Effect of plantgrowth substances on rhizogenesis of stem cuttings in pointed gourd (*Trichosanthes dioica* Roxb.)

Abstract

An experiment was conducted to know the influence of growth regulators IBA, NAA and salicylic acid with different concentrations on rooting of stem cuttings in pointed gourd (*Trichosanthes dioica* Roxb.) in College of Horticulture, Venkataramannagudem, during the year 2023-2024. The experiment was laid out by following Factorial Randomized Block Design (FRBD) with twenty treatment combinations which consists of two factors, Factor-1: types of cuttings (male and female) and Factor-2: growth substances (10). By adopting standard methodology, observations on root and shoot growth were recorded and statistically analyzed. Studies on the effects of various growth substances on the formation of roots in cuttings of pointed gourd vines showed that IBA at 150 ppm recorded highest percentage of rooting, the longest root, the number of rootsper cutting the number of leaves per cutting, the length of the shoot and the percentage of establishment in main field among various growth substances. In comparison to female cuttings, male cuttings showed a considerably higher percentage of rooting, as well as more roots per cutting, longest root, longest shoot, more leaves per cutting and a higher percentage of establishment in the main field. IBA 150 ppm + male cuttings recorded considerably more roots per cutting and the longest root than the other combinations, according to the interaction between growth substance and type of cutting.

Keywords: Pointed gourd, rooting, stem cutting, IBA, NAA and their combination

Introduction

Pointed gourd (*Trichosanthes dioica* Roxb.) is king of gourds. Tropical cucurbitaceous vegetable crop (2n=22) originated in the Indian subcontinent. This species belongs to Cucurbitaceae and is locally known as Potol or Parwal and Green Potato (Kumar and Singh, 2012). *Trichosanthes* species are predominantly found in tropical and subtropical regions of Asia and Australia. They are particularly common in countries such as India, China, and Southeast Asian nations. Basically, it is perennial cucurbit and grows like a vine (creeper) with dark green cordate, ovate, oblong, not lobed, rigid and pencil size thickness. Roots are tuberous with a long tap root system. Flowers are tubular white takes 16-19 days from initiation to anthesis time for pistillate flowers and 10-14 days for staminate flowers. Stigma remains viable for approximately 14 hours and 40-70% of flowers set fruit. Fruits are small, round, thick and green with long white stripes. The pointed gourd is usually propagated through vine cuttings and root suckers. In general, seeds are not used as planting material because of poor germination and the inability to determine the sex of plants before flowering. To meet the internal demand and also to make a significant dent in the export trade, it would be necessary to take up its cultivation on a commercial scale. The first pre-requisite for popularizing the crop commercially should be the availability of large quantities of genetically pure planting material by easy and quick method of multiplication.Vegetative propagation through stem cuttings is considered to be the most important quick method of propagation. The process of regeneration of roots in cuttings is largely controlled by internal factors including the hormonal and nutritional status of the cuttings and external factors like humidity, light, temperature and rooting media. Synthetic growth substances have been shown to stimulate rooting in cuttings of many plant species. The stem cuttings obtained from male and female plants provide good planting material for quick multiplication. With this, a desired sex ratio can also be maintained.

Materials and methods

The experiment was carried out in College of Horticulture,Venkataramannagudem, during the year 2023-2024.The experiment was laid out in aFRBD (Factorial Randomized Block Design) with 20 treatments replicated thrice consisting of growth regulators IBA, NAA and salicylic acid and their different combinations T_1- C_1G_1 (Male + IBA 100 ppm), T_2 - C_1G_2 (Male + IBA 150 ppm), T_3 - C_1G_3 (Male + IBA 200 ppm), T_4 - C_1G_4 (Male + NAA 100 ppm), T_5 - C_1G_5 (Male + NAA 150 ppm), T_6 - C_1G_6 (Male + NAA 200 ppm), T_7 - C_1G_7 (Male + Salicylic acid 50 ppm), T_8 - C_1G_8 (Male + Salicylic acid 75 ppm), T_9 - C_1G_9 (Male + Salicylic acid 100 ppm), T_{10} - C_1G_{10} (Male + Control), T_{11} - C_2G_1 (Female + IBA 100 ppm), T_{12} - C_2G_2 (Female + IBA 150 ppm), T_{13} - C_2G_3 (Female + IBA 200 ppm), T_{14} - C_2 G_4 (Female + NAA 100 ppm), T_{15} - C_2G_5 (Female + NAA 150 ppm), T_{16} - C_2G_6 (Female + NAA 200 ppm), T_{17} - C_2G_7 (Female + Salicylic acid 50 ppm), T_{18} - C_2G_8 (Female + Salicylic acid 75 ppm), T_{19} - C_2G_9 (Female + Salicylic acid 100 ppm) and T_{20} - C_2G_{10} (Female + Control) (dipped in distilled water). Cuttings were collected from one year old shoots with 4-5 nodes each.

