Himachal Journal of Agricultural Research 47(2): 256-259 (2021)

Short Communication

Effect of indole butyric acid (IBA) and honey on root parameters of different sized stem cuttings in bell pepper

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Manuscript Received: 07.08.2021; Accepted: 28.10.2021

Abstract

Bell pepper has become a major vegetable crop in India and is widely produced under open as well as protected environments and yields remunerative returns. Growing hybrid bell pepper from seed is an expensive affair, hence, there is a need to find out an efficient technique of vegetative propagation of bell pepper plants. Rooting hormone IBA is the most commonly utilized plant hormone for promoting root development and generating new roots in tomato plants propagated through stem cuttings. The analysis of variance revealed that effect of different concentrations of rooting hormone (IBA), and honey on different sized stem cuttings was significant for number of days to root initiation, number of roots per cutting, total root length (cm), root volume (cm^3) and survival percentage. A significant impact on the days to root initiation (10.07 days), maximum number of roots per cutting (22.20), increase in root length (166.47cm), highest survival percentage of stem cutting (75%) and maximum root volume (2.20cm3) were observed in treatment $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm). All treatments resulted in a considerable improvement in all root parameters.

Key words: IBA, honey, bell pepper, stem cuttings, rooting.

Bell pepper (*Capsicum annuum* L. var. *grossum*), a member of the solanaceae family with the chromosome number 2n=24, is also known as sweet pepper, capsicum or Shimla mirch. It is a very important vegetable crop cultivated around the world for its delicate taste, pleasing flavor and colour. It is a leading crop under protected conditions all over the world.

It is an economically important crop all over the world, both for the fresh vegetable market as well as for processed food sector. Bell pepper has become a major vegetable crop in India, where it is grown in tropical, subtropical and mild temperate temperature zones. Besides that, bell pepper is widely produced under protected environments and yields remunerative returns. Growing hybrid bell pepper from seed is expensive due to the high cost of hybrid seeds. As a result, there is a need to find out an efficient technique of vegetative propagation of bell pepper plants for year-round multiplication and cultivation. Growth regulators influence fundamental plant growth and development processes. Indole Butyric Acid (IBA) is a plant growth regulator that belongs to the auxin family. IBA regulates growth and influences a variety of developmental processes, including stem elongation, early root formation, callus formation, flowering enhancement, enzyme induction, leaf and fruit senescence. IBA is the most commonly utilized plant hormone for promoting root development and generating new roots in tomato plant cloning by cuttings (Kachru *et al*., 2017). Other naturally available metabolites of organics, in addition to synthetic substances, are also known to contain important plant growth components that promote plant

growth and development. One such natural product honey also possesses antifungal and antiseptic properties that enhance the root growth and keep the plant healthy. Honey is also applied on cuttings to safe guard them against bacterial or fungal infections (Ibironke and Oyedokun, 2016). The current study was conducted to investigate a viable method for root development in bell pepper cuttings, decreasing the cost of purchasing hybrid seeds each time for a new crop and obtaining one or two extra crops through cuttings.

The present study was carried out at the Vegetable Research Farm of Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, during the rainy-autumn-winter season of 2020-21. In the experiment, IBA with varying concentrations (IBA @ 50 and 100 ppm) and honey (pure) was used to treat cuttings of three sizes (5,10 and 15 cm) and then grown in soilless media composed of a 3:1:1 ratio of cocopeat, perlite and vermiculite. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Prior to treating succulent cuttings, a slant cut was given at the base with a sharp knife to reduce cutting damage and promote root multiplication. The cuttings were dipped in the IBA solutions and honey for 25-30 seconds and planted in soilless media. The data were recorded for root parameters *viz*., number of days to root initiation, number of roots per cutting, total root length (cm), survival percentage of the stem cuttings and root volume (cm^3). The data were analyzed as per the standard statistical procedures (Gomez and Gomez, 1983).

The results in the Table 1 showed that the different treatments utilized in the current study had a significant impact on the days to root initiation. However, the rooting hormone IBA had a great impact on rooting and callusing than honey and control. Root initiation is the process through which particular cells in the vascular cambium divide and differentiate, resulting in the creation of roots. Because of its excellent ability to induce root initiation, low toxicity and increased stability in contrast to auxins like NAA and IAA, IBA is the most extensively used auxin to stimulate rooting in cuttings.

Perusal of data indicates that the treatment $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) took the least days (10.07) for roots initiation followed by $RH_1C_2S_2$ (RH_1 = IBA, C_2 = 100 ppm and S_2 = 10 cm), and both these treatments were comparable and outperformed all other treatments, The maximum days for root initiation were taken by the treatment HnS_1 (Hn=honey and S_1=5 cm). The reduction in days to root initiation in treatments $RH_1C_2S_3$ could be attributed to the quick dip in IBA solution, which accumulated the endogenous auxin content at the base of the cuttings, accelerating root initiation and the development of root primordia, resulting in rooting in treated cuttings. Without IBA, the endogenous hormonal balance was presumably more conducive to shoot development. Exogenous IBA may thus aid in modifying the endogenous level of growth regulators in order to achieve an adequate hormone balance for root proliferation. These findings are also backed up by research findings of Nizam-ud-din *et al*. (2005), Kachru et al. (2017) and Nikmatullah *et al*. (2018) who also observed significant disparities in the number of days required for root initiation.

The stem cuttings treated with various doses of rooting hormones and honey significantly altered the number of roots per cutting in bell pepper. In the treatment $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) the maximum number of roots per cutting (22.20) was recorded which was significantly superior to the controls. However, two other treatments viz., $RH_1C_2S_2$ (RH_1=IBA, C_2=100 ppm and S_2=10 cm) $RH_1C_1S_3$ (RH_1=IBA, C_1=100 ppm and S_3=15cm), were also comparable for number of roots per cutting. The least number of roots per cutting (16.27) were observed in Control S_1 i.e. 5 cm stem length.

