Virgilia (Keur): Some Preliminary Results Of Species And Provenance Differences In Establishment And Early Growth

B.E. van Wyk

SYNOPSIS

A provenance trial of 18 geographically representative seed collections of *Virgilia* was planted at Stellenbosch in 1981. Survival and height were assessed one year after planting. These results indicate significant differences in survival between *V. oroboides* (Berg.) Salter and *V. divaricata* Adamson, the latter being the hardier of the two. Survival and growth were generally poor, although some trees had already reached a height of 1,5 m. No significant differences in height growth were found between the species and provenance of either species.

INTRODUCTION

Virgilia seems a feasible indigenous hardwood for commercial afforestation, due to its fast growth rate, acceptable timber properties and some other important considerations (Van Wyk, 1982). It was recently found to be an excellent species for rotary peeling, producing a high quality veneer.

At present, very little has been published about the natural variation in the genus. This is clearly manifested in the taxonomy. Due to marked variation between individual trees and different provenances, the delimitation of species and subspecific taxa is a difficult task. Finding reliable diagnostic characters to identify the two major forms in the genus seems to be the problem (Ross, 1980).

Three distinct forms of *Virgilia* can be recognised. Two of these are the well-known *V. oroboides* (Berg.) Salter and *V. divaricata* Adamson. A third group of populations from around George in the Southern Cape, is somewhat intermediate between the two species and this apparant transition probably resulted in the mix-up between the two species. Morphologically, the intermediate group is more akin to *V. oroboides,* although the inflorescences and other features are identical to *V. divaricata.* It was therefore decided to include the latter under *V. oroboides* at subspecific level (Van Wyk, M.Sc. work in progress). The three taxa are: *Virgilia oroboides* (Berg.) Salter, subsp. *oroboides* from the South-Western Cape to Swellendam, *Virgilia oroboides* (Berg.) Salter subsp. *ferruginea* B-E van Wyk, *ined.*, from around George in the Southern Cape and *Virgilia divaricata* Adamson, with a wide distribution in the Southern Cape up to Port Elizabeth (see Table 1). These names are given here simply to allow an interpretation of the data presented in this paper. The taxonomic information will be published later.

A wide genetic base is available from which selections can be made for commercial afforestation. In order to obtain some insight in the botanical variation and performance of different geographical populations of *Virgilia,* a trial was planted at Stellenbosch in August 1981. This paper reports on some aspects of survival and initial growth.

LAYOUT OF PROVENANCE TRIAL

An area of 0,96 ha on the lower slopes of Stellenbosch Mountain (just below the Ertjieskloof dam situated above the Coetzenburg sports grounds) was available for the trial. Unfortunately this site is quite unsuitable for a proper evaluation because of the heavy clay soil and hot, dry, northern aspect. Nevertheless, it was thought that useful data could be obtained. The initial purpose of the trial was to facilitate comparisons between provenances grown under identical environmental conditions, thereby excluding the environmental effect on certain morphological and physiological characters (flower colour and flowering time for example). It was intended for botanical rather than silvicultural comparisons.

The layout consisted of 171 plots of nine trees each, planted in a randomized block design at a square espacement of 2,5 x 2,5 m. A total of 18 provenances are represented in each of seven replications.

MATERIAL

Seeds were collected throughout the natural distribution range along the South-Western and Southern Cape coastal areas, from the Cape Peninsula up to Port Elizabeth. Table 1 shows the exact localities and other details of the seed collections.

Plants were raised in polystyrene containers (planters' flats) and planted two months after sowing, when two pairs of leaves had emerged.

OBSERVATIONS

Survival: Many of the seedlings did not survive the dry summer months. The poor survival can be ascribed to the small seedlings used, the unsuitable (clayey) soil with no soil preparation other than pitting, the exposed northern aspect and possibly also the absence of suitable *Rhizobium* bacteria on the site.

Table 2 shows the percentage survival of 18 different provenances (grouped in three taxa) one year after planting. An analysis of variance (Table 3) revealed significant differences in survival between the two species.

