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EFFECT OF ROOTING HORMONES ON ADVENTIOUS ROOT FORMATION OF BRANCH CUTTINGS OF *DENDROCALAMUS GIGANTEUS* EX MUNRO. (GIANT BAMBOO) THROUGH *EX-VITRO* METHODS

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Abstract

An attempt was made to induce rooting from binodal cuttings of *Dendrocalamus giganteus* under natural conditions. The binodal cuttings were pretreated with different concentrations of IAA, NAA and IBA and kept in open sun light. Maximum (40.42%) rooting percentage, were recorded in untreated cuttings that is control with (1.90) number of roots and (18.67 cm) root length followed by the cutting as treated with IBA 500 ppm with (37.71%), (1.79) number of roots and (19.45 cm) root length. The adventitious rooting was obtained after three months from the planting. However, minimum (28.12%) rooting percentage were achieved in the cuttings treated with NAA 500 ppm with (1.76) number of roots and (18.32 cm) root length. Variation in all the Physiological characters with treatment was significant at 0.1% except with the number of roots which was significant at 0.2%, respectively.

Key words : *Dendrocalamus giganteus*, bamboos, physiological characters, root length.

Introduction

Bamboos are fast growing short rotation and multipurpose plant species having high economic, ecological, social and industrial importance. Bamboo is one the most universally useful plant commodity. The name bamboo is itself a vernacular term for more than 75 genera and 1250 species of the family Poaceae throughout the world (Soderstrum and Ellis, 1988). Bamboo occur worldwide and have an extremely wide range of distribution, with some bamboos reported from altitude as far as 46^0 North and as far as 47^0 South, although the great majority occurs in tropics. North eastern states are rich in bamboo bioresources and represent about 66% of the growing stock of bamboo in the country. Bamboo size ranges from miniature to giant culm over 60 meters, which provide scope for selection of commercial point of view, which also happens to be dominant species. Apart from the indigenous species, about 10 species are introduced (exotics). Among exotics, *Dendrocalamus giganteus, Dendrocalamus asper, Guadua angustifolia* and *Phyllostachys bambusoides* having high economic and industrial importance.

Dendrocalamus giganteus Munro. is the tallest of bamboos with close culms and slender branches. Culms 24-30 m tall, 20-30 cm in diameter, thick-walled, dull green, covered with white waxy crust when young. It is native to Burma and regarding its introduction into India Munro said, "it appears to have flowered in Calcutta in 1861, thirty years after it had been originally introduced" (Bennett *et al*., 1990). This species is frequently cultivated in Arunachal Pradesh, Assam, Manipur, Nagaland, and West Bengal and occasionally in other parts of the country. It is also growing in Bambusetum, Forest Research Institute, Dehradun. It can be grown on moist hill slopes and flat lands with rich loam soils (Yadav, 1964) and comes up well in tropical and subtropical moist areas in India.

Culms are used for building purposes, mast of boats, flower vases, various other decorative purposes and also as buckets. In Siang district of Arunachal Pradesh, Abors and Mishims use this bamboo mainly as water pitcher (Rao and Joseph, 1965). The palatable vegetable products

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are prepared in Manipur from the young shoots of this species (Janmeja Singh, 1986). Gupta *et al*. (1976) after conducting pulping experiment on this species and *Dendrocalamus giganteus* have concluded that this is a better raw material than *D. strictus* for paper making. This species is widely used in Sri Lanka for scaffolding, and manufacturing of curious handicraft (Vivekananda, 1980). In southern Taiwan, it gave an annual yield of 20-30 tonnes/ha of culms and was found to be an excellent material for pulp. The shoot yield recorded was 2.7 times more than that of native *Dendrocalamus latiforus* (Anonymous, 1983). *Dendrocalamus giganteus* produces good amount of biomass and is easy to harvest.