Length of the cuttings used for planting was ranging from 10-15 cm. The cuttings were treated with growth regulators by quick dip method and for this a required amount of growth regulator was weighed and dissolved in 0.2 N NaOH and then the volume was made up to 1 liter using distilled water and the cutting was dipped in solution for 2 minutes and planted in polybags. After planting cuttings were examined and the following observation were recorded on percentage of rooting, number of days taken for 50 percent rooting, number of roots per cutting, length of the longest root (cm), length of the shoot (cm), number of leaves and percentage of establishment in the main field.

Observations recorded

The following observations were recorded. Number of cuttings rooted were counted after planting in each treatment in each replication and expressed in percentage. Number of days taken for 50 percent rooting from date of planting in each treatment in each replication were counted and expressed as mean. The average number of roots per each selected cuttings were counted for each treatment excluding the laterals and the mean number of roots per cutting was calculated. The average length of roots per each selected cuttings were measured from the root initiation by using measuring scale and average value was expressed in centimeter. The length of the longest root of each rooted cutting was measured by measuring scale from base to the tip of the root and the mean length was calculated.Number of rooted cuttings established in the main field were counted and expressed in percent after 15 days of planting.Length of shoot was measured in centimeters from cuttings in each treatment in each replication and their mean was computed and expressed in centimeters. Number of leaves produced were calculated from cuttings per treatment per replication and their mean was computed and expressed in number.

Results and discussion

Percentage of rooting in vine cuttings

Highest percentage of rooting was recorded with cuttings treated with IBA 150 ppm (87.66)while, the minimum per cent of rooting in vine cuttings was recorded with control (58.53). The interaction between type of cuttings and growth substances the maximum percentage of rooting in vine cuttings were observed with G_2C_1 -IBA 150 ppm + male (91.13).This might also be due to the fact that optimum concentration of IBA leads to mobilization and utilization stored of carbohydrates and nitrogen fraction with the presence of

co-factor at the wound site, which may have helped in better root initiation. It enhances the root development, increased propagation success, faster rooting, improves plant quality and reduced losesSimilar results were reported by Karimi *et al.* (2012) in Pomegranate. This makes it one of the finest rooting stimulants when compared to other auxin compounds.

Number of days taken for 50 percent rooting

The lessnumber of days taken for 50 percent rooting with G_2-IBA 150 ppm (13.00) while,higher number of days taken for 50 per cent rooting with G_{10}-control (20.71) over rest of the treatment combinations. Significant variations were noticed between the two types of cuttings for number of days taken for 50 percent rooting. Male cuttings (12.52) recorded considerably took less number of days for 50 per cent rooting than female cuttings (13.49) at G_2-IBA 150 ppm concentration. Krishnamoorthy (1981) states that auxin treatment of the parenchyma of the pericycle, cell phloem divisions, and auxin-regulated metabolite flow direction are the sources of the root primordia. Furthermore, the two processes that increase cell size and necessitate auxins and oxygen are absorption of the cell wall and cell wall growth. Auxin, according to Thiman (1969), activates the messenger type of RNA, which causes the creation of particular enzymes to aid in the insertion of new materials into the cell wall and aid in cell wall elongation. The beginning of adventitious roots on shoots is known to require auxins, whether they are naturally present or supplied exogenously (Leopold, 1955). With the application of IBA and other growth agents compared with control, all the aforesaid biochemical and physiological alterations may have induced early rooting.

