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THE RISE AND FALL OF *PINUS PINASTER* PLANTATIONS IN SOUTH AFRICA: FROM A SIGNIFICANT COMMERCIAL TIMBER SOURCE TO A DECLARED EXOTIC WEED

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Abstract

Although the species have been showing good growth potential in South Africa, with excellent tree form and timber qualities, it failed to maintain a significant portion of the local market. This was mainly because (a) its general growth rate was below that of other species in the Cape forest regions, such as Pinus radiata and (b) its superior timber quality was never appreciated in the form of a price rebate. The future of Pinus pinaster was further degraded because the species was declared as an invader in the natural fynbos vegetation, thus as an exotic weed.

It is suggested that the species should be re-evaluated as a source of high quality timber, and that it is re-introduced in particular to the W. Cape and E. Cape forest regions, particularly where poor sandy soils occur, which are otherwise not suitable for commercial tree growing in plantation-form.

Keywords: *Pinus pinaster*, South Africa, commercial forestry, fynbos, exotic weeds.

INTRODUCTION

As early as during the last part of the 18th century, *Pinus pinaster* Ayton was introduced to the Western Cape Province of South Africa. During the19th and early 20th century, more *P. pinaster* seed was imported, and by the year 1980, a total of 40000 ha of commercial plantations had been established - and was being maintained on a sustainable yield basis - mainly in the Cape forest regions.

An intensive research programme was launched during 1928, to identify different races and strains of the species and their sources, which identified the "Portuguese race" of *P. pinaster* as having the best growth rate, tree form and timber quality. From 1932 onwards, only the Portuguese race was used for commercial forestry plantings. The species not only proved to be providing an excellent timber quality for sawn timber production, but also a reliable species on a range of sites and soil types, in the winter and constant rainfall regions of the Western and Eastern Cape Provinces of South Africa.

Unfortunately *P. pinaster* was found to be generally slower growing than other commercial tree species established in the Cape forest regions, such as *Pinus elliottii* and *Pinus radiata.* Between 1961 and 2001 an intensive silvicultural research and tree-breeding programme further improved the species' performance significantly. Results from this programme included a significant response to site-specific fertilization (though less in terms of percentage added tree growth increment than what was recorded in *P. radiata*) and later also by the establishment of 2nd and 3rd generation seed orchards. However, yields of healthy *P. pinaster* did still not reach the levels of that of e.g. healthy *P. elliottii* and *P. radiata* (which today should exceed 11 cu.m./ha/yr to be profitable in South Africa). As a result, after the year 2003 all stands with *P. pinaster* are being converted to other spp., phased out and/or put back to natural fynbos, or to agriculture, where this is introduced as an alternative land use option. However, it has also been recorded that *P. pinaster* is not as susceptible to e.g. Diplodia damage after hailstorms as *P. radiata*, and that *P. pinaster* can withstand drought and phosphate deficiencies (common in the region) significantly better than (in particular) *P. radiata*.

The species also featured aggressive trends in forming natural forests on sites covered by natural fynbos vegetation, and today millions of South African Rands are being spent to eradicate these trees and their seed source from (particularly) the mountainous areas, where these trees regenerated in abundance. Another reason why the species is being phased out in South Africa is because the industry failed to pay a premium for *P. pinaster*'s superior sawn timber, which is far stronger and durable than all other *Pinus* timber produced in the country. However, some sites have been identified as not being profitable for any species' establishment (including *P. pinaster*), grown for commercial plantation forestry in the region, and these areas are at present being clear felled, and not replanted. Most of these abandoned sites are found along the mountain foothills of the main mountain ranges of the Cape forest regions, where soils are very shallow, with serious inherited nutrient problems and water logging. Along these lower mountain slopes, only natural fynbos and some temperate indigenous forests can survive the harsh conditions and regular wildfire exposure.

TREE GROWTH CHARACTERISTICS AND SITE REQUIREMENTS

Maritime pine (*Pinus pinaster*) is native to the Mediterranean and sub-Mediterranean climates of Europe and North Africa. It is a medium sized tree that has a thick plate-like bark that protects it well from low intensity fires (de Ronde, 1982 and 1988; Unknown author, 2001). In Western Australia, it is regarded as a suitable species within the 400m to 600mm rainfall zone, which was confirmed by Poynton (1956). It was also found to be resistant against drought, frost and wind, but susceptible for damage by *Diplodia pinea* after hail, and as result the species were only planted in South Africa at a commercial scale in the Western Cape and the western part of the Eastern Cape provinces (Poynton, 1956; Unknown Author, 2001).

