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Study of IBA Containing Rooting Powder on Root Induction Behavior of Hardwood Cutting of Grape (*Vitis vinifera* L.)

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ABSTRACT

Background: Grapes are mostly propagated by hardwood cutting. Most of the time, auxin (Indole Butyric Acid) is used in liquid form. There are some problems associated with using auxin in liquid form *viz.* cell sap may exude from cutting end on dipping in solution that may lead to contamination, every time auxin solution should be freshly prepared *etc.* In order to address these problems, auxin hormone is used in powder form by using Talcum powder.

Methods: In the present investigation, rooting powders containing different concentration of auxin were tried for root induction behavior. Approximately 15-20 cm long and 1-1.5 cm thick hardwood cuttings of grapes were taken.

Result: The results indicates that grape cuttings treated with Indole Butyric Acid @ 3000 ppm in powder form was found to be best for root induction behavior. However, in most of the cases observations were *at par* with Indole Butyric Acid @ 2000 ppm (powder form) and with treatment @ 2000 ppm in liquid form but if we consider other benefits like long shelf life, no contamination *etc.* It can be concluded the rooting hormone in powder form should be considered better alternative to liquid form for root induction.

Key words: Asexual, Auxin, Clonal, Propagation, Rooting, Stem cutting, Vegetative.

INTRODUCTION

Grape (*Vitis vinifera* L.) is cultivated extensively in the both subtropical climate of northern India and tropical climate of southern and western India. Mostly grapes are cultivated in Andhra Pradesh, Maharashtra, Tamil Nadu and Karnataka. Grapes are mostly propagated by hardwood cutting. Most of the time, auxin (Indole butyric acid) is used in liquid form. Many research work has been carried out to know the correct concentration of auxin treatment to hardwood cuttings of grapes. But in most of the cases, auxin mostly IBA is used in liquid form *i.*e. hormonal solution is prepared and cuttings are treated by dipping for some time. In one of the research it was described that the mixture of NAA and IAA at 2000 ppm and 6000 ppm proved harmful and reduced the minimum survival percentage (Patil *et al*., 2001). The best rooting was found when the cutting base were dipped in a solution of IBA at 150 ppm for 24 hours in 4 cultivars of grapes *viz.* Thompson seedless, Flame seedless, Beauty seedless and Anab-e-Shahi (Song *et al*., 2001). It was found that the highest percentage of rooting in the form of results that is (64.2%) was observed in IBA at 50 ppm + 2,4-D at 50 ppm per liter in the cuttings of Kyoho grape cultivar (Liu, 2001). While in one of the investigation, it was found that IBA treated cuttings at 2500 ppm for 30 seconds lead to production of increased number and length of roots in grape rootstock Salt creek (24.5 and 28 cm) and Dogridge (42.5 and 24 cm) respectively. It was also found that increased percentage of sprouting (80.0 and 86.6) by IBA treatment at 1500 ppm for 30 seconds in Salt creek and Dogridge rootstocks. Mixture of (NAA and IBA @ 2000 ppm and 6000 ppm) was harmful to survival percentage of cuttings and almost all characteristics of root (Garande *et al*., 2002).

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There are some problems associated with using auxin in liquid form *viz.* cell sap may exude from cutting end on dipping in solution that may lead to contamination, every time auxin solution should be freshly prepared. This IBA solution have to be prepared freshly every time after utilization as we cannot reuse this IBA solution for not more than 15 days due to contamination and denaturing. Some workers use excess Ethyle alcohol for quick dissolving of auxin in solution, it may lead to toxicity and dryness in the cuttings after application. In order to address these problems, auxin hormone is used in powder form by using Talcum powder (Magnesium Silicate) as a base material.