Number of roots per cutting

After planting the day after applying growth substances, the interaction between type of cuttings in improving this character varied not significant for length of the longest root in vine cuttings of pointed gourd.Among the treatment combinations, the higher number of roots per cuttings was recorded with cuttings treated with G_2-IBA 150 ppm (30.66) The lower number of roots per cuttings was recorded with G_{10}-control (15.16). The interaction between type of cutting and growth substances Male cuttings (33.00) recorded considerably higher number of roots than female cuttings (28.33) at G_2-IBA 150 ppm concentration. This may be due to increase in carbohydrate and metabolic activities.Auxins are known to promote stem cell elongation, which results in enhanced linear growth of the stem. The outcomes of IBA in Jhumpuri are consistent with Das and Mohanty's (2001) findings. The average number of roots exhibited a reversal trend as the concentration of IBA rose above 150 parts per million. This could be the result of auxin's limited ability to suppress behaviour beyond a specific threshold. Higher concentrations than the critical acceptable limits may lead to subpar or unfavourable conditions, which can make endogenous hormones and exogenously applied chemicals poisonous (Hartmann and Kester, 1989). In the cuttings treated with larger amounts of auxin, the length of shoots may have resulted from the new cells' enlargement and differentiation into leaves and other stem components. The current study found that while endogenous auxins that reach the cambial are insufficient to initiate rooting primordia in pointed gourd cuttings, external application of IBA 150 ppm seems to work best when combined with endogenous auxins to produce a larger number of roots.

Length of the longest root (cm)

Data recorded on effect of type of cutting, growth substances and their interaction on length of the longest root was presentedin table 1. After planting the day after applying growth

substances, the interaction between type of cuttings in improving this character varied not significant for length of the longest root in vine cuttings of pointed gourd.

Percentage of establishment in the main field.

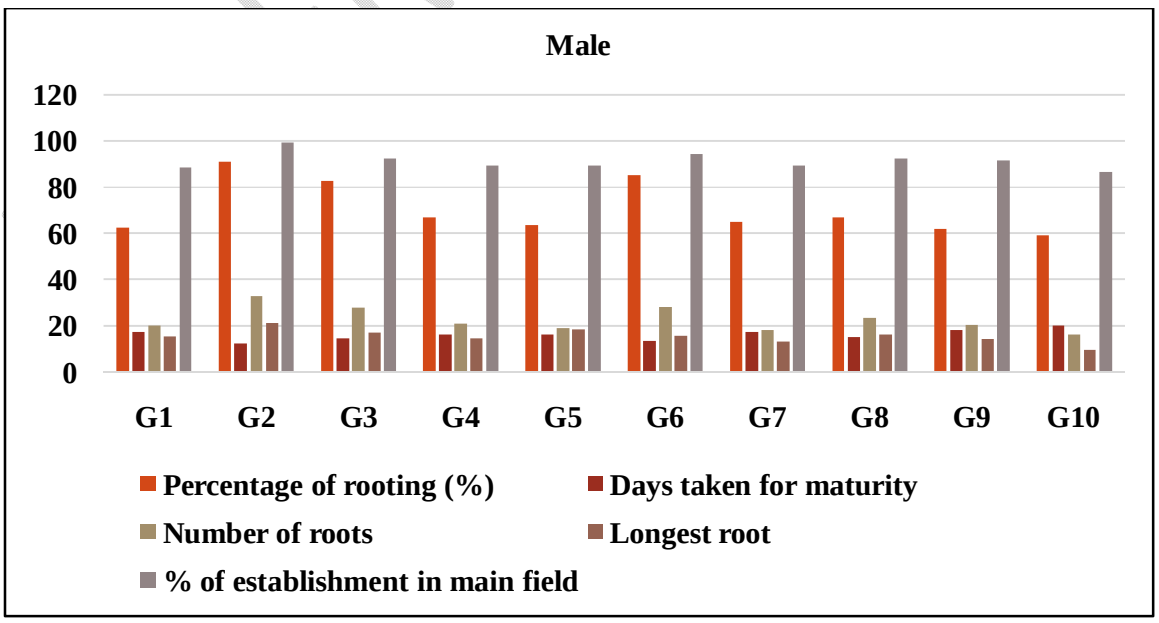
Among the treatment combinations, cuttings treated with G_2-IBA 150 ppm (98.03) had the highest percentage of establishment in the main field. Control had a lower establishment percentage in the main field (86.71). The interaction between type of cutting and growth substances male cuttings (99.35) recorded considerably maximum percentage of establishment in main field than female cuttings (96.42) at G_2-IBA 150 ppm concentration.An increase in IBA concentration above 150 ppm was associated with a significant decrease in the percentage of rooted cutting establishment, which may have resulted from nutritional imbalances and reduced root absorption ability at higher concentrations. Additionally, the length of the roots and the number of leaves per cutting have encouraged greater nutrient and water uptake. Research on tamarind, grapevine, Singh *et al.* (1986), Ramsundar and Abdul Khader (1986), and Sunitha (1991) all revealed similar findings.

