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INFLUENCE OF SEASON AND PHYTOHORMONES ON ROOTING BEHAVIOUR OF GREEN BAMBOO BY CUTTINGS

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Abstract

Bamboos are important sources of income for rural households in India and elsewhere. Bamboo is increasingly identified as potential species for poverty reduction programs in many countries including India. The present study was carried out to develop the farmer's friendly protocol for mass multiplication of Bambusa vulgaris through ex vitro methods. During the present study rooting was obtained in three seasons except winter season and the variation in all the physiological characters with seasons & treatments were significant at P<0.001. Maximum average (62.00) rooting percentage and (24.41 cm) root length was found in rainy season followed by summer season with average (50.33) rooting percentage and (15.31 cm) root length. However, (47.33) rooting percentage and (16.80 cm) root length was achieved in spring season. Among the three auxins used for pretreatment, IBA showed more positive response on rooting as compared to IAA and NAA. In winter season no rooting and sprout were observed in any treated cuttings.

Keywords: *Mass multiplication; Branch cuttings; Phytohormones; Season; Rooting Response.*

Introduction

Bamboo is a multipurpose, fast growing woody species, which occupies an important place in the diverse phases of life and culture of the people. It is the most universally useful plant known to man. It is fascinating to the craftsman, the poet, the artist and the scientist alike. Bamboo is said to be poverty alleviator. The multiple uses of bamboos for food, fodder, raw material for pulp & paper industry, handicraft industries, construction, windbreaks and in preventing soil erosion make it ideal choice for social and agroforestry plantations. Bamboo is a cultural feature of South-east Asia. No country in the region is without an indigenous bamboo flora. Its plethora of essential uses has led to the use of terms such as "bamboo culture", "green gold", "poor man's timber", "bamboo friend of the people" and "the cradle to coffin timber".

The genetic resources of bamboos show a wide spectrum of variability in terms of their taxa, distribution range, economic traits and end-uses. The major genera of economic importance are *Dendrocalamus*, *Bambusa*, *Gigantochloa*, *Arundinaria*, *Phyllostachys* and

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Pseudoxytenanthera. These taxa show genetic and physiological variability as regards to the flowering behavior, chromosome number, size of pollen grains, fertility and germination. Variation in morphological features of rhizome, culm-sheath, leaves, shape and size of hairs on leaves, culms and their internodal length, growth behavior, stomata size and frequency have been observed. Among the anatomical features variation is found in fibre characteristics, ratio of vascular bundles and fibre tissues. Bamboo seeds have a short life. Vegetative propagation is complicated and can result in an undesirable narrowing of the genetic base. Tissue culture is not yet possible without seed to provide initial embryogenic callus. Thus ex-situ conservation is not yet a viable option [1] and for practical purposes successful conservation of bamboo diversity, probably depends upon the protection of natural habitats along with deliberate management or cultivation. This requires a good understanding of their ecology and the effects that different land management practices may have upon different species. Bamboo is the secondary form of vegetation. In many places especially in the southern range of the biosphere reserve, illegal cutting of bamboo species was reported while surveying the Nokrek Biosphere Reserve area [2].

Bambusa vulgaris var. Green: commonly known as green bamboo, is a common bamboo species growing in all parts of the country. It is a preferred species for erosion control and has many uses. Propagation of bamboo through seed faces serious setback due to its erratic flowering and prolonged flowering cycle. In most of the literature it was mentioned that in many parts of the world this has not flowered. Propagation of bamboo through branch cuttings could be a useful approach because branch cuttings are easily available and easy in handling [3]. Propagation through macro proliferation technique for many bamboo species is a major break through but it has again the limitation of requirement of seeds to begin with. The propagation through offset planting is difficult and labour intensive as well as only limited number of plants can be produced by this method. So, vegetative propagation methods can cater to the increasing demand of its planting stock. Hence, a study was conducted to find out the effect of seasons (spring, rainy, autumn and winter) and rooting hormones (three different concentrations of IAA, IBA and NAA) on adventitious root induction in this species.

