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Effect of Indole-3-Butyric Acid (IBA), Cow urine and Vermiwash during Winter Season on Tomato Stem Cuttings

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ABSTRACT: Layout was followed with control, IBA (50 ppm, 100 ppm and 150 ppm), cow urine and vermiwash (5%, 10% and 15%) as treatments which were replicated three times. Observations were taken at 15 and 30 days after planting (DAP). Maximum shoot growth at 15 DAP were observed for number of leaves at cow urine 10%, fresh weight of cutting at IBA 100 ppm, shoot length and shoot diameter at vermiwash 10%. Maximum shoot growth at 30DAP were observed for number of leaves at IBA 150 ppm, fresh weight of cutting at IBA 100 ppm, shoot length and shoot diameter at vermiwash 10%. The majority of root parameters *i.e.*, number of roots per cutting, length of root, fresh and dry weight of roots, root volume as well as survival percentage and chlorophyll content observed to be influenced by IBA 100 ppm. Tomato cuttings were propagated using various treatments but overall best result was seen with IBA treatments.

Keywords: IBA, cow urine, vermiwash, tomato, cutting, propagation.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is the most commonly grown, widely available and popularly used fruit-type vegetable. It is a member of the solanaceae family, which embraces more than 3000 species including significant food, spice and drug plants (Ganaie *et al.,* 2018). It contains a good amount of minerals, vitamins, antioxidants, phenolic and carotenoid contents; hence due to its nutritive properties, tomato is also known as protective food (Frusciante *et al*., 2007). In South American countries, the use of vine cutting in propagating tomatoes to circumvent the excessive cost of purchasing new tomato seeds for planting is prevalent (Heder *et al*., 2010). The major issue related to this crop is the availability of the seed of the desired hybrids or varieties to be grown in a protected environment. Rooting of any cutting is influenced by many factors like type of cutting, size of The investigation was undertaken from November 2022 to December 2022 at the Hi-Tech Horticulture Unit, Department of Horticulture, Rajasthan College of Agriculture, Udaipur. The research was conducted in a nursery having size of 126.4 m^2, where the top was covered with UV stabilized polyethylene film and sides with 40 mess net in Udaipur is located at 24º 58' N latitude and 73º 70' E longitude with an elevation of 582.17 meters above mean sea level.

cuttings, type of rooting substrate, irrigation, temperature, rooting growth regulator (especially auxins), etc. (Hartmann *et al.,* 2002). Vegetative propagation requires a controlled environment for initiation of callus formation at the cut, followed by differentiation of cells into root primordia and then to the developed roots, this whole process requires the utmost care. Cow urine contains 95 per cent water, 2.5 per cent urea and the remaining 2.5 per cent a mixture of salts, hormones, enzymes and minerals (Jandaik *et al*., 2015). The fresh vermiwash houses a large number of beneficial microorganisms which help in plant growth and protect it from several infestations. It also contains sugars, amino acids and phenols along with plant growth-promoting hormones such as indole acetic acid and humic acid (Gulsar and Iyer 2006).

MATERIALS AND METHODS

Table 1: Influence of IBA, cow urine and vermiwash on number of leaves and shoot length (cm) on tomato cutting.

Treatment	Number of leaves					Shoot length (cm)				
	0 DAP	15 DAP	% increase from 0 DAP	30 DAP	% increase from 0 DAP	0 DAP	15 DAP	% increase from 0 DAP	30 DAP	% increase from 0 DAP
T1	3.6	3.67	1.9	3.8	5.6	11.07	11.21	1.3	11.68	5.5
T2	3.6	3.8	5.6	4	11.1	11.24	11.51	2.4	12.25	9.0
T3	3.4	3.53	3.8	3.93	15.6	11.95	12.17	1.8	12.9	7.9
T4	3.6	3.67	1.9	4.2	16.7	11.75	12.51	6.5	13.58	15.6
T5	3.53	3.67	4.0	3.93	11.3	11.51	12.15	5.6	13.05	13.4
T6	3.33	3.53	6.0	3.87	16.2	11.25	11.55	2.7	12.05	7.1
T7	3.6	3.73	3.6	3.87	7.5	11.48	12.04	4.9	12.51	9.0
T8	3.4	3.6	5.9	3.87	13.8	11.63	11.92	2.5	12.82	10.2
T9	3.6	3.8	5.6	3.93	9.2	10.71	11.55	7.8	12.4	15.8
T10	3.4	3.53	3.8	3.87	13.8	10.87	11.63	7.0	12.15	11.8
SE(m) ±	0.052	0.043	-	0.073	-	0.177	0.112	-	0.169	-
C.D. (p = 0.05)	N.S.	0.129	-	0.217	-	N.S.	0.333	-	0.502	-

