EFFECT OF AUXINS ON SEASONAL ROOTING RESPONSE OF STEM CUTTINGS OF *DALBERGIA SERICEA*

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UNIYAL, R.C., PRASAD, P. & NAUTIYAL, A.R. 1995. Effect of auxins on seasonal rooting response of stem cuttings of *Dalbergia sericea*. A seasonal variation in adventitious root formation in stem cuttings of *Dalbergia sericea* was recorded which was spread over a major part of one year. Rooting failed to take place in the month of the onset of senescence even in the presence of auxins. In contrast, root formation was observed in warmer months which corresponded to full leaf and pod development and in which exogenous application of auxins increased rooting as well as callus formation significantly over control sets. Best rooting took place in the leafless stage planted cuttings.

Key words: Vegetative propagation - seasonal variation - *Dalbergia sericea* - auxins - rooting

UNIYAL, R.C., PRASAD, P. & NAUTIYAL, A.R. 1995. Kesan auksin ke atas tindak balas pengakar bermusim bagi tebangan batang *Dalbergia sericea*. Satu perubah bermusim di dalam pembentukan akar adventitius di dalam penebangan batang *Dalbergia sericea* telah direkodkan yang mana telah disebarkan di bahagian-bahagian utama dalam masa setahun. Pengakar gagal berlaku di akhir bulan walaupun dengan adanya auksin. Sebaliknya pembentukan akar telah diperhatikan di bulan-bulan bercuaca panas yang sesuai untuk daun penuh dan pertumbuhan lenggai yang mana aplikasi auksin secara eksogen telah meningkatkan pembentukan pengakar dan kalus dengan ketara berbanding dengan set-set kawalan. Pengakar paling baik berlaku pada tahap penanaman tampang tidak berdaun.

Introduction

Vegetative propagation through rooted stem cuttings offers the advantage of cloning trees of desired genetic constitution in a relatively short time. A wealth of information is now available on the role of growth regulators in controlling the rooting ability of stem cuttings (Nanda & Anand 1970, Srivastava & Manggil 1981, Bojarczuk 1985, Davies & Hartmann 1988, Puri & Shamet 1988, Hartmann *et al.* 1990). Studies have been undertaken on vegetative propagation of several trees practised under social forestry/agroforestry programmes in the mountains (Nagpal & Singh 1986, Puri & Shamet 1988, Bhatt & Todaria 1990) but such information on many tree species is still not available. *Dalbergia sericea* G. Don. is a multipurpose tree species with a high potential for biomass production as well as soil amelioration. Vegetative propagation through stem cuttings has been reported in this species by Uniyal *et al.* (1993) through auxin treatment of the cuttings, but the cuttings were taken only in one month of the year. However, seasonality is reported to be one of the important factors in controlling rooting of cuttings (Bojarczuk & Jankiewicz 1975, Bassuk & Howard 1981, Rana *et al.* 1987, Bhatt & Todaria 1990). Keeping this factor in view, the present study was undertaken to determine the seasonal rooting ability of the cuttings of *D. sericea* as influenced by the application of two different growth substances.

Materials and methods

Branch cuttings of *D. sericea* were collected from a healthy tree growing in a natural mature tree stand of this species at Khanda (760 m altitude) 10 km southwest of Srinagar (30°31°N and 78°- 70°48' E) at two-month intervals from July 1991 to March 1992. The cuttings wrapped in wet gunny bags to avoid desiccation were brought to the laboratory at Srinagar. Uniform cuttings of 26 - 27 cm length and 0.6 - 0.7 cm diameter were selected and divided into 5 groups, each consisting of 30 cuttings. While the first group served as control, groups 2 to 5 were treated with 100 and 500 ppm of indole-3-acetic acid (IAA) and indole-3-butyric acid (IBA) respectively. For treatment, about 7 cm basal cut ends were dipped into the respective solutions for 24 h. Distilled water was used for the control set. After treatment the cuttings were planted in non-transparent polythene bags containing equal proportions of garden soil, sand and farmyard manure. The bags were kept in the glass house at Srinagar with no artificial illumination and watered regularly. Observations with the naked eye on the number of cuttings sprouted and rooted, callus formation, average root length, number of roots and buds per cutting were recorded at monthly intervals up to three months by uprooting 10 cuttings of each treatment. The soil temperature at 10 cm depth was recorded daily during the entire period of the study. Regular observations on the phenological cycle of the species were also made. The climate at Srinagar is typically subtropical with marked seasonal variation from hot summer during May to August and the temperature declining in September to severe winter during December to February. Spring (March to April) and autumn (October to November) intervene in between.