Materials and Methods

The study was carried out at Plant Physiology Discipline, Botany Division, Forest Research Institute Dehradun. The branch cuttings of 1-2 cm diameter of *B. vulgaris* were collected in the month of March 2009 to February 2010 from the main culms of this species growing in Plant Physiology, Botany Division FRI Dehradun (Fig.1). Binodal branch cuttings were prepared and surface sterilized with 0.1% Mercuric chloride solution prepared in water. After surface sterilization 20 cuttings were treated in each treatment with different auxins (IAA, IBA and NAA) in 100, 300 and 500 ppm concentration for 24 hours. The control was treated with water only. After hormonal treatment the cuttings were planted horizontally in plastic trays filled with soil, sand and FYM in the ratio of 2:1:1 and shifted to the glass house. The experiment was conducted during spring (March to May), rainy (June to August), Autumn (September to November) and winter (December to February) seasons of the year 2009-2010 to know the effect of season and rooting hormones on the rooting performance of this economical important bamboo species and to find out easy and cost effective method of propagation of this species. After 75 days these cuttings were uprooted and observation on

rooting of cuttings were recorded. Observation on number of cuttings rooted, root length, number of sprouts and sprout length of all cuttings were recorded for each treatment.

Fig.1. Main Clump

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

The rooting response of branch cuttings of *B. vulgaris* var. Green was very encouraging (Fig 2). The data pertaining to rooting and sprouting of this species is given in Table 1 and Table 2.

Fig.2. Rooted cuttings under different phytohormone concentrations

Table 1. Variation in Physiological Characters with Season

	Characters				
Seasons	Roots	Root Length	Rooting %	Sprouts	Sprout Length
Season1	4.71	15.32	50.33	3.04	21.43
Season2	5.70	23.41	62.00	3.53	24.96
Season3	4.41	16.81	47.33	2.77	18.25
Significance	***	***	***	***	***
CD	0.274	0.504	2.178	0.163	0.694

***= Significant at 0.01%
Season1=Spring season, Season2=Rainy season, Season3=Autumn season

Variation in Physiological Characters with Season

Number of roots per cutting

Treatment had a significant effect in all seasons (0.01% level) on the mean number of roots (Table 1). Maximum (5.70) numbers of roots were noticed in the cuttings planted in rainy season followed by the cuttings planted in autumn season (4.71), while the cuttings planted in spring season showed 4.41 roots per cutting. In winter season no rooting was observed.

Root length per cutting

The mean root length per cutting is highly significantly at (0.01 % level) in all seasons of cutting (Table 1). Maximum (23.41 cm) root length had been noticed in the cuttings planted in rainy season followed by the cuttings (16.81 cm) planted in autumn season. The cuttings which were planted in spring season showed 15.30 cm root length per cutting.

Rooting percentage

The variation in rooting percentage among the different seasons is highly significant at 0.01% level (Table 1). The maximum (62.00%) rooting percentage was discernible in cuttings planted in rainy season followed by the (50.33%) planted in spring season, while the cuttings which were planted in autumn season resulted in 47.33% rooting. No rooting was observed in the cuttings planted in winter season.

Mean number of sprouts per cutting

Season was also significant at (0.01%) in relation to number of sprouts per cutting (Table 1). Maximum (3.53) sprout were noticed in the cuttings planted in rainy season followed by the cuttings (3.04) planted in spring season while minimum (2.77) sprouts were observed in the cuttings planted in autumn season. No sprout was observed in the cuttings planted in winter season.

Sprout length

Season was also significant at (0.01%) in relation to Sprout length (Table 1). Maximum (24.96 cm) sprout length were noticed in the cuttings planted in rainy season followed by the cuttings (21.43 cm) planted in spring season, while minimum (18.25 cm) sprout length were observed in the cuttings planted in autumn season.

Variation in Physiological Characters with Treatments

Number of roots per cutting

Treatment had a significant effect in all seasons (0.01% level) on the mean number of roots (Table 2).

