Propagating South African Trees©

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Vegetative propagation techniques were studied for rooting cuttings of the following South African tree species: *Ficus sur, Olea europaea* subsp. *africana*, *Podocarpus falcatus* (see *Afrocarpus falcata* and *A. gracilior*), and *Syzygium cordatum*. These tree species are considered problematic since they produce unwanted fruits in urban areas which attract frugivores, that cause damage to vehicles and property. Experiments were conducted to test age, type and length of cuttings, environmental factors, growth season, hormone application, various treatments, and rooting mediums for each of these species. *Ficus sur* and *Syzygium cordatum* showed the highest rooting success, i.e., 85% to 90%, followed by *Olea europaea* subsp. *africana* (75% to 80%), and *Podocarpus falcatus* (60%). The study showed that rooting success in individual species is directly related to the growth stage of parent plants as well as the season during which the cuttings were taken. With progress towards successful vegetative propagation of sterile problem plant species, these plants will continue to function economically and aesthetically in the South African urban environment.

INTRODUCTION

Plants in urban areas have come to fulfil certain requirements and functions, for example as street trees. In South Africa the idea of planting indigenous trees such as *Olea europaea* subsp. *africana*, *Podocarpus falcatus* (see *Afrocarpus falcata*), *Syzygium cordatum*, and *Ficus sur* as urban street trees is climatically, economically, and aesthetically feasible. However, local authorities failed to realise the problems these trees would cause once established. All these trees have a high seed output which attracts large numbers of fruit bats and birds, causing pollution and damage to buildings and cars. This has become a major problem for local authorities as bats feed throughout the year on fruit of *P. falcatus, O. europaea* subsp. *africana*, and *F. sur* and defecate on the walls of buildings causing extensive nonremovable staining and damage to paint work (Jacobs, 1996). Presently the only effective means of preventing the damage is to remove the fruit from the trees before they ripen. The cost of the removal of the fruit and the repainting of buildings annually is prohibitive and necessitates alternative solutions.

Replacing problem trees in municipal areas with male or sterile trees is a long-term solution, and necessary if these species are to be continued for ornamental use in South Africa. Studies are presently underway in breeding sterile plants. These include, using seedless trees, the artificial development of triploid trees by crossing cholchicine-induced tetraploids with normal diploids, and the development of sterile hybrids by other means (De Zwaan, 1980). Gamma-irradiation as a tool in mutation breeding, may be a further method of breeding sterile genotypes. Existing species which are either male or have not produced seed during an observation period of at least 3 consecutive years, could also be considered as a possibility of sterility (De Zwaan, 1980).

Once sterile trees are obtainable the main concern would be to reproduce sterile material vegetatively on a large scale. Vegetative propagation has the advantage of mass production, uniformity of larger plants in a shorter time, producing the exact replica of the parent plant, cloning of plants with desirable characteristics (Beardsell, 1985), and ensuring genetic purity (Hartmann et al., 1990). Planting of indigenous trees rather than exotic species in urban areas has the additional advantage of trees which require less watering, no supplementary nutrients, and which readily adapt to the existing climate. Improved methods of propagation must therefore be found to retain the useful characteristics of these species. Hitherto, propagation methods for these specific plant species have not been recorded, with the result that there are limited guidelines available to growers (De Zwaan, 1980). The objective of this study, therefore, is to investigate suitable vegetative propagation methods which would be economically viable for large-scale production of sterile trees of these species.

MATERIALS AND METHODS

Vegetative propagation techniques were studied at the Cape Technikon Nursery in the Western Cape from May 1994 to June 1998. Cutting material for *F. sur, O. europaea* subsp. *africana, P. falcatus,* and *S. cordatum* was collected from selected seed-producing trees as sterile trees were not available. Cuttings were taken throughout the year but varied according to the growth season of specific plant types, and were collected from young moderately vigorous parent plants. Various stem, heel, and mallet cutting types were tested. Lengths varied from 50 to 300 mm, depending on type and age of wood, and diameter widths varied between 5 to 15 mm.