The experiment was laid in completely randomized design with T_1 (control), T_2 (IBA 50 ppm), T_3 (IBA 100 ppm), T_4 (IBA 150 ppm), T_5 (cow urine 5%), T_6 (cow urine 10%), T_7 (cow urine 15%), T_8 (vermiwash 5%), T_9 (vermiwash 10%) and T_{10} (vermiwash 15%) treatments replicated three times. The experiment was conducted during winter (November-December). The observation was recorded at 0, 15 and 30 days after planting (DAP) for various parameters *i.e.*, number of leaves per cutting, shoot length (cm), shoot diameter (mm), fresh weight of cutting (g), number of roots per cutting, length of root, fresh weight and dry weight of roots, root volume and survival percentage.

The tomato mother plant of variety "Heem Sohna" was used for cutting preparation having an age of 45-60 days old. The size of the cutting was 10-13 cm with 3-4 leaves planted in the sole coco peat as media after treatment of cutting by dipping base in solution for 15 minutes. Commercial IBA solution was prepared by dissolving the desired amount of powder in absolute ethanol so that IBA can be dissolved completely before solution preparation, then mixed with 1 litre distilled water for complete formulation. Similarly, cow urine and vermiwash solution were prepared. The EC and pH were also measured for cow urine, vermiwash and coco peat. The data was analyzed as a part of an experiment done by the following analytical method as followed for Completely Randomized Design (CRD). Analysis of variance was calculated using OPSTAT website and the least significant difference (LSD) at 5% level of significance for separation of difference in the treatment means.

RESULTS AND DISCUSSION

Number of leaves: The number of leaves (Table 1) at 15 DAP revealed that the maximum increase of number of leaves (3.53 *i.e.*, 6 percent increased as compared to 0 DAP) for treatment T_6 (Cow urine 10%). Results at 30 DAP showed that the maximum increase in number of leaves (4.2 *i.e.*, 16.7 percent increased as compared to 0 DAP) was observed for treatment T_4 (IBA 150 PPM). More number of leaves might be due to the activation of auxin in vegetative parts by using IBA, as IBA reduces the level of stress and increases the photosynthetic pigments in vegetative parts like leaves. These findings are supported by the results of Modi *et al.* (2019) while working on little gourd, Tien *et al.* (2020) while working on *Solanum procumbens* and Ullah *et al.* (2013) while working on marigold. Positive effects of cow urine on the number of leaves have also been observed by Santoso *et al.* (2016) while working on chrysanthemum and Faridah (2002) while working on coffee, this impact might be due to composition of cow urine as it contains water, urea and the mixture of salts, hormones, enzymes and minerals (Jandaik *et al*., 2015).

Table 2: Influence of IBA, cow urine and vermiwash on shoot diameter (mm), fresh weight of cutting (g) and number of roots per cutting on tomato cutting.

Treatment	Shoot diameter (mm)					Fresh weight of cutting (g)		Number of roots per cutting	
	0 DAP	15 DAP	% increase from 0 DAP	30 DAP	% increase from 0 DAP	15 DAP	30 DAP	15 DAP	30 DAP
T1	3.71	3.82	3.0	4.01	8.1	2.81	3.14	8.53	9.80
T2	4.14	4.38	5.8	4.77	15.2	3.45	4.13	10.13	11.53
T3	4.96	5.17	4.2	5.3	6.9	4.44	4.79	11.20	13.33
T4	4.37	4.88	11.7	5.24	19.9	4.15	4.72	11.53	12.87
T5	4.35	4.55	4.6	4.87	12.0	3.7	4.11	10.47	11.40
T6	4.02	4.23	5.2	4.56	13.4	3.44	3.8	9.73	11.00
T7	4.65	5.02	8.0	5.56	19.6	4.15	4.64	11.87	13.20
T8	4.17	4.34	4.1	4.56	9.4	3.59	4.14	10.00	11.93
T9	3.98	4.46	12.1	4.78	20.1	3.47	4.06	10.00	11.20
T10	4.49	4.68	4.2	5.07	12.9	3.67	4.15	10.00	11.40
SE(m) ±	0.044	0.082	-	0.067	-	0.054	0.066	0.583	0.618
C.D. (p = 0.05)	N.S.	0.243	-	0.199	-	0.160	0.196	1.732	1.836

