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Influence of Cutting Position, Medium, Hormone and Season on Rooting of Fever Tea (*Lippia javanica* L.) Stem Cuttings

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ABSTRACT

Cutting position, rooting medium and rooting hormone are critical factors that affect rooting development of stem cuttings. In this study, the objectives were to determine the best cutting position, ideal propagation medium and the effect of hormone on rooting of fever tea (*Lippia javanica* L.) stem cuttings. Results of this study demonstrated that apical cuttings rooted earlier than basal cuttings, but at 15 to 20 days after establishment both cuttings rooted similarly. Composted pine bark growing medium, compared to sand, resulted in improved root length of the cuttings. Basal cuttings had thicker stem circumferences and more number of leaves as compared to apical cuttings. Seradix® No. 2 hormone (0.3% IBA) increased fresh mass, stem circumference, number of roots and number of leaves for both apical and basal cuttings. Therefore, the results of this study suggest that for the establishment of fever tea stem cuttings, both apical and basal cuttings can be used but composted pine bark is the ideal propagation medium. Furthermore, fever tea stem cuttings can be ready for transplanting at 15 to 20 days after establishment and Seradix® No. 2 hormone is recommended to promote rooting.

Keywords: apical, basal, indole butyric acid, pine bark, sand, vegetative propagation

INTRODUCTION

Lippia javanica (L.) (fever tea) is a medicinal and essential oil plant used as a respiratory remedy by traditional African people (van Wyk and Gericke 2000). The leaf infusions are used as anthelmintics for respiratory and febrile ailments and also as prophylactics against dysentery, diarrhoea and malaria (Mabogo 1990). The roots are used as antidotes for suspected food poisoning and for sore eyes (Hedberg and Staugard 1989). Fever tea is also recommended as an effective mosquito repellent due to its insecticidal properties (van Wyk and Gericke 2000).

It has been reported that rooting success of stem cuttings is dependent on factors such as position of the cuttings on the shoots (Hasen 1986, 1988), rooting medium used (Jawanda *et al*. 1991; Hartmann *et al*. 1997), presence or absence of hormone and concentration (Al-Saqri and Alderson 1996), season when the cuttings were made (Leaky 1983, 1990; Klein *et al*. 2000) as well as physical and environmental factors (Leaky and Mohammed 1985; Loach 1992; Wilson 1993).

The influences of cutting position, medium and hormone on rooting of fever tea have not been documented. However, the use of auxin containing products such as indole-3-butyric acid (IBA) has been reported to stimulate adventitious roots in apical cuttings of herbal tea (Araya *et al*. 2007). The potential of the species for domestication and development has been reported by van Wyk and Gericke (2000). However, data is lacking on the use of stem cuttings for vegetative propagation of fever tea. Therefore, the objective of the study was to establish how cutting position, medium, hormone and season influenced rooting of fever tea stem cuttings. The present results could facilitate the establishment of cheap, reliable and simple techniques of propagation when establishing a fever tea industry in South Africa.

MATERIALS AND METHODS

Experimental site and plant material

An experiment on vegetative propagation of fever tea was carried out on a mist bed in a greenhouse located at the Experimental Farm of the University of Pretoria (25° 45′ S, 28° 16′ E). The propagation unit was supplemented with 24 hr a day misting and fogging systems (Environmist, Pretoria, South Africa) which worked automatically based on the humidity of the greenhouse. The used mist bed was 5 m long, 1.5 m wide and 1 m high. Throughout the experimental period, the temperature of the greenhouse was measured using a thermograph. The measured mean minimum and maximum temperatures during the study period were 17.0 and 34.7°C in summer, 12.8 and 29.6°C in autumn, 9.0 and 27.8°C in winter and 13.0 and 34.2°C in spring, respectively. Stem cuttings were collected from mother plants of *Lippia javanica* (MR-III-029) received from the Council for Scientific and Industrial Research (CSIR) (Pretoria, Gauteng Province, South Africa).

Experimental design and treatment details

The experiment was a 2^3 factorial experiment laid out in a randomised complete block design (RCBD) with 10 replicates. The treatments consisted of medium (sand or composted pine bark), hormone (with or without Seradix® No. 2; 0.3% IBA) and position (apical or basal).

