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Seasonal Change and Indole Butyric Acid (IBA) Effect on Survival and Branch Development in Culm Cuttings of *Bambusa balcooa* Roxb. and *Dendrocalamus stocksii* Munro

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted under nursery condition in agroforestry research farm, Nagpur (Maharashtra), India during year 2023-24 to investigate the impact of various concentrations of Indole-3-butyric acid (IBA) treatments on plant survival percentage and branch production during two distinct seasons, the rainy (S_1) and summer (S_2) periods. The experiment was consisting of 12

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treatment combinations based on two factors. Cuttings were treated with IBA 500 ppm, 1000 ppm, 1500 ppm, 2000 ppm and 2500 ppm. In the rainy season, survival rates ranged from 16.67% (control) to 80.00% (2500 ppm), with the highest survival at 2500 ppm in culm cuttings of B_2. The number of branches per plant varied from 0.67 to 2.67 across treatments. No significant interaction was observed between the factors for both survival and branching in this season. During the summer season, survival rates were higher, ranging from 59.00% (control) to 96.67% (2500 ppm). The number of branches also increased significantly, reaching up to 9.00 branches in the 2000 ppm treatment for culm cuttings of B_2. A significant interaction was noted for survival percentage between IBA concentration and branches in the summer season, while branching was not significantly affected by the interaction. Overall, the application of IBA, especially at higher concentrations, positively influenced survival and branching, with more pronounced effects in the summer season compared to the rainy season.

Keywords: Indole-3-butyric acid (IBA); bamboo survival; branch production; concentrations; rainy season; summer season; survival rate.

1. INTRODUCTION

Bamboo species are perennial woody grasses. These are significant multipurpose plants that develop quickly and produce a large amount of biomass. More than 1,250 species exist in higher temperatures or tropical climates, and they differ greatly in terms of structure and form. They also have substantially varied ecological circumstances (Banik, 1995). Vegetative propagation of bamboo involves using part of the parent plant to produce a new plant (Hamalton et al., 2022). Vegetative propagation of bamboos involves various procedures, most of which aim at transforming the innumerable buds present at every node into planting material (Banik, 1980). Among these procedures, propagation through adventitious rhizogenesis of culm/branch cuttings is a viable option having the advantage of obtaining enormous number of cuttings from a clump and low costs of transport, handling and labour (Dransfield & Widjaja, 1995).

The demand for bamboo has increased in recent years in several Asian countries as a raw material for furniture making, as panel boards in lieu of wood, as a vegetable, and for other uses apart from the traditional agriculture and construction-related uses. Plantation development has come to focus on high-demand bamboo species (Saad et al., 2016). Auxins, mainly IBA and NAA, have been employed with variable success in different types of bamboo cuttings e.g. *Bambusa vulgaris* (Uchimara, 1978). However, the different seasons of culm cuttings also behave differentially for growth of seedlings. Thus, we examined the influence of seasonal variation and indole-3- butyric acid (IBA) on survival and branch development in culm cuttings of *Bambusa balcooa* Roxb. and *Dendrocalamus stocksii* Munro. with the view of evolving efficient clonal multiplication procedures for both species.

2. MATERIALS AND METHODS

Two economically bamboo species of Maharashtra were selected for the investigation. Two years superior culms of bamboo were collected from healthy clumps of two different types of bamboo species using a sharp axe from Agroforestry research farm, Nagpur involving 12 treatment combination (2 different bamboo culm cuttings X 6 different concentrations of IBA) in Factorial RBD with 3 replications and 10 cuttings of each bamboo species were planted in each replication. Different bamboo species that were used in this experiment are as follows: *Bambusa balcooa* and *Dendrocalamus stocksii*. Collection was done in two seasons i.e. rainy (S_1) and summer (S_2) for IBA treatments of bi-nodal cuttings different concentrations i.e. 0 ppm (control), 500 ppm, 1000 ppm, 1500 ppm, 2000 ppm and 2500 ppm, solution was prepared. Round shaped hole was made in between the culms using an electrical driller so that IBA hormone solution can be filled inside. In order to plant the bi-nodal culms appropriate solution of IBA (20-25 ml) was poured inside the prepared hole and it was covered with a fresh soil so that the complete circumference of the hole can be covered. A light irrigation was given just after planting with drip irrigation. The entire beds were subjected to watering everyday with exception to extreme hot weather and shower. During extreme hot days irrigation was double and during rainy days it was skipped. The observations were recorded at 90 days after planting (DAP).

3. RESULTS AND DISCUSSION

3.1 Survival Percentage

3.1.1 Interaction (season X culm cuttings X IBA)

3.1.1.1 Season I: Rainy

The data regarding survival percentage as influenced by different concentrations of IBA doses and species was recorded at 90 days after planting in *bambusa balcooa* and *Dendrocalamus stocksii* and presented in Table 1. The sprouting percentage varied from 16.67 (T_1B_1) to 80.00 (T_6B_2). The treatment combination of (T_6B_2) gave significantly highest survival percentage of 80.00 in bamboo cuttings of *D. stocksii* treated with 2500 ppm IBA.

The interaction effect of different concentrations of IBA doses and species were found non-significant in respect of survival percentage. Similar findings were also reported by Pattanaik et al. (2004); Othman (2005); Hossain et al. (2006); Islam et al. (2011) and Ilorkar et al. (2021).

3.1.1.2 Season II: Summer

Data pertaining to interaction effect between application of different concentrations of IBA and species on survival percentage is given in Table 1. There was a significant difference between application of different concentrations of IBA and species on survival percentage. The sprouting percentage varied from 59.00 (T_1B_1) to 96.67 (T_6B_2). The treatment combination of (T_6B_2) gave significantly highest survival percentage of 96.67 in bamboo cuttings of *D. stocksii* treated with 2500 ppm IBA.

