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Effect of different Concentrations of IBA and Saccharides on Physiological Parameters and benefit Cost ratio of Pomegranate Semi-hard Wood Cuttings

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ABSTRACT: Pomegranate (*Punica grantum*) is the major commercial fruit crops in arid and semi-arid region of the India, and it is multiply through cutting at large scale with the help of plant growth regulators. The PGR cost, availability and its solution prepration are not easy for the all nursery mans as well as successes rate is also not upto optimum marks. Therefore, some sugar sources are used in this study to enhance the rooting percentage and success rates. The present experiment entitled “Effect of IBA and Saccharides on rooting and growth in stem cuttings of pomegranate (*Punica granatum* L.) cv. Bhagwa” was carried out during 2019-2020 at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, J.N.K.V.V., Jabalpur (M.P.). The present experiment was conducted to study the effect with seventeen treatment and three replications in Completely Randomized Design (CRD) under polyhouse condition on physiological parameters and benefit cost ratio. The study revealed that significant differences were existed among different treatments for different growth parameters. Among the seventeen treatments sucrose 5000 ppm (T_4) performed superior in physiological parameters and benefit cost ratio. Of the seventeen treatments sucrose 5000 ppm recorded significantly maximum leaf area of rooted cuttings (331.10 and 485.25 cm^2), highest leaf area index of cuttings (6.42), maximum leaf area duration (12.25 cm^2 days), highest chlorophyll content index (32.55), minimum light transmission ratio (30.83 %), minimum cost per cutting (13.94), maximum benefit per plant (21.06) and maximum benefit cost ratio (2.51). From the present investigation it can be concluded that the cuttings treated with sucrose 5000 ppm (T_4) gave pronounced effect on physiological parameters indicating its eliteness for propagation in pomegranate under polyhouse conditions.

Keywords: Physiological parameters, Saccharide, Semi hard wood cuttings.

INTRODUCTION

Pomegranate (*Punica granatum* L.) belongs to the dicotyledonous family Punicaceae. Its scientific title derives from the Latin words ‘pomum’ (apple) and granatus (grainy), meaning seeded apple (Dhillon, 2013). Pomegranate is native to central Asia, notably Iran. The pomegranate is widespread throughout the world including the Mediterranean, Asia, and California due to its highly adaptive to a wide range of climates and soil conditions including arid regions, particularly the Mediterranean regions, which are the leading producers (Hussein and Gouda, 2018).

In India, the pomegranate is one of the most suitable fruit crops for arid and semi-arid regions and gaining popularity in the Deccan plateau of India. For the last decade, its area, production and export have increased greatly in India and the country has occupied the prime position globally (Chandra *et al.,* 2006; Jadhav and Sharma, 2007).

India is the only country in the world where pomegranate is available throughout the year (January-December). It is cultivated in 3 seasons (Ambe Bahar, Mrig Bahar, and Hasth Bahar) in the Deccan plateau of India. During 2018-19, the pomegranate was cultivated over an area of 0. 24 million ha with an annual production of 2.86 million tones and productivity of 10.3 MT/ha. The production share (%) of pomegranate was 0.9 % among the total fruit production of the country during 2018-2019. At present, Maharashtra is the leading state under pomegranate cultivation concerning area and production, while Tamil Nadu leads in pomegranate productivity. The other important states with successful cultivation of pomegranate are Karnataka, Gujarat, Madhya Pradesh, Andhra Pradesh, Rajasthan, Tamil Nadu, Telangana, etc. in the country (National Horticulture Board Database, 2018-19).

Pomegranate is commercially propagated by vegetatively using stem cuttings, layering, and grafting in pomegranate trees is rarely done because many different types of grafts have not been successful enough for use in commercial production (Hartmann *et al*., 1997). Propagation by stem cuttings is an easy, fast, and economic technique of plant multiplication. Generally, pomegranate is propagated by cuttings with 15-20 cm in length and pencil size in diameter and use of hardwood or semi-hardwood (Melgarejo *et al*., 2008; Saroj *et al*., 2008; Polat and Caliskan, 200). The rooting capability of cuttings varies from cultivar to cultivar, location to location, season to season, and age of branch. The success percent of Pomegranate cutting depends upon many factors such as the condition of the mother plant, part of the tree from where the cutting is made, time of operation, rainfall, temperature fluctuation, aftercare, etc. Besides different environmental conditions growth regulators also play a major role in rooting, sprouting and growth of successful cuttings sapling. Therefore, a successful cutting sprout is required proper structure, and adequate knowledge of the nursery man about the PGR, and other supplement to enchance the success rate of rooting and sprout of cutting as well as better survibility.

