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Growth Regulators and Sucrose Application to Improve the Success Rate of Grape Cuttings

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Abstract

Cuttings are the most convenient and cheapest method for obtaining the true to type plants. To develop early rooting in cuttings, an experiment was conducted to enhance the rooting of grape cv. Perlette. Hardwood cuttings were treated with Indole butyric acid (IBA 1000, 2000, 3000 and 4000 ppm), Poly-3-hydroxy butyrate (PHB 500, 750 and 1000 ppm), Sucrose (10, 20, 30 and 40 g/L) and water (control) by quick dip method. Periodical observations were taken after 120 days. The treated lots in every instance had a greater percentage of rooted cuttings with a higher number of roots per cutting. Among the various treatments IBA @ 3000 ppm resulted into highest number of roots per cutting, more fresh weight of roots, minimum days to first sprouting, highest sprouting percentage, a greater number of shoots per cutting, high average stem diameter, a greater number of leaves and total leaf area. Hence, it can be concluded from the present investigation that IBA @ 3000 ppm is proved to be best in term of root and shoot enhancement of grape cv. Perlette.

Keywords: IBA; Cuttings; Roots; Shoot; Grapes; Perlette

Introduction

Grape (*Vitis vinifera* L.) is one of the oldest fruit belongs to the family Vitaceae. Grape is the most essential, delicious and refreshing commercial fruit crop of temperate to sub-tropical regions (Rolaniya et al., 2018). Grapes are well known for their delicacy and are a fairly good source of minerals like calcium, phosphorus, iron, vitamins like B_1 and B_2 and sugars like glucose, fructose and sucrose (Jamwal et al., 2013). Due to its high nutritive value, excellent taste, multipurpose use and better returns, grape is becoming more popular. On a worldwide basis, table grape consumption has increased. Grape cv. Perlette is quite successful in North Indian region occupying more than 90 % of the total area. (Rather et al., 2011). The grape vine is generally propagated by vegetative method such as hard wood cutting (Rolaniya et al., 2018). It is the most convenient and cheap method of obtaining a fully developed strong plant in less span of time, give more yield and quality fruit every year (Kareem et al., 2016; Kaur and Kaur 2016).

Application of plant growth regulators with optimal concentrations are the important factors that should be considered carefully for increasing rooting of cuttings (Galavi et al., 2013). Auxin is one of the most important hormones that used on the stem cuttings for accelerating the formation of adventitious roots (Galavi et al., 2013). The essential role of auxin has been documented on induction rooting and root formation (Ajmal, 2014). IBA is well known as a rooting hormone, it helps to increase the root growth and development. Growth regulators like IBA, when treated on cuttings resulted in higher percentage of rooting of cuttings in pomegranate. The plant growth regulators such as IBA induce the initiation and proliferation of callus and new vascular tissue by

promoting cell division and/or cell development (Bonner et al., 1952; Rost et al., 1984; Raven et al., 1992).

Materials and Methods

The present study entitled "Growth regulators and sucrose application to improve the success rate of Grape cuttings" was carried out in the nursery, Department of Horticulture, Khalsa College, Amritsar during the year 2018-19. The cuttings were taken from healthy, free from attack of diseases and pests with uniform sized branches of grape cv. Perlette. The cuttings were selected preferably of pencil thickness about 9 inches size. A round cut was given at the upper side and slanting cut was given at the lower end of the cutting. Cuttings were treated with IBA 1000, 2000, 3000 and 4000 ppm, PHB 500, 750 and 1000 ppm, sucrose 10 g, 20 g, 30 g and 40 g/l and with plain water. Treatments were given by quick dip method. The experiment was composed of 12 treatments of different growth regulators, sucrose and control. Each treatment was replicated thrice. Twenty-five cuttings were used in one replication, 75 cuttings were used in each treatment and total 900 cuttings were planted on the raised beds prepared by incorporating a mixture of sand, soil and farmyard manure in a proportion of 1:1:1. While planting about 2/3rd length of the cuttings were buried in the soil, leaving 1/3rd exposed to the environment. The cuttings were planted 20 cm apart with row-to-row distance of 30 cm. Observations on days to first sprouting, sprouting percentage (%), number of shoots per cutting, stem diameter (mm), number of leaves per cutting, total leaf area (cm^2), number of roots per cutting and fresh weight of roots (g) were recorded and statistically analyzed by using Randomized Block Design. All statistical analysis were performed at the level 5 % using statistical software EDA package developed by John Tukey (1970).

Results and Discussion

Days to sprouting (days)

The data on the days to sprouting are presented in Table 1. IBA 3000 ppm recorded minimum number of days to sprouting, while maximum was under control. The reason for the earliness in sprouting may be due to the fact that the stored carbohydrates, nitrogen and other factors were better utilized with the help of growth regulators (Chandramouli, 2001). Early sprouting may also be due to the fact that sucrose is a good source of carbohydrate which supply direct energy to cuttings, which leads to early sprouting (Dey et al., 2017).

Sprouting percentage

The data regarding sprouted cuttings influenced by different concentrations of IBA, PHB and sucrose is presented in Table 1. All the growth regulators had significant influence on the sprouting percentage of cuttings. Among the treatments, the highest sprouting (81.33 %) of cuttings were recorded with IBA 3000 ppm under quick dip method, while the least sprouting (42.67 %) in control. The increased level of auxin activity and its slow degradation by auxin destroying enzyme, resulting in earlier completion of physiological processes in rooting and sprouting of cuttings (Kaur, 2017).

