ROOTING RESPONSE OF SEMI-HARDWOOD SHOOT CUTTINGS OF *GREWIA OPTIVA* AND *LAGERSTROEMIA PARVIFLORA*

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Introduction

Clonal propagation of most forest trees is severely limited due to the fact that their vegetative propagules resist to root, even when the environmental conditions are conducive for adventitious rooting. Two such important species are *Grewia optiva* Drummond and *Lagerstroemia parviflora* Roxb., in which adventitious rhizogenesis poses a great impasse in the way of developing clonal propagation procedures for large-scale mass multiplication of superior genotypes.

Grewia optiva is a popular multipurpose tree of Western Himalaya, providing strong elastic wood (Anon., 1956) and protein-rich fodder (Joshi, 1981; Singh; 1982). Mature hardwood cuttings of *Grewia optiva* are very difficult-to-root (Puri and Shamet, 1988). However, varied degree of success has been achieved in vegetative propagation through coppice shoot cuttings, juvenile softwood cuttings and air layering (Khosla *et al.*, 1982; Nagpal and Sehgal; 1985; Shamet and Dhiman, 1991; Kanwer *et al.*, 1995). The second species, *Lagerstroemia parviflora* is even more problematic. Apart from being 'extremely difficult-to-root' (Prasad *et al.*, 1992) it also possesses severe limitations in seed production, dormancy and germination (Prakash, 1991). These difficulties are a matter of concern in view of the utility value of *Lagerstroemia parviflora*. The timber of the species is variously used for building construction, agricultural implements, boxes, tool handles (Anon., 1962) and suitable for plywood making (Shukla and Shukla, 1989). Therefore, the present study was conducted to evaluate adventitious rhizogenesis in mature semi-hardwood shoot cuttings of *Grewia optiva* and *Lagerstroemia parviflora* as influenced by a range of treatments including auxin, vitamins and sodium acetate.

Material and Methods

Cuttings of approximately 20 cm length and 1.0 cm diameter were collected in the third week of April 2002, from a population of trees, about 7 years (*Grewia optiva)* and 12 years (*Lagerstroemia parviflora*) of age. Cuttings were randomly arranged into 5 groups of thirty cuttings each and sterilized with 0.2 % mercuric chloride for about 15 minutes, followed by thorough washing with the running water. Separate groups of cuttings were administered with equimolar doses (2mM) of indole 3-butyric acid (T_1), sodium acetate (T_2), ascorbic acid (T_3) and thiamine (T_4) for 24 h by basal dipping. A water treated control (T_0) was also maintained. The cuttings were then planted in polythene

bags (15 cm x 23 cm) filled with sterilized river sand and placed on mounted angle iron beds in a shadehouse (temperature 30 5°C; relative humidity 70 5%) and provided regular irrigation (manually from water pipe with sprinkler attachment) thrice a day, i.e. in the morning, midday and evening.

At the termination of the experiment after ten weeks of planting, observations were recorded for sprouting (%), rooting (%), root number, root length and root-sprout ratio(R : S). The data obtained were subjected to analysis of variance and 'F' test to ascertain significant difference among treatments at $p < 0.05$. If found significant, LSD at $p = 0.05$, i.e. $LSD_{0.05}$ was computed to compare treatment means for various characteristics of adventitious roots (Gomez and Gomez, 1984).

Results and Discussion

Characteristics of adventitious rhizogenesis in semi-hardwood shoot cuttings *Grewia optiva* and *Lagerstroemia parviflora* as influenced by various treatments have been presented in the Table 1. Out of the four chemical treatments, viz., IBA, sodium acetate, ascorbic acid and thiamine, treatment with IBA significantly enhanced induction and growth of adventitious roots in *Grewia optiva* and that with thiamine in *Lagerstroemia parviflora* (Figs.1a, b).

Fig. 1 (a and b)

Adventitious rhizogenesis in semi-hardwood shoot cuttings as influenced by IBA in *Grewia optiva* (a) and thiamine in *Lagerstroemia parviflora* (b).

Exogenous auxin application has been widely reported for induction and growth of adventitious roots in various types of shoot cuttings (Blakesley *et al.*, 1991). For its stability, IBA is probably the most extensively employed root hormone for excellent fibrous root induction on cuttings. The effectiveness of this hormone in adventitious rhizogenesis has been substantiated in shoot cuttings of woody perennials e.g. *Albizia procera* (Singh and Ansari, 2000; Singh *et al.*, 2003), eucalypts (Chandra and Yadav, 1986), *Gmelina arborea* (Surendran, 1990), *Tectona grandis* (Mundt, 1997). In the present study also, the treatment of *Grewia optiva* shoot cuttings with IBA (2mM) significantly induced rooting (67%), whereas, the water treated control had absolutely no rooting (Table 1). Similarly, root number was also significantly maximum in IBA treatment. IBA administration exhibited a high R: S ratio (0.80) indicating that 80 % of the sprouting in cuttings was translated into rooting. R : S ratio is reliable indicator of the efficacy of the root growth regulator (Ansari *et al.*, 1994). Marked increase in the R: S ratio by 2mM IBA in the present investigation conforms to above contention. All other treatments failed to promote adventitious rhizogenesis with ascorbic acid and sodium acetate exhibiting insignificant rooting. Contrary to earlier workers, who have reported maximum 77.5 % and 60 % rhizogenesis using juvenile softwood cuttings (Shamet and Dhiman, 1991; Kanwer *et al.*, 1995) and air layering (Khosla *et al.*, 1982; Nagpal and Sehgal; 1985), respectively, we have obtained remarkable root induction in difficult-to-root semi-hardwood shoot cuttings from mature trees.