MATERIALS AND METHODS

This experimental was conducted in the Horticultural Nursery of Lovely Professional University, Phagwara, Punjab. Various combinations and concentrations of IBA containing rooting powder were tried for the induction of rooting in hardwood

cuttings of grapes during 2018 to 2019. The cultivar used in this experiment as "Punjab Macs Purple". In this investigation recommended amount of IBA was used and mixed with minimum quantity of Ethyl alcohol after the uniform mixing Talcum powder in the form of Magnesium Silicate was mixed into mixture in powder form. Magnesium silicate (Talcum powder) was taken as a carrier for making the rooting powder for increasing the overall concentration of IBA. A total of nine treatments, comprising *viz.* T_1 - Control; T_2 - IBA @ 2000 ppm (Liquid form); T_3- Only magnesium silicate; T_4- IBA @ 1000 ppm; T_5- IBA @ 2000 ppm; T_6- IBA @ 3000 ppm; T_7- IBA @ 1000 ppm with zinc sulfate @ 5000 ppm; T_8 - IBA @ 2000 ppm with zinc sulfate @ 5000 ppm; T_9 - IBA @ 3000 ppm with zinc sulfate @ 5000 ppm were used. About seven (T_3 to T_9) treatments were prepared in powder form with base material (as a carrier) Talcum powder (Magnesium silicate). In this investigation healthy hardwood cuttings (one year old) were taken and detached from mother plant. The base of cutting was moistened. Recommended amount of rooting hormone was poured into the container, after that the base of the cutting was coated with this rooting powder mixture and rolled along with the length of cutting and planted into the soil. There were 10 cuttings in each replications *i.e* 30 cuttings in each treatment and total 270 hard wood stem cuttings were taken for the investigation. Cuttings were wounded at the base for early emergence of roots from the plants. Cuttings were planted in each bed at height of 5 to 10 cm depth into the soil and irrigated uniformly. Observations related to rooting parameters were recorded *viz*. rooting percentage, number of roots, length of the roots (cm), diameter (girth) of the roots (mm), number of sprouts, time taken for rooting, time taken for first bud sprouts, fresh root weight (gm) and dry root weight (gm) were taken. These observations were taken at 100 days, 125 days 150 days and the data were interpreted accordingly. This research was carried out adopting randomized block design (RBD) statistical designed.

RESULTS AND DISCUSSION

The results obtained in the current investigation are presented hereunder.

Effect on rooting percentage (%)

A perusal of Table 1 indicates that the various concentrations of IBA significantly affected the root induction. The maximum rooting percentage was obtained in T_6 (IBA @ 3000 ppm) followed by T_2 (IBA @ 2000 ppm in liquid form) and T_5 (IBA @ 2000 ppm) which were *at par* with each other.

The effects of various IBA treatments on rooting percentage of grapes cuttings were found to be significant. Highest rooting percentage (92.0%) was found in the treatment T_6 (IBA 3000 ppm) at 150 days after planting, it was statistically *at par* with treatment T_2 (IBA 2000 ppm) *i.e* 86.1% and T_5 (IBA 2000 ppm) at 150 days after planting. Lowest rooting percentage was found in T_1 (Control) *i.e*. 45.7% at 150 days after planting.

Effect on number of roots

A perusal of Table 2 as well as of Plate 1 indicates that the various concentrations of IBA significantly affected the studied characteristics in root formation.

The maximum number of roots were obtained in T_5 (IBA @ 2000 ppm in powder form) followed by T_2 (IBA @ 2000 ppm in liquid form) and T_6 (IBA @ 3000 ppm) which were *at par* with each other, while minimum number of roots were observed in T_1 (control) that is (6.1) in 150 days.

Effect on root length (cm)

A perusal of Table 3 as well as of Plate 1 indicates that the different concentrations of IBA significantly affected the root length growth. This table reveals that root length increased at the dose of IBA @ 3000 ppm in treatment T_6 followed by IBA @ 2000 ppm in liquid form in treatment T_2 and IBA @ 2000 ppm in treatment T_5 which were *at par* with each other. Minimum root length was observed in T_1 (control) that is (5.3 cm) in 150 days.

Effect on root diameter (mm)

A perusal of Table 4 indicates that the different concentrations of IBA significantly affected the variation in root diameter growth. Results revealed that root diameter increased with concentration of IBA @ 3000 ppm in treatment T_6 followed by IBA @ 2000 ppm in liquid form in treatment T_2 and IBA @ 2000 ppm in powder from in treatment T_5. The maximum root

Table 1: Effect of various concentrations of IBA in powder form on rooting percentage of hardwood cuttings of grape at different intervals.