The following are some examples of tree growth characteristics recorded in South Africa (Table 1):

Table 1. Examples of *Pinus pinaster* tree growth characteristics in South Africa (selected and converted from Poynton, 1956).

Plantation/ Region	Soil texture and depth	Yearly rainfall (mm)	Age (years)	Stems per hectare	Average DBH (cm)	Average tree height (m)	Average volume per tree (u.b. cu.m.)	Average yearly increment (cu.m./ha/yr)
W. Cape:								
Cecilia	Deep Clay/loam	965	54	296	48	29	1.61	15.9
Elgin	Deep Sand	1016	50	358	47	27	1.42	14.5
Elgin	Deep Grey sand	1016	43	605	38	22	0.77	23.9
Kluitjieskraal	Deep Yell. sand	660	58	333	42	23	1.03	10.3
Tokai	Deep Clay/loam	965	50	494	39	25	0.95	10.5
Tokai	Deep sand	965	43	1201	26	17	0.31	12.6
Tokai	Deep sand	865	35	559	38	30	1.14	22.1
S. Cape:								
Kleinplaat	Shallow dark/loam	559	16	508	19	12.5	0.11	4.9
Kleinplaat	Rocky Clay/loam	559	14	508	18	12.8	0.10	7.1
Kruisfontein	Deep sand	914	40	843	30	25	0.58	16.5
Kruisfontein	Deep sand	914	40	386	36	25	0.81	11.2
Tsitsikamma:								
Blueliliesbush	Deep Clay/loam	1016	29	2662	20	24	0.19	19.4
Blueliliesbush	Deep Clay/loam	1016	29	335	35	27	0.64	11.9
Lottering	Deep Sand/loam	991	32	1839	25	26	0.42	23.0
Lottering	Deep Sand/loam	991	26	508	34	26	0.81	18.1
Lottering	Shallow Sand/loam	991	15	711	14.5	8.5	0.06	2.3
Storms River	Sandy loam	1092	43	457	35	23	0.72	14.1
E. Cape:								
Loerie	Sand	787	32	1016	27	17.7	0.33	-
Transkei:								
Ntsubane	Fine sand	1499	19	635	31	23	0.56	

Although of slower growth than *Pinus radiata*, its site requirements are less exacting and was therefore regarded earlier as the most important pine for poor sandy soils of the southern and south-western Cape Province* (Poynton, 1979), in the winter and uniform rainfall areas (Malan, 2005). In Western Australia the species was also reported to be most suitable on various sandy soil bases, such as low productive sands. However, it was found to provide significantly better growth rates on sandy soils, with a better moisture storage capacity and nutrient availability (Unknown author, 2001). It was then also on the poor mountainous sites of the Western Cape

Province that the species was found to produce a significantly higher growth rate than other *Pinus* species, but most of these areas are now being faced-out and put back to natural fynbos, because of unrealistically-set growth rate standards by the SA Forestry Industry. Fertilizer application (mainly at time of planting) could increase growth rates further on these soils, and some Mean Annual Increment (MAI) improvements of up to 40% at stand age 20 have been recorded on some sites (unpublished results, C. de Ronde).

SILVICULTURE, TREE BREEDING AND TEST TRIALS

Correlated Curve Trails (CCT's) were established in the western portion of the Western Cape Province and western portion of the Eastern Cape, where various combinations of planting espacements and thinning regimes were tested. Provenance trials of unreplicated arboretum plots were also established at six localities in the winter and uniform rainfall areas of South Africa, between 1934 and 1936. Five distinct geographical strains manifested themselves in these experiments namely Portuguese, Landes, Esterel, Corsican and Maroccean Races and a control. These races (represented in South Africa) were described by Rycroft and Wicht (1947). It was found that the Portuguese Race out-performed the rest with regard to volume production, stem form and wood density.

Genetic improvement of the species started in 1962 with the main emphasis on establishing a breeding population. By 1963 enough superior trees had been identified to commence the establishment of the first seed orchards. During 1975 further seed orchards were established**. 13 Progeny trials were also established, and one Provenance trial.