Table 2. Variation in Physiological Characters with Seasons & Treatments

Season	Treatment	Characters				
		Roots	Root Length	Rooting %	Sprouts	Sprout Length
Season 1	Control	5.66	18.54	51.67	2.50	21.90
	IAA100ppm	4.73	15.34	53.33	2.73	23.41
	IAA200ppm	4.90	13.25	43.33	2.56	21.52
	IAA500ppm	3.86	12.07	53.33	3.00	23.52
	IBA100ppm	3.43	14.54	50.00	2.66	23.90
	IBA200ppm	5.33	16.34	63.33	3.20	21.17
	IBA500ppm	7.70	19.96	53.33	4.43	26.73
	NAA100ppm	4.63	14.78	45.00	3.23	19.70
	NAA200ppn	3.16	12.41	40.00	3.16	20.24
	NAA500ppm	3.50	15.94	50.00	2.96	16.17
	Average	**4.69**	**15.317**	**50.332**	**3.043**	**21.826**
Season 2	Control	7.80	24.29	73.33	3.86	26.53
	IAA100ppm	5.86	21.42	51.67	3.30	22.21
	IAA200ppm	5.20	19.48	61.67	2.80	21.40
	IAA500ppm	4.50	24.42	66.67	3.20	26.00
	IBA100ppm	3.46	24.07	61.67	3.33	25.59
	IBA200ppm	6.13	25.28	56.67	4.23	27.68
	IBA500ppm	9.63	26.78	81.67	4.33	30.68
	NAA100ppm	4.23	22.30	51.67	3.50	22.82
	NAA200ppn	5.23	23.28	53.33	3.26	22.88
	NAA500ppm	5.00	22.81	61.67	3.46	23.84
	Average	**5.704**	**23.413**	**62.002**	**3.527**	**24.973**
Season 3	Control	5.13	21.34	50.00	2.73	17.04
	IAA100ppm	4.20	17.18	43.33	2.40	17.07
	IAA200ppm	3.43	14.38	51.67	2.90	15.38
	IAA500ppm	3.73	13.08	46.66	2.50	17.95
	IBA100ppm	3.66	18.61	46.67	2.70	20.40
	IBA200ppm	4.16	18.31	43.33	2.50	28.70
	IBA500ppm	7.20	21.74	60.00	3.20	19.69
	NAA100ppm	4,70	15.19	40.00	2.40	21.55
	NAA200ppn	3.53	13.18	50.00	3.20	19.25
	NAA500ppm	4.40	15.07	41.67	3.20	15.42
	Average	**4.414**	**16.808**	**47.333**	**2.773**	**19.245**
Significance		***	***	***	***	***
CD		0.867	1.595	6.886	0.517	2.195

*** - Significant at 0.01%, Season 1 - Spring season, Season 2 - Rainy season, Season 3 - Autumn season

Average maximum number of roots (5.70) was recorded in rainy season followed by spring season with average (4.69) numbers of roots per cutting however; average minimum (4.41) number of roots was noticed in autumn season. Maximum (9.63) number of roots per cutting were noticed in the cuttings treated with IBA 500 ppm in rainy season while, minimum (3.10) number of roots was observed in the cuttings treated with NAA 200 ppm treated cuttings. As regards season fourth (winter season) no rooting has been recorded.

Root length per cutting

Treatment had a significant effect in all seasons (0.01% level) on the mean root length (Table-2). Average maximum root length (23.41 cm) was recorded in rainy season followed by autumn season with average (16.80 cm) numbers of roots per cutting. Maximum (26.78 cm) root length was noticed in the cuttings treated with IBA 500 ppm in rainy season while, minimum (12.07 cm) were recorded in the cuttings treated with IAA 500 ppm in summer season.

Rooting percentage

From the analysis it was revealed that the treatments had a significant effect in all seasons (0.01% level) with the rooting (Table-2). Average maximum (62.00%) rooting was recorded in rainy season followed by spring season (50.33%). As regards treatment, maximum (81.67%) rooting were noticed in the cuttings treated with IBA 500 ppm in rainy season while, minimum (40.00%) rooting was observed in the cuttings treated with NAA 200 ppm in summer planted cuttings and NAA 100 ppm in autumn.

