

Source to cold resistance in Eucalyptus breeding programs



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ABSTRACT

The global area forested with Eucalypt has exceeded 20 million hectares, distributed in more than 90 countries with the most diverse climates. About 50% of these surfaces are located in low temperature countries with frequent frost. This is risky for the production and can cause death in juvenile trees; and also combined with other damages like fungal or insects reducing its growth. The correct species and provenance selection for cold resistance phenotypes is a key factor before starting the tree improvement program. The comparison of native original climates with the exotic regions can be inferred with climate mapping software, associated with genetics studies and field tests. A wide range of genetic variability of Eucalyptus genus ensures the availability of species and germplasm resistance. The species *E. globulus*, *E. dunnii*, *E. nitens*, *E. viminalis*, *E. benthamii* and *E. pauciflora*, are originated from the coldest region of Australia. These species have good frost resistance and optimal growth. In the case of *E. pauciflora* is distinguished by its extreme cold resistance, representing optimal model specie for the physiological basis to cold resistance researches. These species were used in different countries and continents, producing different results on each of the experiences.

OBJECTIVE

The aim of this article is to review different strategies and results obtained from cold resistant breeding around the world.

CLIMATE, SPECIES AND ORIGINS

The colder region in Australia are located in the southeast coast of New South Wales and the island of Tasmania. The coldest spots have an average minimum temperature in the year 3-6 ° C (Figure 1). However in the days with frost, the temperature decreases below 2°C with a frequency of between 75-150 days (Fig 2; Station 2013).

Cold Resistant Species

The Eucalyptus genus has about 800 species (Coppen 2004), is the sub-genre *Symphomyrtus* contains some 300 species (Pryor & Jhonson 1971) within which one can find the most important species from the productive point of view and that have characteristics of tolerance frosting: *E. globulus*, *E. dunnii*, *E. nitens*, *E. viminalis*, *E. pauciflora* and *E. benthamii*. The wide diversity of this genus and the optimal capacity for adaptation ensure their use as genetic resource.

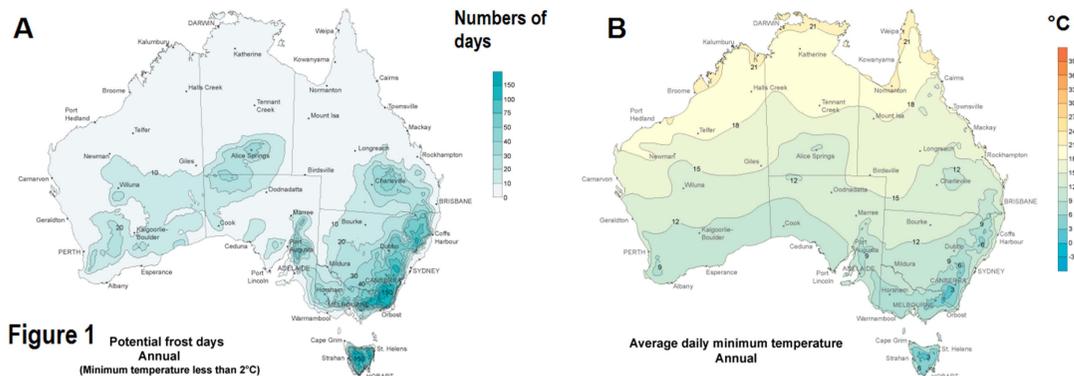


Figure 1 Potential frost days Annual (Minimum temperature less than 2°C)

Eucalyptus globulus. It is the main species cultivated in Uruguay, Spain and Portugal (Torres-Dini et al 2011;. Iglesias Trabado 2009). This group can be subdivided into four main sub-species: *Eucalyptus globulus* itself *E. pseudoglobulus*, *E. bicostata* and *E. maidenii*. The highest growth rate occurs in *E. globulus* and *E. pseudoglobulus*. presents, but that the provenances of *E. bicostata* and *E. maidenii* compensate with better resistance to frost. All of them are capable of hybridization and generation hybrids through genetic improvement. The sub species *E. globulus* has its natural habitat primarily on the island of Tasmania and in the southernmost territory of Vitoria. *E. pseudoglobulus* has distribution only in the south east of the mainland territory of bordering Victoria and New South Wales. *E. bicostata* limits south to the populations of *E. Pseudoglobulus* racing in Victoria and New South Wales but the subspecies *maidenii* lies on the southern coast of this New South Wales (Fig 2).

Studies comparing these subspecies and origins of them for cold phenotype indicated that the most resistant provenances were Bolaro Mountain of ssp *maidenii* and Moogora of *globulus* ssp. In agreement with the results all the remaining provenances and subspecies evaluated make ice (Moraga et al., 2006). On the other hand a major drawback that has this feature and susceptibility to *Teratosphaeria nubilosa* that combined with heavy frost causes the death of young trees that have not yet changed to adult foliage and even om 80% of defolição (Balmelli et al. 2013) this and the main ration by which *E. globulus* ceases to grow in South Africa and Uruguay go the same way.

