

SHELTERBELTS AND WINDBREAKS: PRINCIPLES FOR INSTALLATION

The importance of species selection, installation and management



THE WHAT AND WHY

Tree elements for wind protection

Wind can affect crops and animals, by directly or indirectly acting on mechanical or physiological processes related to microclimate and soil. There are several tree elements that, when correctly planned, allow the reduction of these effects. At the landscape level, most of the time they are used in combination with each other to reduce wind damage. According to their structure three types of green barriers may be considered (Pavari 1961):

- 1) shelterbelts – strips of wide multiple rows of trees or shrubs;
- 2) windbreaks – afforestation with single or multiple rows of trees (up to 4 or 6 maximum);
- 3) single hedges – single linear elements for the immediate protection of crops, composed by trees, shrubs or other.

HOW IS THE CHALLENGE ADDRESSED

Species selection and installation

Choosing the right woody plants to include in shelterbelts or windbreaks requires careful and timely assessment of the ecological needs, of the structure required, the climate, soil, crops and other elements on the farm. Regardless of location or conditions, there are some vital principles that ensure success. Windbreaks and shelterbelts should:

- Provide protection from prevailing winds.
- Include a minimum of two or three rows of trees and/or shrubs, planted at spacing that meets the maintenance objectives.
- Be designed so that the width between the outside stems does not exceed the tree height.
- Be installed after guaranteeing that the site preparation ensures high rooting success and high initial growth, good soil drainage and respiration. This may be achieved through tillage, summer fallowing, subsoiling, terracing, contour planting, fertilizing, etc., according to local conditions.
- Include beating up practices (replacing dead trees after planting), as early as possible, following the year of planting.
- Be monitored to guarantee the necessary tree thinning, pruning and cutting operations.
- Be monitored to guarantee that after they reach maturity and gaps start appearing, tree replanting is carried out.

Trees		
Species	Advantages	Disadvantages
<i>Populus spp</i>	Well adapted to riparian areas	Deciduous tree, ineffective for wind protection in winter unless shrubs are combined
<i>Alnus spp e Salix spp</i>	Suitable for riparian and row afforestation Can be used in pollarding and coppice Good for secondary windbreaks together with <i>Populus spp</i>	Some species are not adapted to dry soils
<i>Platanus spp</i>	Vigorous growth Dense canopy	Deciduous tree, ineffective in winter for wind protection unless shrubs are combined Not adapted to very humid soils
<i>Robinia pseudoacacia</i>	Fast growth Dense canopy Grows well from the coppiced stump Quality wood Good for honey bees Very useful in slope areas with a tendency to erode High protein content to feed animals	Becomes invasive due to root shoots (suckering)
<i>Ulmus pumila</i>	Adapted to several types of soil Fast growth and dense canopy Used as natural trellises in vineyards	Ill adapted to low temperatures
<i>Eucalyptus spp</i>	Fast growth Well adapted to several environments	There are some current government restrictions to planting
<i>P. pinea</i> <i>P. halepensis</i> <i>P. pinaster</i>	Well adapted to Mediterranean areas Do well in shallow soils Do well with high summer temperatures	<i>P. pinaster</i> should be used in multiple rows instead of single lines
<i>P. radiata</i>	Suitable for dense rows Good income source in short rotations (15 to 20 years)	Does not adapt to arid climates
<i>Cupressus sempervirens</i>	Fast growth Root system not invasive in the first few decades Well adapted to cold climates	
<i>C. macrocarpa</i>	Very fast growth	Not adapted to low temperatures or limestone or clay soils Does not last long
<i>C. arizonia</i>	More resilient than <i>macrocarpa</i> Hybridizes easily with <i>glabra</i> and <i>lusitanica</i> , and other species, its 1 st generation hybrids are very vigorous	Sensitive to ice
<i>C. glabra</i> and <i>C. lusitanica</i>	Very fast growth	Less resilient than <i>C. arizonia</i>

Some species of trees suitable for windbreaks and shelterbelts



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727872.

Keywords: Hedgerows, wind protection, hedgerow installation, hedgerow management, trees, shrubs

eurafagroforestry.eu/afinet



HIGHLIGHTS

- Windbreaks and shelterbelts are fundamental in minimizing the unpleasant effects of wind upon crops, livestock and property.
- Their function depends on factors including height, length, thickness and density.
- In order to maximize their wind protection function, it is essential to ensure suitable species selection, good installation and management.
- Shelterbelts and windbreaks have a multitude of advantages and their disadvantages can be overcome by clever choice of crops for their adjacent areas.

