measures [6,7].

An example of primary prevention might be to avoid that a newborn baby with at least one parent with allergy (therefore considered at risk) becomes allergic. An example of secondary prevention might be to prevent symptoms in people who are already sensitized to an allergen. In this latter topic, the characteristics of the environment in which we live, both indoors and outdoors, play an important role. The Asthma and Allergy Foundation of America (AAFA) [8] periodically indicates which cities have the highest pollen load in the different seasons of the year, in order to adopt appropriate preventive measures and therapies. Allergies are the sixth leading cause of chronic disease in the United States according to the Center for Disease Control and Prevention [9] and represent a health cost of 18 billion dollars. The promotion of a "low allergenic charge environment" may not be easily carried on but is not unfeasible. To achieve this goal, it is important to spread the

knowledge related to the pathogenetic mechanisms of allergy, as well as the life cycle of plants that are most often implied in allergic manifestations [10].

Plants and Pollen

Pollens in the atmosphere are the key element (male gametophyte) for the reproduction of seed plants. The pollen grain has a protective layer made up of two walls: an external (hexin) and an internal (intin) wall. When the pollen is mature, it is released for pollination and can reach the female part of the flower, carried by the wind (anemophilous plants) or through insects (entomophilous plants), water, birds and other animals [11]. Pollens that can cause allergies in general have some common characteristics [12]:

- a. They belong to anemophilous plants,
- b. They contain allergenic components that stimulate the immune system of the allergic subject genetically predisposed to produce specific antibodies,
- c. They have to be produced in large quantities from plants widespread in the area, and
- d. They have to be small and light in order to be carried by the wind at a great distance [13].

The wall of the pollen grains has numerous proteins that allow the recognition of the granule by the female part of the flower. These same proteins are responsible for allergic reactions in genetically predisposed sensitive subjects, acting as antigens and stimulating the immune system to produce antibodies (IgE). When antibodies and antigens meet, chemical mediators are produced, including histamine, triggering the inflammatory process underlying allergic symptoms, e.g. rhinitis, conjunctivitis, asthma [11]. Some plants (monoecious) have male and female flowers on the same plant, others (dioecious) are male or female: the latter, i.e. the dioecious, are the most allergenic. Mosses and ferns produce pollens that propagate in the surrounding environment, unlike conifers (which belong to gymnosperms) and other plants with flowers (angiosperms); the latter produce large quantities of pollen which spread at considerable distances. Plants with flowers or angiosperms can have different morphologies: ancestral magnolia-type flowers, inconspicuous flowers such as Grasses and *Ambrosia*, complex flowers such as orchids and sunflowers.

A "perfect" plant for allergic people is the one that has male and female parts in the same flower as tulip, poppy, orchid and magnolia [13]. In the anemophilous angiosperm plants often petals and sepals of the flower are absent or vestige only, and the male part is separated from the female; the flowers constitute inflorescences, that is groups of flowers together like oaks, birches and mulberries. A list of main anemophilous plants that cause allergies is shown in Table 1. Finally, it must be remembered that pollution, especially the particles derived from diesel combustion, increases the allergenicity

of pollen. A particular mention is deserved by the Grasses, *Ambrosia*, and the *Parietaria* as they produce the highest quantity of clinically relevant allergens. The concentration of the various types of pollen in the atmosphere depends above all on the presence and diffusion of the plants on the territory, as well as on some environmental parameters such as wind, humidity, temperature and atmospheric turbulence. Climate change also affects pollen: the increase in temperatures is associated with lengthening and anticipation of the pollen season, the distribution and establishment of pests and contributes with high concentrations of CO₂ to the increase in pollen production [14,15].

Grasses

This family includes about 9,000 species spread all over the world; some are annual because they produce seeds over a year, others are perennial because they live for several years and produce seeds several times. In unfavourable situations, perennials have the aerial part that emerges from the completely dry soil, while the underground stems survive and give rise to new leaves and flowers in the favourable seasons. Grasses adapt to survive in extremely variable climatic conditions. All the cereals belong to the *Grasses* family, such as wheat, corn, rice and barley, but also other well-known plants such as bermuda grass, sugar cane and bamboo. The vast plains on all continents such as the Asian steppes, the African savannahs, the prairies of North America or the pampas of South America are dominated by the *Grasses* plants. In urban environments, the grasses, in addition to forming meadows, grow in abandoned lands, along the slopes and at the edges of the roads. Grasses have mostly anemophilic pollination; in fact, only some cultivated species, such as wheat, become self-pollinating and in this case, pollen is released in very low quantities. The grasses continuously produce pollens, some of which are able to bloom - depending on the climatic zones - even during autumn and winter. Within the individual species there is a wide variability regarding the flowering period.