Availability of suitable planting material of bamboo is always a problem as the unavailability of seeds every year as well as difficult conventional vegetative propagation methods. Vegetative propagation is not a breeding method but a way to rapidly multiply and disseminate the desired clonal material according to its genetic potential. In vegetative propagation, the genetic potential of a species, including the non additive variance, is automatically transferred to the new plant (Puri and Khara, 1992). However, in nature the tree populations are highly heterozygous and vegetative population helps to utilize maximum genetic gains in the shortest possible time. The success of vegetative propagation depends upon a proper environment, genetic component and the physiological status of cuttings etc. (Cunningham, 1986).

Vegetative propagation is a good tool for propagating the selective genotype. Cloning by rooting of cuttings has developed a lot because it became possible to use improved genetic material in the establishment of seed orchards, in nutrition trials, in increasing hybrids with more genetic accuracy for tests and establishment of large industrial forests through mass propagation of clonal planting material. Due to unavailability of seeds every year propagation techniques for many bamboo species is a major break. Keeping this problem in view, branch cuttings of *Dendrocalamus giganteus*, which are easily available were tried for their rooting response to produced quality planting material and the results are given in this paper.

Materials and Methods

The present investigation was carried to find out the influence of three growth regulators with different concentrations on sprouts and rooting of *D. giganteus* culm branch cuttings. The branch cuttings of this bamboo species were collected from the already established clumps of this species growing in Forest Research Institute Dehradun in rainy (June-August), autumn (September-November), winter (December-February) and spring season (March-May). The cuttings were collected fresh and put in a plastic buckets filled with water to avoid desiccation of the vegetative material. The branch cuttings collected were treated with different Auxins for 24 hours in all four seasons (rainy, autumn, winter and spring season) as given following hormonal treatments:

S. no.	Hormones	Concentration (ppm)
1	Control	Only water no Auxin
2	IAA	100
3	IAA	200
4	IAA	500
5	IBA	100
6	IBA	200
7	IBA	500
8	NAA	100
9	NAA	200
10	NAA	500

The different concentrations of these auxins with three replicates were prepared fresh by dissolving desired amount of auxins in running tap water.

All the data pertaining to rooting and subsequent growth was loaded in Microsoft excel and subjected to analysis of variance using Genstat statistical package (Genwin 3.2 version). In the analysis of variance for studied parameters, the mean values of each replication were estimated. For comparison of different means of different treatment, the critical difference (CD) were calculated based on student's t test at $p<0.05$ level.

Results

Rooting response of branch cuttings of *Dendrocalamus giganteus* were studied under natural (open sunlight) conditions during the year 2008-2009 and 2009-2010. Effect of hormone treatments on rooting response is given in tables 1 & 2. The rooting behavior with respect to number of roots per cutting, root length (cm), rooting percentage (%), number of sprouts and sprout length were recorded during the experiments and were analyzed by ANOVA. Variation in physiological characters with treatment and year and treatment are described as follows.

Variation in physiological characters with treatment

Number of roots per cutting

Cuttings had a significant effect in all treatments (0.001% level) on the mean number of roots (table 1). Maximum (2.4) numbers of roots were noticed in the cuttings treated with IBA 500 ppm followed by the

untreated cuttings (1.90), while minimum (1.67) roots were observed in the cuttings treated with IAA 500 ppm.

Root length per cutting

The mean root length per cutting is highly significant at (0.01% level) in all treatments (table 1). Maximum (20.66 cm) root length has been noticed in the cuttings treated with IBA 500 ppm closely followed by the cuttings (19.45 cm) treated with IBA 200 ppm. However, minimum root length of (18.15 cm) was recorded in the cuttings treated with NAA 100 ppm.

Rooting percentage

The variation in rooting percentage among the different treatments is highly significant at 0.001% level (table 1). The maximum (40.42%) rooting percentage was discernible in untreated cuttings that is control followed closely by the cuttings (37.71%) treated with IBA 500 ppm, while minimum (28.12%) rooting has been achieved in the cuttings treated with NAA 500 ppm.