Number of shoots per cutting

Number of shoots emergence with different treatments are presented in the Table 1. The experiment revealed the significant effect of IBA, PHB and sucrose on number of shoots per cuttings. The maximum number of shoots (4.67) were obtained from the cuttings treated with IBA 3000 ppm, however minimum (1.50) shoots under control. IBA and PHB application affects the cell division in the vascular cambium, resulting in cell proliferation and control of differentiation into different types of cambial tissues resulting in increase of number of shoots (Devi et al., 2016).

Stem diameter (mm)

The data relating to stem diameter under the influence of IBA, PHB and sucrose is presented in Table 1 showed that IBA 3000 ppm was found to increase stem diameter up to 10.01 mm. Whereas, Minimum diameter (7.33 mm) was measured under control. The growth of

sprouts in terms of length and width depends on the optimal balance of root and shoot ratio which is essential for absorption and translocation of moisture and nutrients (Shukla et al., 2004).

Number of leaves per cutting

The number of leaves per cutting were significantly affected by various concentrations of IBA, PHB and sucrose as shown in the Table 1. It is evident from the results that the maximum number of leaves per plant (79.83) were counted after 120 days under IBA 3000 ppm treatment, while the minimum was recorded in control. The increase in leaf number may be due to the vigorous rooting which enables the cuttings to absorb more nutrients through growth regulators and thus produces more leaves (Stancato et al., 2003).

Table 1. Effect of growth regulators and sucrose on shoot and root characters of grape cuttings cv. Perlette

Treatments	Days to first sprouting	Sprouting (%)	Number of shoots	Stem diameter (mm)	Number of leaves	Total leaf area (cm^2)	Number of roots	Fresh weight of roots (g)
T_1	35.21	66.67	2.17	7.47	47.83	122.34	32.67	0.82
T_2	34.67	70.67	3.50	8.63	56.17	172.54	25.67	0.97
T_3	33.33	81.33	4.67	10.07	79.83	320.63	41.83	2.28
T_4	33.52	78.67	4.17	9.50	79.17	290.26	36.67	2.05
T_5	38.33	56.00	2.50	7.63	35.67	85.05	10.83	0.40
T_6	36.67	62.67	4.00	8.70	79.00	269.79	20.17	0.42
T_7	35.67	70.67	3.83	8.77	75.50	233.84	23.67	0.57
T_8	35.75	68.00	2.83	8.03	39.83	101.14	16.50	0.61
T_9	34.00	76.00	3.17	8.53	54.33	162.45	40.17	1.01
T_{10}	35.00	74.67	3.00	8.17	47.83	122.93	33.67	1.14
T_{11}	35.19	61.33	1.83	7.63	33.83	73.62	29.17	1.31
T_{12}	42.95	42.67	1.50	7.33	32.50	67.47	19.33	0.36
Mean	35.86	67.44	3.10	8.37	55.12	168.50	27.33	0.99
CD (0.05)	1.78	8.88	1.215	0.56	1.65	47.82	2.48	0.32

T_1: 1000 ppm IBA, T_2: 2000 ppm IBA, T_3: 3000 ppm IBA, T_4: 4000 ppm IBA, T_5: 500 ppm PHB, T_6: 750 ppm PHB, T_7: 1000 ppm PHB, T_8: 10 g Sucrose, T_9: 20 g Sucrose, T_{10}: 30 g Sucrose, T_{11}: 40 g Sucrose and T_{12}: Control

Total leaf area (cm^2)

The data on total leaf area per cutting were recorded after 120 days. It could be depicted that the different concentrations of IBA, PHB and sucrose had significant effect on leaf area (Table 1). The maximum leaf area (320.63 cm^2) was recorded in IBA 3000 ppm treatment, while minimum leaf area (67.47cm^2) was obtained under control. Leaf area is one of the major characters contributing to the vegetative growth of the plant. The increase in the leaf area, increases the photosynthetic activity resulting into increased carbohydrates which results in higher growth (Patil et al., 2001).

Number of roots per cutting

The data with regard to the average number of roots per cutting after 120 days are delineated in Table 1. It was found that the application of IBA, PHB and sucrose were found to be helpful in increasing number of roots per cutting. The maximum number of roots per cutting i.e. 41.83 were counted in IBA 3000 ppm treatment, while minimum recorded under PHB 500 ppm. The increasing number of roots were probably due to the effect of auxin, promoted cell division and cell elongation and the differentiation of cambial root primordial in the mobilization of reserve food material to sites of root initiation by auxin, thus produced higher number of roots per cutting (Chakraborty et al., 2018). The effect of sucrose on rooting could be explained that

generally carbohydrates supply energy and carbon skeleton for the synthesis of organic compounds which are used for root formation (Deepika et al., 2015).

Fresh weight of roots (g)

The data of the fresh weight of roots affected by IBA, PHB and sucrose are presented in Table 1. Maximum fresh weight (2.28 g) of roots was recorded in cuttings treated with IBA 3000 ppm, while minimum (0.36 g) recorded under control. Higher fresh weight of roots was attributed to the fact that auxin naturally occurring or exogenously applied are for initiation and growth of roots. Low auxin activity and its slow degradation by auxin destroying enzyme led to the growth and vigour of roots. This might also be due to the reserved food in the cuttings (Singh et al., 2013).

Conclusion

The treatment IBA 3000 ppm with quick dip method was found to be most efficacious in encouraging both rooting parameters and shoot characters. Hence, grapes cv. Perlette can be propagated successfully through cuttings treated with IBA 3000 ppm. Treatment IBA 4000 ppm stood runners up, it was followed by IBA 2000 ppm and IBA 1000 ppm in line.

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GK, SS and MS conceived the concept, wrote and approved the manuscript.

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