Ambrosia

The genus *Ambrosia* belongs to the weed flora and is native to North America. Over 40 species are known, of which the most common are *Ambrosia artemisiifolia*, *Ambrosia trifida* and *Ambrosia coronopifolia*. *Ambrosia artemisiifolia* (in America called ragweed) is the most invasive and causes allergic crisis in the summer. It was imported into Europe in the early twentieth century, with a prevalent interest in the Hungarian plain. It generally reaches a height of 100-150cm. Pollen is highly allergenic as well as being produced in large quantities: a single plant can produce over a billion pollen grains per season. The pollen grain is small (15-25 microns) for which it can be transported for thousands of kilometers. *Ambrosia artemisiifolia* is today rapidly spreading in urban areas of central-northern Italy; *Ambrosia coronopifolia* is present in uncultivated land and in rural areas. They are perennial herbs with long creeping woody rhizomes.

Parietaria

The genus *Parietaria* belongs to the *Urticaceae* family and is typical of temperate and tropical regions. They are annual or perennial herbaceous plants reaching 20–80cm of height. The leaves are alternate, simple, entire, often with a cluster of small leaves in their axils. Flowers are produced in clusters of three to many in the leaf axils, and can either be bisexual or both male and female. The fruit is a small dry achene. The term *Parietaria* stems from the Latin *paries*, i.e. wall, as it tends to grow onto old walls. *Parietaria* pollen is the most important cause of pollen allergies in the Mediterranean area, as the plant is common in this region [16]. The *Parietaria* pollen mean diameter is measured in micrometres and is larger than 10mm. Thus, the grains generally induce inflammation in the upper airways and bronchi, whereas they cannot reach the terminal bronchioles. A recent study addressing the seasonality of *Parietaria* pollination found that it lasts 6–7 months on average, with two main peaks during mid-spring and early fall, respectively [17].

Impact of Climate Change on Pollens

Human activities and industrialization have led to an increase in atmospheric greenhouse gases and climate change. Indeed, CO₂ atmospheric concentration has risen from 280 p.p.m. in 1750 to more than 370 p.p.m. in 2002, whereas global average surface temperature has turned up by 0.6 °C [18]. Projections estimate that CO₂ concentration and temperature increase will top at around 541-970 p.p.m. and 1.4-5.8 °C by 2100 [18]. This epochal climate change is exerting a significant impact on aeroallergen-mediated allergy by a multitude of effects, i.e. pollen amount, pollen allergenicity, pollen season, and plant and pollen distribution [19,20]. Two studies found a significant increase in the production of pollen by *Ambrosia*, paralleled by the rise in CO₂ atmospheric concentration

Measures to Reduce the Burden of Allergy

How to Select Low Allergenic Plants for the Landscape

Table 1: Main pollen-producing plants. Plants with a higher allergenic potential are in bold characters.

Trees	Shrubs	Grass	
Fir			
Maple tree			
Birch			
Cypress			
Cedar			
Eucalyptus			
Beech tree			
Ash tree			
Halzenult tree	Hawthorn		
Walnut tree	Blackberry tree		
Elm tree	Juniper		
Alder	Elder		
Pine tree			
Poplar			
Plane tree			
Oak tree			
Willow			
Sycamore			
Yew			
Olive tree			
		Oats	Wood sorrel
		Holcus lanatus	Amaranth
		Timothy grass	Artemisia
		Bermuda grass	Ambrosia
		Poa	Chamomile
		Wheat	<i>Chenopodio</i>
		Lolium	<i>Medicago sativa</i>
		Dactylis	<i>Chenopodium album</i>
		Barley	Nettle
		Anthoxanthum odoratum	Plantain
		Rye	Parietaria
			Sage
			Dandelion

[21,22]. Ahlholm, et al. [23] examined the amount of the pollen allergen Bet v 1 produced by mountain birch (*Betula pubescens*) grown at two different temperatures and found significantly higher allergenicity for the trees at higher temperature [23]. Two Italian studies reported an earlier start of the pollen season related to a warming in temperature over the years 1981-2000 [24,25]. Last, Kelly, et al. [26] found that the average altitude of the allergenic plants in Southern California increased by 65m between 1976 and 2006, thus augmenting pollen production; this shift was attributed to an increase in average surface temperature [26].

