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Research article

Macropropagation of *Bambusa jaintiana* R.B. Majumdar

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Abstract: *Bambusa jaintiana* one of the species known for long internode of north east India was investigated for propagation through culm cutting at the Institute of Forest Productivity, Ranchi during March 2018 to June-2022. Four year-old culms of *Bambusa jaintiana* R.B. Majumdar were selected for investigation. Double node bamboo culm cuttings were sterilized with the Bavistin after that administered with different concentration of plant growth regulators and implanted horizontally in sand bad. The results exhibited the highest percentage of cuttings sprouted (96.29%) and the percentage of rooting (92.58%). The synergistic effect of 500 ppm NAA + 1000 ppm IBA was recorded with maximum rooting and associated parameters. The hardened plants transplanted in the field showed 96% survival irrespective of treatments. This procedure can be utilized for mass-scale production along with a higher rate of survival of *B. jaintiana* introduced first time in eastern India and possesses high potential for incense stick industry and manufacturing of other handicrafts.

Keywords: Bamboo propagation - Plant growth regulators - Tropical moist deciduous forests - Double node cuttings.

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INTRODUCTION

Bambusa jaintiana R.B. Majumdar is the species with long internode *i.e.*, 27 inches, (Fig. 1A) without hollowness (solid) and its growth pattern is very much similar to *Bambusa tulda* Roxb. except culm diameter which we recorded upto 2.5 cm. The species is, however, highly suited to the production of various value-added products, including incense sticks, kites, and other bamboo species, such as *Bambusa polymorpha* Munro, *Cephalostachyum pergracile* Munro [*Schizostachyum pergracile* (Munro) R.B. Majumdar], and *Schizostachyum dullooa* (Gamble) R.B. Majumdar [*Teinostachyum dullooa* Gamble], which have longer internodes and can therefore be used to make larger kites (Bhattacharya 2014).

Insect repellent, spiritual purposes, religious rites, and aromatherapy all involve burning agarbatti (Hyams & Cushner 2004). Incense sticks are utilised for a variety of religious rituals, including air purification, atmospheric filling, and the removal of negative energy from our immediate surrounds (Jetter *et al*. 2002). The largest cottage industry in the world, the *agarbatti* sector in India is expanding, with a market of Rs. 2000 crores annually, mostly from rural India's cottage level (Balasubramanyam 2013). India is the second largest producer of bamboos and a significant portion of the agarbatti sector imports 70% of its bamboo needs. Despite availability of a large number of species of bamboo, *viz*., *Bambusa vulgaris* green Schrad. *ex* J.C. Wendl., *Bambusa balcooa* Roxb., *Dendrocalamus longispathus* Kurz. etc., the most commonly used species for stick production in Jharkhand is *Bambusa tulda* Roxb. because of long internode. The constant supply of *Bambusa tulda* Roxb. shoots for stick production is the major problem and most of the stick industries in Jharkhand have stopped production of incense stick due to acute shortage of raw materials. The less supply of *Bambusa tulda* as raw materials coupled with scarce of planting materials for plantation make the situation precarious.

In this situation *Bambusa jaintiana* R.B. Majumdar can serve as an important alternate species with on par intermodal length like *Bambusa tulda*, which can supplement the huge requirement of *B tulda*. The present study demonstrates a simple macropropagation method reporting optimum rooting success and field demonstration of *Bambusa jaintiana* R.B. Majumdar for the first time.