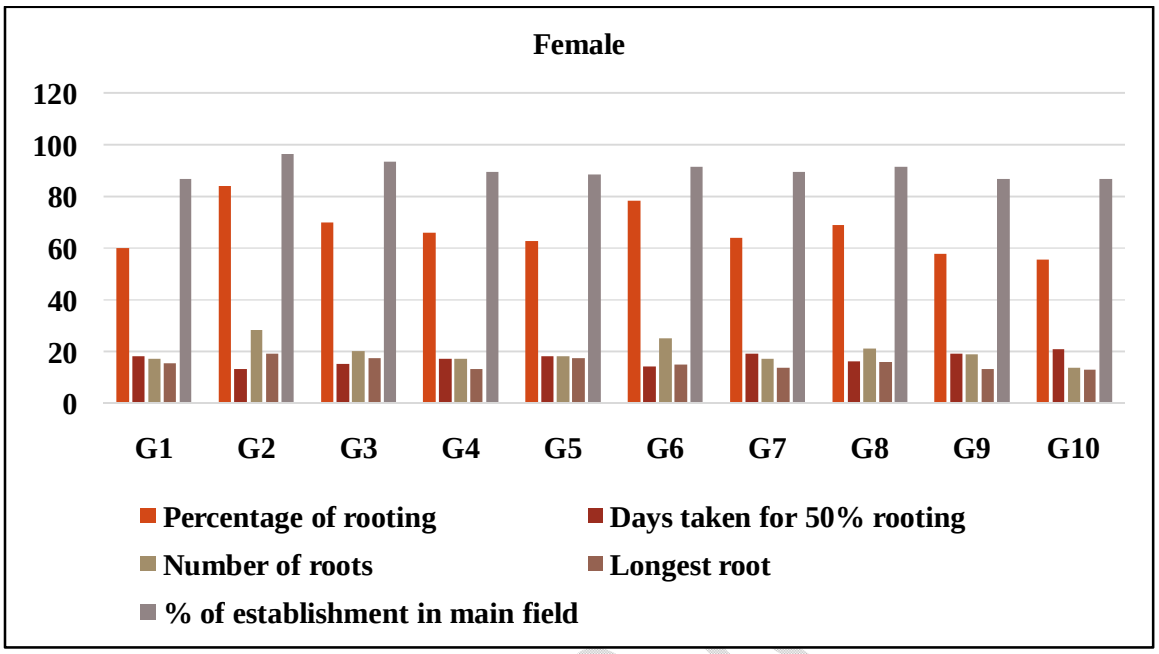
Table 1:Effect of growth substances onPercentage of rooting, Days taken for 50 % rooting. number of roots per cutting, Length of the longest root (cm) and Percentage of establishment in main field

Treatments	Percentage of rooting (%)			Days taken for 50 % rooting		
	C_1 (M)	C_2 (F)	Mean G	C_1 (M)	C_2 (F)	Mean G
G_1 (IBA 100 ppm)	62.53	60.27	**61.40**	17.34	18.3	**17.82**
G_2 (IBA 150 ppm)	91.13	84.20	**87.66**	12.52	13.49	**13.00**
G_3 (IBA 200 ppm)	82.77	69.89	**76.33**	14.45	15.41	**14.93**
G_4 (NAA 100 ppm)	66.84	66.01	**66.42**	16.38	17.34	**16.86**
G_5 (NAA 150 ppm)	63.89	62.70	**63.29**	16.38	18.3	**17.34**
G_6 (NAA 200 ppm)	85.39	78.40	**81.90**	13.49	14.45	**13.97**
G_7 (SA 50 ppm)	65.01	64.08	**64.55**	17.34	19.27	**18.3**
G_8 (SA 75 ppm)	67.10	69.10	**68.10**	15.41	16.38	**15.89**
G_9 (SA 100 ppm)	62.08	57.88	**58.82**	18.3	19.27	**18.78**
G_{10} (Control)	59.22	55.57	**58.53**	20.23	21.19	**20.71**
Mean C	**70.60**	**66.81**		**16.18**	**17.34**	
Factors	**SE (m)**	**C.D.**		**SE(m)**	**C.D.**	
Factor (C)	0.141	0.404		0.014	0.041	
Factor (G)	0.315	0.904		0.032	0.092	
(C × G)	0.445	1.279		0.045	0.131	