How to Define the Allergenicity of a Plant

Despite all the limitations of a relatively refined stratification, a book published by the botanist Thomas Ogren entitled “The allergy-fighting garden” ranks the potential allergenicity of plants (OPALS Allergy Index Scale) [27]. Plants are categorized from slightly allergenic (1 or 2) to highly allergenic (9 or 10), based on several factors, such as: the quantity of pollen produced, the power of the pollen, the duration of flowering of the plant, size, gravity and adhesiveness of the pollen grain. Recently the Aerobiology Committee of the American Academy of Allergy, Asthma & Immunology defined the criteria and modalities on how to choose plants with least allergenic potential [13]. The recommended plants are shown in Tables 2 & 3. The list of recommended plants was obtained by combining the data present in the literature [13,28]. Another recent tool is the Pollen Contribution Index (PCI), which considers phenology, pollen grain size, species abundance and pollen production and performed well in identifying a small subset of plants responsible for most airborne grass pollen in a Mediterranean region [29]. Further, Damialis et al. have recently reviewed epidemiological studies worldwide on the allergenic properties of airborne pollen from different plant taxa [15].

The selection of plants for the landscape can be a difficult task. There are many recommendations on the least allergenic species to choose, depending on whether the climate is dry or wet (13,30). Tables 1-3 show a list of grass and plants to be avoided and chosen, respectively. In case of doubts on a plant which is not mentioned, a simple algorithm can be adopted (Figure 1), illustrating how to proceed. If the plant produces flowers and has an entomophilic reproduction, through insects, it can be a candidate. If it has toxic or infesting actions, it should be abandoned. Then, it should be checked whether it is appropriate for the climatic area and if it is described with low allergenic potential. In case of positive

responses, the plant is selected. The fruit trees are for the most part entomophilic, however they need particular attention if inserted in the landscape only for an aesthetic choice; some trees, such as persimmon, lend themselves very well to entering into a landscape architectural project. For the lawn it would be advisable to choose a grass that produces a reduced amount of pollen and that does not need frequent mowing. Examples of low-pollen grass are hybrid varieties, such as Australian ones called Santa Ana and Windsor. An added feature of these hybrid varieties is that they are very drought tolerant, while the downside is that they are very invasive and difficult to remove once planted.

