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Efficacy of Growth Regulators on Sprouting of Bush Pepper Cuttings (*Piper nigrum* L.)

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ABSTRACT

Bush pepper propagation through cuttings often faces challenges in sprouting and growth, necessitating effective use of growth regulators to enhance establishment and productivity. Hence, the present study was carried out in Sirumalai, located in the Dindigul district of Tamil Nadu, over the period 2020-2022. The experimental setup followed a Completely Randomized Design (CRD), comprising 12 distinct treatments with three replications each. The findings indicated that treating with Indole-3-Butyric Acid (IBA) at 1000 ppm notably improved the shoot growth characteristics. Specifically, it reduced the time required for sprouting (18.89 days), increased the sprouting percentage (78.64%) and improved the leaf area (104.03 cm²) at 180 days after planting (DAP). Furthermore, it promoted shoot height (34.96 cm and 42.77 cm), increased the number of leaves (4.48 and 9.51) and enhanced leaf dimensions (length: 6.40 cm and 9.88 cm; width: 4.52 cm and 8.00 cm) at both 90 and 180 DAP. These results were statistically on par with the effects observed at a higher IBA concentration of 1250 ppm, whereas the untreated control exhibited the least favourable growth outcomes. In conclusion, this investigation identified IBA at 1000 ppm as the optimal treatment for promoting rooting, sprouting and overall growth performance in bush pepper cuttings.

Key Words: Bush Pepper, Growth, Regulators, Shoot, Sprouting, Leaves.

INTRODUCTION

Black pepper crop belongs to the family Piperaceae, with Vietnam, Indonesia, India and Brazil recognized as the leading producers (Anonymous, 2019). In recent years, the cultivation of bush pepper- both in open fields and protected environments has gained traction, particularly in the Konkan region of Maharashtra, encompassing areas such as Sindhudurg, Ratnagiri, Thane, Palghar and Raigarh (Sharon *et al,* 2019). Bush pepper plants have an economic lifespan of approximately 12-15 years, with yields beginning in the second year of planting, producing about 1 kg of green berries per bush. By the fourth year and beyond, yields typically increases to 2-3 kg of green berries per bush. The variety Panniyur-2, utilized in this experiment, originates from the Pepper Research Station in Panniyur. It is an open-pollinated progeny of the Balankotta variety, known for its shade tolerance and suitability for all pepper-growing regions in Kerala. Panniyur-2 is highly productive, with alternate bearing characteristics, making it a valuable cultivar for cultivation.

Cultivating bush pepper has become an important approach to address the imbalance between the supply and demand of black pepper (Madhura *et al,* 2000). Moreover, the rising interest among urban dwellers in growing bush pepper in home gardens and terrace spaces has led to a surge in the need for quality planting materials (Ramya *et al,* 2017). This trend highlights the dual importance of bush pepper cultivation for commercial production and small-scale urban farming. The main objectives of the study were to evaluate the effectiveness of different concentrations of growth regulators, particularly Indole-3-Butyric Acid (IBA), on the sprouting and growth performance of bush pepper cuttings. The research aimed to identify the most suitable treatment for enhancing rooting, shoot development, and overall plant vigor under the agro-climatic conditions of Sirumalai, Tamil Nadu.

MATERIALS AND METHODS

The current study was conducted at Sirumalai in Dindigul district during the 2020-2022 cropping season, following a Completely Randomized Design (CRD) with 12 treatments and three replications.

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Healthy black pepper plants of the variety Panniyur-2, aged over six years, were selected as the source for cuttings. These mother plants, grown in the Sirumalai estate, provided plagiotropic shoots, which were used to prepare cuttings. The cuttings, measuring 20 cm in length and containing 3-4 nodes, were obtained from the middle portion of the shoots. Leaves were removed, leaving only the petioles attached. After collection, the cuttings were thoroughly washed with distilled water and allowed to air-dry in shade for 10 minutes before being subjected to growth regulator treatments. Solutions of plant growth regulators-Indole-3-Butyric Acid (IBA), α-Naphthalene Acetic Acid (NAA), and Indole-3-Acetic Acid (IAA)-were prepared following standardized procedures. For application, the lower 2 cm segment of each cutting, including the basal node, was immersed in the respective solution for 15 seconds. After treatment, the cuttings were transplanted into polybags containing a rooting substrate, ensuring the basal node was properly embedded in the medium. Control cuttings were planted directly without exposure to growth regulators. The experiment was conducted inside a mist chamber located in the field. Manual Misting equipment, fixed at a height of 2 meters, maintained a controlled environment with temperatures ranging from 35-38°C and humidity levels around 90%. The conditions were consistently maintained during the entire experimental period to promote rooting and shoot emergence in the cuttings.

