Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 598-605

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 598-605**
Journal homepage: http://www.ijcmas.com

Original Research Article

Effect of Different Plant Growth Regulators on Sprouting, Survival and Growth Performance of Bush Pepper (*Piper nigrum* L.)

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A B S T R A C T

The present study entitled "Effect of different plant growth regulators on sprouting and survival of bush pepper (*Piper nigrum* L.)" was conducted at nursery of Department of Horticulture, College of Horticulture, Dr. B. S. K. K. V. Dapoli, Dist. Ratnagiri (MS) during the year 2018-2019. The experiment was executed in randomized block design with four treatments and five replications. In different plant growth regulators, the earliest sprouting of cuttings (26.2) recorded in T_3, the highest sprouting percentage (52.40 %) and survival percentage (31.00 %) was observed in T_3 *i.e.*, Humic acid (215 ml/L). Also this treatment was found best with respect to vegetative growth parameters *viz.* plant height (27.34 cm), number of leaves (4.81), total leaf area (323.86 cm^2) and relative growth rate (0.008 cm/ cm/ day). The highest root length (31.33 cm) and the highest net profit (Rs. 837.43/-) promoting highest B : C ratio (1.82) was noted in T_3 i.e. Humic acid @ 215 ml/L.

Keywords

Bush pepper, Plant growth regulator, Sprouting, Survival

Introduction

Black pepper, the 'King of Spices' and 'Black gold', is the most important and most extensively used spice in the world, occupying a position that is utmost and unique (Ravindran, 2006). It is one of the important spice crop belongs to family Piperaceae. Black pepper is commonly known as Kali Mirch in Urdu and Hindi, Pippali in Sanskrit, Milagu in Tamil and Peppercorn, White pepper, Green pepper, Black pepper and Madagascar pepper in English (Damanhouri *et al.*, 2014). Black pepper is originated in the tropical evergreen forests of the Western Ghats; and Malabar coast of India was the centre of the pepper trade from time immemorial. From here, pepper was carried to Indonesia and Malaysia by traders and travellers, and these countries became major producers during the first half of the present century (Ravindran, 2006).

The leading countries in the production of the Black Pepper are Vietnam, Indonesia, India and Brazil (Anon., 2019a). In India the area and production of Black Pepper is 1, 37, 378 ha and 6, 1000 tonnes in India (Anon., 2019b) with major black pepper producing regions as Kerala, Karnataka, Konkan, and

Tamil Nadu (Anon., 2019a). Annual export of black pepper from India is 16, 250.00 MT earning Rs. 55, 187.48 lakhs foreign exchange (Anon., 2019b).

Growing bush pepper is one of the important suggestions to bridge the gap between demand and supply of black pepper (Madhura *et al.,* 2000). Considerable interest among urban people has been noted to grow bush pepper in the garden and terrace which in turn increased the demand for planting materials (Ramya *et al.,* 2017).

Bush pepper can be grown in tubs and are kept in front of the house as an ornamental plant and also for meeting the least possible requirement of black pepper for a family. In cities where the space for growing is limited, this technique can be used for terrace gardening. As plagiotropic branches have limited growth and root induction compared to the vegetative branches, plant growth hormones can be used to stimulate rooting Kavindi *et al.,* (2013). Cuttings when treated with plant growth regulators (PGRs) can encourage root sprouting, which is needful for multiplication of cell and root elongation. Many scientists have worked in black pepper as well as in crops belongs to piperaceae family but very less work has been found in use of the plant growth hormone and performance in the propagation of the Bush Pepper. As therefore the various plant growth regulators in various concentrations were used.