Shoot length: Shoot length at 15 DAP and at 30 DAP (11.55 cm *i.e.*, 7.8 percent increased as compared to 0 DAP and 12.40 cm *i.e.*, 15.8 percent increased as compared to 0 DAP) were recorded maximum for treatment T_9 (vermiwash 10%), respectively. These findings are in line with the work done by Trivedi *et al.* (2022) while working with bougainvillea, who observed most increase in shoot length with 10 % application of vermiwash, this might be due to the important role of vermiwash in the plant growth and development through contribute to the initiation of rooting, root growth, plant development, promotion growth rate and improvement in crop production.

Shoot diameter: **S**hoot diameter at 15 DAP and 30 DAP (4.46 mm *i.e.*, 12.1 percent increased as compared to 0 DAP and 4.78 mm *i.e.*, 20.1 percent increased as compared to 0 DAP) were recorded maximum for treatment T_9 (vermiwash 10%), respectively.

Fresh weight of cutting: Fresh weight at 15 DAP and at 30 DAP (4.44 g and 4.79 g) were recorded maximum with T_3 (IBA 100 ppm). These results are in agreement with the findings of Ayoub and El-Zeiny (2012) while working on cucumber, Al-Taha *et al.* (2013) while working on brinjal and Dahshan *et al.* (2018) while working with potato, as they also observed increasing effects of IBA for this trait.

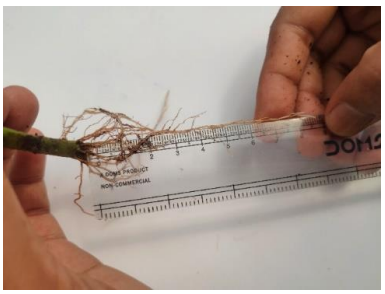
Chlorophyll content: During winter season maximum, chlorophyll a, b and total (1.269, 0.589 and 1.858 mg/g) and (1.291, 0.602 and 1.893 mg/g) were observed at 15 and 30 DAP for treatment T_3 (IBA 100 ppm), respectively. Shoot and root character were significantly influenced by various concentrations of indole-3-butyric acid, cow urine and vermiwash which might have resulted in better establishment of cuttings due to this, chlorophyll content might increase.

Number of roots per cutting: Number of roots per cutting (Table winter season results at 15 DAP revealed that the maximum number of roots per cutting (11.87) was recorded for treatment T_7 (cow urine 15%). These findings were in agreement with the work of Santoso *et al.* (2016) while working on chrysanthemum and Hansah (2020) while working on grape, whereas at 30 DAP showed a maximum number of roots per cutting (13.33) was observed for treatment T_3 (IBA 100 ppm).

Table 3: Influence of IBA, cow urine and vermiwash on length of root, fresh weight and dry weight of roots and root volume on tomato cutting.

Treatment	Length of root (cm)		Fresh weight of roots (mg)		Root volume (cm^3)		Dry weight of roots (mg)	
	15 DAP	30 DAP	15 DAP	30 DAP	15 DAP	30 DAP	15 DAP	30 DAP
T1	2.70	4.56	109.33	193.40	0.51	0.89	4.60	9.87
T2	3.84	5.44	159.87	230.27	0.75	0.95	9.30	13.83
T3	5.29	7.65	231.87	336.20	0.92	1.19	13.83	20.93
T4	4.81	6.83	208.43	292.87	0.87	1.12	11.27	18.43
T5	4.19	5.31	176.10	225.93	0.78	0.94	10.80	14.00
T6	3.59	4.86	148.87	205.13	0.66	0.91	7.23	12.30
T7	4.74	6.99	203.37	306.27	0.85	1.12	11.97	19.63
T8	3.95	5.77	168.60	247.67	0.69	0.96	8.77	14.43
T9	3.83	5.29	205.27	227.87	0.69	0.88	10.13	13.60
T10	3.89	5.47	162.90	238.40	0.68	0.92	9.63	14.73
SE(m) ±	0.456	0.588	23.186	26.363	0.09	0.068	1.819	2.27
C.D. (p = 0.05)	1.356	1.748	N.S.	78.317	N.S.	0.203	N.S.	N.S.