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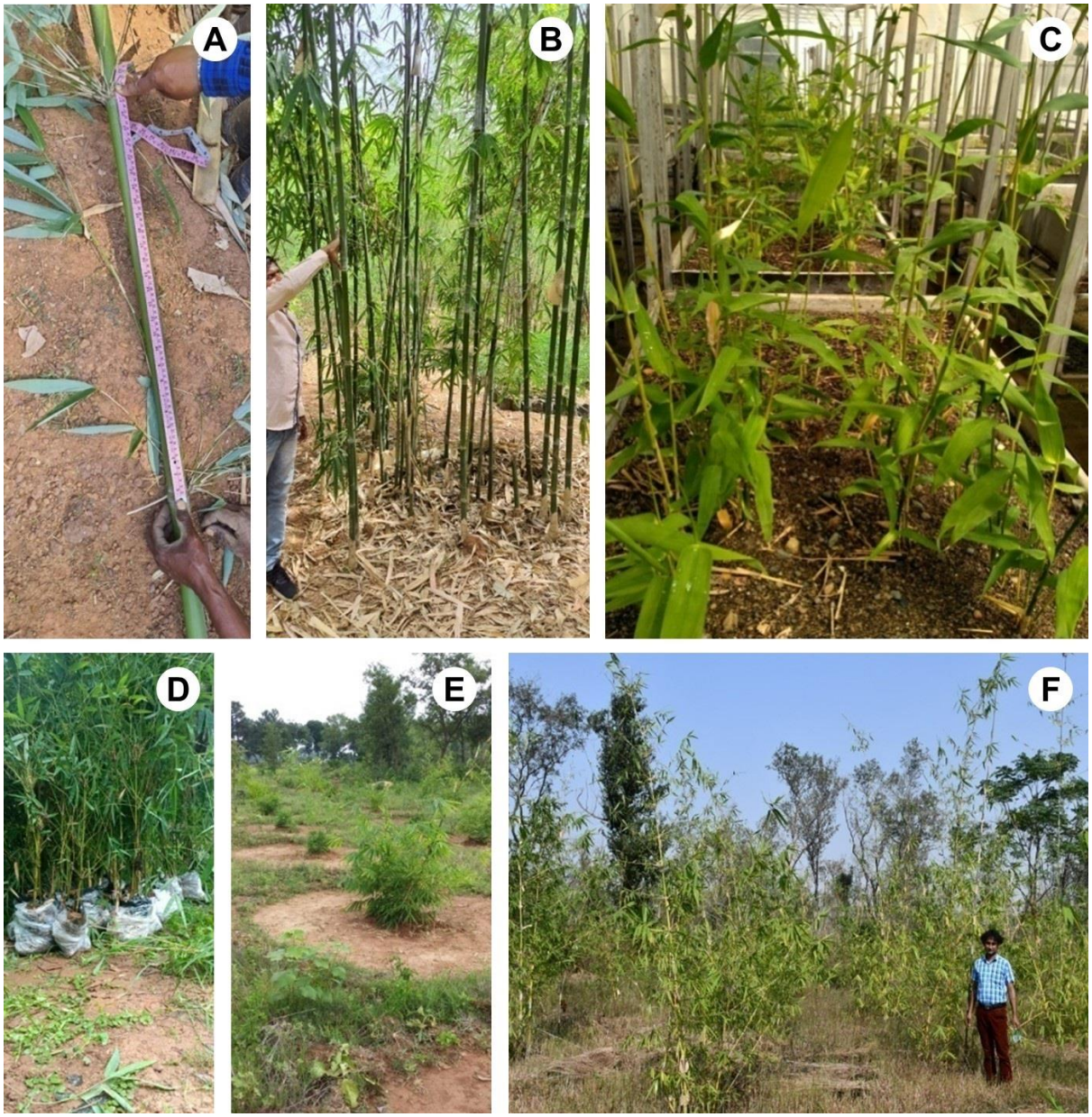

Figure 1. Macropropagation of *Bambusa jaintiana* R.B. Majumdar: **A**, Propagation thrugh node cuttings approx 27 inches length of internode; **B**, Three years old clump of *B. jaintiana* assembled in the germplasm bank of the institute; **C**, Implanting cuttings under shadehouse condition; **D**, Transfer of plants in polypots; **E** & **F**, Field transplantation of plants after 3 months and 24 months.