Materials and Methods

The experiment was conducted at College of Horticulture, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.) India, 415 712. The experiment was conducted in the Randomized Block Design with four treatments and five replications. The planting material *i.e.* the plagiotropic shoots with 2-3 nodes of Panniyur – 1 variety cuttings of average 10.66-17.89 cm length of pencil size thickness (1.14 - 2.31 mm girth) with 3-4 buds were selected prior to planting. Four different plant growth regulators were used: T_1- Cow urine (10 %), T_2- Vermiwash (10 %), T_3- Humic acid (215 ml/L) and T_4- IBA (2000 ppm). The solution of growth regulators of 2000 ppm of IBA (Hameed, 2018), 215 ml/L Humic acid solution (Baldotto., 2012), 10% Vermiwash solution (Karthikairaj *et al.,* 2013) and 10% Cow urine solution (Smitha and Umesha, 2012) were prepared by using standard procedure and used in experiment. Prior to planting, the cuttings were dipped in Carbandezim (5 g lit^{-1}) solution for 15 min. Basal portion of the cuttings (about 3.5-4 cm) was dipped in the growth regulator solution of IBA (10 sec) and Humic acid (30 min) whereas as drenching with vermiwash and cow urine @ 10% was given @ 50 ml/cutting at the time of planting. The planting of cutting was done in media consisting of soil + FYM (1:1). The number of days required for sprouting was recorded at an interval of fifteen days. The count of sprouted cuttings was recorded fifteen days after planting of cutting. The sprouting percentage was calculated from the number of cuttings sprouted in each replication. The survival percentage was recorded at an interval of fifteen days up to end of experiment. Similarly the growth parameters of bush pepper were also recorded at an interval of fifteen days up to end of experiment (180 DAP). The data obtained in the present investigation were statistically analysed by the method suggested by Panse and Sukhatme (1995).

Results and Discussions

Number of days to sprout

The earliest number of days for sprouting (Table 1) was found in treatment T_3 (26.20)

i.e. Humic acid (215 ml/L). The late number of days for sprouting was found in treatment T_4 (18.00) *i.e*. IBA (2000 ppm).

Per cent sprouting

The maximum per cent sprouting (Table 1) was significantly observed in treatment T_3 (52.40) whereas the minimum per cent sprouting was observed in treatment T_4 (36.00). T_3 showed 45.55 per cent more sprouting (%) over T_4.

Per cent survival

The highest per cent survival (Table 1) was noted in treatment T_3 (31.00) followed by T_2 (27.00). The lowest per cent survival was recorded in treatment T_1 (20.00) followed by T_4 (24.00).

Number of leaves

Significantly the highest number of leaves (Table 2) was observed in treatment T_3 (7.33) followed by T_2 (6.39). The minimum number of leaves was observed in treatment T_4 (3.84) followed by T_1 (6.24).

Plant height

Statistically at 360 DAP the maximum height of plant (Table 2) was recorded in treatment T_3 (30.63 cm) followed by T_2 (27.21 cm). The minimum height of plant was recorded in treatment T_4 (25.80 cm) which was at par with T_1 (26.64 cm).

Total leaf area

Statistically the maximum leaf area (Table 2) was noted in treatment T_3 (456.20 cm^2) followed by T_2 (419.30 cm^2). The minimum leaf area was noted in treatment T_1 (382.50 cm^2) followed by T_4 (408.20 cm^2).

Relative growth rate on height basis

The relative growth rate (Table 2) on height basis was noted highest in treatment T_3 and T_4 (0.009 cm/cm/day) while lowest in treatment T_2 and T_1 (0.008 cm/cm/day).

Root length

The highest root length (Table 2) was recorded in the treatment T_3 (31.33 cm) *i.e.,* Humic acid @ 215 ml/L and minimum root length was recorded in treatment T_1 (24.27 cm).

Benefit cost ratio

The cost of production ((Table 2) for the bush pepper cuttings grown in different plant growth regulators is given in Table No. 24. The highest net profit (Rs. 837.43/-) was recorded in T_3 i.e. Humic acid @ 215 ml/L was promoting highest B : C ratio (1.82). Lowest net profit (Rs. 242.34/-) and B : C ratio (1.25) was reported in T_1 i.e. Cow urine @ 10%.

Number of days to sprout

Earliness in sprouting might be due to utilization of stored food material present in cuttings, nitrogen and other factors with the aid of growth regulators (Chandramouli, 2001). Humic acid and cow urine contain auxins; auxins are involved in the chelation of iron for the plant, improving growth, health and nutrient intensity of the plant, especially the development of the root system of the plant. (Jackson, 1973) The weather condition during experimental period was also congenial for increasing the cell activity for formation of root. Hence the number of days required for sprouting were less in treatment of humic acid followed by cow urine. Similar findings were recorded by Sandor *et al.,* (2015) in pomegranate 50 %

concentration of humic acid. Smitha and Umesha (2012) IBA 500 ppm and cow urine diluted in water (1:10) for stevia cuttings (*Stevia rebaudiana* (Bertoni) Hemsl.).