Mean number of sprouts per replicate

Number of sprouts per cutting per treatment was also significant at (0.001%). Maximum (9.37) sprout were noticed in the untreated cuttings (control) closely followed by the cuttings (8.66) treated with IBA 500 ppm, while minimum (6.50) sprouts were observed in the cuttings treated with NAA 500 ppm.

Sprout length

Cuttings per treatment had significant influence ($P<0.01$) on mean sprout length (table 1). Maximum (24.76 cm) sprout length was noticed in the cuttings treated with IBA 500 ppm followed by the cuttings (20.91 cm) treated with IBA 200 ppm. The minimum (18.37 cm) sprout length was observed in the cuttings treated with NAA 200 ppm.

Variation in physiological characters with year and treatment

Number of roots per cutting

Cuttings have significant effect at (0.001% level) on the mean number of roots in both years (table 2). Maximum (2.54) numbers of roots were noticed in first year (2008-09) in the cuttings treated with IBA 500 ppm closely followed by untreated cuttings in the second year (2009-10). However, minimum (1.54) mean number of roots was recorded in the cuttings treated with IAA 200 ppm in second year.

Root length per cutting

The mean root length per treatment is highly significantly at (0.01 % level) in all treatments of cutting (table 2). Maximum (21.94 cm) root length has been noticed in the cuttings treated with IBA 500 ppm in first year (2008-09) closely followed by the cuttings (19.82 cm) treated with IBA 200 ppm in the same year. While minimum (17.11cm) root length was recorded in the cuttings treated with NAA 500 ppm treated cuttings in second year (2009-10).

Rooting percentage

The variation in rooting percentage among the different treatments was non significant (NS). In first year the maximum (41.25%) rooting was discernible in untreated cuttings followed by IBA 500 ppm treated cuttings with (37.92%) rooting. while in second year maximum (39.58%) rooting has also been achieved in the untreated cuttings followed closely by the cuttings treated with IBA 500 ppm. However minimum (27.92%) rooting has been observed in the cuttings treated with NAA 500 ppm in both years (table 2).

Mean number of sprouts per replicate

Number of sprouts per treatment was significant at (0.05%).Maximum (10.00) sprout were noticed in the untreated cuttings in first year closely followed by the cuttings treated with IBA 500 ppm in the same year. while minimum(6.41) sprouts has been recorded in the cuttings treated with NAA 200 ppm in second year.

Sprout length

Treatment had significant influence ($P<0.01$) on mean sprout length per cutting (table 2). Maximum (27.18 cm) sprout length was noticed in the cuttings treated with IBA 500 ppm in first year followed by the cuttings with IBA 200 ppm in the second year with (22.23 cm) sprout length. The minimum (17.41 cm) sprout length was observed in the cuttings treated with IAA 200 ppm in first year.

Discussion

Auxin is one of the most important substances for root induction in the adventitious rooting of cuttings. Auxin probably are changed chemically (partially oxidized or conjugated with other small or large molecular weight compounds) before they act physiologically (Gurumurti *et al*., 1973; Dhaliwal *et al*., 1974). Various auxins *viz*. IAA, IBA, NAA and 2, 4, d etc. promote the rooting of stem cuttings but the effectiveness of the auxins varies with season, concentration, chemical nature and mode of treatment of the auxin (Nanda, 1970; Pain and Roy, 1981).

During the present study maximum rooting (40.42%) and sprouting (20.26 cm) were achieved in untreated cuttings that is control followed by the cuttings treated

Table 1 : Variation in physiological characters with treatment.