RESULTS AND DISCUSSION

The influence of various growth regulators at different concentrations on the time required for the first sprout emergence, sprouting percentage, shoot length, number of leaves, leaf length, leaf width and leaf area in bush pepper cuttings is summarized in Table 1. The data highlight the significant effects of treatments on these growth parameters at 90 and 180 days after planting (DAP), as well as on the leaf area at 180 DAP.

Days taken for the first sprout

A significant variation was observed in the days taken for the first sprout to appear among cuttings treated with different growth regulators. The earliest sprouting was recorded in cuttings treated with T_4 (IBA at 1000 ppm), which required 18.89 d, closely followed by T_5 (IBA at 1250 ppm) with 19.67 days for sprouting. Conversely, the longest duration for sprouting was observed in the untreated control, with an average of 40.25 days. It might be due to promotion of faster cell divisionand callusing by auxin, which helps to start physiological activities in plant parts resulting in early sprouting of cuttings. Similar results were reported by Akshay *et al* (2019) in black pepper and Bhagwat *et al* (2021) in betel vine.

The same treatments also significantly enhanced the sprouting percentage compared to the control, as detailed in Table 1. The highest sprouting percentage (78.64%) was achieved with T_4 (IBA at 1000 ppm), which was statistically on par with T_5 (IBA at 1250 ppm), showing a sprouting percentage of 76.50%. The control exhibited the lowest sprouting percentage (38.81%). This effect could be linked to auxin-induced cell division and the initiation of sprouting, along with the buildup of carbohydrates within the cuttings. Comparable observations have also been documented by Kumari *et al* (2019) in *Rauvolfia serpentina* and *Gymnema sylvestre*, Pawar *et al* (2020) in bush pepper and Bhagwat *et al* (2021) in betel vine.

Shoot length

Significant variations in shoot length were observed across treatments at both 90 and 180 DAP. The highest shoot length was recorded in T_4 (IBA @ 1000 ppm), with values of 34.96 cm and 42.77 cm, respectively. This was statistically at par with T_5 (IBA @ 1250 ppm), which recorded 34.48 cm and 41.95 cm. The control treatment resulted in the shortest shoot lengths, measuring 25.59 cm and 30.12 cm at 90 and 180 DAP, respectively. The increase in shoot length by application of IBA might be due to increase in cell division and cell elongation caused by actions of auxins which helped in better utilization and uptake of water and nutrients resulted in higher shoot length.

Number of leaves per cutting

The data show significant differences in the number of leaves per cutting at both time points. The maximum number of leaves (4.48 and 9.51) was observed in cuttings treated with T_4 (IBA @ 1000 ppm), followed closely by T_5 (IBA @ 1250 ppm), with 4.39 and 9.30 leaves per cutting, respectively. The control treatment yielded the fewest leaves, with 2.06 and 4.12 leaves at 90 and 180 DAP. Leaf length was significantly influenced by the treatments. The longest leaves were observed in T_4 (IBA @ 1000 ppm), measuring 6.40 cm and 9.88 cm at 90 and 180 DAP, respectively, which was statistically on par with T_5 (IBA @ 1250 ppm), recording 6.1 cm and 9.4 cm. The shortest leaves were found in the control treatment, with lengths of 1.34 cm and 3.06 cm.

Table 1: Efficacy of growth regulators on sprouting of bush pepper cuttings.