Per cent sprouting

Root volume plays an important role in the sprouting of cutting. Humic acid and cow urine contain auxins, they are involved in the development of the root system of the plant (Jackson, 1997). The weather condition during experimental period was also congenial for increasing the cell activity for formation of root. Hence, maximum per cent sprouting was obtained in treatment of humic acid. Similar findings were recorded by Sandor *et al.,* (2015) reported for pomegranate cuttings with 50 % concentration of humic acid. Smitha and Umesha (2012) with IBA 500 ppm and cow urine diluted in water (1:10) for stevia cuttings (*Stevia rebaudiana* (Bertoni) Hemsl.).

Table.1 Effect of different plant growth promoters on number of days to sprout, sprouting percentage of bush pepper cuttings

Treat-Ments	Growth parameters					
	No. of leaves (no.) at 360 DAP	Plant height (cm) at 360 DAP	Total leaf area (cm^2) at 360 DAP	Root length (cm) at 360 DAP	Relative growth rate(cm/cm/day) at 360 DAP	B : C ratio
T_1	6.24	26.64	382.54	24.27	0.008	1.25
T_2	6.39	27.21	419.25	24.62	0.008	1.67
T_3	7.33	30.63	456.19	31.33	0.009	1.82
T_4	3.84	25.80	408.18	25.78	0.009	1.50
Mean	**12.5**	**27.57**	**416.54**	**26.50**	**0.008**	
S.E.±	**0.05**	**0.43**	**2.82**	**0.14**		
C.D. at 5%	**0.15**	**1.31**	**8.68**	**0.44**		

(Value in parenthesis indicates the per cent sprouting and survival**)**

Table.2 Effect of plant growth promoters on growth parameters and B : C ratio of bush pepper cuttings

Treat-Ments	Growth parameters					
	No. of leaves (no.) at 360 DAP	Plant height (cm) at 360 DAP	Total leaf area (cm^2) at 360 DAP	Root length (cm) at 360 DAP	Relative growth rate(cm/cm/day) at 360 DAP	B : C ratio
T_1	6.24	26.64	382.54	24.27	0.008	1.25
T_2	6.39	27.21	419.25	24.62	0.008	1.67
T_3	7.33	30.63	456.19	31.33	0.009	1.82
T_4	3.84	25.80	408.18	25.78	0.009	1.50
Mean	**12.5**	**27.57**	**416.54**	**26.50**	**0.008**	
S.E.±	**0.05**	**0.43**	**2.82**	**0.14**		
C.D. at 5%	**0.15**	**1.31**	**8.68**	**0.44**		

Per cent survival

The cuttings treated with humic acid resulted in development of effective root system and increase in number and length of roots per cutting which might have influenced the uptake of nutrients and water. The overall performance in relation to growth parameters of root and shoots were comparatively better in this treatment which ultimately increased the survival percentage. Hence the significant effect was observed in the survival per cent when treated with humic acid. Rajan *et al.,* (2018) humic acid @ 10 ml/lit for mango nursery grafts cv. Alphonso. Bhai *et al.,* (2018) phosphorus solubilising bacteria (PSB) @ 5 g/ plant + Azospirillum @ 5 g/lit + 0.02 (%) humic acid + 0.5 (%) fish extract in black pepper.

Number of leaves

Humic matter has been shown to increase the nitrogen uptake by plants, and to increase soil nitrogen utilization efficiency, and therefore increasing the vegetative growth of plants *i.e*. number of leaves. The auxins activated shoot growth by rapid cell division and cell elongation which might have resulted in increase in number of leaves through cell division (Jackson, 1997). Similar findings were recorded by Baldotto *et al.,* (2012) with AH20 mol lit^{-1} in croton. Bhai *et al.,* (2018) application of Phosphorus Solubilising Bacteria (PSB) @ 5 g/ plant + Azospirillum @ 5 g/lit + 0.02 % humic acid + 0.5 % Fish extract in black pepper.