Treatment	Rooting percentage		
	At 100 days	At 125 days	At 150 days
T_1- (Control)	42.2	45.1	45.7
T_2- (IBA 2000 ppm in liquid form)	84.5	85.0	86.1
T_3- (Only magnesium silicate)	45.5	47.2	49.1
T_4- (IBA 1000 ppm in powder form)	70.2	72.1	74.3
T_5- (IBA 2000 ppm in powder form)	80.7	81.5	82.2
T_6- (IBA 3000 ppm in powder form)	90.5	91.2	92.0
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	56.2	60.1	61.2
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	59.7	62.2	62.8
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	46.5	48.2	49.2
SE(m)	4.07	3.73	3.62
C.D @ 5%	12.5	11.2	10.8

Table 2: Effect of various concentrations of IBA in powder form on number of roots of hardwood cuttings of grape at different intervals.

Treatment	Number of roots		
	At 100 days	At 125 days	At 150 days
T_1- (Control)	3.2	4.5	6.1
T_2- (IBA 2000 ppm in liquid form)	20.0	24.2	25.3
T_3- (Only magnesium silicate)	9.8	12.2	13.2
T_4- (IBA 1000 ppm in powder form)	18.2	19.7	20.2
T_5- (IBA 2000 ppm in powder form)	24.2	26.2	30.1
T_6- (IBA 3000 ppm in powder form)	20.5	25.3	26.2
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	18.0	19.3	21.2
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	17.8	18.3	18.8
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	12.5	14.7	15.2
SE(m)	1.38	1.51	1.64
C.D @ 5%	4.2	4.5	4.9

Plate 1: Photographs showing rooting behavior of hardwood cutting of grape treated with T_1, T_2 and T_6.

diameter was obtained in T_6 (IBA @ 3000 ppm) followed by T_2 (IBA at 2000 ppm in liquid form) and T_5 (IBA @ 2000 ppm) and declined thereafter in control. Minimum root diameter was observed in T_1 (control) that is (1.16 mm) at 150 days.

Effect on number of sprouts

A perusal of Table 5 indicates that the different concentrations of IBA significantly affected the studied characteristics increase in the number of sprouts. The maximum number of sprouts were obtained in T_5 (IBA @ 2000 ppm) followed by T_2 (IBA @ 2000 ppm in liquid form) and T_6 (IBA @ 3000 ppm) and minimum number of sprouts were observed in control. Minimum numbers of sprouts were observed in T_1 (Control) 1.2.

Effect on time taken for first bud sprout and rooting (In days)

A perusal of Table 6 indicates that the different concentrations of IBA not affected the days to first rooting and shooting non significantly. However rooting was observed in T_6- (IBA @ 3000 ppm) 78 days after planting into the soil and first bud sprout was observed at 85 days after planting and in treatment T_1 (control) days taken for the formation of first rooting and sprouting was late recorded as 83 days for rooting and 90 days for sprouting. The data was recorded after every 5 to 7 days interval in each treatment. There was no effect of treatments over number of days to rooting and sprouting.

Effect on root fresh weight and root dry weight at days after planting

A perusal of Table 7 indicates that the different concentrations of IBA significantly affected the studied characteristics increase in the root dry weight percentage.

This table reveals that dry weight percentage increased at the concentration of IBA @ 3000 ppm in treatment T_6 followed by IBA @ 2000 ppm in liquid form in treatment T_2 and IBA @ 2000 ppm in treatment T_5. The maximum root dry weight percentage over root fresh weight was obtained in T_6 (21.7%) (IBA @ 3000 ppm) followed by T_2 (17.98%) (IBA @ 2000 ppm in liquid form) and T_5 (19.77%) (IBA @ 2000 ppm) and declined thereafter in control. Treatment T_6 was *at par* with treatment T_3 (Magnesium silicate only) and T_4 (IBA @ 1000 ppm). In this percentage of dry weight was calculated from the freshly detached roots from the soil. Maximum root dry weight percentage was calculated in T_6 (IBA @ 3000 ppm) which signifies that these roots are best in terms of quality and strength as they have the capability to survive under various adverse climatic conditions and they are resistant to disease.

Table 3: Effect of various concentrations of IBA in powder form on root length (cm) of hardwood cuttings of grape at different intervals.