Methods used for preparing and handling cuttings included: wounding, fungicide treatment [10 min and weekly soaking in Captan 5 g to 5 litres (0.1%) of water or Benlate 6 g to 10 (0.15%) litres of water (Eldridge et al., 1994)]; refrigeration of *O. europaea* subsp. *africana* at 10^{o}C for 2 to 3 weeks (Hartmann et al., 1990); and soaking basal ends of cuttings in nutrient solutions for 24 h (Wright, 1973). Cuttings were treated with rooting hormone, indole butyric acid (IBA No.1 to No. 3 powders), to improve root formation (Janick, 1986). Concentrated dip solutions for 5 sec were used and varied from 2000 to 8000 ppm (0.2% to 0.8%) of growth hormone in 50% alcohol(Hartmann et al., 1990). Cuttings were monitored continuously for signs of rooting or callus formation. Rooting mediums included, coarse river sand (2 to 10 mm), peat moss, bark, vermiculite, and polystyrene. Environmental requirements were maintained at 20 to 28^{o}C, with an average relative humidity of 70%. Intermittent spray (10 sec every 18 min) was used to irrigate cuttings. Cuttings were rooted in greenhouse benches with temperatures at 21 to 23^{o}C.

Ficus sur.

Trial 1. Observation of new growth indicated that late autumn/early spring was a favourable time to prepare nodal, inter nodal, and mallet cuttings of *F. sur*. Semi hardwood cuttings ranging from 60 to 180 mm were taken from vigorously growing stock plants. Hormone treatment ranged from No. 1 to No.3 IBA powders. Combinations of rooting mediums included river sand, peat and polystyrene (1 : 1, v/v), and peat, sand, and vermiculite (1 : 1 : 1, by volume). Stem, mallet, and half-mallet cuttings were placed in a temperature controlled greenhouse, either on a hot bed or on a gravel floor with no heating.

Trial 2. A randomised block design was used to compare the rooting success of different cutting lengths between 60 to 180 mm, leaf numbers from 0 to 2, and bottom temperature. Half mallet cuttings were all treated with No.3 IBA powder and rooted in peatmoss to polystyrene (1 : 1, v/v) rooting mixture.

***Olea europaea* subsp. *africana*.** In the preliminary experiments for this study the propagation methods for *O. europaea* subsp. *africana* recorded by Hartmann et al. (1990), were used as guidelines and expanded on to improve results. Cuttings were collected throughout the year, with an emphasis on the summer growing season.

Trial 1. Tip, stem, heel, half mallet, and heel tip cuttings were taken from vigorous growing water shoots on older trees with lengths varying between 50 to 300 mm. Mallet cuttings were preferred because of the large and older cambium layers which were exposed during wounding. Hormone treatments ranged between No.2 IBA, 4000 to 6000 ppm IBA, and 1 to 2 h soaking (0.2% IBA in 1 litre of water). Cuttings were planted in river sand for good drainage, with bottom heating.

Trial 2. A randomised block design was used to compare the rooting success in *O. europaea* subsp. *africana* with terminal, stem, and mallet cuttings. The cuttings were reduced to between 50 to 200 mm, and 5 to 10 mm diameter widths, with 0 to 4 leaves retained at the upper end. Cuttings were all dipped in 4000 ppm IBA, for 5 sec, and planted in coarse river sand with bottom heat.

Trial 3. Rooting success in *O. europaea* subsp. *africana* was studied using terminal mallet cuttings, 100 to 150 mm long, 8 mm in diameter with 2 leaves. During this trial rooting medium combinations of peat, sand, and polystyrene (1 : 1 : 1, by volume); peat, vermiculite, and polystyrene (1 : 1 : 1, by volume); peat and polystyrene (1 : 1, v/v); and river sand were tested.

***Podocarpus falcatus*.** For *P. falcatus,* soft-tip and semihardwood cuttings of moderate size and vigour were found the most suitable for cuttings.