MATERIALS AND METHODS

The present investigation was conducted at the Institute of Forest Productivity, Ranchi which is situated at an altitude of about 651 meters above mean sea level, *23° 20' 39.53'' N and 85° 17' 45.64'' E* from March 2018 to June 2022. The rhizome of *Bambusa jaintiana* was collected from Chalsa village of Jalpaigudi (26°52.81'88.53" N and 88°46.8' 45.64" E) and assembled in the germplasm bank in 2014 as part of the All India Bamboo Genetic Improvement Programme, which was funded by the Indian Council of Forestry Research and Education (ICFRE) Dehradun, India, and the Bamboo Technology Support Group (BTSG). The present investigation of cultivation of the species was conducted under All India Coordinated Research Project (AICRP-Bamboo).

The node culm cuttings were collected from three year old culms of *Bambusa jaintiana* R.B. Majumdar assembled in the germplasm bank of the institute (Fig. 1B). The culm cuttings of current year were collected and surface sterilized with the Bavistin (0.01% i.e., Carbendazim, a broad-spectrum systemic fungicide to prevent the attack of fungi) for 45 minutes and after that administered with different concentration of plant growth regulators. In the present investigation, two sources of auxins *viz*., NAA, IBA were tested alone or in combinations with 500, 1000 and 1500 ppm. Treatment consists of T1 (NAA 0 + IBA 0 Control), T2 (NAA 500

ppm + IBA 0), T3 (NAA 1000 ppm + IBA 0), T4 (NAA 1500 ppm + IBA 0), T5 (NAA 0 + IBA 500 ppm), T6 (NAA 500 ppm + IBA 500 ppm), T7 (NAA 1000 ppm + IBA 500 ppm), T8 (NAA 1500 ppm + IBA 500 ppm), T9 (NAA 0 + IBA 1000 ppm), T10 (NAA 500 ppm + IBA 1000 ppm), T11 (NAA 1000 ppm + IBA 1000 ppm), T12 (NAA 1500 ppm + IBA 1000 ppm), T13 (NAA 0 + IBA 1500 ppm), T14 (NAA 500 ppm + IBA 1500 ppm) and T15 (NAA 1000 ppm + IBA 1500 ppm) with 3 replications. Fifteen culm cuttings of each treatment under each replication were planted horizontally in the sand bed in shadehouse condition under 35% relative humidity (Fig. 1C). Observations recorded under experiment were, percentage of cuttings sprouted, percentage of rooting, at the end of experiment (after 3 months) and survival percentage after transplanting in polybags (after 6 months). The observations were recorded and analyzed with Complete Randomized Designed (CRD) as prescribed by Panse & Sukhatme (1967). The rooted plants were separated from their source with the help of sharp knife and transferred to polythene bags (10 x 15 cm) filled with sand, soil and farmyard manure (FYM) (1:1:1; v/v/v) for acclimatization and the tillered plants (Fig. 1D) were subjected to macroproliferation.

Survival in polythene bags, out planting and field survival

Twelve culm cuttings of each treatment under each repetition were planted in the polythene bags containing sand, soil and Farm Yard Manure (FYM) 3:3:3 ratio and survival percentage was recorded after 3 months.

The plantation was carried out in July 2020. The plants of each treatment were planted in three blocks (replications) and each block comprised nine plants of treatment at 3m x 3m spacing. Therefore, the trial had a total of 432 plants in the randomized block design. The data on the number of tillers and field survival was finally assessed in July 2022 after the completion of two years of plantation.