Treatments	Root length (cm)		
	At 100 days	At 125 days	At 150 days
T_1- (Control)	3.1	4.7	5.3
T_2- (IBA 2000 ppm in liquid form)	7.8	8.3	9.4
T_3- (Only magnesium silicate)	4.6	4.9	5.5
T_4- (IBA 1000 ppm in powder form)	6.2	7.6	8.1
T_5- (IBA 2000 ppm in powder form)	8.7	12.3	13.6
T_6- (IBA 3000 ppm in powder form)	9.5	13.1	14.4
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	5.4	6.3	7.6
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	5.1	5.9	6.7
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	5.0	5.5	5.8
SE(m)	0.38	0.46	0.52
C.D @ 5%	1.05	1.38	1.49

Table 4: Effect of various concentrations of IBA powder form on root diameter (mm) of hardwood cuttings of grape at different intervals.

Treatments	Root diameter (mm)		
	At 100 days	At 125 days	At 150 days
T_1- (Control)	1.01	1.08	1.16
T_2- (IBA 2000 ppm in liquid form)	1.63	1.94	2.61
T_3- (Only magnesium silicate)	1.12	1.20	1.35
T_4- (IBA 1000 ppm in powder form)	1.53	1.68	2.43
T_5- (IBA 2000 ppm in powder form)	1.89	2.01	2.91
T_6- (IBA 3000 ppm in powder form)	2.33	2.48	3.47
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	1.48	1.57	2.24
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	1.29	1.31	1.64
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	1.21	1.27	1.41
SE(m)	0.14	0.19	0.23
C.D @ 5%	0.37	0.4	0.66

On the basis of the results of the current investigation, it can be observed that cuttings treated with IBA @ 3000 mg (T_6) was showing good results in terms of rooting percentage, number of roots, length of the roots (cm), diameter (girth) of the roots (mm), number of sprouts, time taken for rooting, time taken for first bud sprouts, fresh root weight (gm) and dry root weight (gm) were taken parameters. However, in most of the cases observations were *at par* with T_2 (IBA @ 2000 ppm in liquid form) and T_5 (IBA @ 2000 mg). Similar results were also observed in cv. Anab-e-shahi treated with IBA 3000 mg per litre (Ram *et al*, 2005).

The powder form don't contain residues of alcohol as compared to IBA in liquid form which lead to desiccation (dryness) in cuttings and while dipping the grape cutting into IBA solution, cell sap may exude from cutting end and mix in IBA solution that may lead to fungal or bacterial infection.

As we have used IBA in powder form there were less chances of dying and drying of the plants due to contamination. Due to this reason, rooting hormone IBA in powder form is better alternative for root induction. Similar results were also obtained by the use of Rhizopon powders (containing various concentrations of Auxins in powder form) which was found to play an important and significant role in development of roots, rooting percentage and growth of plants (Monder, 2016). The results obtained were in conformity with Reddy *et al.* (2008) in case of fig.

IBA @ 3000 mg (T_6) was found to be the best in comparison to control in terms of maximum rooting percentage, induction of roots andincrease in root length, root diameter and root fresh and dry weight. It is due to the factor that in the presence of auxin the cell division is stimulated by auxin and their extension and differentiation of cambial initials into the primordial of root and in the transfer and translocation of reserve food material to root formation and initiation sites by providing maximum number of roots, increase in root length, root diameter. Cambial cells are the region of meristematic tissues which in later stages helps in the formation of vascular bundles (Xylem and Phloem) which leads to the ease in transfer of reserve food material during photosynthesis. More metabolites and reserve food material might have been transported and trans located to the application site of IBA *i.e.*, cutting's base resulting in enhancing the rooting percentage. (Krishnamurthy, 1981).

When cuttings are treated with auxin, in later stages helps in activation of cytokinin which leads to the formation of reserve food material, but in control (T_1) due to absence of auxin there was no activation of cytokinin which leads to minimum formation of reserve food materials resulting in lowest number of roots, rooting percentage, root length and

Table 5: Effect of various concentrations of IBA in powder form on number of sprouts of hardwood cuttings of grape at different intervals.

Treatments	Number of sprouts		
	At 100 days	At 125 days	At 150 days
T_1- (Control)	0.9	1.1	1.2
T_2- (IBA 2000 ppm in liquid form)	2.1	2.3	2.6
T_3- (Only magnesium silicate)	1.0	1.1	1.4
T_4- (IBA 1000 ppm in powder form)	2.0	2.2	2.4
T_5- (IBA 2000 ppm in powder form)	3.3	3.6	3.9
T_6- (IBA 3000 ppm in powder form)	2.4	2.7	3.4
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	1.9	2.2	2.3
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	1.4	1.6	1.8
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	1.2	1.3	1.6
SE(m)	0.22	0.23	0.25
C.D @ 5%	0.68	0.71	0.77

Table 6: Effect of various concentrations of IBA in powder form on time taken for first bud sprout and rooting (In days).