Results

The results obtained on seasonal variation in vegetative propagation of *D. sericea* stem cuttings and the soil temperature are shown in Table 1 and Figure 1. In the July planted cuttings rooting and sprouting took place in all the sets but the percentage as well as the number of roots and buds per cutting varied. It is interesting that while the number of buds per cutting was nearly the same in the control as well as in the 100 ppm IAA and IBA treated cuttings, the percentage of sprouted cuttings varied considerably between these treatments. Maximum sprouted cuttings (53%) were observed in the IBA 100 treatment followed by the IAA 100 treatment (37%). In contrast to sprouting, rooting failed to occur without auxin treatment. IBA and IAA treatments produced rooting resulting in 53% rooting in the case of IBA 100. It was noted that the lower concentration, i.e. 100 ppm of IAA and IBA, was more effective in causing rooting than the 500 ppm. Similar to sprouting, callus formation also took place in all the treatments with a maximum of 13% in the IAA 100 and IBA 500 treatments, but it failed to differentiate into rooting in the control set. The IBA 100 ppm treatment of cuttings also resulted in the highest number of roots as well as root length/cutting.

Table 1. Seasonal variation in vegetative propagation of *D. sericea* stem cuttings

Treatments (ppm)	Percentage of cuttings			Per cutting average		
	Sprouted	Rooted	Callused	Buds (no.)	Roots (no.)	Root length (cm)
July						
Control	20.0	0.0	10.0	2.58	0.00	0.00
IAA 100	36.6	13.3	13.3	2.48	8.00	6.89
500	10.0	6.6	6.6	1.00	5.00	5.42
IBA 100	53.3	53.3	3.3	2.69	21.59	13.00
500	3.3	3.3	13.3	0.33	8.33	3.3
September						
Control	26.6	0.0	3.3	1.97	0.00	0.00
IAA 100	33.3	0.0	23.3	2.58	0.00	0.00
500	20.0	23.3	16.6	1.58	3.27	3.10
IBA 100	3.3	6.6	16.6	0.67	3.17	1.83
500	0.0	13.3	13.3	0.00	5.62	2.67
January						
Control	0.0	0.0	0.0	0.00	0.00	0.00
IAA 100	0.0	0.0	0.0	0.00	0.00	0.00
500	3.3	0.0	0.0	0.33	0.00	0.00
IBA 100	0.0	0.0	6.6	0.00	0.00	0.00
500	0.0	0.0	13.3	0.00	0.00	0.0
March						
Control	71.4	20.0	14.3	3.44	3.53	4.67
IAA 100	77.1	14.3	20.0	2.99	8.39	5.07
500	51.5	30.3	9.0	3.31	13.28	4.61
IBA 100	75.0	40.6	9.4	2.95	19.49	6.66
500	84.3	43.8	12.5	2.44	14.03	3.37