Table 1: Details of seed collections of Virgilia *Poir*

Species	Prov. no	Locality	Longitude ° ′	Altitude (m)	Date Collected	Stand details	Collection no's of voucher specimens
	1	Red Hill, Simonstown	18° 25′	245	4/1/80	Multi-stemmed trees, 4 m. In Fynbos, sandy soil	698, 701, 702, 703
	2	Platteklip, Table Mountain	18° 25′	240	15/6/80	Mostly single-stemmed, 6-8 m. In open riverine forest. Type locality?	505, 506, 508, 509
	3	Window Stream, Kirstenbosch	18° 26′	200	15/6/80	Young trees, 4-6 m, growing along stream. Probably introduced.	512, 514, 515, 516
V. oroboides subsp. *oroboides*	4	Lourensford Estate, Somerset-West	18° 54′	270	8/6/80	Tall trees with wide, spreading crowns, 5-15 m. Forest patch along stream.	491, 492, 493, 496, 497
	5	Betty's Bay	18° 55′	140	14/6/80	Only two large trees, 10 m with spreading crowns, rest small. Moist kloof.	499, 501, 502, 503
	6	Kleinplasie, Jonkershoek	18° 57′	290	21/5/80	Mostly multi-stemmed, 6-8 m. Moist site with alluvial soil.	463, 479, 483, 484
	7	Tradouws Pass, Barrydale	20° 42′	340	8/5/80	Tall trees with spreading crowns, 8-10 m; DBH 20-30 cm. Moist site on river bank.	471, 472, 800, 801, 805
V. oroboides subsp. *ferruginea*	9	Geelhoutboom, George	22° 20′	—	—	—	ex C. Geldenhuys
	10	Montagu Pass, George	22° 25′	370	18/5/80	Single-stemmed, 6-9 m. Dense stands.	454, 455
	22	Victoria Bay, George	22° 33′	120	17/5/80	2 km from sea. Multi-stemmed, 2-6 m; DBH 5-10 cm. Shale. Perhaps old forest margin, now completely open.	405, 406, 409 410
	8	Seweweekspoort, Ladismith	21° 25′	615	31/10/80	Dense stands in and along river, 2-4 m, mostly shrubby and multi-stemmed. Type locality of *V. divaricata* Adamson.	591, 592, 593
	11	Groenvlei, George	22° 51′	16	17/5/80	Shrubby, compact habit, 2-4 m. Deep sand.	420, 421, 422, 423, 425, 426
	12	Keurdraaibos, Plettenberg Bay	23° 09′	400	17/5/80	Tall, single-stemmed trees up to 12 m. Moist valley.	437, 438
	13	Die Vlug Willowmore District	23° 11′	280	17/5/80	Multi-stemmed trees along river bed, 4-6 m.	445, 447, 449
V. divaricata	14	Harkerville, Knysna District	23° 13′	260	17/5/80	Tall, upright with narrow crown. Typical forest margin situation. Deep, black sand.	433
	15	Paul Sauer Bridge, Storms River	23° 51′	230	1/11/80	Single-stemmed, 8 m. Typical Tsitsikama form.	671, 672, 673, 674
	16	Hans Mei River, Humansdorp	24° 12′	225	1/11/80	Young stand, 2 m. On recently burnt area.	660, 661, 662, 664, 666
	17	Baviaanskloof, Willowmore	24° 32′	340	1/11/80	Single-stemmed, 3-4 m. On river bank in open forest. Unusual light pink form.	633, 634, 652, 653, 655
	18	Vanstadens Pass, Port Elizabeth	25° 12′	80	1/11/80	Young trees, 4 m. On river bank below bridge.	656

An analysis of the survival of provenances, done for each species separately, showed no significant differences.

Height growth: Fig. 1 depicts the distribution of height measurements over all plots. Because of the marked skewness in the distribution, an analysis of variance could not be done. The null hypothesis that the distribution of the observed values in the different height classes is independent of the species and subspecies of *Virgilia,* was tested in a chi-square test (Table 4).

Table 2: Percentage survival and mean height of Virgilia *provenances one year after planting*

Species	Provenance no.	Survival (%) (mean of seven blocks)	Mean height (mm) of tallest tree in each plot
V. oroboides subsp. *oroboides*	1	57,3	407
	2	34,9	370
	3	36,4	327
	4	27,0	536
	5	40,0	592
	6	30,0	355
	7	34,9	302
mean for subspecies		37,2 ± 9,8	413 ± 110
V. oroboides subsp. *ferruginea*	9	33,3	573
	10	33,2	460
	22	30,0	365
mean for subspecies		32,2 ± 1,9	466 ± 104
V. divaricata	8	36,6	347
	11	39,7	468
	12	44,3	667
	13	47,7	559
	15	61,9	581
	16	44,4	523
	17	62,0	446
	18	47,7	896
mean for species		48,0 ± 9,4	561 ± 166
Overall mean		41,2 ± 10,7	487 ± 148

Table 3: Analysis of variance of percentage survival+ one year after planting

Source	df	MS	F	P
Blocks	6	568,46		
Species	2	465,57	4,682*	0,05
V. oroboides vs *V. divaricata*	1	810,48	8,151*	0,05
ssp. *oroboides* vs ssp. *ferruginea*	1	120,66	1,213 NS	
Error	12	99,43		

+ An arc sin transformation of percentage survival made no substantial difference to the analysis.