The cuttings were prepared using sterile pruning scissors. Semi hardwood cuttings (320) with 3 leaves each were made. One hundred and sixty were apical cuttings and the other 160 cuttings were basal cuttings, all having a length of 8 cm. Forty sections of seedling trays were cut from the 200 cavity seedling trays and each tray consisted of 8 cavities.

Two different propagation media, namely sand and composted pine bark were used in the experiment. The two media were randomly assigned to seedling trays with 5 × 3 × 4.5 cm (width, breadth and depth) cells. To maintain the medium moist before planting the filled trays were put under a mist system set to come on at 2 min intervals for 8 seconds. A mercury thermometer was

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Short Communication

inserted to a depth of 2 to 4 cm to measure the misting bed temperature.

Shoots of 16 to 32 cm long were cut from the stock plants early in the morning (between 06:30 and 07:30), and wrapped with wet tissue paper followed by immediately placing them in plastic bags in order to keep them cool and turgid until taken to the working area. Working on the humid misting bed, shoots were further divided into a total of 320 semi-hardwood cuttings each with 8 cm length and 0.04 to 0.3 cm diameter range. Bottom leaves were clipped off, leaving only the top three followed by taking the fresh mass and initial circumference of each cutting. The bases of the cuttings were dipped in water and depending on the treatment type (with or without hormone) were then dipped into a rooting hormone powder (Seradix® No. 2) consisting of 0.3% IBA in a talc to a depth of approximately 1 cm. Excess rooting powder was tapped off before planting. According to Hartmann and Kester (1983) in order to avoid brushing off of the powder during planting, a trench was made in the rooting medium with a stick. The cuttings were directly planted after treatment into the pre-wetted rooting medium (composted pine bark or 0.5 mm sand) to a depth of 2 cm. Sampling was done after every 5, 10, 15 and 20 days after planting.

Measurements and statistical analysis

After every 5 days, eighty cuttings were harvested from the trays. The fresh mass of each cutting was determined, the stem circumference was measured using a vernier calliper, the number of leaves and roots were counted and the root length was measured using a vernier calliper. The data was analysed using General Linear Model of SAS programme (Statistical package version 8.2) (SAS Institute Inc. 1999) and the analysis of variance was performed to determine the effect of cutting position, rooting medium and rooting hormone on the dependent variables. Means were compared using Tukey's test, at the 5% level of significance.

RESULTS AND DISCUSSION

Cutting fresh mass

Results in **Table 1** show that fresh mass was affected by the interaction of cutting position and growth hormone at 20 days after establishment. Apical cuttings treated with hormone had similar fresh mass as compared to apical cuttings without the application of hormone. However, basal cuttings treated with hormone had greater fresh mass than basal cuttings treated without hormone. Basal cuttings treated with hormone also had greater fresh mass compared with cuttings treated with hormone (**Table 1**).

Medium did not affect fresh mass of fever tea cuttings. Although there were no significant differences on the fresh mass for both apical and basal cuttings of fever tea in different media, hormone treated cuttings performed better when propagated on composted pine bark than in sand (data not presented).

Table 1 Interactive effect of hormone and cutting position on fresh mass of fever tea cuttings at 20 days after establishment.

Cutting position	Hormone	Fresh mass (mg)
Apical	With	1.27 b
	Without	1.25 b
Basal	With	1.67 a
	Without	1.18 c

Means within a column followed by the same letter are not significantly different at 5% level, using Tukey's test.

There were significant differences in fresh mass of cuttings at 5 and 15 days after planting when cuttings were treated with rooting hormone compared to untreated cuttings (**Fig. 1**). Even though at 10 to 20 days after planting there were no statistical differences, cuttings treated with hormone tended to have more fresh mass.

Cutting root number and root length

Results in **Table 2** show that there were significant interactions between cutting position and medium on the number of roots of fever tea cuttings at 20 days after establishment. Apical cuttings grown in sand had more roots than apical cuttings grown in composted pine bark medium. In contrast, basal cuttings grown in pine bark had more roots than basal cuttings grown in sand. Similar findings were also reported by Araya *et al*. (2007) on bush tea (*Athrixia phylicoides*) stem cuttings.