Treatments	Days to first rooting	Days to first bud sprout
T_1- (Control)	83	90
T_2- (IBA 2000 ppm in liquid form)	81	87
T_3- (Only magnesium silicate)	84	89
T_4- (IBA 1000 ppm in powder form)	82	88
T_5- (IBA 2000 ppm in powder form)	80	86
T_6- (IBA 3000 ppm in powder form)	78	85
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	79	86
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	81	87
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	79	84
SE(m)	0.5	0.7
CD	NS	NS

Table 7: Effect of various concentrations of IBA in powder form on root fresh weight and root dry weight at days after planting.

Treatments	Root fresh weight (gm)	Root dry weight (gm)	Dry weight percentage (%)
T_1- (Control)	10.8	1.7	15.74
T_2- (IBA 2000 ppm in liquid form)	18.9	3.4	17.98
T_3- (Only magnesium silicate)	10.3	2.06	20.00
T_4- (IBA 1000 ppm in powder form)	16.4	3.4	20.73
T_5- (IBA 2000 ppm in powder form)	26.8	5.3	19.77
T_6- (IBA 3000 ppm in powder form)	28.9	6.3	21.7
T_7- (IBA 1000 ppm in powder from+5000 ppm $ZnSO_4$)	14.8	2.8	18.91
T_8- (IBA 2000 ppm in powder form+5000 ppm $ZnSO_4$)	12.4	2.I2	17.74
T_9- (IBA 3000 ppm in powder form+5000 ppm $ZnSO_4$)	10.9	1.8	16.51
SE(m)	1.75	0.56	0.62
CD	5.17	1.31	1.70

diameter, root fresh and dry weight and number of sprouts in some research conducted (Adsule *et al.*, 2012). Similar result was found that the maximum number of roots, root length and rooting percentage was observed in grape cuttings treated with IBA 3000 mg per litre (Ram *et al*, 2005), IBA @ 2500 mg per litre with Norton rootstock of grape (Rao, 2004) and IBA @ 2500 mg per liter in grape rootstock (Garande *et al.,* 2002). These results resembles with the research in which IBA increased the root length, root number and fresh and dry weight of roots in cuttings of grape (Galavi, 2013). Similar findings were also recorded by Kaur (2015) observed that hardwood cuttings of peach cv. Shan-e-Punjab treated with IBA (3000 ppm) found to be most suitable for highest sprouting percentage, survival percentage, average number of roots, length of main root, root girth *etc*. Similar results are also found in hardwood cuttings of *Vitex negundo* treated with 3000 ppm Indole Butyric Acid (IBA) obtained maximum rooting success (Bhagya *et al*, 2014).

There was no positive effect of adding zinc sulfate along with the IBA in the treatments @ 5000 mg). This might be due to the reason as zinc acts as catalyst in natural Auxin synthesis. Absorption of zinc at initial stage and its incorporation and participation into auxin synthesis process may take longer time (more than 150 days). This may be the reason that hardwood cutting responded better with the external application of IBA as compared with zinc sulfate. It was found that zinc treatment in various combinations with Auxin in the form of IBA and IAA for enhancement of rooting percentage (80%) in cuttings of Mango (Yamashita *et al.* 2006).

CONCLUSION

On the basis of the current investigation, it can be concluded that IBA @ 3000 mg (T_6) was found to be best for the induction of roots with all quality parameters. However in most of the cases observations were *at par* with T_2 (IBA @ 2000 ppm in liquid form) and T_5 (IBA @ 2000 mg) but if we consider other benefits *viz.* long shelf life of powder form as compared to liquid form, Less chances of toxicity of Ethyle alcohol with cutting, No chances of spreading contamination from unhealthy cuttings to healthy cuttings as the powder form doesn't require any type of dilution with the liquid as cuttings can be simply dipped in powder. Hence IBA hormone mixed in powder form is considered better alternative for rooting.

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