RESULTS AND DISCUSSION

Rooting and associated Growth parameters

Table 1. Effect of hormonal combinations in rooting parameters of *Bambusa jaintiana* R.B.Majumdar

Treatment	**Sprouting%**		**Rooting %**		**Length of shoots (cm)**	
(Doses in ppm)	**Mean**	**S.E.**	**Mean**	**S.E.**	**Mean**	**S.E.**
T1 (NAA 0 + IBA 0 Control)	25.92 (30.49)	2.37	14.81 (22.34)	2.88	19.27	2.24
T2 (NAA 500 + IBA 0)	25.92 (30.49)	2.37	22.22 (27.60)	4.56	15.66	2.12
T3 (NAA 1000 + IBA 0)	48.14 (43.91)	5.71	37.033 (37.23)	4.55	28.67	3.39
T4 (NAA 1500 + IBA 0)	66.66 (54.90)	3.94	59.25 (50.40)	4.30	26.77	3.94
T5 (NAA 0 + IBA 500)	37.03 (37.23)	4.55	22.22 (27.60)	4.56	21.42	3.45
T6 (NAA 500 + IBA 500)	74.06 (60.16)	6.49	74.06 (59.97)	5.26	34.45	4.23
T7 (NAA 1000 + IBA 500)	62.95 (52.78)	5.86	51.84 (46.04)	5.71	29.82	4.21
T8 (NAA 1500 + IBA 500)	85.17 (67.61)	2.88	66.66 (54.90)	3.94	32.55	2.76
T9 (NAA 0 + IBA 1000)	48.14 (43.91)	2.12	33.33 (35.05)	3.95	32.34	2.07
T10 (NAA 500 + IBA 1000)	96.29 (83.49)	6.50	92.58 (76.99)	6.50	35.72	4.52
T11 (NAA 1000 + IBA 1000)	48.14 (43.91)	2.12	33.33 (35.05)	3.95	32.00	2.02
T12 (NAA 1500 + IBA 1000)	25.92 (30.49)	2.37	18.51 (25.22)	2.88	19.89	2.13
T13 (NAA 0 + IBA 1500)	25.92 (30.49)	2.37	18.51 (25.22)	2.88	12.32	2.12
T14 (NAA 500 + IBA 1500)	85.17 (67.61)	2.88	74.06 (59.97)	5.26	33.33	2.67
T15 (NAA 1000 + IBA 1500)	44.44 (41.73)	3.72	37.03 (37.42)	2.18	311.29	2.98
T16 (NAA 1500 + IBA 1500)	25.92 (30.49)	2.37	22.22 (28.11)	0	19.89	2.11
C.D.	11.57		12.27		4.46	
SE(m)	3.99		4.24		2.33	
SE(d)	5.65		5.99		3.22	
C.V.	14.78		18.10		7.56	

The recorded pooled data depicted in table 1 pertaining to growth parameters revealed that the highest percentage of cuttings sprouted (96.29 %), maximum length of sprout (35.72 cm) at the end of experiment were recorded in the combination with the low concentration of NAA and high concentration of IBA i.e. treatment T10 - NAA500 ppm + IBA 1000 ppm while minimum or lowest values were recorded in T1: Control for these two parameters (25.92 % and 12.32 cm, respectively). T10 was recorded with significantly highest sprouting and shoot length as compared to other treatments followed by T8 (NAA 1500 ppm + IBA 500 ppm) which recorded with 85.19% sprouting and 34.45 cm shoot length. Similarly, highest rooting *i.e*, 92.58% was recorded in treatment T10 which significantly higher and invariably found as the best among all other combinations and the response was 77% higher than the control. Whereas on par rooting response was observed in T6 (74.06%) and T8 (66.66%) which were ranked next to T10. The sprouted cuttings were produced mostly a single shoots,

therefore we recorded only length of the shoots and statistically a non significant difference was observed in the treatment of T6, T8, T9, T10, T1, T14 and T15. Due to changes in morphological characteristics, endogenous amounts of stored photosynthates, and axillary compounds, different bamboo species generally responded differently. These outcomes closely align with the previous research findings of Saharia & Sen (1990). Earlier studies have demonstrated that the external application of several growth regulators, particularly auxins, positively affects the induction and growth of bamboo culm cuttings (Agnihotri & Ansari, 2000; Singh et al., 2002). Auxins can be applied exogenously if endogenous levels are low, for instance, because of a dormant development period or decreased accumulation in distant plant sections. Similar patterns of results were previously documented for *Teinostachyum dullooa* Gamble and *Bambusa pallida* Munro by Nath *et al.* (1986).