Treatments	Number of roots per cutting			Length of the longest root (cm)			Percentage of establishment in main field		
	C_1 (M)	C_2 (F)	Mean G	C_1 (M)	C_2 (F)	Mean G	C_1 (M)	C_2 (F)	Mean G
G_1 (IBA 100 ppm)	20.33	17.33	**18.83**	15.63	15.63	**15.63**	88.64	86.71	**87.68**
G_2 (IBA 150 ppm)	33.00	28.33	**30.66**	21.34	19.21	**20.27**	99.35	96.42	**98.03**
G_3 (IBA 200 ppm)	28.00	20.33	**24.16**	17.29	17.63	**17.46**	92.49	93.46	**92.97**
G_4 (NAA 100 ppm)	21.00	17.33	**19.16**	14.85	13.47	**14.16**	89.60	89.60	**89.60**
G_5 (NAA 150 ppm)	19.33	18.33	**18.83**	18.56	17.78	**18.17**	89.60	88.64	**89.12**
G_6 (NAA 200 ppm)	28.33	25.33	**26.83**	15.97	15.16	**15.57**	94.42	91.53	**92.97**
G_7 (SA 50 ppm)	18.33	17.33	**17.83**	13.37	14.00	**13.69**	89.60	89.60	**89.60**
G_8 (SA 75 ppm)	23.33	21.33	**22.33**	16.38	16.01	**16.20**	92.49	91.60	**92.01**
G_9 (SA 100 ppm)	20.66	19.00	**19.83**	14.20	13.42	**13.81**	91.53	86.71	**89.12**
G_{10} (Control)	16.33	14.00	**15.16**	9.56	13.08	**11.32**	86.71	86.71	**86.71**
Mean C	**22.86**	**19.86**		**15.72**	**15.54**		**90.66**	**90.37**	
Factors	**SE (m)**	**C.D.**		**SE (m)**	**C.D.**		**SE (m)**	**C.D.**	
Factor (C)	0.054	0.156		0.197	NS		0.045	0.130	
Factor (G)	0.122	0.349		0.708	2.028		0.020	0.058	
(C × G)	0.172	0.494		1.002	2.868		0.064	0.184	

Figure 1:Effect of growth substances onPercentage of rooting, Days taken for 50 % rooting. number of roots per cutting, Length of the longest root (cm) and Percentage of establishment in main field





Effect of different growth substances and cuttings on length of the shoot and number of leaves per cutting in vine cuttings of pointed gourd

The date on shoot parameters showed significant differences among different treatments the cuttings treated with G_2-IBA 150 ppm.

Length of the shoot

Male cuttings with different growth substances gave more length of the shoot over respective growth substances with female cuttings. Significant differences were also recorded for a number of roots per cutting with different growth substances. The maximum length of the shoot was recorded with cuttings treated with G_2-IBA 150 ppm (30.69). Minimum length of the shoot was recorded with control (16.83). The interaction between type of cutting and growth substances was found significant. Male was recorded maximum length of the shoot at 150 ppm of G_2-IBA (31.75) than female (29.63). Auxins are known to promote stem cell elongation, which results in enhanced linear growth of the stem. In the cuttings treated with larger amounts of auxin, the lengthier shoots may have resulted from the new cells enlargement and differentiation into leaves and other stem components. Reddy *et al.*, (1984) reported similar results with mango. G_2-IBA 150 ppm produced more leaves per cutting than the other growth chemicals.