Sucrose is commonly known as “table sugar” or “cane sugar” is a carbohydrate formed from the combination of glucose and fructose. Glucose is a simple carbohydrate formed as a result of photosynthesis. Fructose is nearly identical except for the location of double-bonded oxygen. They are both six-carbon molecules, but fructose has a slightly different configuration. When the two combine, the become sucrose.

The rooting in woody cuttings is chiefly influenced by the concentration of carbohydrates. High carbohydrate levels in the shoot are thought to be conducive to root formation (Hartmann and Kester, 1983). Sucrose is a good source of carbohydrate which gives direct energy to the cuttings. High sugar level affects rooting by reducing the level of nitrogen which is essential for the rooting process (Yeboah *et al.,* 2009). This may be the reason due to which sucrose produces higher rooting percentage compare to control. On the other hand, the better response of sucrose might be due to the reason that carbohydrates are known as building blocks which act as necessary energy source for plant tissues. The availability of carbohydrates is often considered exclusively as an energetic requirement and a carbon skeleton source to drive root development (Correa *et al.,* 2005).

Sucrose contributes a significant role for vegetative propagation by cutting which is reported in Karonda (*Carissa carandas* L.) (Deepika *et al*., 2015) and pear cv. Patharnakh (Dhand *et al.,* 2019).

MATERIALS AND METHODS

The present investigation entitled “Effect of IBA and Saccharides on Rooting and Growth in Stem Cuttings of Pomegranate (*Punica granatum* L.) cv. Bhagwa.” was carried out during the year 2019-2020at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The present experiment was conducted to study the effect with seventeen treatment and three replications in Completely Randomized Design (CRD) under polyhouse condition on physiological parameters and benefit cost ratio of rooted cuttings.The type of cuttings was semi hard wood, length of cuttings was 15-20 cm and size of polybags was 30 × 15 cm^2. The concentration of Saccharides for treating the semi hard wood pomegranate cuttings were used for getting better growth parameters. The cuttings were treated with different concentration of IBA and Saccharides before the planting of cuttings and observation were recorded afterwards. All five cuttings were tagged for recording the observations and average value for each treatment was computed and recorded.

RESULTS AND DISCUSSION

A. Physiological parameters

The data recorded on various aspects were tabulated and subjected to statistical analysis in comparison with treatments. Data regarding the effect of IBA and Saccharides on Rooting and Growth in Stem Cuttings of Pomegranate (*Punica granatum* L.) cv. Bhagwa.” showed significant maximum leaf area at 90 and 120 days (331.10 and 485.25), maximum leaf area index at 120 days (6.42), maximum leaf area duration (12.25), maximum chlorophyll content index (32.55) and minimum light transmission ratio (30.83) was recorded by treating the cuttings with Sucrose 5000 ppm (T_4), which was significantly superior. The better performance with the use of Sucrose could be explained by the larger carbon skeleton provided by this carbohydrate, resulting in higher availability of biosynthetic blocks (Correa *et al.*, 2005; Rajkumar *et al.*, 2016). The difference in carbohydrate content in the cuttings was considered as an important factor that determines the variability in rooting capacity among genotypes (Hartmann *et al.,* 2007; Rajkumar *et al.*, 2017).

Maximum leaf area might be due to increasing sugar concentration has a visibly stronger influence on leaf area than on leaf number because sugar as a carbon source for biomass production that increase the leaf area of plant. Carbohydrates are necessary as metabolic “building blocks” and energy source for plant tissues. The availability of carbohydrate is often considered exclusively as an energetic requirement and carbon skeleton source to drive root development. Besides, the ratio between glucose and sucrose concentrations has influence on morphogenesis, affecting cell division rates (Borisjuk *et al.*, 1998).

Maximum leaf area index might be due to Sugars play a regulatory role in photosynthesis, growth, and development, sugars can also act as signalling molecules. They can modulate gene expression and influence various signalling pathways. Increase leaf area index due to higher dry matter accumulation through the process of photosynthesis in plants. Maximum leaf area durationthe carbohydrate is the basic part of photosynthesis/food material in the plants system; it provide the better longevity of the plants and its parts, it inhibits those biomolecules are increased the senescence in the plants/leaves. The chlorophyll is an essential component of chloroplasts as green pigments in all photosynthetic plant tissues and credited to more uptake of sugar by the plant. Minimum light transmission ratio Sucrose treated plants were produced more leaf numbers and lengths due to higher physiological process eg. photosynthesis, respiration and absorption of nutrient and water. The higher number of leaves and its number definitely increase the light transmission ratio Leaf area growth was determined the light interception and productivity of plants (Koester *et al*., 2014).