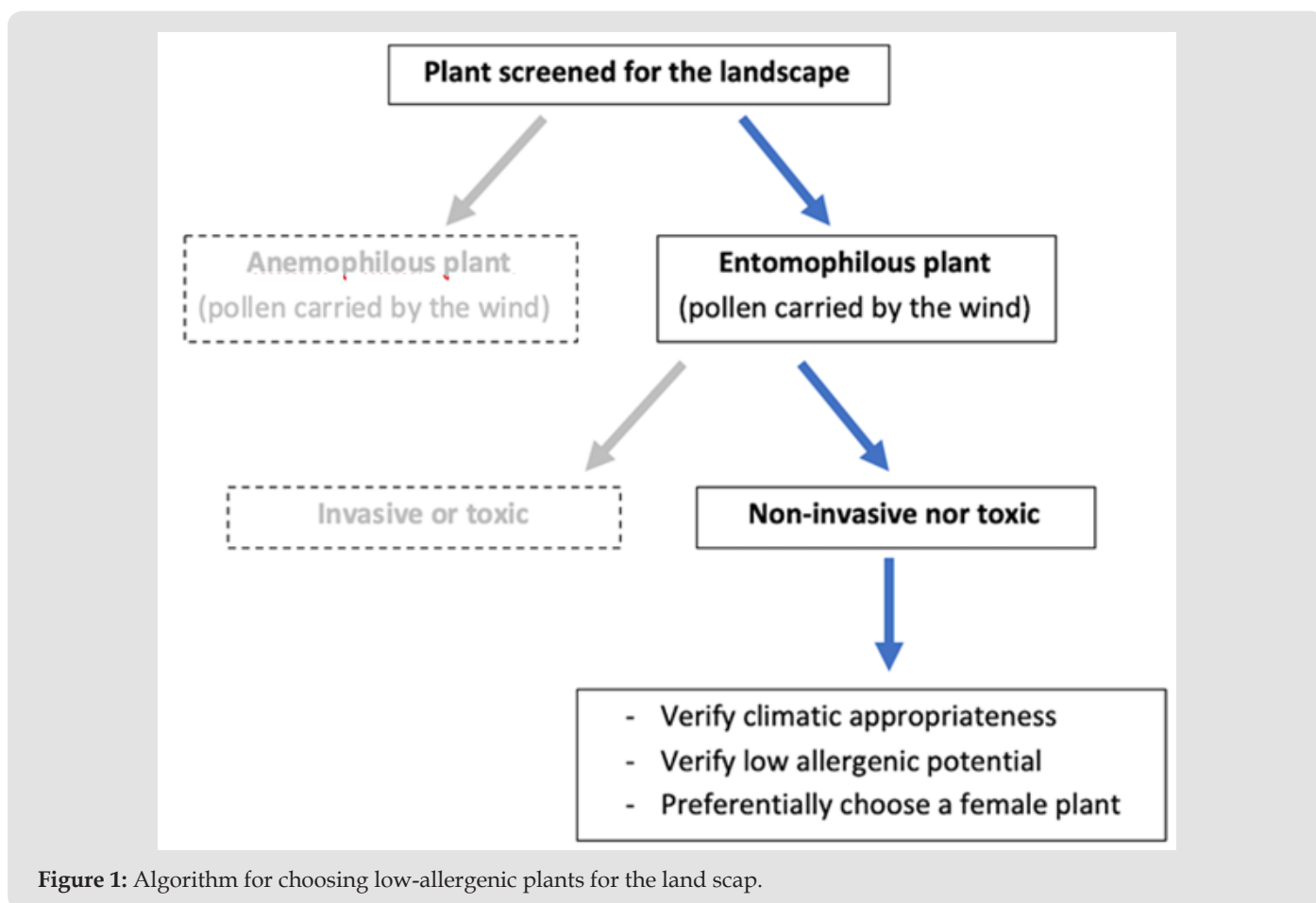


Figure 1: Algorithm for choosing low-allergenic plants for the land scap.

Table 2: Entomophilous tree plants (i.e. insect-pollinated flowers) which can be chosen for a low-allergenic landscape [13,28].

Species	Family	Short Features
Ilex opaca	Aquifoliaceae	It is an evergreen tree, belongs to the agrifolio family. The winter buds are brown, short, dull or sharp.
Cornus florida	Cornaceae	It includes shrubs or trees, with deciduous leaves. It is a fairly rustic plant and is used in isolation, in groups or to form hedges.
Cornus sanguinea	Cornaceae	The species spreads by seeds and stolons. Its natural range covers most of Europe and western Asia. It is especially abundant in riversides, especially in shady areas and ravines.
Diospyros kaki	Ebenaceae	It is among the oldest cultivated plants, having been in use in China for more than 2000 years.
Diospyros virginiana	Ebenaceae	The tree grows wild but has been cultivated for its fruits and wood since prehistoric times by Native Americans. Its fruit is a kind of persimmon.
Kalmia latifolia	Ericaceae	Native to North America, where it grows spontaneously in fresh woods, under the foliage of large trees; it is a magnificent evergreen shrub.