Number of leaves

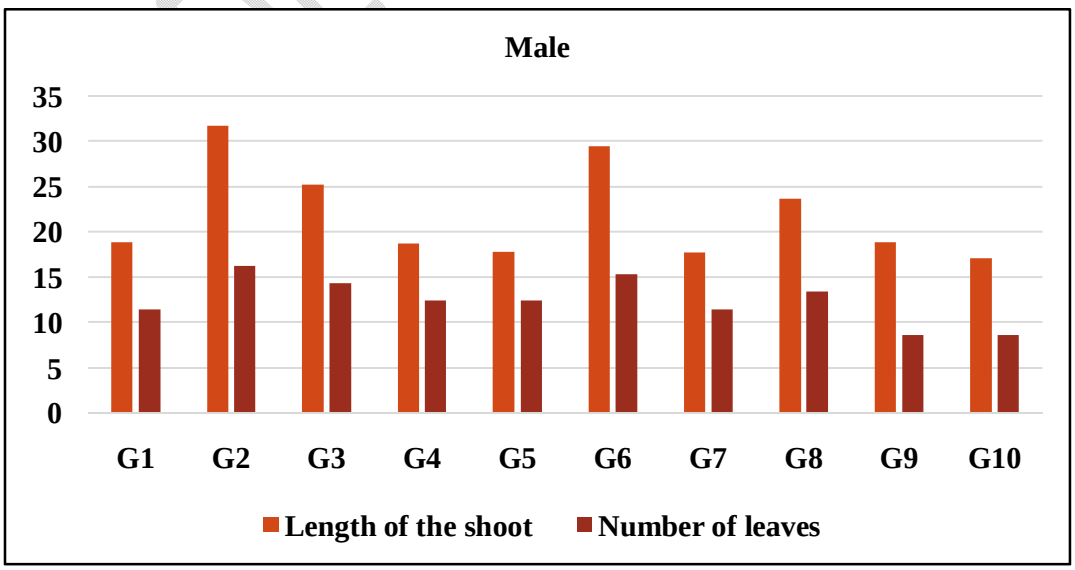
Among all treatments, IBA 150 ppm was recorded maximum number of leaves (15.31) and minimum number of leaves was recorded with G_{10}-control (8.13). interaction between male and female, male was recorded maximum number of leaves with G_2-IBA 150 ppm **(**16.26) than female cuttings (7.65). Examining the data shows that IBA produced the most leaves, compared to all other treatments, by a significant margin. Effective root system development, a friendly environment, increased water and nutrient translocation as a result of growth agent application to cuttings, and more new leaf formation at G_2-IBA 150 ppm may

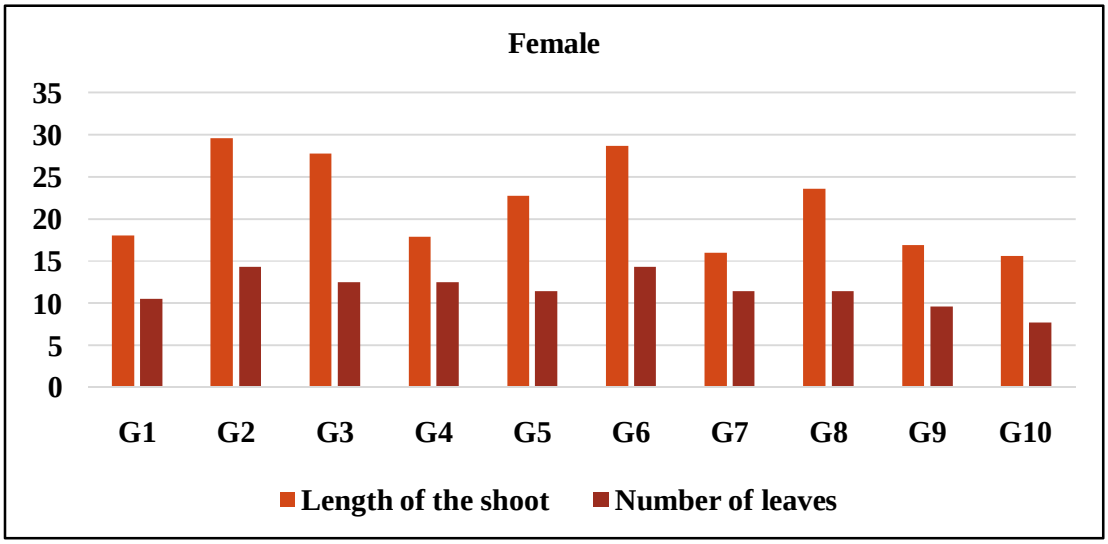
have contributed to improved shoot growth. Panwar *et al.* (1994) in bougainvillea reported similar outcomes with IBA.