Mean number of sprouts per cutting

Treatment had a significant effect in all seasons ($P<0.001$) on the mean number of sprouts (Table 2). Average maximum number of sprouts (3.52) was recorded in rainy season followed by spring season with average (3.04) numbers of sprouts per cutting however, average minimum (2.77) were noticed in autumn season. Maximum (4.43) number of sprouts per cutting were noticed in cuttings treated with IBA 500 ppm in rainy season while, minimum (2.40) number of sprouts was observed in the cuttings treated with IAA 100 ppm and NAA 100 ppm in spring season.

Sprout length

Treatment had a significant effect in all seasons (0.1% level) on the mean sprout length (Table 2). Average maximum sprout length (24.97 cm) was recorded in rainy season followed by spring season with average (21.82 cm) numbers of roots per cutting however, average minimum (19.24 cm) were noticed in autumn season. Maximum (30.68 cm) sprout length was noticed in the cuttings treated with IBA 500 ppm in rainy season however, minimum (15.38 cm) sprout length was observed in the cuttings treated with IAA 200 ppm in spring season.

Discussions

The rooting of cuttings is influenced by many external and internal factors, which have been known for a long time and excellent reviews on this subject have appeared from time to time [4-6]. Of the external factors, season play an important role on adventitious rhizogensis. The seasonal changes and effect of their choice on rooting of stem cuttings have been reported

by many workers [7, 8]. The influence is probably due to changes in the temperature, light and humidity conditions, which prevail at the time of collection and planting of cuttings.

Effect of season or period of collection of cuttings on rooting frequency has been reported in various tree species. [9] Observed high rate of rooting from the branch cuttings of *Taxus baccata* collected during March-October, whereas in *F. religiosa*, March-July proved the best period for rooting. Winter (November-February) period proved ineffective in root induction from both the species. [10] reported that maximum rooting percentage in stem cuttings of *Azadirachta indica* and *Pongammia pinnata* was observed in the cuttings collected in the month of February and March respectively. In our study, maximum rooting percentage was achieved in the cuttings treated with IBA, which is also supported by the values reported by [11] in single node culm and culm branch cuttings of *B. nutans* and he observed that the cuttings treated with IBA and planted in the month of May gives best results for rooting. In *Bambusa vulgaris* var. striata [12] opined that cuttings of April and May months could be effectively utilized for large scale. However, [13] also reported that cuttings collected in February and April showed significantally maximum root induction and growth of adventitious roots in *B. bamboos* and *D. strictus* respectively. They observed that cuttings collected in December in *B. vulgaris* did not induce rooting, while as cuttings obtained during April to July in *D. strictus* exhibited steep declined rooting percentage and no root induction was observed from the cuttings collected during August to January. [14] Observed non significant difference in rooting from the single node cuttings collected during April, July and August in *D. hamiltonn*. Raveendran et al. [15] observed maximum 60 percent rooting response in culm cuttings of *Dendrocalamus giganteus,* and also observed that the summer season cuttings only gave rooting response while, the winter and rainy season cuttings sprouted in initial stages and failed to produce roots and eventually dried up.

Very little information is available regarding to rooting behavior of bamboo species with various seasons. However, the rooting performance in deciduous trees has been correlated to emergence of new sprouts after winter leaf fall. The reason for such behavior of trees is ascribed to mobilization of stored food material in the shoots together with the synthesis of auxin and other rooting co-factors in the new sprouts [16].The above studies clearly indicate that in *Bambusa vulgaris* rooting period coincides with the cessation of winter season and continues till the end of warm season. This possibility reveals that the rooting in bamboos is related to the resumption of active growth by rhizomes which are store houses of photosynthates and auxiliary substances. In turn, these substances become available to new culms and culm branches which also incidentally developed during March to September in most bamboos in India.

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