Treatments	Characters				
	Roots	**Root length**	**Rooting %**	**Sprouts/replicate**	**Sprout length**
Control	1.9	18.67	40.42	9.37	20.06
IAA100ppm	1.87	18.51	31.67	7.12	18.37
IAA200ppm	1.71	18.31	30.83	6.83	20
IAA500ppm	1.67	18.23	32.29	7.41	19.01
IBA100ppm	1.83	18.21	31.88	6.75	19.19
IBA200ppm	1.79	19.45	33.96	7.79	20.91
IBA500ppm	2.4	20.66	37.71	8.66	24.76
NAA100ppm	1.75	18.15	30	6.95	19.78
NAA200ppn	1.81	18.36	29.79	6.54	19.18
NAA500ppm	1.76	18.32	28.12	6.5	18.8
Significance	***	**	***	***	***
CD	0.190	1.316	2.225	0.551	1.367

***=Significant at 0.001%, **=Significant at 0.01%.

Table 2 : Variation in physiological Characters with year and treatment.

Year	Treatment	Characters				
		Roots	**Root length**	**Rooting %**	**Sprouts**	**Sprout length**
1st year	Control	1.8	18.48	41.25	10	20.53
	IAA100ppm	1.93	18.63	32.08	7.33	17.41
	IAA200ppm	1.79	17.71	30.83	6.91	20.04
	IAA500ppm	1.8	18.5	32.5	8.08	17.76
	IBA100ppm	1.87	18.46	31.67	6.83	18.5
	IBA200ppm	1.84	19.82	32.92	8.25	21.27
	IBA500ppm	2.54	21.94	37.92	9.08	27.18
	NAA100ppm	1.64	17.68	30	7	19.82
	NAA200ppn	1.83	17.79	30.42	6.66	19.3
	NAA500ppm	1.75	17.11	27.92	6.58	18.95
2nd year	Control	2	18.86	39.58	8.75	19.58
	IAA100ppm	1.8	18.4	31.25	6.91	19.33
	IAA200ppm	1.63	18.9	30.83	6.75	19.96
	IAA500ppm	1.54	17.95	32.08	6.75	20.25
	IBA100ppm	1.75	17.97	32.08	6.66	19.89
	IBA200ppm	1.75	19.09	35	7.33	20.55
	IBA500ppm	2.26	19.39	37.5	8.25	22.33
	NAA100ppm	1.64	18.63	30	6.91	19.75
	NAA200ppn	1.83	18.94	30.42	6.41	19.06
	NAA500ppm	1.71	19.52	27.92	6.42	18.65
	Significance	**	**	NS	*	***
	CD	0.26	1.861	-	0.780	1.933

NS=Non Significant, *=Significant at 0.05% **=Significant at 0.01%, ***= Significant at 0.001%.

with various auxins (IAA, IBA, NAA) with different concentrations of 100 mg l^{-1}, 200 mg l^{-1} and 500 mg l^{-1} same results were also achieved by Nautiyal *et al.* (2007) and found that the branch cuttings of *Dendrocalamus giganteus* treated with simple water (control) respond better than the cuttings treated with various concentrations of different auxins however, Sethalakshmi (1983) studied the effect of 10 and 100ppm each of coumarin, IAA, GA_3 and NAA alone and in various combinations on adventitious root induction in branch/ culm cuttings of *Bambusa balcooa* in two separate experiments respectively. Of the treatments, 100ppm coumarin with 10ppm IAA proved optimum, inducing 50% rooting in culm cuttings and 40% rooting in branch cuttings and Agnihotri and Ansari (2000) also studied that the branch cuttings treated with IAA 100 ppm showed highest result of rooting in *D. strictus* and *B. vulgaris*. IAA treatment significantly promoted root induction percentage in *B. vulgaris* (54.9%) and *D. strictus* (24.6%). Banik (1984) induced adventitious roots and rhizome formation by cutting basal end of one year old culms of some *Bambusa spp*. and *D. giganteus*. However, *Melocanna baccifera,* (a thin walled bamboo) was a failure. Adventitious roots and rhizomes were significantly more (60-93%) inside fiberglass tent than those received intermittent misting.

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