Baptisia australis	Fabaceae	It is a perennial, attractive green-blue foliage; the flower is blue-lilac, its flowering period is June - August.
Sophora japonica	Fabaceae	Deciduous tree with erect bearing, vaguely resembling Robinia, slowly reaches 20 m in height.
Cercis canadensis	Fabaceae	It reaches 11 meters in height, the width is greater than 8 meters, has considerable resistance to cold.
Sassafras albidum	Lauraceae	Sassafras is a shrubby plant common in North America; from the root an essential orange-yellow oil is obtained.
Liriodendron tulipifera	Magnoliaceae	It is an often multi-stemmed, deciduous tree with a wide spreading, flat topped, rounded, or even spike shaped open habit. The tree is a popular nesting shrub for songbirds.
Magnolia grandiflora	Magnoliaceae	Although endemic to the lowland subtropical forests on the Gulf and south Atlantic coastal plain, magnolia grandiflora is widely cultivated in warmer areas around the world. The timber is hard and heavy, and has been used commercially to make furniture, pallets, and veneer.
Liriodendron tulipifera	Magnoliaceae	The liriodendro or Tulip tree sometimes exceeds 30 m in height with cupped flowers similar to those of the tulip.
Magnolia soulangeana	Magnoliaceae	It is a cultivation hybrid obtained from the French agronomist Soulange-Bodin.
Magnolia soulangiana	Magnoliaceae	It is a hybrid plant. Its flowers emerge dramatically on a bare tree in early spring, with the deciduous leaves expanding shortly thereafter, lasting through summer until autumn.
Magnolia stellata	Magnoliaceae	The tree blooms at a young age, with the slightly fragran flowers covering the bare plant in late winter or early spring before the leaves appear. The flowers are star-shaped.
Forsythia viridissima	Oleaceae	It is a deciduous Shrub growing to 2.5 m.
Chionanthus virginicus	Oleaceae	Its name is evocative: it means from the Greek "flower of snow", rustic tree. It does not fear the most intense frosts, it does not suffer from particular diseases, it is almost never attacked by parasites.
Amelanchier arborea	Rosaceae	Native to North American. The fruit is a berry similar to blueberry, with a sweet taste reminiscent of gooseberries.
Crataegus monogyna	Rosaceae	It is a species of hawthorn native to Europe, northwest Africa and western Asia. It has been introduced in many other parts of the world. It can be an invasive weed.
Eryobrotrya japonica	Rosaceae	It is a large evergreen shrub or tree, grown commercially for its yellow fruit, and also cultivated as an ornamental plant.
Malus domestica	Rosaceae	It is a deciduous tree that produces apples.
Mespilus germanica	Rosaceae	It is a large shrub or small tree, and the name of the fruit of this tree.
Prunus laurocerasus	Rosaceae	It is an evergreen species of cherry, native to regions bordering the Black Sea in southwestern Asia and southeastern Europe, from Albania and Bulgaria east through Turkey to the Caucasus Mountains and northern Iran.
Crataegus phaenopyrum	Rosaceae	It is a species of hawthorn commonly known as Washington hawthorn. It is widely cultivated as an ornamental plant and can reach 10 m in height. The red berried fruits have a delicate flavor, eaten raw or cooked.
Pyrus communis	Rosaceae	It is a species of pear native to central and eastern Europe and southwest Asia. It is one of the most important fruits of temperate regions.
Spiraea vanhouttei	Rosaceae	It is a vase-shaped, deciduous shrub with branching that arches toward the ground. It is a hybrid.

Table 3: Entomophilous perennial herbaceous plants (i.e. insect-pollinated flowers) which can be chosen for a low-allergenic landscape [13,28].

Species	Family	Short Features
Ilex opaca	Aquifoliaceae	It is an evergreen tree, belongs to the agrifolio family. The winter buds are brown, short, dull or sharp.
Polygonatum odoratum var	Asparagaceae	Perennial herbaceous plant, also called Solomon's seal; present in the woods.
Aster tataricus	Asteraceae	Perennial plant, erect bearing, the flower is light blue purple with a yellow center; its flowering period is October - November.
Boltonia asteroides	Asteraceae	It is a perennial, elongated greyish-green foliage, the flower is white; its flowering period is July - September.
Coreopsis verticillata	Asteraceae	It is a plant with bush development, which can reach 90 cm in height, slowly expanding through underground rhizomes. The flower head is yellow
Echinacea purpura	Asteraceae	Perennial plant native to North America with ornamental and herbal interest.
Rudbeckia fulgida var. sullivantii	Asteraceae	Herbaceous plant with typical "daisy" inflorescence.
Symphotrichum novae-angliae	Asteraceae	Small herbaceous perennial plant; spontaneous.

