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Influence of rooting hormone on macropropagation of *Schizostachyum pergracile* (Munro.) through culm cutting

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Abstract
The present investigation entitled "Macro Propagation of long internode *Schizostachyum pergracile* (Munro.)" was laid out at Bamboo Nursery, College of Forestry, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during March-2015 to June-2017. Culms of Three year old bamboo culms of *S. pergracile* (Munro.) was selected for investigation. Three noded bamboo culm cuttings were sterilized with the fungicide after that administered with different concentration of Plant Growth Regulators (auxins). The results revealed the highest percentage of cuttings sprouted (77.16 %), percentage of cuttings rooted (69.75 %), number of leaves per plant (61.17), number of roots (30.72), length of root (24.67 cm), days taken for initiation for first sprouting (13.28 days), length of sprouts (101.34 cm) and percentage of plants survived after transplanting (69.17 %) were recorded in combination of treatment NAA 200 ppm + IBA 500 ppm which was followed by NAA 200ppm, while minimum or lowest values were recorded in T_1: Control for first two parameters are (4.53 % and 19.77, respectively). Hence, it can be concluded that the NAA 200 ppm + IBA 500 ppm can be used for large scale production along with higher rate of survival of long internode bamboo *S. pergracile* due to its high demand in kite industry, paper-pulp industry and other handicrafts.

Keywords: *S. pergracile,* Macro Propagation, Plant Growth Regulators, Long internode, Auxins

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 belonging to Poaceae family. There are about 88 genera and 1400 species of bamboos distributed worldwide covering an area of more than 14 million hectares with 80% of species and area under bamboos confined to south and south-east Asia, largely in China, India and Myanmar (Wu and Raven, 2006) [15]. Bamboos form the backbone of the rural economy of many south-east Asian countries including India sustaining the livelihood of millions of people and are often referred to as "poor man's timber" (Yeasmin *et al*. 2014) [14]. India is rich in bamboo genetic resource having 125 indigenous and 10 exotic species spread over an area of 8.96 million hectares which constitutes 12.8% of total forest area (Anonymous, 2003 and Rathore *et al*. 2009) [2, 10]. North-eastern states are rich in bamboo bio-resources and represent about 66% of growing stock of bamboo in the country (Rai and Chauhan, 1998) [9]. India is a well-known for kite festival especially in Gujarat state. The species recommended by Scientist T. C. Bhuyan are *Bambusa polymorpha*, *Cephalostachyum pergracile* (*Schizostachyum pergracile*) and *Teinostachyum dullooa* (*Schizostachyum dullooa*) because they have longer internodes and therefore could be used to make larger kites (Bhattacharya, 2014) [3]. Among them above mentioned long internode bamboo species *Schizostachyum pergracile* (Munro.) has been selected for its wide utility in construction, mat, basketry industry, pulp industry and also high demand in kite industry.

Materials and Methods
The present investigation entitled "Macro Propagation of long internode *Schizostachyum pergracile* (Munro.) R. B. Majumdar" was conducted during March - 2015 to June - 2017, at the Bamboo nursery, College of Forestry, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India which is situated at an altitude of about 12 meters above mean sea level, 200–58' North latitude and 720–54' East longitude. Experimental material (Rhizome) were brought from (RFRI, Jorhat, Assam), (KFRI, Kerala) and Bambusetum, Silva Division Forest Department, Rajpipla, Gujarat. Three years old plants of *S. pergracile* raised in Bambusetum of ASPEE College of Horticulture and Forestry was

selected for the present investigation. In the present investigation, effect of forms of Auxins NAA, IBA, Boric acid and Coumarin and combination of both on the performance of culm cuttings of *S. pergracile* was studied. Treatment consists of T_1: Control, T_2: NAA-200 ppm, T_3: NAA-500 ppm, T_4: NAA-200 ppm + IBA-500 ppm, T_5: NAA-500 ppm+ IBA-200 ppm, T_6: IBA-200 ppm, T_7: IBA-500 ppm, T_8: Boric acid 200 ppm, T_9: Coumarin 200 ppm, T_{10}: Coumarin 200 ppm + IBA 200 ppm and T_{11}: Coumarin 200 ppm + IBA 200 ppm + NAA-200 ppm with 3 repetition. Nine culm cuttings of each treatment under each repetition were planted in the planting media under sand, soil and vermicompost in 2:1:1 ratio. Observations were recorded under experiment are percentage of cutting sprouted (%), percentage of cutting rooted (%), number of leaves per plant, number of roots at the end of experiment (cm), length of roots (cm), days taken for initiation of first sprouting, length of sprout at the end of experiment (cm), survival percentage after transplanting in polybags (%) and survival percentage after transplanting in field (%). The recorded observations were analyzed with CRD (Panse and Sukhatme, 1967).