Root numbers were significantly affected by application of hormone at different days after planting (**Fig. 2**). Regardless of sampling date, number of roots produced was significantly improved when rooting hormone was applied. Al-Barazi and Schwabe (1982) also reported that treating cuttings with auxins increased the percentage of rooting, root initiation, root number and as well as uniformity of roots in adult *Pistacia vera*.

Plants grown in composted pine bark had longer roots than plants grown in sand (**Fig. 3**). *Rosa centifolia* cuttings resulted in significantly greater root length when grown in perlite than in vermiculite (Al-Saqri and Alderson 1996).

Table 2 Interactive effect of cutting position and growth medium on root number of fever tea cuttings at 20 days after establishment.

Cutting position	Medium	Root number
Apical	Sand	25.94 a
	Composted pine bark	16.45 b
Basal	Sand	14.39 c
	Composted pine bark	23.29 ab

Means within a column followed by the same letter are not significantly different at 5% level, using Tukey's test.

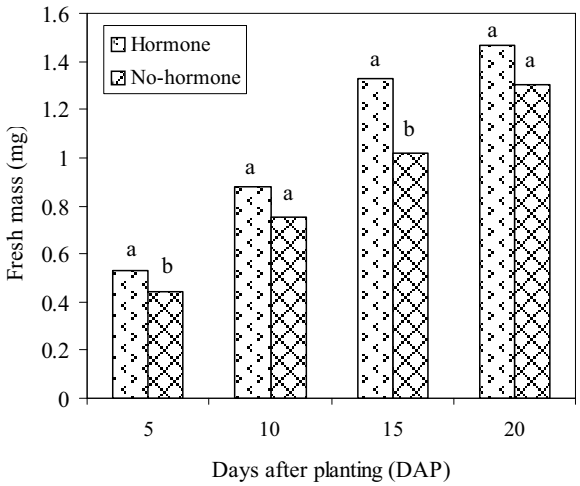

Fig. 1 Effects of rooting hormone on fresh mass of fever tea stem cuttings at 5, 10, 15 and 20 days after planting. Statistical comparison is between histograms within each day after planting (Tukey's test, P<0.05).

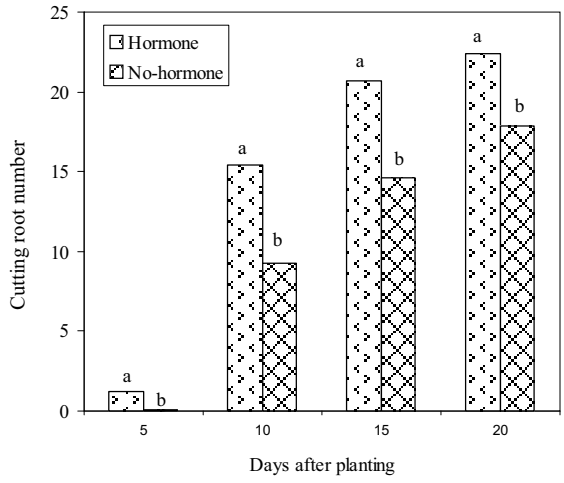

Fig. 2 Effects of rooting hormone on number of roots of fever tea stem cuttings. Statistical comparison is between histograms within each day after planting (Tukey's test, P<0.05).

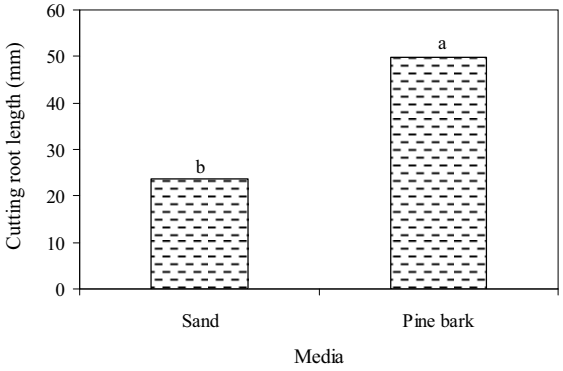

Fig. 3 Effects of growing medium on root length of fever tea stem cuttings. (Tukey's test, P<0.05).