Complexity of the physiology of adventitious rhizogenesis is widely acknowledged and different species have shown specific requirements of exogenous treatments for the process. Non-auxin synergists or co-factors sometimes greatly influence adventitious rooting. Indispensability of thiamine for *in-vitro* growth and development of excised roots

Table 1

Characteristics of adventitious rhizogenesis in mature semi-hardwood shoot cuttings of Grewia optiva and Lagerstroemia parviflora.

Treatment	Sprouting (%)		Rooting (%)		Root number		Root length (cm)		R: S ratio	
	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
T_0	66.67	100.00	0	0	0	0	0	0	0	0
T_1	83.33	93.33	66.67	3.33	59.57	1.00	12.40	4.67	0.80	0.04
T_2	46.67	53.33	3.33	0	2.67	0	6.33	0	0.07	0
T_3	46.67	96.67	3.33	0	3.33	0	0.83	0	0.07	0
T_4	50.00	100.00	0	13.33	0	2.67	0	10.67	0	0.13
$LSD_{0.05}$	NS	NS	16.12	7.29	14.50	NS	NS	NS	-	-

S_1- *Grewia optiva*; S_2- *Lagerstroemia parviflora*

of many plant species is well established (Bonner and Bonner, 1948; Aberg, 1961). Thiamine may act directly or indirectly in root induction and growth. In fact, the polar movement of thiamine in the petiole of tomato is identical to that of auxins and gibberalins (Kruszewski and Jacob, 1974). Recently, the role of thiamine in the promotion of adventitious rhizogenesis has been authenticated in *Adhatoda vasica* (Hati *et al.*, 1990), *Dalbergia sissoo* (Ansari and Kumar, 1994), *Taxus cuspidata* and *T. brevifolia* (Chee, 1995) and *Azadirachta indica* (Palanisamy *et al.*, 1998). In *Lagerstroemia parviflora,* thiamine (2mM) treatment resulted in significantly better adventitious rhizogenesis than other treatments. Thiamine registered 4 times increment in root induction than IBA and also enhanced root number, root length and R : S ratio. However, low values, i.e.13.3% for adventitious rhizogenesis in *Lagerstroemia parviflora* still remain largely unresolved. It is likely that the concentration of thiamine used as treatment for shoot cuttings of *Lagerstroemia parviflora* was either inadequate or supra optimal, eliciting a poor or suppressive response of adventitious rhizogenesis. Nonetheless, the results of the present study offer a new insight to undertake in depth investigation of the role of thiamine in adventitious root induction in shoot cuttings of *Lagerstroemia parviflora*.

Conclusion

Exogenous application of 2 mM IBA markedly augments adventitious rooting in semi-hardwood shoot cuttings and is recommended for mass clonal propagation of superior genotypes of *Grewia optiva.* Treatment with 2mM thiamine provides some relief for clonal propagation of *Lagerstroemia parviflora*, an extremely difficult-to-root species. Further studies are required to investigate the efficacy of thiamine in different concentrations and in combination with various auxins for optimizing adventitious rhizogenesis in shoot cuttings of both species.

SUMMARY

Adventitious rhizogenesis in semi-hardwood shoot cuttings of two 'rooting recalcitrant' forestry species, *Grewia optiva* and *Lagerstroemia parviflora* was investigated. The cuttings of approximately 20 cm length and 1.0 cm diameter were treated with equimolar (2mM) doses of indole 3-butyric acid, sodium acetate, ascorbic acid and thiamine for 24 h by basal dipping. After ten weeks of planting, observations were recorded for sprouting (%), rooting (%), root number, and root length and root-sprout ratio. Treatment with IBA significantly induced adventitious rooting (upto 67%) in *Grewia optiva.* In *Lagerstroemia parviflora,* treatment of thiamine resulted in significantly better adventitious rhizogenesis than other treatments.

अर्द्ध–कठोरकाष्ठ *ग्रीविया ऑप्टिवा* और *लैगरस्ट्रोमिया पार्विलोरा* की प्ररोह कलमों में जड़े निकलने का प्रतिचार

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सारांष

दो जड़ें निकलने की प्रतिरोधी वानिकी जातियों, *ग्रीविया ऑप्टिवा* और *लैगरस्ट्रोमिया पार्विलोरा* की अर्द्ध–कठोरकाष्ठ प्ररोह–कलमों में आगन्तुक जड़ें निकलने का अन्वेषण किया गया। लगभग 20 सेमी लम्बी और 1.0 सेमी व्यास की कलमों का इण्डोल 3–ब्यूटिरिक अम्ल, सोडियम एसिटेट, एस्कोर्बिक अम्ल और थायामीन की

समव्यूहाणु मात्राओं (2mM) से उनके मोटे भाग को 24 घंटे तक डुबाए रख उपचारित किया गया। रोपने के दस सप्ताह बाद अंकुरण (%), जड़ें निकलने (%) जड़ों की संख्या तथा जड़ों की लम्बाई और जड़ाकुंरण अनुपात के पर्यवेक्षण आलेखित किए गए। इण्डोल ब्यूटिरिक अम्ल उपचार से आगन्तुक जड़े निकलने को काफी बढ़वार (67%) *ग्रीवियां ऑप्टिका* में मिला। *लैगरस्ट्रोमिया पार्विलोरा* में अन्य उपचारों की तुलना में थायामीन से किए उपचार से आगन्तुक जड़ों का जनन श्रेष्ठतर हुआ।

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