ROOTING RESPONSE OF CUTTINGS COLLECTED AT TWO DIFFERENT ALTITUDES OF TWO HIMALAYAN MULTIPURPOSE TREE SPECIES

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BHATT, B.P. & TODARIA, N.P. 1993. Rooting response of cuttings collected at two different altitudes of two Himalayan multipurpose tree species. Influences of altitudinal source and hormonal treatments on rooting response of *Boehmeria rugulosa* and *Debregeasia salicifolia* were studied. It was observed that high altitude (1760 *m* a.s.l.) enhanced significantly the root-shoot attributes of branch cuttings of both the species compared to low altitude (560 *m* a.s.l.).

Key words: Vegetative propagation - altitude - multipurpose tree species - *Boehmeria rugulosa* - *Debregeasia salicifolia*

BHATT, B.P. & TODARIA, N.P. 1993. Gerakbalas akar dua spesies pokok terhadap altitud yang berbeza di Himalaya. Kesan altitud dan rawatan hormon yang di berikan terhadap gerakbalas akar *Boehmeria rugulosa* dan *Debregeasia salicifolia* di kaji. Hasil kajian menunjukkan altitud yang lebih tinggi (1760 *m*) merangsang pertumbuhan sulur akar pada potongan-potongan dahan bagi kedua-dua spesies berbanding dengan pokok-pokok yang tumbuh pada altitud yang lebih rendah (560 *m*).

Introduction

In the mountain villages of Garhwal Himalaya various agroforestry tree species have become threatened due to their over-exploitation for fuel, fodder and timber (Todaria & Bhatt 1992). Among various tree species, *Boehmeria rugulosa* (ganthi) and *Debregeasia salicifolia* (syanru) are diminishing rapidly as the wood is excessively used for fuel (Bhatt & Badoni 1990, Bhatt & Todaria 1990a) and leaves for fodder (Bhatt 1991). Simultaneously, the wood of *Boehmeria rugulosa* is used for making various agricultural implements and wooden utensils. Distribution of both the species varies from 500 to 1800 *m* a.s.l. The tremendous potential of rooting response in both the taxa through vegetative propagation has been recorded (Bhatt & Todaria 1990 b,c). The present communication deals with the effects of altitudinal change (source of the branch cuttings) and hormone treatment on rooting attributes.

Materials and methods

Although rooting trials were conducted in four seasons, *i.e.* spring (February - May), summer (May - August), rainy (August - November) and winter (November - February), rooting response in the two species was only recorded during the spring season. Vegetative multiplication of tree species is normally achieved by treating branch cuttings with exogenous application of auxins and then planting. For the present investigation, stem cuttings of the juvenile phase of both species were collected from two different altitudes (1760 and 560*m*) in the spring of 1989. Branches of uniform size (12 to 15 *mm* diameter) were cut into 25 *cm* long pieces. After excising the apical portion and the leaves, the top cut ends were sealed with moist cotton to minimize water losses. Twenty cuttings of each species were treated for 24 *h* with 100, 200, 500 and 1000 *ppm* aqueous solutions of indole - 3 - acetic acid (IAA), indole -3- butyric acid (IBA), naphthalene acetic acid (NAA) and dichlorophenoxyacetic acid (2, 4 - D). Thus a total number of 16 treatments were used. Twenty cuttings of both species were also treated with double distilled water to serve as control. Treated branch cuttings were planted in the net house of the forestry department (situated at 30° - 31° N latitude and 78° - 78° 48' E longitude at an elevation of 550 *m* a.s.l.) in earthen pots having 1:1 ratio of sand and soil with a small quantity of farmyard manure. Branch cuttings were watered twice a day at 6 a.m. and 6 p.m. continuously up to 90 days. The maximum and minimum air temperatures at the experimental site were 25.0° *C* and 14.0° *C* respectively with an average rainfall of 100.0 *mm*. Observations on vegetative growth were made at monthly intervals, while the rooting response was recorded only after 90 days of planting.

For statistical analysis of the rooting attributes, test of significance t was computed for various growth parameters irrespective of hormonal treatments.

Results

Table 1 depicts the data on sprouting and rooting potential of *B. rugulosa* and *D. salicifolia* under various treatments. *B. rugulosa* showed that high altitude (1760 *m*) cuttings had more sprouts and roots then did low elevation branch cuttings (560 *m*). Not only did fewer treated cuttings sprouted from the low altitude but some treatments induced no sprouts at all (Table 1). Moreover, sprouts per sprouted cutting were low in low altitude collection as compared to higher ones. Number of cuttings rooted, number of roots per segment and average root length were generally greater in high altitude cuttings as compared to lower ones. The 100 and 200 *ppm* dichlorophenoxyacetic acid treatments induced profuse rooting in branch cuttings obtained from lower as well as high altitudes.

Simultaneously branch cuttings of *D. salicifolia* treated with different concentrations of auxin showed growth almost with all the treatments; however, IBA 200, NAA 500 and 2, 4-D 200 treatments were unable to induce either root or shoot growth in the branch cuttings of *D. salicifolia* (Table 1). Sprouted branch segments were more in high altitude cuttings than in those of lower altitude. Similar to sprouting, numbers of rooted cuttings were higher in high elevation cuttings. Only those concentrations of auxins which induced sprouting in greater number of cuttings were able to induce rooting in maximal number of branch cuttings. The effect of origin of mother trees was more pronounced on number of roots per cutting and average length as both these attributes were 2-5 times higher in cuttings collected from higher elevation. Number of rooted segment was comparatively

Table 1. Rooting response of cuttings collected at two different altitudes of two Himalaya multipurpose tree species