Table 4 Frequency of height measurement of three taxa of Virgilia *(expected values in brackets)*

Species and subspecies	Height classes (mm)								
	0-100	101-200	201-300	301-400	401-600	601-800	801-1000	>1000	Total
V. oroboides ssp. *oroboides*	110 (116)	470 (439)	500 (420)	230 (182)	160 (213)	40 (91)	30 (50)	20 (50)	1560
V. oroboides spp. *ferrugihea*	60 (50)	170 (188)	180 (180)	40 (78)	140 (92)	40 (39)	30 (22)	10 (22)	670
V. divaricata	200 (204)	760 (773)	660 (740)	310 (320)	380 (376)	210 (160)	100 (88)	130 (88)	2750
Total	370	1400	1340	580	680	290	160	160	4980

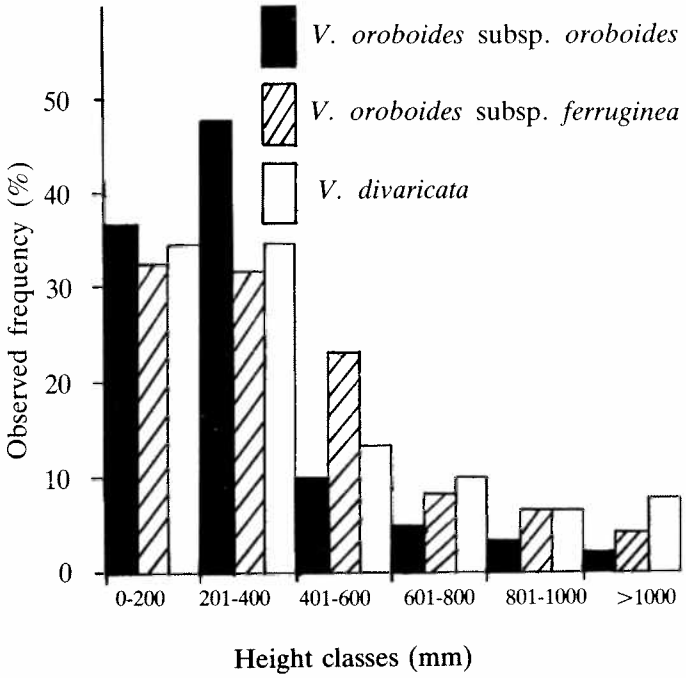

Fig. 1 Observed frequency of height measurements, one year after planting

Fig. 2 Adjoining plots in the provenance trial. V. divaricata *(provenance no. 18) on the left (height approx. 1,3 m) and* V. oroboides *(provenance no. 2) with a height of approx. 300 mm. Striking differences like these were unfortunately obscured by the tremendous variability in height measurements within plots.*

Since the critical value for chi-square at the 0,05 level is 236,8 and the calculated value is 200,8, it must be concluded that the height distribution is independent of species and sub-species.

To give some indication of the height growth of different provenances, only the tallest tree in each plot was considered. The values in Table 2 represent means for the tallest tree in each plot over all seven replications.

General observations: A large proportion of the trees shows signs of chlorosis and stress, while some at least, seems to be growing very well. This is also reflected in the histogram of height distributions.

A number of plants grown in containers under optimal moisture conditions, showed the same phenomenon. When examined for root nodules, none could be found on ailing plants, while the healthy ones had at least some signs of *Rhizobium* activity. The poor survival and growth is therefore likely to be a result of insufficient inoculation, possibly also the absence of suitable *Rhizobium* strains from the site. This important aspect seems worthy of investigation.

Striking differences in growth between adjoining plots were observed (Fig. 2). These can only be attributed to provenance (species) or *Rhizobium* inoculation differences, since the soil is identical.

DISCUSSION

The data on survival indicate that *V. divaricata* is the hardier of the two species. This seems surprising at first, since it is restricted mainly to the constant rainfall area, while *V. oroboides* subsp. *oroboides* is indigenous in the winter rainfall area. Microclimatic conditions are possibly the overriding factor, since *V. oroboides* can mostly be found in moist situations such as river banks and sheltered forest patches, while *V. divaricata* is apparently less restricted in its distribution. Differences in the nitrogen fixing bacteria may also be the explanation, rather than drought resistance *per se.*

The survival of *V. oroboides* subsp. *ferruginea* (see Table 3) seems to confirm its affinity with *V. oroboides* subsp. *oroboides.*

Although no statistically significant differences in height could be shown, some no doubt exist.

Phillips (1926) reported heights of 4,6 to 7,7 m within four years under normal conditions. No other references to early growth of *Virgilia* could be found. Some of the better trees in the trial (after one year between 1,0 and 1,5 m) might well reach this height.

CONCLUSIONS

Despite poor survival and growth, some useful data has already been obtained from this trial.

V. divaricata survives significantly better than *V. oroboides* on dry sites. (The reverse may of course be true for optimal conditions).

Heights of 1,5 m (possibly more under optimal conditions) can be attained 14 months after sowing.

Inoculation with a suitable *Rhizobium* strain is necessary to ensure good establishment, at least on some sites.

Very few aspects of the silvicultural requirements of *Virgilia* are known. Soil requirements, the role of nitrogen-fixing bacteria and its effect on growth, establishment techniques and many other problems need to be solved. A repeat of this trial on a better site would be most worthwhile.

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