<i>Berberis julianae</i>	Berberidaceae	Native to Central China. It is a compact evergreen shrub with rigid, glossy elliptic leaves and racemes of yellow flowers, tinged with red, in late spring. Bloomy black berries in autumn
<i>Mahonia aquifolium</i>	Berberidaceae	Native to Western North America. It is an evergreen shrub with pinnate leaves consisting of spiny leaflets, and dense clusters of yellow flowers in early spring, followed by dark bluish-black berries
<i>Radicans tecoma</i>	Bignoniaceae	It is commonly called trumpet vine or trumpet creeper, is a dense, vigorous, multi-stemmed, deciduous, woody, clinging vine that attaches itself to structures and climbs by aerial rootlets. It is native to the Southeastern America including Missouri, but has naturalized in many northern states.
<i>Lobelia cardinalis</i>	Campanulaceae	Perennial plant typical of humid places and with beautiful scarlet flowers, it adapts very well to living in the waters of temperate aquariums.
<i>Chimonanthus praecox</i>	Calycanthaceae	It is a vigorous deciduous shrub with strongly scented pendent flowers.
<i>Viburnum opulus</i>	Caprifoliaceae	The common name 'guelder rose' relates to the Dutch province of Gelderland, where a popular cultivar, the snowball tree, supposedly originated. It is a deciduous shrub.
<i>Viburnum rhytidophyllum</i>	Caprifoliaceae	It is an evergreen shrub. Produces flat cymes of creamy white flowers in the spring and berries in early fall which first appear red and then change to a glossy black.
<i>Viburnum tinus</i>	Caprifoliaceae	It is a dense, evergreen shrub with dark and oval, glossy leaves, which contrast beautifully with fragrant pinkish-white flowers, followed by dark black fruit.
<i>Sedum ternatum</i>	Crassulaceae	Perennial plant with round foliage; the flower is white.
<i>Ginkgo biloba</i>	Ginkgoaceae	Native to China, the tree is widely cultivated, and was cultivated early in human history.
<i>Lavandula angustifolia</i>	Labiatae	It is popular for its colourful flowers, its fragrance, and its ability to survive with low water consumption.
<i>Rosmarinus officinalis</i>	Labiatae	It is an aromatic evergreen shrub with leaves similar to hemlock needles. It is native to the Mediterranean and Asia, but is reasonably hardy in cool climates.
<i>Caratonia siliqua</i>	Leguminosae	Native to the Mediterranean region and the Middle East, it is widely cultivated for its edible pods, and as an ornamental tree in gardens and landscapes.
<i>Cercis siliquastrum</i>	Leguminosae	It is commonly known as the Judas tree or Judas-tree, is a small deciduous tree from Southern Europe and Western Asia which is noted for its prolific display of deep pink flowers in spring.
<i>Gleditsia triacanthos</i>	Leguminosae	It is a deciduous tree, native to central North America where it is mostly found in the moist soil of river valleys.
<i>Sophora japonica</i>	Leguminosae	It is native to China; despite the name, it was introduced in Japan. It is a popular ornamental tree in Europe, North America and South Africa, grown for its white flowers, borne in late summer after most other flowering trees have long finished flowering.
<i>Lagerstroemia indica</i>	Lythraceae	It is a very popular flowering shrub/small tree in mild-winter states.
<i>Hibiscus syriacus</i>	Malvaceae	It is a hardy deciduous shrub. It is upright and vase-shaped, bearing large trumpet-shaped flowers with prominent yellow-tipped white stamens.
<i>Ficus carica</i>	Moraceae	It is an Asian species of flowering plant in the mulberry family, known as the common fig.
<i>Maclura pomifera</i>	Moraceae	It is a small deciduous tree or large shrub, The fruits secrete a sticky white latex when cut or damaged.
<i>Musa basjoo</i>	Musaceae	It is a herbaceous perennial. The species produces male and female flowers on the same inflorescence which may extend for over 1 m.
<i>Trachycarpus fortunei</i>	Palmae	It is a species of hardy evergreen palm tree.
<i>Penstemon digitalis</i>	Plantaginaceae	Evergreen perennial plant, beautiful large foliage, slightly wavy; the flower is white.
<i>Phlox divaricate</i>	Polemoniaceae	Plants native to America and Asia. The herbaceous stem ends with numerous tubular flowers, variously colored and speckled, of great decorative effect.
<i>Punica granatum</i>	Punicaceae	It is a fruit-bearing deciduous shrub. It is grown for its fruit crop, and as ornamental trees and shrubs in parks and gardens. Mature specimens can develop sculptural twisted-bark multiple trunks and a distinctive overall form.
<i>Helleborus orientalis</i>	Ranunculaceae	It is also called Christmas Rose, because it blooms between December and February, as soon as warm days occur during the winter.
<i>Heuchera micrantha</i>	Saxifragaceae	Evergreen with beautiful lobed leaves and erect racemes of small tubular flowers. It is mainly cultivated for highly ornamental foliage throughout the whole year.
<i>Paulownia tomentosa</i>	Scrophulariaceae	It is an extremely fast-growing deciduous tree, and is a persistent exotic invasive in North America.
<i>Tamarix gallica</i>	Tamaricaceae	It is a deciduous, herbaceous, twiggy shrub or small tree reaching up to about 5 meters high.