Table 2: Effect of growth substances on Length of the shoot (cm) and Number of leaves in cutting

Treatments	Length of the shoot (cm)			Number of leaves in cutting		
	C_1 (M)	C_2 (F)	MeanG	C_1 (M)	C_2 (F)	Mean G
G_1 (IBA 100 ppm)	18.89	18.02	**18.45**	11.48	10.52	**11.00**
G_2 (IBA 150 ppm)	31.75	29.63	**30.69**	16.26	14.35	**15.31**
G_3 (IBA 200 ppm)	25.25	27.75	**26.50**	14.35	12.44	**13.39**
G_4 (NAA 100 ppm)	18.70	17.86	**18.28**	12.44	12.44	**12.44**
G_5 (NAA 150 ppm)	17.83	22.73	**20.73**	12.44	11.48	**11.96**
G_6 (NAA 200 ppm)	29.48	28.67	**29.08**	15.31	14.35	**14.83**
G_7 (SA 50 ppm)	17.70	15.96	**16.83**	11.48	11.48	**11.48**
G_8 (SA 75 ppm)	23.63	23.60	**23.61**	13.39	11.48	**12.44**
G_9 (SA 100 ppm)	18.83	16.90	**17.87**	8.61	9.57	**9.09**
G_{10} (Control)	17.13	15.6	**16.38**	8.61	7.65	**8.13**
Mean C	**21.92**	**21.68**		**12.44**	**11.57**	
Factors	**SE (m)**	**C.D.**		**SE (m)**	**C.D.**	
Factor (C)	0.015	0.043		0.017	0.048	
Factor (G)	0.034	0.097		0.037	0.106	
(C × G)	0.048	0.137		0.052	0.150	

Figure 2:Effect of growth substances onlength of the shoot (cm) and number of leaves in cutting





Conclusion

The findings of the present experiment, torch up our paths in the way to standardize the type of cutting and concentration of growth substances for rooting and success rate in vine cuttings of pointed gourd. It can be concluded that among all treatments, IBA 150 ppm showed comparatively good results with respect to rooting and shooting parameters followed by the NAA 200 ppm. Based on the findings of the current investigation, it is recommended that vegetative method of propagation through stem cuttings in Pointed gourd is reliable for commercial plant production as it is quick and economical method of vegetative propagation.

Disclaimer (Artificial intelligence)

Option 1:

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 the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.ChatGPT

2.Meta

3.

References

Das J. N. and Mohanty C. R. (2001).Vegetative propagation of Jhumpuri (*Phyllochlamys spinosa Bueav*) by stem cuttings. *Vegetable science* 28 (1): 88-89.

Hartmann H. T. and Kester D. E. (1989).Plant propagation principles and practices. *Prentice Hall of India Private Limited, New Delhi*, 264 and 321.

Karimi H, Mostafa A, Mansouri MZ. (2012). The effect of IBA and salicylic acid on rooting and vegetative parameters of pomegranate cuttings. *Int. J Agri. Res. Review*. 2:1085-91.

Krishnamoorthy, H. N. and Bhatia, U, and Talukdar, A. R. (1976). Effect of growth retardants and ethrel on the flowering and sex expression of (*Luffa acutangula*, Haryalla)*Hart. Sci.*,5(3/4): (189-194).

Kumar and Singh, (2012), pointed gourd: botany and horticulture. *Horticultural Reviews* 39(1):203-238.

Leopold A. C. (1955). auxins and plant growth. Barkley and Loss Angles, University of California (Press).

Panwar, R.D., Gupta, A.K., Sharma, J.R. and Rakesh (1994). Effect of growth regulators on rooting in Bougainvillea var. Alok. *Internat. J. Trop. Agric.*, 12 (3-4): 255-261.

Ramsundar V. and Abdul Khader J. B. M. (1986). Studies on rooting of sapota cuttings. *South Indian horticulture* 34(1): 40-43.

Reddy Y. N. (1984).Studies on propagation techniques in fruit crops. IIHR Annual Reports.

Singh BP. and Wayne F. (1986). Whitehead Pointed gourd: Potential for temperate climates. *J Janick*; 118:27-35.

Sunitha P. (1991). effect of auxins and auxin synergists on rooting of grapevine (*Vitis vinifera* L.) cuttings.*Acta horticulture* 287: 369-374.

Thimman K. V. (1969). On the chemical nature of the root forming hormone. *Farm science journal* 37: 456-459.