Trial 1. Terminal, mallet, and half-mallet cuttings were collected from softwood and semihardwood. Cuttings varied from 100 to 150 mm and hormone treatments were used varying from No.1 to No. 2 IBA powders. Combinations of bark; sand and bark (1 : 1, v/v); sand, bark, and polystyrene (1 : 1 : 1, by volume); and peat and polystyrene (1 : 1, v/v) with bottom heat and no heat conditions were tested.

Trial 2. A randomised block design was used to study the success of terminal and stem cuttings, with cutting lengths 100 to 200 mm, with the number of leaves 0 to 6. Cuttings were all treated with No. 2 IBA powder and planted in coarse river sand with bottom heating.

***Syzygium cordatum*.** Cuttings of *S. cordatum* were mainly collected from 2- to 3-year-old, nursery-grown trees which were vigorous in growth.

Trial 1. Terminal, heel, and stem cuttings were selected from softwood and hardwood with lengths 50 to 150 mm. Hormone treatments were compared, using No. 1 to No.3 IBA powders, 6000 ppm IBA, or no hormone treatment. Cuttings were planted in river sand with bottom heating.

Trial 2. A randomised block design was used to study the response of heel and straight stem cuttings, with cuttings 50 to 150 mm and diameter widths 6 to 10 mm.

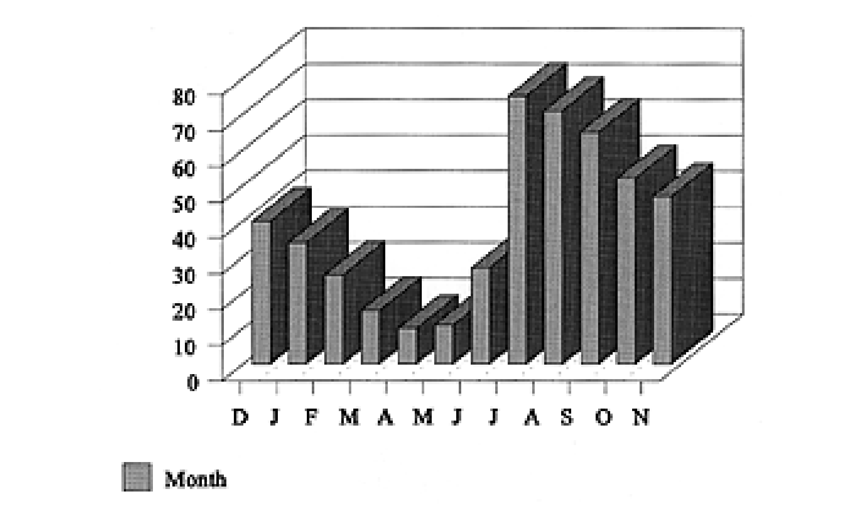

Figure 1. Rooting success in *Olea europaea* subsp. *africana* during different seasons.