B. Benefit cost ratio

Minimum cost per cutting (13.94), maximum benefit per plant (21.06) and maximum benefit cost ratio (2.51) were recorded with the application of Sucrose 5000 ppm (T_4) as compared to others treatments. This maximum returns were noted with T_4 might be due to minimum cost of the treatment. The sucrose treated plants were obtained higher rooting and shooting success and its survival percentage at different level of observation or at marketable stage, the higher length of plants with higher and healthy canopy attract to the customer/growers and gave good return. When the plants were obtained with higher success and survival percentage ultimately reduced the cost and increased the benefit per plants or benefit cost ratio.

Table 1: Effect of IBA and Saccharides on leaf area (cm^2), Leaf area Index, Leaf area duration, Chlorophyll Content Index, Light transmission ratio of pomegranate cuttings.

Treatments	Treatment detail	Leaf area		Leaf area Index	Leaf area duration	Chlorophyll Content Index	Light transmission ratio
		90 days	120 days	120 days	120 days	120 days	120 days
T1	Sucrose 1000ppm	182.88	268.02	3.55	6.76	19.28	58.29
T2	Sucrose 2000ppm	236.78	347.01	4.59	8.76	25.51	46.88
T3	Sucrose 3000ppm	309.93	454.22	6.01	11.46	30.42	36.32
T4	Sucrose 5000ppm	331.10	485.25	6.42	12.25	32.55	30.83
T5	Glucose 1000ppm	167.48	245.45	3.25	6.19	17.28	65.04
T6	Glucose 2000ppm	213.68	313.16	4.14	7.90	21.26	51.95
T7	Glucose 3000ppm	254.10	372.40	4.93	9.40	22.88	43.50
T8	Glucose 5000ppm	273.35	400.62	5.30	10.11	27.55	38.86
T9	Honey 1000ppm	165.55	242.63	3.21	6.12	15.89	68.0
T10	Honey 2000ppm	198.28	290.59	3.84	7.33	19.18	55.75
T11	Honey 3000ppm	207.90	304.69	4.03	7.69	25.33	55.33
T12	Honey 5000ppm	252.18	369.58	4.89	9.33	25.34	45.61
T13	IBA 1000ppm	177.10	259.55	3.43	6.55	18.36	59.97
T14	IBA 2000ppm	227.15	332.91	4.40	8.40	22.22	49.84
T15	IBA 3000ppm	265.65	389.33	5.15	9.82	25.99	40.12
T16	IBA 5000ppm	296.45	434.47	5.75	10.96	29.47	36.74
T17	Control	140.53	205.95	2.72	5.20	16.93	72.65
SEm±		**10.71**	**15.70**	**0.21**	**0.40**	**2.76**	**2.35**
CD at 5%		**30.86**	**45.23**	**0.60**	**1.14**	**7.96**	**6.77**

Table 2: Effect of IBA and Saccharides on benefit - cost ratio of cuttings.

Treatments	Treatment detail	Cost per cutting	Benefit per plant	Benefit Cost ratio
T1	Sucrose 1000ppm	26.32	8.68	1.33
T2	Sucrose 2000ppm	23.69	11.31	1.48
T3	Sucrose 3000ppm	14.71	20.29	2.38
T4	Sucrose 5000ppm	13.94	21.06	2.51
T5	Glucose 1000ppm	27.21	7.79	1.29
T6	Glucose 2000ppm	24.50	10.50	1.43
T7	Glucose 3000ppm	23.02	11.98	1.53
T8	Glucose 5000ppm	15.39	19.61	2.27
T9	Honey 1000ppm	27.06	7.94	1.29
T10	Honey 2000ppm	24.23	10.77	1.45
T11	Honey 3000ppm	22.59	12.41	1.55
T12	Honey 5000ppm	14.75	20.25	2.37
T13	IBA 1000ppm	32.66	2.34	1.08
T14	IBA 2000ppm	30.52	4.48	1.15
T15	IBA 3000ppm	18.56	16.44	1.89
T16	IBA 5000ppm	20.35	14.65	1.72
T17	Control	30.69	4.31	1.14
SEm±		**0.79**	**0.81**	**0.05**
CD at 5%		**2.26**	**2.32**	**0.16**

CONCLUSION

Based on the results of present investigation, it can be concluded that Sucrose 5000 ppm (T_4) had significantly effective and promote the maximum leaf area at 90 and 120 days (331.10 cm and 485.25 cm), maximum leaf area index at 120 days (6.42), maximum leaf area duration (12.25), maximum chlorophyll content index (32.55) and minimum light transmission ratio (30.83 %) at 120 days. Similarly, the concentration Sucrose 5000 ppm (T_4) had significantly minimum cost per cutting (13.94), maximum benefit per plant (21.06) and maximum benefit cost ratio (2.51).

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Conflict of Interest. None.

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