GENERAL PROPERTIES OF SOLID WOOD

The mechanical properties of *P. pinaster* and other softwood, tested in South Africa, can be summarized (Table 2). The superior quality of the *P. pinaster* softwood is clear, with *P. radiata* a close second best. Both these species are only grown commercially in the Western and Eastern Cape Provinces.

Table 2. Mechanical properties of selected South African and international softwoods: Mean values.

Species	Density (kg/sq m)	Modules of rupture (static bending) (Mpa)	Modules of elasticity (Mpa)	Max.crushing strength in compression parallel to grain (Mpa)	Side-grain hardness (Janka test) (N)
Pinus elliottii	494	71	9264	37.3	2938
Pinus patula	498	73	11042	40.9	2776
Pinus pinaster	**673**	**107**	**13806**	**54.8**	**4291**
Pinus radiata	611	101	13721	53.3	4170
Pinus taeda	578	91	11225	50.7	3432
Cupressus spp.	483	75	8691	41.9	2982
Pinus sylvestris (Scots Pine)	513	89	10000	47.4	2980
Pseud. menz.(Douglas Fir)	545	81	13238	51.2	2980
Tsuga heteroph. (W. Heml.)	465	70	10274	42.8	2580

(http://www.protea-timbers.co.za/properties.htm)

* = Under the new SA province distribution, this area is now covered by the whole of the Western Cape Province, and the western portion of the Eastern Cape Province.

** = Unfortunately these were all destroyed by a wildfire during 2005. Fortunately a significant source of improved seed exists in the country for future establishment of high quality trees if and when required.

Branching in well-tended stands is usually fairly light, though dead stumps persist for many years. The presence of numerous knots in un-pruned lengths is usually the most serious source of degrade. In the upper part of the bole, knots often occur in clusters of 3 to 8 but their diameter seldom exceeds 50 mm and the clusters are usually separated by clear internodes. The tree generally has an open, cone-shaped crown or somewhat rounded crown of no great length or spread (Poynton, 1979; Malan, 2005).

INVASIVE ABILITY

The species also featured aggressive trends in forming natural forests on sites covered by natural fynbos vegetation, and today much money is being spent to eradicate these trees and their seed source from (particularly) the mountainous areas of the Cape forest regions, where they regenerated in abundance. The species regenerates profusely after fire, often resulting in dense thickets of plants. These dense thickets suppress native plants, change fire regimes and hydrological properties and habitats for many animals. As many *P. pinaster* stands were established on edges of mountain catchment areas covered by natural fynbos (particularly on the southern slopes of the mountain ranges in the Western Cape Province and the western part of the Eastern Cape Province), it is difficult to stop this kind of invasion once it has been allowed to develop, apart from applying regular mechanical and chemical control of seedlings and trees. Early removal of seedlings by hand or by means of chemical control, however, can address this problem before it advances too far.

Latest developments are that the actual seed production potential of the trees can be reduced to minor levels by “genetic engineering progresses” (pers. comm. Mr. Dave Richardson, Univ. of Stellenbosch, Stellenbosch, South Africa).

CONCLUSIONS

One of the main reasons why the species is being phased out in South Africa is because the industry failed to pay a premium for *P. pinaster*'s superior sawn timber, which is far stronger and durable than all other *Pinus* timber produced in the country (Table 2). A further problem, developing over recent years, is that some Western and Eastern Cape *P. pinaster* sites have been identified as not being profitable for the species' re-establishment. These areas have also been identified as being unsuitable for planting with other *Pinus* species, grown for commercial plantation forestry in the region. These areas are at present being clear felled, and not replanted, and left to return to natural fynbos vegetation. Most of these abandoned sites are found along the southern mountain foothills of the main mountain ranges of the Cape forest regions, where soils are very shallow, with serious inherited nutrient problems and water logging. Along these lower-mountain slopes, only natural fynbos and some temperate (indigenous) forests can survive the harsh conditions and regular wildfire exposure.

The writer has serious reservations about *P. pinaster* being eradicated from South Africa, and is of the opinion that the real potential of the species in the Cape forest regions has been underrated. Research of the past has proved that not only are these trees performing better on most sites in the Cape mostly suitable for forestation with other Pine species but that the species are providing a superior timber source for which a higher price should be paid for by the timber industry.

The ability of the species to invade fynbos is acknowledged, but this can be controlled, if the problem is addressed at an early seedling stage (own opinion). Genetic engineering could also assist in this process.

Mediterranean countries are encouraged to tap this knowledge base and negotiate purchases of improved seed through the SA Government.

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