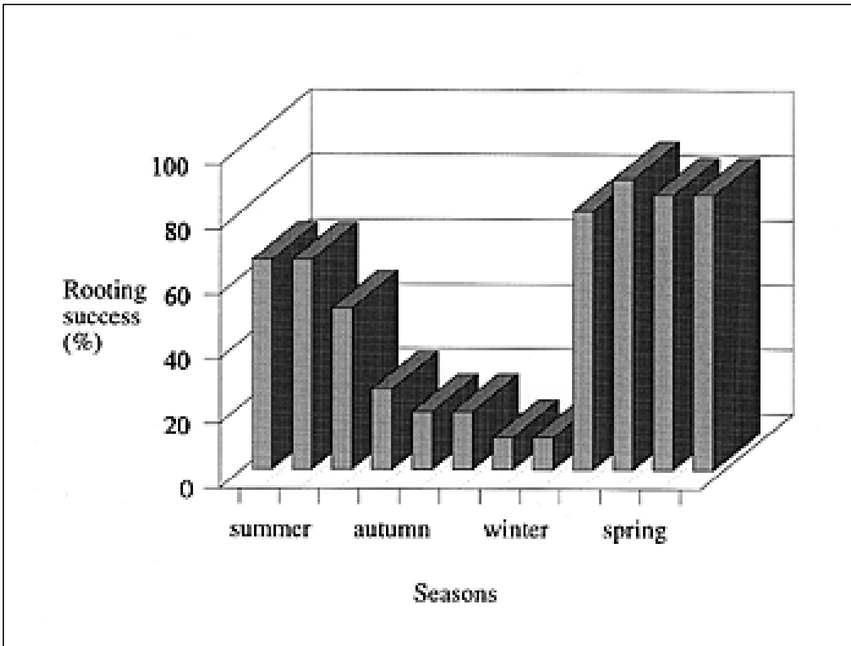

Figure 2. Rooting success in *Syzygium cordatum* cuttings prepared from juvenile nursery stock collected during different seasons.

These cuttings were all treated with No. 2 IBA powder and planted in coarse river sand with bottom heating.

RESULTS

Ficus sur.

Trial 1. Half mallet cuttings with the shoot tip removed and no bottom heat, planted in a peat, sand, and vermiculite (1 : 1 : 1, by volume) rooting medium, rooted with 20% success after 6 weeks. Similar results were obtained from heeled stem cuttings with bottom heat in peat and polystyrene (1 : 1, v/v) rooting medium. In both cases rooting was optimum with No. 3 IBA powder.

Trial 2. Results are presented in Table 1.

Olea europaea subsp. africana.

Trial 1: Terminal cuttings, 50 mm long, treated with 0.6% IBA, diluted in 1000 ml water and soaked for 2 h resulted in 75% rooting. Similar results were obtained from mallet cuttings 100-300 mm long.

Trial 2: Terminal cuttings with 2 leaves, 50 to 100 mm long, taken during late winter and early spring, and treated with 4000 ppm IBA were planted in river sand with bottom heat rooted 77% within 6 weeks after planting. Mallet cuttings resulted in 75% rooting during the same time.

Trial 3: Results are presented in Table 2.

Podocarpus falcatus.

Trial 1: Stem tip with half mallet cuttings, 100 to 150 mm long treated with No. 2 IBA powder, planted in river sand with no bottom heat, rooted with 55% success after 8 weeks. Terminal and stem cuttings treated with No. 1 and No. 2 IBA powders both resulted in 42% rooting during the same period.

Trial 2: Results are shown in Table 3.

Syzygium cordatum.

Trial 1: Heel cuttings, 100 to 150 mm long with No.2 IBA powder resulted in 86% rooting. Similar results were obtained with terminal cuttings, 50 to 100 mm long, and No. 1 IBA powder.

Trial 2: Results are presented in Table 4.

CONCLUSION AND RECOMMENDATIONS

The likelihood that cuttings will initiate roots, as opposed to rot, depended on a number of factors, e.g., the season during which the cutting was taken, the age, type, and length of the cuttings, environmental factors, and the rooting medium used.

Ficus sur. The best results were produced with 60 mm cuttings, with two leaves, treated with No. 3 IBA powder. Bottom heat improved both rooting quality and rooting rate of cuttings harvested in summer. Even though both conventional vegetative propagation and air layering techniques have proved to be highly successful in *Ficus* species (Poincelot, 1980), further research, possibly on in vitro propagation, would be required to maximize production for commercial purposes.

***Olea europaea* subsp. *africana*.** This taxon has mainly been used as rootstock for propagation of edible olive cultivars. Recent advancements have successfully propagated *O. europaea* vegetatively (Hartmann et al., 1990). This study showed that cuttings taken from selected parent plants can root successfully. Further research should aim at developing techniques which will ensure more rapid rooting and increased production numbers.