The interaction effect of different concentrations of IBA doses and species were found significant in respect of survival percentage. The survival rate of IBA treated plantlets was higher in comparison to control. Kaushal et al. (2011) explained that the application of IBA greatly increased the seedling survival percentage. Similar result was reported by Kalanzi et al. (2023).

Table 1. Seasonal change and IBA effect on survival percentage in culm cuttings of *Bambusa balcooa* and *Dendrocalamus stocksii* (90 days after planting)

Variables	**Characteristics**			
		Survival (%)		
	A	**B_1**	**B_2**	**Mean**
Season	**Factor A (IBA Concentrations)**			
S_1 Rainy	T_1 : Control	16.67	23.33	20.00
	T_2 (500 ppm)	23.33	26.67	25.00
	T_3 (1000 ppm)	30.00	23.33	26.67
	T_4(1500 ppm)	36.67	46.67	41.67
	T_5 (2000 ppm)	43.33	43.33	43.33
	T_6 (2500 ppm)	43.33	80.00	61.67
	Avg.	**32.22**	**40.56**	**36.39**
	Interaction (A X B)			
	F test	**NS**		
	SE±	**6.74**		
	CD=(P=0.05)	**-**		
S_2 Summer	T_1 (Control)	59.00	72.00	65.50
	T_2 (500 ppm)	64.00	84.67	74.33
	T_3 (1000 ppm)	66.33	88.67	77.50
	T_4(1500 ppm)	75.00	93.00	84.00
	T_5 (2000 ppm)	77.00	94.00	85.50
	T_6 (2500 ppm)	81.00	96.67	88.83
	Avg.	**70.39**	**88.17**	**79.28**
	Interaction (A X B)			
	F test	**S**		
	SE±	**1.22**		
	CD=(P=0.05)	**3.58**		

Notes: B_1 Bambusa balcooa cuttings; B_2 Dendrocalamus stocksii culm cuttings

Table 2. Seasonal change and IBA effect on branch development in culm cuttings of *Bambusa balcooa* and *Dendrocalamus stocksii* (90 days after planting)

Variables	Characteristics			
	Number of branches per plant			
	A	**B_1**	**B_2**	**Mean**
Season	**Factor A (IBA Concentrations)**			
S_1 Rainy	T_1 : Control	0.67	1.67	1.17
	T_2 (500 ppm)	1.67	1.33	1.50
	T_3 (1000 ppm)	2.33	2.33	2.33
	T_4(1500 ppm)	1.33	2.00	1.67
	T_5 (2000 ppm)	2.67	2.33	2.50
	T_6 (2500 ppm)	1.33	2.67	2.00
	Avg.	**1.67**	**2.06**	**1.86**
	Interaction (AXB)			
	F test	**NS**		
	SE±	**0.31**		
	CD=(P=0.05)	-		
S_2 Summer	T_1 (Control)	1.33	6.00	3.67
	T_2 (500 ppm)	2.00	6.67	4.33
	T_3 (1000 ppm)	2.67	7.00	4.83
	T_4(1500 ppm)	3.00	7.67	5.33
	T_5 (2000 ppm)	3.33	9.00	6.17
	T_6 (2500 ppm)	3.67	8.00	5.83
	Avg.	**2.67**	**7.39**	**5.03**
	Interaction (A X B)			
	F test	**NS**		
	SE±	**0.34**		
	CD=(P=0.05)	-		

Notes: B_1 Bambusa balcooa cuttings; B_2 Dendrocalamus stocksii culm cuttings

3.2 Development of Branches

3.2.1 Interaction (season X culm cuttings X IBA)

3.2.1.1 Season I: Rainy

Data regarding number of branches as influenced by species are presented in Table 2 and showed the significant differences among the various growth regulators in both bamboo species. The number of branches per plant varied from 0.67 (T_1B_1) to 2.67 (T_6B_2). The treatment combination of (T_6B_2) gave significantly highest number of branches per plant of 2.67 in bamboo cuttings of *D. stocksii* treated with 2500 ppm IBA.

The interaction effect of different concentrations of IBA doses and species were found non-significant in respect of number of branches. The results confirm with the findings reported by Pandey et al. (2011).

3.2.1.2 Season II: Summer

Data regarding number of branches as influenced by species are presented in Table 2. Number of branches increased progressively with the advancement of culm cuttings age and there was marked increase as the culm cuttings proceeded towards physiological growth during summer season. The number of branches per plant varied from 1.33 (T_1B_1) to 9.00 (T_5B_2). The treatment combination of (T_5B_2) gave significantly highest number of branches per plant of 9.00 in bamboo cuttings of *D. stocksii* treated with 2000 ppm IBA.

The interaction effect of different concentrations of IBA doses and species were found non-significant in respect of number of branches. Similar findings are also reported by Ilorkar et al. (2023) in *Bambusa balcooa.*

4. CONCLUSION

The experiment demonstrates that the application of Indole-3-butyric acid (IBA) significantly improves plant survival and branch production, particularly at higher concentrations. Survival rates and branch numbers were notably higher during the summer season compared to the rainy season. The optimal concentration of

IBA was 2500 ppm, which resulted in the highest survival rate in both seasons. Additionally, a significant interaction between IBA concentration and survival was observed during the summer season, while no such interaction was found for branching. Overall, these findings highlight the beneficial effects of IBA treatments, particularly at higher concentrations, in improving plant resilience and growth across different seasons.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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