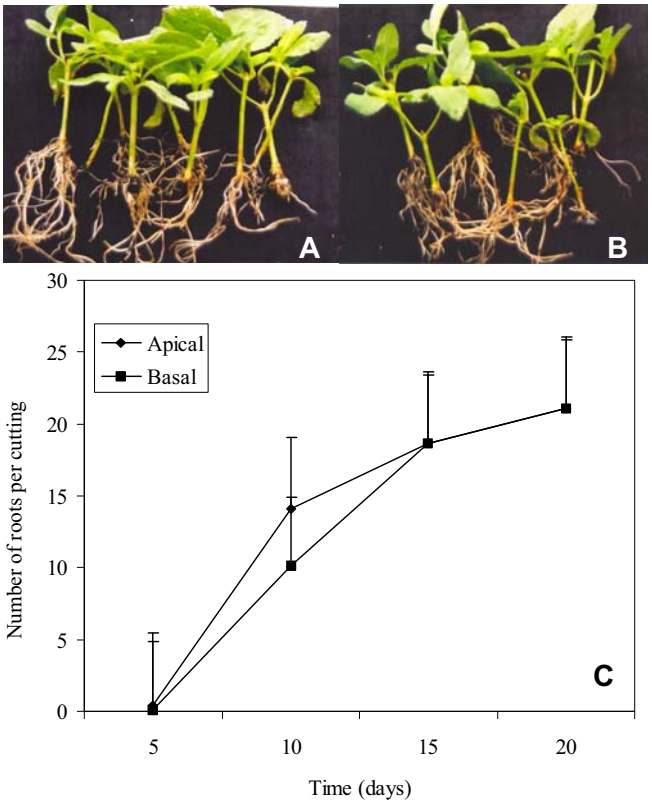

Fig. 4 (**A**) Rooted apical cuttings at 15 days after establishment. (**B**) Rooted basal cuttings at 15 days after establishment. (**C**) Rate of rooting (± standard error) of fever tea stem cuttings (n = 10).

Rate of rooting of cuttings

At 5 days after planting, apical cuttings showed callus development on the stems, whereas on basal cuttings none had formed. By 10 days after planting, most of the apical cuttings showed more roots than basal cuttings. However, at 15 to 20 days after planting, basal cuttings rooted similarly to apical cuttings (**Fig. 4A-C**).

Cutting leaf number

There were no significant interactions on the number of leaves of fever tea cuttings at 10 or 20 days after establishment. However, there was a significant effect at day 15 on the number of leaves due to cutting position and growing medium (**Table 3**). Basal cuttings had significantly more leaves than apical cuttings. Cuttings planted in composted pine bark medium also had significantly more leaves than cuttings planted in sand at 15 days after establishment. However, hormone treatment had no significant effect on the number of leaves of fever tea cuttings (data not presented). Composted pine bark medium increased the number of leaves presumably due to higher water holding capacity than sand. Furthermore, it was observed that most of the cuttings grown in sand lost some of their leaves as compared to cuttings grown in composted pine bark.

Table 3 Effect of cutting position and growing media on leaf number of fever tea cuttings.

Days after planting	Cutting position (A)		Growing medium (B)	
	Apical	Basal	Sand	Composted pine bark
10	6.49 a	5.43 a	5.84 a	6.17 a
15	7.39 b	9.61 a	7.38 b	9.27 a
20	11.10 a	11.97 a	11.11 a	11.87 a

Means within a row of a section (A or B) followed by the same letter are not significantly different at 5% level, using Tukey's test.

CONCLUSION

Results of this study suggest that for the establishment of fever tea stem cuttings, both apical and basal cuttings can be used but composted pine bark is the ideal propagation medium. Cuttings can be ready for transplanting at 15 to 20 days after establishment and Seradix® hormone (0.3% IBA) is recommended for rooting of fever tea stem cuttings.

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