Results and Discussion

Growth Parameters

The recorded results depicted in Table 1 pertaining to growth parameters revealed that the highest percentage of cuttings sprouted (77.16 %), maximum length of sprout at the end of experiment (101.34 cm), minimum days taken for initiation first sprouting (13.28) and number of leaves per plant (61.17) were recorded in treatment combination of T_4: NAA-200 ppm + IBA-500 ppm while minimum or lowest values were recorded in T_1: Control for first two parameters are (4.53 % and 19.77, respectively). whereas, minimum number of leaves (10.83) and maximum days required for initiation for sprouting (34.94 days) were recorded in T_{11}: Coumarin 200 ppm + IBA 200 ppm + NAA-200 ppm and T_9: Coumarin 200 ppm, respectively. The data depicted in Tables –1 clearly revealed that combination of low concentration of NAA + high concentration of IBA and NAA alone were found to be more effective than IBA, Boric acid, Coumarin and Coumarin combination in different concentration in *S. pergracile*. The treatment T_4 (NAA 200 ppm + IBA 500 ppm) recorded significantly maximum percentage of sprouting, sprout length, number of leaves per plant and at the end of experiment as well as earlier sprouting in *S. pergracile.* The next best treatment in order to response in all growth parameters are T_2 (NAA 200 ppm). Variable response among various bamboo species generally resulted due to the differences in morphological features and endogenous levels of stored photosynthates and axillary substances. These results are in close proximity with the earlier findings of Saharia and Sen (1990) [11]. The exogenous application of various growth regulators, mostly auxins, has been reported to positively influence on induction and growth in culm cuttings of bamboos (Agnihotri and Ansari, 2000 and Singh *et al.* 2002) [1]. Exogenous application of auxins becomes effective if their endogenous level is low for example due to inactive growth phase or less accumulation in distal plant parts. Similar trends of results were earlier reported by Nath *et al.* (1986) [5] in *Bambusa pallida* and *Teinostachyum dullooa*.

Root Parameters

It is evident from the Table 2 pertaining to root parameters highest percentage of cuttings rooted (69.75 %), number of roots at the end of experiment (30.72) and length of root (24.67 cm) were recorded in the treatment combination of T_4: NAA-200 ppm + IBA-500 ppm. While, minimum rooting percentage, lowest number of roots and smallest root length were recorded in T_1: Control for all parameters (3.29 %, 1.44 and 5.05 cm, respectively). The second best treatment found for all root parameters is T_2 (NAA 200 ppm). Variable response in percentage of cuttings rooted might be due to different genetic makeup of *S. pergracile*. Moreover, these variations are also due to varied endogenous natural auxins in different species of bamboo. Similar result was earlier reported by Saharia and Sen (1990) [11]. The variation in rooting ability observed due to tried auxins and their combinations may be attributed to species ability of signal reorganization and its amplification which depends on genetic makeup of the species. These results are in close proximity with the earlier findings of Seethalakshmi *et al.* (1983) [12], Nain *et al.* (2007) [4] in *B. tulda* and *B. vulgaris,* Rana *et al.* (1987) [8] in *Dalbergia sissoo* and Nautiyal (1991) [6] in *Tectona grandis*.

Survival Percentage after Transplanting in Bag

As per the obtained result depicted in Table 3 pertaining to percentage of plants survived after transplanting in bag was highest value (69.17%) was recorded in treatment combination of T_4: NAA-200 ppm + IBA-500 ppm which was followed by T_2 (NAA 200 ppm). while lowest survival percentage (4.32 %) was recorded in T_1: Control.