Data obtained on the September planted cuttings indicated a gradual decrease from the July planted cuttings in sprouting as well as rooting in all the treatments. Sprouting was not found in cuttings treated with 500 ppm of IBA. Even in 100 ppm IBA only 3% cuttings sprouted against more than 20% in the other sets. In the September planted set the higher concentration of IAA and IBA resulted in higher percentage of rooting and the IAA 500 ppm treatment resulted in rooting of 23% cuttings. This was in contrast to the July planted cuttings, where lower concentrations of IAA and IBA were more effective in rooting cuttings. Like in the July planted set the cuttings without auxin treatment also failed to root here. Interestingly the number of callused cuttings in September increased from the July planted cuttings with a maximum (23%) in the IAA 100 treatment, but a decrease in the control set was recorded. An overall decrease in the number of buds and roots per cutting as well as the average root length was also recorded in the September planted set as compared to the July planted set. Cuttings planted in November did not show any sign of either sprouting or rooting in any treatment (the results are not shown in the table). In the January planted cuttings also, sprouting was seen only in the IAA 500 treated cuttings, but the number of buds/cutting was drastically reduced as compared to the July and September planted cuttings. Adventitious roots were completely absent in all the treatments. However, cuttings with callus formation were only found in the IBA treatment.

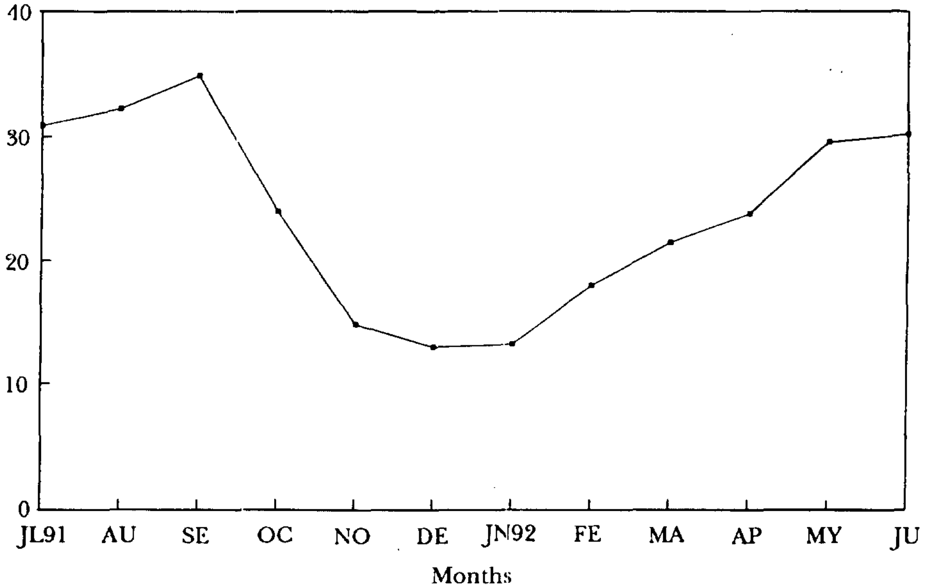

Figure 1. The seasonal variation in soil temperature at Srinagar (550 m)

The results obtained in the March planted cuttings (Table 1) revealed that sprouting, rooting as well as callus formation were more abundant here as compared to cuttings from the other planting months. Sprouting was observed in cuttings of all the treatments from a maximum (84%) in the IBA 500 to a minimum (51%) in the IAA 500 treatments. Like sprouting, rooted cuttings were also seen in all the treatments with varied percentages among the treatments. Even without auxin treatment, 20% cuttings were rooted. The auxin treatment of cuttings enhanced the percentage of rooted cuttings which was maximum in IBA 500 ppm. Further observations on the March planted cuttings revealed that although the number of sprouted cuttings varied among the treatments, the average number of buds/cutting was nearly similar in all the treatments. Contrary to this, the average number of roots/cutting greatly varied among the treatments. Maximum number of roots per cutting was found in the IBA 100 treated cuttings followed by the IBA 500 and IAA 100 treatments and minimum in the control set. Maximum root length/ cutting was found in the IBA 100 and minimum in the IBA 500 ppm treatments.