Podocarpus falcatus. This study showed that *P. falcatus* could be propagated vegetatively from softer tip cuttings in late summer to early winter. The rooting period varied between 6 to 8 weeks. Cuttings were planted in single containers and kept under mist sprayers to eliminate transplant shock. However, due to the low rate of rooting percentages, *P. falcatus* requires further experimentation to improve economically viable vegetative propagation.

Table 1. Rooting success in *Ficus sur* using different lengths of cuttings, numbers of leaves, and heat treatments. Half mallet cuttings taken in spring, treated with No. 3 IBA powder, grown in peatmoss and polystyrene (1:1, v/v) rooting mixture.

Cutting length (mm)	Number of leaves	Bottom heat	Callusing success (%) after 4 weeks	Rooting success (%) after 6 weeks[1]
20-180	0	yes	45	40
60-120	0	yes	60	61
60	0	yes	60	54
120-180	2	yes	55	60
60-120	2	yes	91	80
60	2	yes	97	100
120-180	0	no	15	10
60-120	0	no	21	15
60	0	no	17	15
120-180	2	no	72	67
60-120	2	no	75	70
60	2	no	75	75
120-180	2-4	yes	83	80
60-120	2-4	yes	80	85
60	2-4	yes	85	80
120-180	2-4	no	17	15
60-120	2-4	no	16	10
60	2-4	no	22	18

[1]190 cuttings per treatment

Table 2. Rooting success in *Olea europaea* subsp. *africana* using different types and diameter of cuttings, number of leaves, distances from apex, and rooting media during late winter and spring.

Cutting type	Leaves (no.)	Distance from apex (mm)	Cutting diameter (mm)	Medium	Callusing success (%) after 4 weeks	Rooting success (%) after 6 weeks[1]
Tip with mallet	2	100-150	8	1 : 1 : 1 (by volume) peat, sand, polystyrene	72	75
Tip with mallet	2	100-150	8	1 : 1 : 1 (by volume) peat, vermiculite, polystyrene	81	80
Tip with mallet	2	100-150	8	1 : 1 (v/v) peat, polystyrene	70	66
Tip with mallet	2	100-150	8	river sand	75	71

[1]190 cuttings per treatment.

Table 3. Rooting success in *Podocarpus falcatus* using different types and lengths of cuttings, and number of leaves. Cuttings all treated with No. 2 IBA powder, planted in coarse river sand with bottom heat.

Cutting type	Cutting length (mm)	Number of leaves	Callusing success (%) after 6 weeks	Rooting success[1] (%) after 8 weeks
Terminal	100-150	2-6	60	60
Stem	100-150	2-6	55	60
Terminal	150-200	2-6	65	60
Stem	150-200	2-6	51	58
Terminal	100-150	none	41	37
Stem	100-150	none	50	51
Terminal	150-200	none	35	38
Stem	150-200	none	44	48

[1]190 cuttings per treatment.

Table 4. Rooting success in *Syzygium cordatum* using different types, lengths, and diameter of cuttings. Cuttings were all treated with No. 2 IBA powder and planted in coarse river sand with bottom heat.

Cutting	Cutting	Cutting	Callusing success		Rooting success[1]	
Type	length (mm)	diameter (mm)	%	Week	%	Week
Terminal with heel	50-100	6-8	81	5	80	6
Stem with heel	50-100	6-8	90	5	90	6
Straight stem	50-100	6-8	75	6	70	7
Terminal with heel	100-150	8-10	80	6	80	7
Stem with heel	100-150	8-10	86	5	80	6
Straight stem	100-150	8-10	69	7	72	8

[1] 190 cuttings per treatment.

Syzygium cordatum. This study suggested that vegetative propagation of *S. cordatum* is suitable for commercial production. The relatively high rooting success obtained from cuttings harvested from juvenile nursery stock could have important implications for future nursery production of this species. With high rooting percentages, cuttings would be less costly to produce and could be rooted directly in the production container, reducing transplant failure, production losses, and yielding better quality material. It is therefore recommended that vegetative propagation of *Syzygium cordatum* be encouraged and applied in propagation nurseries for propagation of sterile trees.

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