Table 1: Effect of Plant Growth Regulators on growth parameters of *Schizostachyum pergracile* (Munro.) R. B. Majumdar

Treatments	1	2	3	4
	PCS (%)	**NLP**	**DTIFS**	**LS (cm)**
T_1	4.53	20.50	30.50	19.77
T_2	71.60	53.17	15.83	90.68
T_3	66.85	50.17	19.83	80.61
T_4	77.16	61.17	13.28	101.34
T_5	56.17	39.83	22.50	66.48
T_6	35.19	34.17	27.83	54.18
T_7	45.99	34.50	23.94	59.90
T_8	59.26	40.67	16.11	80.40
T_9	10.49	20.83	34.94	30.20
T_{10}	16.97	23.83	25.28	43.13
T_{11}	7.41	10.83	27.50	35.19
SEM (T)	1.48	1.21	0.77	1.26
CD(T)	4.36	3.56	2.25	3.69
SEM (Y XT)	2.09	1.71	1.08	1.78
CD (Y X T)	NS	NS	NS	NS
CV	8.83	8.38	8.00	5.11

Table 2: Effect of Plant Growth Regulators on root parameters of *Schizostachyum pergracile* (Munro.) R. B. Majumdar

Treatments	5	6	7
	PCR (%)	**NR**	**LR (cm)**
T_1	3.29	1.44	5.05
T_2	63.58	19.56	21.77
T_3	58.64	16.89	21.11
T_4	69.75	30.72	24.67
T_5	51.54	11.39	17.67
T_6	31.79	6.39	13.67
T_7	42.90	9.50	15.20
T_8	57.10	13.39	17.83
T_9	8.02	4.28	7.57
T_{10}	19.14	2.94	10.57
T_{11}	4.94	1.72	8.27
SEM (T)	1.45	0.36	0.59
CD(T)	4.26	1.05	1.74
SEM (Y XT)	2.05	0.50	0.84
CD (Y X T)	NS	NS	NS
CV	9.51	8.13	9.76

Table 3: Effect of Plant Growth Regulators on Survival Percentage after Transplanting in Bag of *Schizostachyum pergracile* (Munro.) R. B. Majumdar

Treatments	8
	PSAT (%)
T_1	4.32
T_2	60.80
T_3	57.10
T_4	69.17
T_5	51.23
T_6	33.52
T_7	43.21
T_8	53.71
T_9	4.94
T_{10}	14.51
T_{11}	5.76
SEM (T)	1.46
CD(T)	4.29
SEM (Y XT)	2.06
CD (Y X T)	NS
CV	9.86

1. PCS (%) : Percentage of cuttings sprouted
2. NLP : Number of leaves per plant
3. DTIFS : Days taken for initiation first sprouting
4. LS (cm) : Length of sprout at the end of experiment
5. PSAT (%) : Percentage of plants survived after transplanting
6. PCR (%) : Percentage of cuttings rooted
7. NR : Number of roots at the end of experiment
8. LR (cm) : Length of root (cm)

T1 : Control
T2 : NAA-200 ppm
T3 : NAA-500 ppm
T4 : NAA-200 ppm+ IBA-500 ppm
T5 : NAA-500 ppm+ IBA-200 ppm
T6 : IBA-200 ppm
T7 : IBA-500 ppm
T8 : Boric acid 200 ppm
T9 : Coumarin 200 ppm
T10 : Coumarin-200 ppm + IBA 200 ppm
T11 : Coumarin-200 ppm + IBA 200 ppm+NAA-200 ppm

Conclusion

From the above depicted experimental results and discussion in the above section it is concluded that the maximum values were recorded with respect to growth and root parameters *viz.* percentage of cuttings sprouted, percentage of plants survived after transplanting, maximum length of sprout at the end of experiment, minimum days taken for initiation first sprouting, number of leaves per plant, percentage of cuttings rooted, number of roots at the end of experiment and length of root (cm) in T_4: NAA-200 ppm + IBA-500 ppm. Whereas, T_2: NAA-200 ppm was found second best treatment for all growth and root parameters during present investigation. Hence, it is concluded that the treatment combination of low concentration of NAA and high concentration of IBA i.e T_4: NAA-200 ppm + IBA-500 ppm can be used for mass propagation of long internode bamboo *S. pergracile* through culm cutting method to mitigate high demand of long internode bamboo in kite industry.

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