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Rooting Ability of Cuttings of *Swietenia macrophylla* King and *Chukrasia velutina* Wight *et* Arn as Influenced by Exogenous Hormone

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ABSTRACT

The present study was conducted to explore the rooting ability of cuttings of *Swietenia macrophylla* King and *Chukrasia velutina* Wight *et* Arn. and the influenced of exogenous hormone. During the study, juvenile shoots were collected from coppice forming stools of phenotypically superior selected trees for cutting. Rooting ability of cuttings of both the species were significantly enhanced by the application of exogenous rooting hormone IBA. The highest percentage of rooting (97%) and root dry mass (41.7 mg) of *S. macrophylla* was observed in cuttings treated with 0.4% IBA and lowest in cuttings without IBA treatment. Though the rooting percentage of cuttings of *C. velutina* (87-100%) was not significantly influenced by IBA treatment, average number of root (16.9) and root dry mass (32.7 mg) were increased in the cuttings treated with IBA.

Key Words: *Chukrasia velutina*; *Swietenia macrophylla;* Stem cutting; Non-mist propagator

INTRODUCTION

Swietenia macrophylla, King and *Chukrasia velutina* Wight *et* Arn. are the two major timber species in Bangladesh. *Swietenia macrophylla* King commonly known as mahogany in Bangladesh is a large deciduous tree with an umbrella-shaped crown, frequently reaching at a height of over 30 m and diameter at breast height (dbh) of over 1.5 m (Lamb, 1966). *S. macrophylla* is an exotic timber species originated from Caribbean countries. It was first planted in Indian sub content in 1872 at the Calcutta Botanical Garden by the seeds from Honduras (Gamble, 1985). Now it became naturalized in some introduced ranges including Bangladesh and widely planted everywhere in Bangladesh including forest land, along roads and highways and at homestead areas. *S. macrophylla* timber is prized particularly for its colour and workability; it is primarily valued for construction of high-value furniture and interior fittings (Palmer, 1994).

Chukrasia velutina Wight *et* Arn. known as Chickrasi or Chitagong wood in Bangladesh is also a very tall, handsome, deciduous to semi-evergreen tree with tall cylindrical bole and spreading crown (Das & Alam, 2001). *C. velutina* grows well naturally in tropical semi-evergreen and moist deciduous forest in India, Srilanka, Myanmar, Bangladesh, Malaysia, Borneo and south-china (Singh *et al.*, 1994). In Bangladesh, it is abundantly grown in Chittagong where, it is probably the chief timber tree species after *Lagerstroemia speciosa* (Gamble, 1985) and that is why the wood is known as the Chittagong wood. Timber is very close-grained, light reddish-brown (Drury, 1985) with moderately fine and uniform texture is excellent for decorative boards in railway carriages, furniture, cabinetwork and plywood (Titmuss, 1971). It is one of the finest timber for ornamental veneers, locally used in house construction as scantlings, posts, and planks, carving, canoes, dug-outs, cooperage etc. (Prakash, 1998).

Various studies show that these two species of Family Meliaceae are becoming a promising plantation species in and around the country due to the high yield and quality timber but are highly susceptible to shoot borer insect (*Hypsipyla robusta* Moree) infestation at the young stage of their growing period. About 47% *C. velutina* trees and 40% saplings of *S. macrophylla* were found to attack by the borer resulting in a loss of 29% potential biomass production (Azad, 2003). The larvae of the shoot borer bore into tender shoots and defoliate the leaves (Prakash, 1998). Sometimes the insects bore into fruit also (Luna, 1996). Low branching and loss of the leading shoot caused by damaging the apical shoot of young trees can drastically reduce future timber production and quality. Numbers of preventive and remedial measures are being tried to limit the shoot borer damage of the species. Genetic improvement is one of them. It is observed that some trees in the *S. macrophylla* and *C. velutina* provenances are resistance to shoot borer attack. The selection and propagation of those resistant trees may be one of the effective preventive measures. Clonal propagation by stem cutting should be the most reliable technique for large-scale plantation with borer resistant planting materials maintaining the genetic gain in both yield and quality. However, the information regarding the clonal propagation of *S. macrophylla* and *C. velutina* by stem cuttings is very scarce. The present study was, therefore, undertaken to explore the rooting responses of stem cuttings of these two Meliaceae tree species and the influence of pretreatment with exogenous hormone IBA.

MATERIALS AND METHODS

The study was conducted over six months from April to September 2003 at Chittagong University campus situated between latitude 22030´ N and longitude 91050´ E. The University campus enjoys typically tropical monsoon, characterized by hot humid summer and cool dry winter.