Survival in polythene bags, out planting and field survival

Table 2. Effect of plant growth regulators on survival percentage after transplantation in polythene bags and in field condition of *Bambusa jaintiana* R.B. Majumdar

Treatment	Survival in poly bags (%)		Survival in the field condition (%)	
	Mean	S.E.	Mean	S.E.
T1 (NAA 0 + IBA 0 Control)	12.32 (10.34)	1.31	89.65 (22.34)	2.85
T2 (NAA 500 + IBA 0)	13.75 (31.72)	1.23	95.86 (27.60)	3.45
T3 (NAA 1000 + IBA 0)	38.21 (23.89)	2.21	93.32 (37.23)	4.21
T4 (NAA 1500 + IBA 0)	46.32 (34.32)	2.83	95.54 (50.40)	3.99
T5 (NAA 0 + IBA 500)	23.04 (19.86)	3.43	92.22 (27.60)	4.21
T6 (NAA 500 + IBA 500)	42.87 (51.55)	5.42	98.89 (59.97)	4.56
T7 (NAA 1000 + IBA 500)	51.61 (39.21)	4.32	95.55 (46.04)	4.89
T8 (NAA 1500 + IBA 500)	61.21 (50.21)	1.54	97.67 (54.90)	3.92
T9 (NAA 0 + IBA 1000)	31.09 (23.34)	1.76	96.33 (35.05)	3.94
T10 (NAA 500 + IBA 1000)	86.94 (72.21)	5.32	99.88 (76.99)	5.32
T11 (NAA 1000 + IBA 1000)	39.32 (29.92)	1.32	95.33 (35.05)	3.25
T12 (NAA 1500 + IBA 1000)	23.92 (18.92)	1.37	98.58 (25.22)	2.21
T13 (NAA 0 + IBA 1500)	19.89 (9.81)	1.09	96.59 (25.22)	2.96
T14 (NAA 500 + IBA 1500)	73.32 (62.43)	1.32	96.66 (59.97)	5.12
T15 (NAA 1000 + IBA 1500)	34.54 (29.92)	2.02	93.78 (37.42)	2.43
T16 (NAA 1500 + IBA 1500)	17,76 (9.89)	1.90	85.65 (28.11)	2.32
C.D.	9.43		10.23	
SE(m)	2.82		3.22	
SE(d)	4.32		4.53	
C.V.	12.21		18.10	

From the perusal of data in table 2 it is apparent that maximum percentage of plants survived after transplanting in poly bags (86.94 %) was recorded in treatment combination of T10: NAA-500 ppm + IBA-1000 ppm which was significantly different from other treatments and followed by T14. While the lowest survival percentage (12.32%) was recorded in T1: Control. More than 90% survival of the plants was reported (Table 2) in most of the treatments except T1 and T16 which recorded with 89.65% and 85.65% survival, respectively.

The survival of the plants in the field condition was reported with more than 96% after 3 months (Fig. 1E) and the formation of tiller in field transferred plants was reported with an average number of 4-5 tillers irrespective of treatments after 24 months of field transfer (Fig 1. F), therefore data was not presented.

CONCLUSION

To our knowledge this is the first study which reports a simple method of propagation of *Bambusa jaintiana en masse* employing a judicious dose of hormones and its field survival. The treatment combination of high concentration of NAA and low concentration of IBA i.e., T5: NAA-500 ppm + IBA-200 ppm can be used for propagation of this long internode bamboo species through culm cutting method to mitigate the shortage of long internode bamboo suitable for incense sticks, kite industry, flute making industry and other handicrafts.

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