The increased number of roots per IBA-treated cutting might be attributed to cambial activity, which resulted in root induction. It is the most well-known activator of root development and plays an important role in plant growth by regulating cell differentiation. It promotes the translocation and mobilisation of certain auxin co-factors and carbohydrates toward the basal part of cuttings. It also counteracts the effects of

other root-inhibiting hormones like gibberellins and cytokinins. These findings are consistent with those of Hossain *et al*. (1998), Bhore *et al*. (1999), Nizam-ud-din *et al*. (2005), Jasim and Abed (2013), Waheed *et al*. (2015), Kachru *et al*. (2017) and Nikmatullah *et al*. (2018) who have also reported variation for number of roots per cutting in their experiments.

Root length is one of the vital factors for nutrient absorption from soil. A poor root system can leads to shorter life cycle as well as poor fruit quality. According to the results in the Table 1, stem cuttings treated with varied concentrations of IBA, honey and stem length employed in the study influenced the length of roots significantly. The perusal of data revealed that the longest total root length of 166.47 cm was observed in treatment $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) followed by $RH_1C_2S_2$, however, it was significantly superior to other treatments. The shortest total roots (131.40) were observed in control S_1 (S_1=5m). IBA clearly increased the root length of stem cuttings, which could be attributed to auxins which aided in cell division and cell expansion, resulting in longer roots and a greater mean length of roots. Cell elongation is characterized by a series of changes in levels or activity of enzyme. IBA increases root length by altering the synthesis of enzymes involved in cell growth. The better effects of IBA on root elongation could be the effect of various reasons, including preferential absorption, transport, metabolization and subsequent gene activation. These results are in concurrence with the findings of Hossain *et al*. (1998), Nizam-ud-din *et al*. (2005), Jasim and Abed (2013), Balliu and Sallaku (2017) and Nikmatullah *et al*. (2018).

Survival percentage of stem cuttings determines the overall yield of the crop because better the plant population higher will be the productivity of crop. From the perusal of data presented in Table 1, it is quite visible that the effect of different concentrations of IBA, honey and stem length on survival of the stem cuttings was significant.

$RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) had the highest survival percentage (75.00%) followed by treatment $RH_1C_2S_2$ and $RH_1C_2S_1$ which were at par and were significantly superior to the controls. The lowest survival percentage (52.73%) was observed in HnS_1 (Hn = honey, and S_1 = 5cm).

It is quite visible that the survival of rooted cuttings was considerably influenced by IBA concentrations, with IBA being found to be more effective than honey. IBA is the best auxin for general use since it is less toxic to plants at higher

Table 1. Effect of indole butyric acid (IBA) and honey on root parameters of different sized stem cuttings in bell pepper

Treatment	No. days to root initiation	No. of roots per cutting	Total root length (cm)	Survival of the stem cuttings (%)	Root volume (cm^3)
$RH_1C_1S_1$	13.60	17.33	142.53	56.53	1.58
$RH_1C_1S_2$	12.87	17.87	149.33	59.07	1.75
$RH_1C_1S_3$	12.13	21.07	159.53	62.60	2.04
$RH_1C_2S_1$	13.13	18.60	148.87	72.80	1.74
$RH_1C_2S_2$	10.60	21.20	160.67	74.87	2.12
$RH_1C_2S_3$	10.07	22.20	166.47	75.00	2.20
HnS_1	16.73	17.13	132.07	52.73	1.16
HnS_2	15.87	18.07	139.33	53.67	1.27
HnS_3	14.73	18.47	140.53	56.60	1.59
Control S_1	15.13	16.27	131.40	55.33	1.25
Control S_2	13.93	16.80	133.67	59.33	1.43
Control S_3	13.00	17.40	136.27	61.20	1.62
SE (m) = ±	0.66	0.50	1.00	0.86	0.05
CD (P0.05)	1.96	1.47	2.95	2.83	0. 15

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 findings are consistent with those of EL-Eslamboly (2014), Waheed *et al*. (2015) and Nikmatullah *et al*. (2018).

Root volume predicts the localized uptake of water as well as nutrient to the plant hence, better root volume is very important for the growth and development of a crop. An examination of the data in Table 1 revealed that stem cuttings treated with various doses of IBA, honey and different size of cutting significantly altered the root volume (cm^3) in bell pepper. The maximum volume of roots i.e. 2.20 cm^3 was recorded in treatment $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) and was far superior than all other treatments. The lowest root volume (1.25 cm^3) were observed in control S_1 (S_1=5m). IBA treatment clearly increased the root volume in stem cuttings, which could be due to the fact that auxins aid in cell division and cell expansion resulting in longer roots and a greater mean volume of roots. Another significant finding is that the root volume increased more in the longest cuttings of 15 cm size. Cell elongation is characterized by a series of changes in enzyme levels or activity and auxins activate the enzymes involved in cell expansion processes. These findings are also supported by the research work of Jasim and Abed (2013) and Balliu and Sallaku (2017).

The investigation revealed that various concentrations of IBA and honey significantly improved all root parameters in stem cuttings of bell pepper. Cuttings treated with $RH_1C_2S_3$ (RH_1=IBA, C_2=100 ppm and S_3=15cm) gave the best results as the minimum days for root initiation, maximum number of roots per cutting,, maximum total root length (cm), the highest survival percentage of the stem cutting and maximum root volume (cm^3) was recorded.

Conflict of interest: The authors declare that there is no conflict of interest in this research paper.

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