Growing of stock plants for propagation. Shoots of *S. macrophylla* and *C. velutina* were collected from hedgerows established in nursery orchard. The hedgerows were established by topping the selected superior stockplants that were not infested by the insect borer. Four years old stockplant of *S. macrophylla* and *C. velutina* growing in stockplants orchard, were topped leaving 30 cm stump above the ground. Average numbers of shoot produced per stump at six weeks (*S. macrophylla)* or four weeks (*C. velutina)* were 4 and 18, respectively for cutting.

Rooting trials in non-mist propagator. Ninety, one-node cuttings with two leaves trimmed to half (*S. macrophylla*) from the shoots of the stockplants were put into a non-mist propagator (Kamaluddin, 1996). Similar number of one-node cuttings with three leaflets were also taken for *C. velutina* (Ahmed *et al*., 2001) and set into the propagator. Effect of Indole Butyric Acid (IBA) on rooting ability of cuttings was explored by treating 30 cuttings of each species with 0.2% IBA and another 30 cuttings with 0.4% IBA solution.

Before IBA treatment the cuttings were immersed briefly in a solution of fungicide, Diathane M45 (Rohm & Co. Ltd., France; 2 g per litre of water) to avoid fungal infection. Then they were rinsed and kept under shade for 10 minutes in open air. For IBA treatment cutting base was briefly dibbed into the IBA solution. The cuttings were then planted into a non-mist propagator in completely randomized blocks. The cuttings were planted into perforated plastic trays (12 cm depth) filled with coarse sand mixed with fine gravel (Plate 2). Each tray contains 10 cuttings and served as a plot. Thus the numbers of replicate cuttings per treatment were three. The cuttings were watered once only just after setting into the propagator and no watering was done till the transfer of rooted cuttings from the propagator. At the same time, cuttings from the stockplants serving as control were also set into the rooting trials.

The propagator used for experiments was a non-mist propagator (Kamaluddin, 1996). It was simply a polythene enclosure consisting of a wooden frame of 1.8 m in length and 1 m in breath with a height of 60 cm on one side and 45 cm on the other side. The sides of the frame were kept clear above 20 cm. A clear polythene sheet was lined inside the wooden frame up to the top of the frame so that the sides and base hold enclosed humid air. The base of the propagator was covered with a 10 cm thick layer of moist coarse sand (mixed with fine gravel). The layer supported rooting media in perforated plastic trays (12 cm depth). The rooting medium was a mixture of coarse sand and fine gravel (0.1-0.3 cm). The frame was covered by closely-fitted polythene lid (Plate 1).

Plate 1. A non-mist propagator 1.8 m in length and 1 m in breath with a height of 60 cm on one side and 45 cm on the other side

Plate 2. Cuttings rooted in the perforated plastic tray

Propagator environment. It was possible to maintain about 85-90% humidity within the propagator. Every day the propagator was opened briefly in the morning and in the late afternoon to facilitate gas diffusion. The propagator was kept under bamboo made shed to avoid excessive heat accumulation. Further shading was achieved by putting jute mat over the roof of the shed. In this way, photosynthetic photon flux inside the propagator was reduced to about 12% full sun. During the experiment mean maximum and minimum temperatures were 32ºC and 25ºC, respectively.

Weaning. The cuttings in the propagator were rooted within six weeks (*C. velutina*) or ten weeks (*S. macrophylla*) after the experiment was set. The cuttings were subjected to weaning before transfer them to polythene pots, particularly towards the end of rooting period during root lignification.

For weaning, the propagator was kept open at night for three days and then at day and night for another three days.

Data collection and analysis. The rooted cuttings were measured for length and diameter. Number of root developed in each cutting was recorded. Roots of each cutting were separated and dried in oven at 70ºC for 48 h for dry weight assessment. Shoots produced in cuttings was also separated and dried in the oven. Possible treatment differences were explored by the Analysis of Variance and Duncan's Multiple Range Test (DMRT). Rooting percentage values were converted to corresponding arc sign square root values before putting the data into analysis of variance.

RESULTS

Rooting percentage. Rooting percentage of *S. macrophylla* cuttings was significantly enhanced by the exogenous hormone (IBA) application but cuttings of *C. velutina* was unaffected by the IBA treatment. Across all the cutting type, percentage of cuttings rooted for *S. macrophylla* 10 weeks after the setting ranged from 73 to 97%. For *C. velutina* rooting percentage of cuttings were 87 to 100% within six weeks after settings. The highest rooting percentage (97%) of *S. macrophylla* was obtained from the cuttings treated with 0.4% IBA followed by the cuttings treated with 0.2% IBA but the lowest in the cuttings without IBA treatment (Fig. 1). There was no significant difference in rooting percentage between the cutting treated with 0.2 and 0.4% IBA.