Treatments	Sprouting response						Rooting response			
	Sprouting percentage (%)		Sprouts/ sprouted cutting		Average sprout length (*cm*)		Rooting percentage (%)		Roots/rooted cutting	
	a	b	a	b	a	b	a	b	a	b
Boehmeria rugulosa										
Control	10	35	1.0	2.9	2.6	12.1	0	0	0.0	0.0
IBA 100 *ppm*	0	60	0.0	2.0	0.0	13.3	0	35	0.0	5.4
IBA 200 *ppm*	0	50	0.0	1.6	0.0	11.4	0	40	0.0	6.7
IBA 500 *ppm*	40	35	1.0	1.1	6.5	13.1	30	35	5.0	7.3
NAA 100 *ppm*	0	45	0.0	1.2	0.0	6.6	0	35	0.0	6.9
NAA 200 *ppm*	0	55	0.0	1.3	0.0	5.9	0	50	0.0	5.8
NAA 500 *ppm*	30	40	1.0	1.3	4.6	23.0	30	25	4.6	5.7
2,4-D 100 *ppm*	70	65	2.0	3.2	7.4	24.3	50	50	7.5	7.9
2,4-D 200 *ppm*	80	80	2.0	3.0	10.4	22.5	60	60	6.5	10.6
Debregeasia salicifolia										
Control	30	50	1.0	1.1	11.6	17.3	0	0	0.0	0.0
IAA 100 *ppm*	40	55	1.2	1.1	35.9	67.1	30	40	7.3	23.3
IAA 200 *ppm*	40	45	1.5	1.2	26.9	51.5	40	45	10.2	13.2
IAA 500 *ppm*	40	65	1.2	1.0	23.9	50.3	40	50	9.5	28.7
IAA 1000*ppm*	30	65	1.3	1.4	30.4	43.9	30	65	7.3	30.7
IBA 100 *ppm*	50	45	1.2	1.3	26.5	39.3	40	30	12.5	27.0
IBA 200 *ppm*	0	40	0.0	1.6	0.0	36.9	0	35	0.0	17.1
IBA 500 *ppm*	60	45	1.5	1.0	34.2	30.8	40	40	10.5	32.3
NAA 100 *ppm*	40	60	1.2	1.1	18.9	48.0	30	45	11.3	37.9
NAA 200 *ppm*	40	45	1.0	1.0	28.9	57.9	40	45	12.3	38.7
NAA 500 *ppm*	0	20	0.0	1.0	0.0	37.4	0	20	0.0	27.9
2,4-D 200 *ppm*	0	45	0.0	1.2	0.0	21.2	0	40	0.0	23.9

*Only those treatments which induced rooting in branch cuttings are mentioned here.
a = Cuttings collected from 560*m* altitude
b = Cuttings collected from 1760*m* altitude

higher with IAA treatments which also promoted higher number of roots per segment but only in high altitude cuttings. Average root length did not vary between different treatments; however, it was also significantly higher in high altitude cuttings.

Discussion

Branch cuttings obtained from the mother trees growing at two different altitudes demonstrated the overall superiority of high altitude cuttings in terms of the root and shoot parameters studied (Table 1). High altitude branch cuttings initiated shoot growth in a significantly ($p < 0.01$ and $p < 0.05$) greater number of branch cuttings in *B.rugulosa* and *D. salicifolia* respectively. The number of sprouts per cutting in *B. rugulosa* was significantly higher ($p < 0.01$) in high altitude cuttings than low altitude cuttings. Similarly, shoot length of *B.rugulosa* and *D. salifolia* was significantly higher ($p < 0.01$) in branch cuttings taken from 1760 *m* than those from 560 *m* altitude. The number of rooted cuttings and root number of high altitude cuttings of *B. rugulosa* proved significantly ($p < 0.05$) higher than for low elevation cuttings and so did root length ($p < 0.01$). *D. salicifolia* stem cuttings from 1760 *m* altitude had significantly higher ($p < 0.01$) root number and root length, while the number of rooted cutting from high altitude was significantly higher at $p < 0.05$. Therefore, high altitude cuttings of both the species showed superiority in vegetative multiplication than those of low altitude cuttings.

It is well known that seed viability and germination vary with seed collected from different locations and time of the year. Several workers have postulated that with increasing altitudinal gradient, the possibility of sexual multiplication decreases (Semwal & Purohit 1980, Ledig & Korbobo 1983) and, therefore, there are better chances of asexual multiplication. Nautiyal (1986) reported an inverse relationship between per cent germination and potential for vegetative propagation by stem cuttings in *Aconitum balfouri* (a high altitude species).

This may be due to more carbohydrate reserves in high altitude mother cuttings than in those of lower altitudes which may be utilized during the course of root initiation (Crawford & Huxter 1977). Further, it may be due to comparatively higher phenolic levels in high altitude populations than in those of lower altitudes (Khanduri & Purohit 1981) because phenols are postulated as auxin cofactors or synergids in root initiation (Hartmann & Kester 1990). Generally, the level of secondary metabolites changes with change in habitat and high altitude species / races contain higher amounts of secondary metabolites (Khanduri & Purohit 1981). Nautiyal & Purohit (1986) in their studies on vegetative propagation in *Berberis* spp. from various sources (altitudes) concluded that only high altitude *Berberis* spp. rooted while the lowland *Berbaris* sp. did not root even after exogenous application of auxins.

Therefore, the results presented here demonstrated that there is clear-cut difference between rooting behaviour of branch cuttings of high and lowland mother trees. Lowland branch cuttings rooted poorly as compared to highland stem cuttings. It will be worth mentioning here that *B. rugulosa* is diminishing very rapidly from highlands. Thus, vegetative propagation may be a possible source of mass multiplication in this taxa.

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