Other Measures to be Taken

Other practical advice can be suggested to facilitate the creation of a low allergenic load landscape and can be summarized in the following proposals:

a) If you are interested in planting an anemophilous dioecious plant, it would be advisable to choose the female one, which does not produce pollen.

b) If there is a male plant in the garden and it is not possible to remove it, we recommend planting a female plant near it, which will capture part of the male pollen.

c) A strong annual pruning can reduce the pollen load produced by a male tree. In fact, most trees with high allergenic load such as birches and alders have male cones at the ends, so that pruning the tops by 15-20cm in autumn will reduce the pollen load in the following spring.

d) To reduce the pollen load in your area, you can create a hedge on the borders with female plants.

For example, in warm regions where *Pitirosporium* is present, the planting of a female hedge of *Pitirosporium* will capture many male pollens; a yew hedge in colder climates can perform the same function. For meadows it is important to arrange frequent mowing to prevent the grass from developing inflorescences: knowing that in a region in general the flowering of grasses plants usually begins in April, cutting the lawn in mid-March and soon repeating the cut prevents the plant from producing pollen. Finally, do not forget to weed out the weeds, especially *Ambrosia* and to constantly remove the *Parietaria*. Furthermore, it is necessary to consult the regional/national Bulletin of pollen and spore in order to monitor the local trend of allergens. Patients with known pollen allergy should follow preventive measures, such as

- a.** Limiting outdoor activities when pollen counts are high,
- b.** Keeping windows closed during pollen season,
- c.** Bathing and shampooing their hair daily before going to bed,
- d.** Washing bedding in hot, soapy water once a week,
- e.** Wear sunglasses and a hat when outdoor, and
- f.** Changing and washing clothes worn during outdoor activities.

Conclusion

Allergic diseases are constantly increasing so all the possible measures must be implemented to reduce their clinical potential, intervening at every level [3,13,30]. When addressing the issue of environmental green, both private and public, one must first think of creating a collective culture. It is therefore necessary to integrate information:

a. You need to know which plants are present in the territory with a listing of the existing species.

b. You must consult the Bulletin of pollen and allergenic spores.

c. It is necessary to inform and train those who deal with the management of public green spaces, but also to transmit information to private individuals who still manage a relevant aspect. In this sense, botanical and biological, but also clinical knowledge can help change some habit and some landscape habitats without giving up on having a pleasant and soothing green environment.

The adoption of simple methods to choose the type of plants to be planted can significantly help block the increase in allergic diseases or at least contain its symptoms. The planning of these interventions must be the task of the public structure which must coordinate the measures and favour a culture where the private sector must and can be an important force.

Key Messages

- Allergic pollen-related diseases have a high worldwide prevalence and imply substantial healthcare costs.
- Air pollution and climate change related to industrialization and urbanization contribute to increase pollen allergenicity and sensitization.
- Green areas have multiple positive effects on people's health; on the other hand, they carry an important allergenic load.
- A list of species with the highest and least allergenic potential is provided in order to better choose plants for the landscape.
- Hints to reduce pollen spread in the atmosphere are:
 - a.** Choose entomophilous species or the female gender of anemophilous dioecious plant.
 - b.** Plant female plants near the male ones, in order to capture pollens.
 - c.** Periodically prune male trees such as birches and alders.
 - d.** Create a hedge on the borders with female plants.
- Pollen calendars are useful tools showing the peak pollen times for various plants in different areas.

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