Root number. The number of root produced per cutting of *S. macrophylla* was not influenced significantly by the applied IBA, whereas for *C. velutina* it was significantly higher in the cuttings treated by 0.4% IBA (Fig. 2). Across the treatment, the number of root produced per cutting of *C. velutina* ranged 6.3 to 16.9; whereas, it was only 1.8 to 2.2 for *S. macrophylla*.

Root dry weight. Mean root dry weight of cuttings was significantly increased by IBA application in both *S. macrophylla* and *C. velutina*. The highest root dry weight per cuttings of *S. macrophylla* and *C. velutina* was 41.7 and 32.7 mg, respectively was observed in cuttings treated with 0.4% IBA. The lowest root dry weight (28 mg for *S. macrophylla* and 14.7 mg for *C. velutina*) was observed in the cuttings without IBA treatment (Fig. 3).

Shoot dry weight. The shoots produced by the cuttings of both the species were indifferent to IBA application. Mean shoot dry weight per cutting of both the species was not varied significantly with the IBA treatment. However, shoot dry weight was slightly higher (22.3 and 147 mg for *S. macrophylla* and *C. velutina*, respectively) in the cuttings without IBA treatment (Fig. 4).

Fig. 1. Rooting percentage of cuttings of *S. macrophylla* and *C. velutina* under different treatments

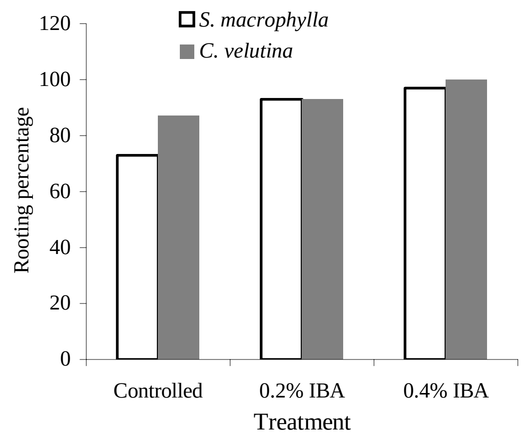
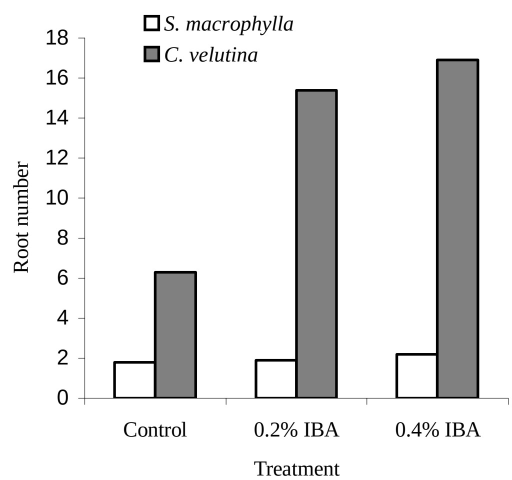


Fig. 2. Number of root produced per cutting of *S. macrophylla* and *C. velutina* under different treatments



DISCUSSION

Rooting ability of cuttings of both *S. macrophylla* and *C. velutina* was significantly influenced by the application of exogenous hormone (IBA). In the present study though the rooting percentage of cuttings of *C. velutina* was unaffected, *S. macrophylla* was highly enhanced by the exogenous hormone (IBA) application (Fig. 1). Across all cutting types, percentage of cuttings rooted for *S. macrophylla* 10 weeks after the setting ranged from 73 to 97%. However, SRD (1994) reported that the rooting percentage of *S. macrophylla* cuttings were 60% without IBA and 80% with IBA treatment. The highest rooting

Fig. 3. Dry weight of roots produced per cutting of *S. macrophylla* and *C. velutina* under different treatments

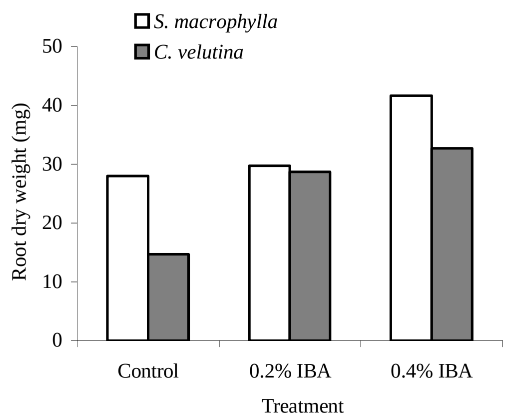
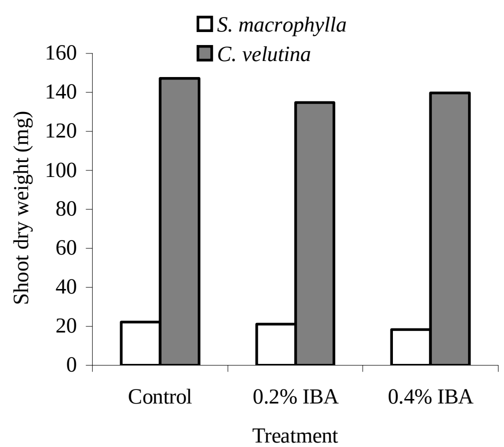