Length of root: The length of root (Table 3) at 15 DAP and 30 DAP (5.29 cm and 7.65 cm) was observed maximum for treatment T_3 (IBA 100 ppm). Lopez *et al.* (2001) while working on husk tomato, Al-Taha *et al.* (2013) while working on brinjal, El-Eslamboly (2014) while working on watermelon, Kachru *et al.* (2017) while working on tomato and Tariq *et al.* (2021) while working with bell pepper also seen the same trend with application of IBA, this might be due to the fact that during cell division and auxin transport, auxins act primarily through selective proteolysis and cell wall loosening with receptor protein transporting inhibitor response 1 and auxin-binding protein 1 (da Costa *et al.*, 2013), which results in increase in length of root cells.



Fresh weight and Dry weight of roots: Fresh weight of roots (Table 3) at 30 DAP (336.20 mg) was observed maximum at T_3 (IBA 100 ppm).

Root volume: Root volume (Table 3) at 30 DAP (1.19 cm^3) was observed maximum at T_3 (IBA 100 ppm). These results are in conformity with the work of Wulanndari *et al.* (2018) while working on pepper and Tariq *et al.* (2021) while working on bell pepper.IBA treatment increased the root volume in stem cuttings, which could be because auxins aid in cell division and cell expansion resulting in longer roots and a greater mean volume of roots.

Survival percentage: Survival percentage (Table 4) was recorded maximum (73%) at T_3 (IBA 100 ppm), however lowest survival percentage (51%) was observed at T_1 (control). IBA is the best auxin for general use since it is less toxic to plants at higher concentrations than NAA or IAA and is also useful in stimulating rooting and survival in a wide range of plant species. Cutting performance may be attributed to high carbohydrate reserves per cutting and optimal IBA concentration. These results are in conformity with the work done by Ayoub and El-Zeiny (2012) while working on cucumber and Tariq *et al.* (2021) while working on bell pepper.

Table 4: Influence of IBA, cow urine and vermiwash on chlorophyll content (a, b and total) on tomato cutting.

Treatment	Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Chlorophyll Total (mg/g)		Survival Percentage
	15 DAP	30 DAP	15 DAP	30 DAP	15 DAP	30 DAP	30 DAP
T1	0.442	0.470	0.168	0.180	0.610	0.650	0.442
T2	1.171	1.194	0.393	0.412	1.564	1.606	1.171
T3	1.269	1.291	0.589	0.602	1.858	1.893	1.269
T4	0.981	1.005	0.321	0.338	1.302	1.343	0.981
T5	0.995	1.012	0.258	0.273	1.253	1.285	0.995
T6	0.841	0.863	0.319	0.331	1.16	1.194	0.841
T7	0.919	0.946	0.169	0.184	1.088	1.13	0.919
T8	0.817	0.844	0.236	0.251	1.053	1.095	0.817
T9	0.598	0.622	0.209	0.223	0.807	0.845	0.598
T10	0.624	0.645	0.147	0.162	0.771	0.807	0.624
SE(m) ±	0.011	0.014	0.004	0.004	0.019	0.021	0.011
C.D. (p = 0.05)	0.033	0.041	0.011	0.013	0.057	0.061	0.033

CONCLUSIONS

From the investigation of the above-mentioned research problem, we can conclude that tomato propagation can be done with side stem cutting. The best result for the highest survival percentage and root growth was obtained from treatment T_3 (IBA 100 ppm), However, shoot growth responses can be observed for most of the treatment.

FUTURE SCOPE

This experiment was mainly focused on various chemicals and seasons by putting ranges on variables for the propagation of tomato stem cuttings. During this research, we observed that rooting of cutting was influenced by length of cutting, girth of stem, number of leaves, media, quality of water, climate, etc. We have used the ranges to minimize the error but further studies need to be done to standardize this technique for different regions.

Conflict of Interest. None.

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