Discussion

This study showed a marked seasonal variation in rooting pattern of *Dalbergia sericea* stem cuttings which was considerably modified by hormonal treatment. There was a progressive decline in rooting ability of cuttings planted from July to January with a resumption of this ability in March (Table 1). This decline in rooting as well as sprouting behaviour in winter months may either be due to winter dormancy of parent plant or to prevailing low temperatures. The latter seems to be a potential reason for this because even if the level of endogenous auxins declined to a state where it failed to cause root differentiation the exogenous application of auxins would have overcome this constraint. The auxin induced effect on rooting of cuttings is presumed to be mediated through its effect in mobilizing the reserve food material by enhancing the activity of hydrolytic enzymes (Nanda *et al.* 1968). However, this mobilization fails to take place at low temperatures (Nanda & Anand 1970) and thus it seems that due to prevailing low temperature the auxins failed to induce their effect on mobilization of food. It was contrary to observations made by Rana *et al.* (1987) in *Dalbergia sissoo* where root initiation was observed in auxin treated cuttings in low temperature months.

A number of workers have shown that rooting is facilitated when carbohydrate reserve foods are in abundance (Kraus & Kraybill 1918, Greenwood & Berlyn 1973, Struve 1981, Haissig 1986, Veierskov 1989). The presence of calluses that are not differentiated into roots on many cuttings may be attributed to many factors including lack of sufficient food reserves, unfavourable temperature-moisture regimes, some internal factors and the age of the cuttings (Girourd 1967, Bonga & Durzan 1982). The results obtained here on seasonal variation in the rooting of *D. sericea* also indicate that best rooting took place in the March followed by the July planted cuttings. This is a period when the plant of this species passes through a phase of active growth (Figure 2) and would be rich in the food material as well as endogenous level of auxins. As indicated in Figure 2 this species enters into a reproductive phase in the month of June-July and the fruits become mature and ready for abscission in November-December. Thus the tree would be in a poor nutritional status during this period. This could be another reason for the poor rooting in the cuttings planted during November and January. It is also evidenced by the fact that even sprouting failed to take place in the January planted cuttings except for the IAA 500 ppm treated set where only 3.3% cuttings sprouted as the early growth of sprouting depends on food reserves available in the cutting (Wright 1975). The nutritional aspect of the root formation in cuttings also gains support from a highly significant positive correlation between sprouting and rooting ($r = 0.716$, $p = 0.001$) calculated for the data obtained here for all the sets.

The cuttings obtained from the plant and planted in the month of November were exposed to low temperature for the following three months wherein neither rooting nor sprouting was recorded but the cuttings planted in January had callus formation in some cuttings treated with IBA. Although the data on monthly observations on rooting of the cuttings are not given in the table here due to their large volume, callus formation in these cuttings started only in March when the temperature had risen to 21°C (Figure 1). This also gives support to the low temperature as one of the potential reasons for failure of rooting in the winter months. Thus seasonality of the rooting seems to be due more to environmental influence than to auxin level because even the exogenous application of auxins failed to initiate rooting in the winter months when temperature declined to 8 - 10 °C.

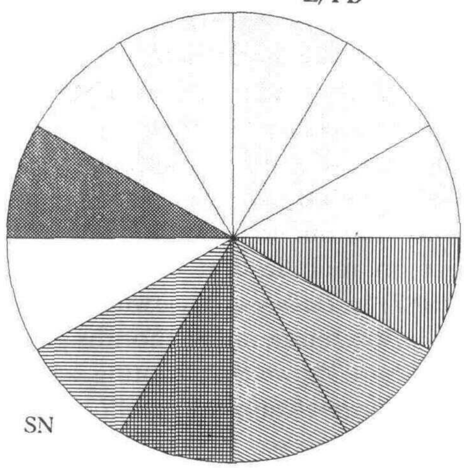

Figure 2. Phenological cycle of *D. sericea* [OS - onset of senescence (January), SN - senescence (February), LL - leafless stage (March), SP/FL - sprouting and flowering (April), L/PD - full leaf and pod development(May to September), FF -fruiting (October), PF - pod fall (November-December)]

In summary, this study showed that March and July are the two months favourable for rooting of *D. sericea*. March seems to be the best month to get optimum rooting because rooting was recorded in cuttings of all the treatments and even without auxin treatment rooting took place in 20% of cuttings (Table 1). Among the hormones used IBA seems to be more effective than IAA in inducing good rooting of *D. sericea*.

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