Fig. 4. Dry weight of shoot produced per cutting of *S. macrophylla* and *C. velutina* under different treatments



percentage (97%) was obtained from the cuttings treated with 0.4% IBA followed by 0.2% IBA and lowest was in the cuttings treated without IBA. On the other hand, rooting percentage of *C. velutina* cuttings ranged between 87% for controlled and 100% for IBA treatment within six weeks after setting in the propagator.

Again, though there was no significant difference in number of roots developed per cutting of *S. macrophylla* treated with IBA or not, average root dry weight per cutting was significantly increased by IBA treatment. The highest (41.7 mg) root dry weight per cutting was observed in cutting treated with 0.4% IBA (Fig. 2, 3). This was possible due to the very few number (1.8 to 2.2) of large root produced per cutting of *S. macrophylla*. In contrast, the root number and the root dry weight of *C. velutina* were highly influenced by the exogenous hormone application. The highest number of root per cutting (16.9) and mean dry weight (32.7 mg) was found in the cuttings treated with 0.4% IBA. Similar observation was reported by Kamaluddin *et al.* (1998) and found that applied auxin significantly increased root number per cuttings of *C. velutina*.

Enhancement of rooting ability of cuttings by IBA application was reported by many scientists. For an example, SRD (1994) reported the best rooting in cuttings of *S. macrophylla* treated with IBA. Dias *et al.* (1999) reported the highest rooting ability when cuttings of *Platanus acerifolia* treated with IBA. Kamaluddin *et al.* (1996) recorded significant increases both in percentage rooting and number of root with the application of IBA for *Artocarpus heterophyllus*. In a separate experiment for *Azadirachta indica*, mean root number was significantly increased by IBA treatment (Kamaluddin & Ali, 1996). Again, Hossain *et al*. (2002) also reported the highest rooting ability in the cuttings of *Artocatus heterophylla* treated with 0.4% IBA.

Applied auxin is known to intensify root-forming process in cuttings. For instance, polysaccharide hydrolysis is activated under the influence of applied IBA, and as a result, the contents of physiologically active sugar increases providing materials and energy for meristamatic tissues and later for root primordia and roots. Hassig (1983) examined the function of endogenous root forming components of plants demonstrated that auxin component was required for development of callus in which root primordia initiated, but for subsequent primordia development both auxin and non-auxin components were needed. It may be possible that in cuttings with optimum amount of endogenous auxin content and increasing of root number reflected the effect of applied auxin.

There were some variations in the rooting behaviour of cuttings of the *S. macrophylla* and *C. velutina*. In the *S. macrophylla*, cuttings the rooting percentage and the mean root dry weight was enhanced by IBA treatment but there was no variation in the average number of root per cutting. On the other hand, reverse scenario was observed in *C. velutina* stem cuttings where average root number and root dry weight were increased significantly by the IBA treatment but rooting percentage exhibited a little response to IBA. Both 0.2 and 0.4% IBA concentration enhanced the root number (15.4 & 16.9) of *C. velutina* in comparison with cutting which were not treated with IBA (Fig. 2).

Though the number of root per cuttings of in *S. macrophylla* was not increased significantly with the IBA treatment, mean root dry weight was significantly increased in both *S. macrophylla* and *C. velutina*. This was possible due to the few number of vigorous root produced by the *S. macrophylla* cuttings compared to the fine roots of the *C. velutina* cuttings.

Again, although there was no significant difference in shoot dry weight among the treatment, in both the cases, cuttings not treated with IBA produced more shoot dry weight in comparison to the cuttings treated with IBA (Fig.

4). This might be possible due to the distribution of the food materials into the root and shoots. In both the cases, when the cuttings produced more root weight the shoot weight was less or vice-versa since the total weight of root and shoot per cutting was almost equal. However, no study report was found regarding this aspect to compare the result of the present study.

CONCLUSION

In the present study, two most valuable timber species (*S. macrophylla* and *C. velutina*) of Family Meliaceae were investigated for the rooting ability of cuttings. The species are highly wanted plantation species in our country at present due to their high yield and quality of timber. Selection of borer resistant superior trees from plantations and propagation by juvenile stem cutting might be the best alternative to mitigate shoot borer infestation problem since present study highlights the potentials of rooting ability of stem cuttings of both the species with or without applied rooting hormone IBA. This may be an important area for future study.

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