Plant height

Humic acid improves soil aggregation, structure, fertility, moisture holding capacity, and increases microbial activity (Chen and Aviad., 1990), microbial population, and cation exchange capacity (Marinari *et al.,* 2000). Humic acid also has direct cytokinin (Zhang and Ervin., 2004) and auxin or gibberellin-like stimulatory effects (Pizzeghello *et al.,* 2001), along with indirect effect on plant metabolism (Piccolo *et al.,* 1991) resulted in plant growth particularly increasing the height of plant. Similar findings were recorded by Sandor *et al.,* (2015) pomegranate cuttings treated with 50 % concentration of humic acid. Ayyobi *et al.,* (2014) application of 7 Mt ha^{-1} vermicompost leachate (100 kg) + vermiwash (50 L) in pepper mint.

Total Leaf area

Humic acid was in general not only beneficial to shoot and root growth but also nutrient uptake of crops (Padem *et al.,* 1997). Leaf total chlorophyll content and leaf area is get increased with increase in concentration of humic acid. Application of humic acid showed beneficial effect on increasing cell membrane permeability, oxygen uptake, respiration, photosynthesis, root cell elongation and phosphate uptake (Aydin and Turan, 2012). Hence maximum leaf area was observed in treatment T_3 *i.e*. humic acid on bush pepper. Moshtaghi *et al.,* (2011) reported that application of HA 2 % and GA_3 400 mg/ lit significantly increased the leaf area (313.3 cm^2) of olive cuttings than control.

Relative growth rate on height basis

During the experimental period, the average relative growth rate on height basis was highest in treatment T_3 (0.006 cm/cm/day) while lowest in treatment T_4 (0.003 cm/cm/day). Humic Acid improves soil aggregation, structure, fertility, and moisture holding capacity, and increases microbial activity (Chen and Aviad., 1990), microbial population, and cation exchange capacity (Marinari *et al.,* 2000). Humic acid also has direct cytokinin (Zhang and Ervin., 2004)

and auxin or gibberellin-like stimulatory effects (Pizzeghello *et al.,* 2001), along with indirect effect on plant metabolism (Piccolo *et al.,* 1991) resulted in increasing relative growth rate in bush pepper plants treated with humic acid.

Root length

Humic acid has beneficial effects such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake and root elongation and hence resulted in increase in length of root of plants (Aydin and Turan, 2012). This may be due to better mobilization of primary metabolites for better root formation with the help of root promoting hormones present in humic acid. Hence the significant effect of humic acid was observed on the length of roots. Similar finding was recorded by Bhai *et al.,* (2018) in treatment phosphorus solubilising bacteria (PSB) @ 5 g/ plant + Azospirillum @ 5 g/lit + 0.02 (%) humic acid + 0.5 (%) Fish extract.

Hence concluded in present study, on effect of PGR, rooting, survival and sprouting of bush pepper cuttings was significantly maximum in humic acid (215 ml/ lit). Bush pepper cuttings raised by dipping treatment of humic acid (215 ml/ lit) (T_4), followed by cuttings raised in vermiwash (10 %) (T_2) gave maximum growth with respect to all morpho-physiological parameters and gave highest net profit with highest B : C. Humic acid improves soil aggregation, structure, fertility, moisture holding capacity and increases microbial activity, microbial population and cation exchange capacity. Humic acid also has direct cytokinin and auxin or gibberellin-like stimulatory effects, along with indirect effect on plant metabolism and hence has positive effect on increasing cell membrane permeability, oxygen uptake, respiration, photosynthesis, root cell elongation and phosphate uptake which resulted in formation of roots and accumulation of food and energy in stem due to which maximum growth of cuttings was noted.

This is a pioneer research on propagation of bush pepper cutting in various media in combination with soil for rooting, survival and growth. Though growth of cuttings was satisfactory, survival obtained was very less in the experiment. Hence repetition of same research on propagation of bush pepper is required with temperature and humidity control condition by using similar PGR for confirmation of these results.

Acknowledgments

This work was carried out with the support of "Cooperative Research Program for Agriculture Science & Technology Development (Project No. PJ008423)" Rural Development Administration, Republic of Korea.

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