Eucalyptus nitens. This specie grows in temperate regions. Australia is the main species cultivated for their good attitude to pulp cellulose and growth at present already has two cycles of improvement (Figure 2, Hamilton et al., 2008). It grown also in Chile and in the Bio-Bio where the altitude variation ranges 0-830 m above sea level region. The temperature variations of 8-32°C in summer and 3-13°C in winter. It is also used in New Zealand and South Africa and beyond have better tolerance to frost has better resistance *Teratosphaeria* compared with other *Eucalyptus spp* (Potts & Hamilton 2007).

Eucalyptus viminalis. This specie is widely distributed in southeastern Australia (Figure 2), and common in eastern Tasmania, the islands of Bass Strait and southeastern territory of F. Vitoria in New South Wales is most keenly in the Tablelands region extending place until the edge of Queensland. The attitudinal change is the rank that goes from sea level up to 1400m. This species shows good resistance to frost as well as good growth and form. Has been studied in trials to countries such as South Africa, Argentina, and China (Cappa et al 2010;. & Arnold Clarke 2004; Jovanovic & Booth 2002). It is advisable to take into account half of high annual rainfall that are necessary for proper growth of this species (Jovanovic & Booth 2002).

Eucalyptus benthamii. This specie recently is beginning to gain importance and show good properties for pulp cellulose, rapid growth and frost tolerance grows well in climates summer uniform. Uruguay with Brazil were among the first countries to start studying this species (Harwood 2011; Paludzyszyn Filho et al., 2006). This species is restricted to a small area west of Sydney and is registered as a species at risk of extinction (Figure 2) (Butcher et al., 2005). This reason led Australia to regulate the sale of seed which makes genetic ex-situ collections of countries like Uruguay and Brazil resources are the main sources of genetic variability for both improves as conservation. The middle rank of socks minimum temperature in the coldest months down from 1 ° C to -1 ° C (Jovanovic & Booth 2002).

Eucalyptus pauciflora. It is a model species for studying the damage from frost, it grows naturally in the most cold regions of Australia. She settled since this region of the Highlands and Tablelands of New South Wales and Victoria extending into Queensland and south east of Australia. Also occurs in lowlands in Vitoria coming up the coast and Tasmania, from low elevations to socks. *E. pauciflora* performs extensively as a continuous distribution and killed at elevations of up to 1500 above sea level (Figure 2) (Woldendorp et al 2007;. Slayer & Morrow 1977). This species can be used for windbreaks, shade, poles, fuel, honey and also for medicinal use. There are medical studies in the genus Eucalyptus and has been said to relieve congestion, prevent infection, relieve muscle pain, cure colds, coughs and helps in digestion. It also has a very good aroma and can be used to cleanse the nasal passages and their essential oils can be used in soaps and shampoos (Maurice 2003). But in traditional uses such as pulp cellulose and be no growth and a species exhibiting good attitude (Eldridge et al., 1993).

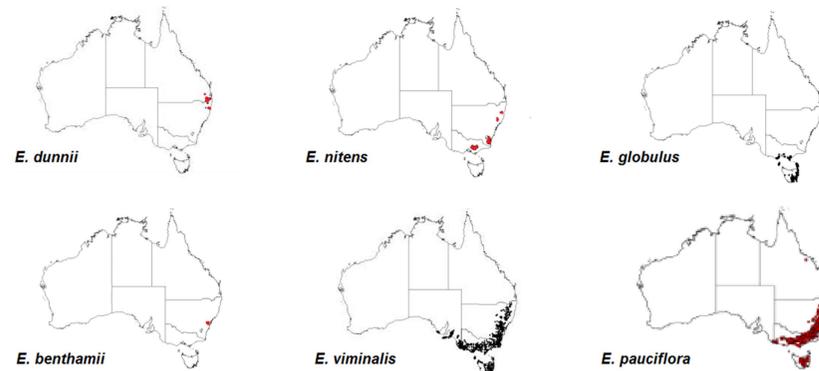


Figure 2. Geographical origins of six *Eucalyptus* species.

CONCLUSION

The damage caused by frost this affects in most temperate countries producers Eucalyptus, by which always have to be a phenotype of the breeders and consider the agenda. Today several days especeis as *dunnii* E., *E. viminalis* and *E. benthamii* incorporating as strategic species that include good performance characteristics as well as cold tolerance at the expense of other species such as *E. grandis* and *E. globulus* estan proving with this order in countries around the world. Besides a good choice of the species of origins prior to use another key point is the genetic improvement. The development of ex-situ collections of genetic resources have to inprorapar in the different producing countries mainly those species at risk of extinction as *E. benthamii*.

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