Shrubs

Species	Advantages	Disadvantages
<i>Tamarix galica</i> <i>T. africana</i>	Well adapted to saline soils and salty wind	
<i>T. articulata</i>	Unlike other <i>Tamarix</i> species it is perennial It can be used in combination with vegetable gardens and orchards (due to non-invasive root system)	
<i>Casuarina spp</i>	Non-invasive root systems Fast growth	Not adapted to harsh winters Not adapted to hot climates
<i>Myosporum spp</i>	Quickly forms a dense barrier Perennial Well adapted to salty winds and the coast Well adapted to warm climates Non-invasive root systems Easily multiplied by cuttings	
<i>Ulex europaeus</i>	Quickly forms a dense barrier Perennial Well adapted to acid soils Enriches soil with nitrogen Fast growth	

Some species of shrubs suitable for windbreaks and shelterbelts.

JOANA AMARAL PAULO (joanaap@isa.ulisboa.pt) and RAQUEL ALMEIDA
 Instituto Superior de Agronomia
 Content editor: Maria Rosa Mosquera-Losada (USC)
 APRIL, 2019

This leaflet is produced as part of the AFINET project. Whilst the author has worked on the best information available, neither the author nor the EU shall in any event be liable for any loss, damage or injury incurred directly or indirectly in relation to the report.

ADVANTAGES AND DISADVANTAGES

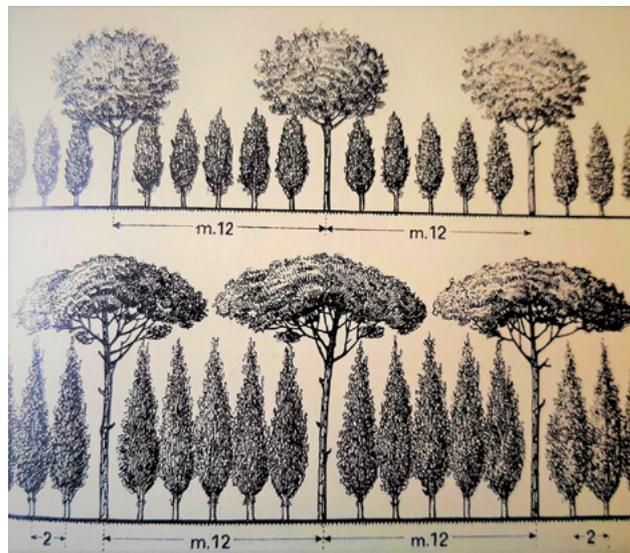
Of the presence of shelterbelts and windbreaks

Advantages

- Helps to regulate the microclimate of adjacent areas, where crops and animals are present.
- Protects crops from heavy winds (e.g. reduces the frequency of wind damage to crop leaves).
- Prevents some seeds from blowing away.
- Reduces soil erosion.
- Benefits animal husbandry (e.g. improves the quality of animal life, reduces energy losses, increases the accessibility of tree fodder).
- Enhances biodiversity, providing habitat for wildlife and shelter for beneficial insects and birds and reducing the need for pesticide use, effectively becoming an important integrated pest management tool.
- They are carbon sinks.

Disadvantages

- Improper installation and management of windbreaks or shelterbelts can have the opposite effect on crops, livestock and property, so it is essential to ensure good management and installation!
- Windbreak and shelterbelt root systems may be a problem if they became invasive, and with time and the increase of light competition, they can reduce crop yields.



Two stages on the development of an hedge with Stone pine and Cypress (distance is in meters). Pavari, A. (1961).

FURTHER INFORMATION

CORNELIS, W.M., & GABRIELS, D. (2005). OPTIMAL WINDBREAK DESIGN FOR WIND-EROSION CONTROL. JOURNAL OF ARID ENVIRONMENTS, 61 pp. 315-332.

GREB, B.W., & BLACK, A.L. (1961) EFFECTS OF WINDBREAK PLANTINGS ON ADJACENT CROPS. JOURNAL OF SOIL AND WATER CONSERVATION, 16(5), pp 223-227.

PAVARI, A. (1961) QUEBRA-VENTOS. NOVA BIBLIOTECA DE INSTRUÇÃO PROFISSIONAL. LIVRARIA BERTRAND. LISBOA. 181 pp. (IN PORTUGUESE) <https://zenodo.org/record/2650108#XMBHMHK170>

STOECKELER, J.H., & WILLIAMS, R.A. (1949). WINDBREAKS AND SHELTERBELTS. YEARBOOK OF AGRICULTURE, pp. 191-199.