Treatment	Days taken for sprouting	Sprouting (%)	Shoot height (cm)		Number of leaves per cutting		Leaf length		Leaf width		Leaf area (cm^2)
			90 days	180 days	90 days	180 days	90 days	180 days	90 days	180 days	
T_1 - Control	40.25	38.81	25.59	30.12	2.06	4.12	1.34	3.06	1.22	2.28	64.89
T_2 - IBA @ 500ppm	27.79	60.53	29.61	37.02	3.38	7.06	4.1	6.78	3.02	5.4	86.13
T_3 - IBA @ 750ppm	24.23	67.77	30.95	39.32	3.82	8.04	5.02	8.02	3.62	6.44	93.21
T_4 - IBA @ 1000ppm	18.89	78.64	34.96	42.77	4.48	9.51	6.40	9.88	4.52	8.00	104.03
T_5 - IBA @ 1250ppm	19.67	76.52	34.48	41.95	4.39	9.3	6.10	9.46	4.31	7.58	101.29
T_6 - NAA @ 250 ppm	33.13	49.67	27.6	33.57	2.72	5.67	2.72	4.92	2.12	3.84	75.51
T_7 - NAA @ 500 ppm	29.57	56.91	28.9	35.87	3.16	6.57	3.64	6.16	2.71	4.88	82.59
T_8 - NAA @ 750 ppm	22.45	71.39	31.62	40.47	4.04	8.53	5.48	8.64	3.91	6.96	97.41
T_9 - NAA @ 1000ppm	26.01	64.15	30.28	38.17	3.60	7.55	4.56	7.40	3.32	5.92	89.66
T_{10} - IAA @ 100ppm	38.47	42.43	26.26	31.27	2.28	4.69	1.80	3.68	1.52	2.80	68.43
T_{11} - IAA @ 200ppm	34.91	46.05	26.93	32.42	2.50	5.10	2.26	4.3	1.82	3.32	71.97
T_{12} - IAA @ 300ppm	31.35	53.29	28.27	34.72	2.94	6.08	3.18	5.54	2.44	4.36	79.05
S. Ed.	0.75	1.52	0.25	0.52	0.08	0.19	0.19	0.26	0.12	0.21	1.42
C.D (P=0.05)	1.5	3.05	0.51	1.04	0.16	0.38	0.38	0.52	0.25	0.43	2.85

Leaf width

Leaf width also showed significant variation among treatments. T_4 (IBA @ 1000 ppm) recorded the widest leaves, with widths of 4.52 cm and 8.00 cm at 90 and 180 DAP, respectively. This was statistically at par with T_5 (IBA @ 1250 ppm), which recorded 4.31 cm and 7.58 cm. The control treatment produced the narrowest leaves, measuring 1.22 cm and 2.28 cm at 90 and 180 DAP. At 180 d after planting (DAP), the treatments had a marked influence on the leaf area of bush pepper cuttings. The maximum leaf area (104.03 cm²) was observed in cuttings treated with T_4 (IBA @ 1000 ppm), which was statistically comparable to T_5 (IBA @ 1250 ppm) with a leaf area of 101.29 cm². In contrast, the control group recorded the lowest leaf area (64.89 cm²), which was significantly lower than all other treatments.

This response might be attributed to the role of auxin in enhancing cell wall plasticity, which increases the permeability of cells to water and nutrients, thereby promoting cell enlargement, callus formation, and overall growth of plant parts. The application of auxin may also stimulate photosynthetic activity and other physiological functions in the leaves, potentially contributing to the rise in leaf number in the treated cuttings. The increase in leaves per cutting could further be explained by the preferential allocation of assimilates to leaf buds, as leaves not only serve as major sites for photosynthesis and respiration but also produce endogenous auxins essential for plant development (Damer *et al,* 2014). Similar findings were reported by Remaand Krishnamoorthy (1993) in Cinnamon, Bharti *et al* (2016) in Sarpagandha and Diwakar *et al* (2011) in Guggul.

CONCLUSION

The study conclusively highlighted the efficacy of Indole-3-Butyric Acid (IBA) in enhancing the rooting and growth performance of bush pepper cuttings. The results clearly demonstrated that IBA at a concentration of 1000 ppm was the most effective treatment for promoting sprouting, shoot development and overall plant growth. This treatment significantly reduced the time to sprouting, achieved the highest sprouting percentage and improved critical growth parameters such as shoot height, number of leaves and leaf dimensions at 90 and 180 d after planting. The findings provide a practical recommendation for nursery and field-level propagation of bush pepper, suggesting that the application of IBA at 1000 ppm offers a cost-effective and efficient method to enhance the productivity and quality of propagation materials for this economically important crop. These results also indicate the potential of IBA in standardizing propagation protocols for large-scale commercial cultivation.

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