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Research Article

ROLE OF PLANT GROWTH REGULATORS AND SUCROSE IN SPROUTING AND ESTABLISHMENT OF CUTTINGS IN POMEGRANATE *CV.* KANDHARI

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Abstract: An experiment was conducted at the nursery of Department of Horticulture, Khalsa College, Amritsar during 2019-2020 to study the role of growth regulators and sucrose in sprouting and establishment of pomegranate cuttings. A trial was undertaken comprised of thirteen treatments of semihard wood cuttings of pomegranate *cv*. Kandhari *viz.* IBA (1000, 2000 and 3000 ppm), Sucrose (10, 20 and 30g/l), PHB (500, 750 and 1000 ppm) and NAA (1000, 2000 and 3000 ppm) by quick dip method along with control and the experiment was replicated thrice. The experimental results indicated that Sucrose 20g/l proved to be the best in terms of minimum days to first sprouting (9.00), maximum sprouting percentage (85.72%), maximum shoot length (18.50 cm), maximum shoot formation (9.00), maximum shoot diameter (2.61 mm), maximum fresh weight of shoot (1.38 g), maximum dry weight of shoot (0.92g), maximum number of leaves (65.00) and maximum total leaf area (357.42 cm^2).

Keywords: *Cuttings, IBA, PHB, NAA, Quick dip, Sucrose, Sprouting*

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Introduction

Pomegranate (*Punica granatum* L.) belongs to family Punicaceae and is one of the oldest edible fruit whose cultivation is mainly confined to tropical and sub-tropical regions of the world [1]. Punica had been classified as the only genus within its family because of the unique structure of the ovary and fruit but recent molecular studies suggest a taxonomic reconsideration, might place Punica within the Lythraceae family [2] [3]. The genus-Punica has two species granatum and protopunica. The scientific name *Punica granatum* is derived from the name Pomum (apple), granatus (grainy or seeded apple). Pomegranate is considered to be native to Iran, Afghanistan, southern Pakistan region and northern India. It has originated in central Asia, but it is grown in variable geographic conditions due to its adaptability to a wide range of climatic and soil conditions. The fruit is a rich source of minerals, vitamins, antioxidant and tannins, while the juice of fruit is an excellent source of vitamins (B,C), sugars, minerals (K, Fe), and antioxidant polyphenols (ellagic acid and punicalagin) which not only lower cholesterol but also lowers blood pressure and prevent both heart attacks and strokes [4]. Pomegranate is a long-lived plant. Seed propagation in pomegranate results in variations in tree growth and fruits. Therefore, the most desirable method for the propagation of pomegranate tree is vegetative propagation. It can be accomplished through air layering, softwood cuttings, hardwood cuttings, tissue culture. However, commercially hardwood stem cutting is generally used as it shortens the duration of juvenility [5]. Reproduction through stem cutting is easy, quick, economic and most convenient method of obtaining true to type trees in considerably less time. Besides, different environmental conditions growth regulators also play an important role in rooting and growth in pomegranate cuttings. IBA is the synthetic plant hormone. It promotes cell elongation which helped to increase the root length [6]. It was previously reported that the growth regulators have positive effects on the rooting, root number, root length and shoot length of the pomegranate cuttings [7]. The hardwood cuttings of pomegranate gave the highest percentage survival when treated with IBA at the rate of 2000 ppm [8]. High carbohydrate level in shoots are thought to be conducive to root formation. Carbohydrates may serve as a source of energy and of carbon for the synthesis of other substances essential for root initiation. The addition of carbohydrate source like starch or sucrose would therefore improve the rooting efficiency [9]. Keeping in view the importance of it the present study was conducted to find out the optimum concentration of growth regulators and sucrose for rapid multiplication of pomegranate cuttings.

Materials and Methods

The present investigations were carried out in the nursery of Department of Horticulture, Khalsa College, Amritsar during the year 2019-2020. The cuttings were taken from healthy uniform sized branches of cultivar Kandhari growing in the nursery of Department of Horticulture, Khalsa College during middle of August. The shoots selected for preparation of cuttings were healthy and free from malady. Cuttings of about pencil thickness and 20 cm in length having 3-6 buds were prepared with a slanting cut given at the upper side and a round cut at the lower end of the cutting. The three growth regulators IBA(1000,2000 and 3000 ppm) PHB(500,750 and 1000 ppm) and NAA(1000, 2000 and 3000 ppm) along with sucrose(10, 20 and 30g/l) and control comprising 13 treatments.1000 ml growth regulator solution of appropriate concentration was taken in beaker and a unit of 20 cuttings was placed in each approximately 1½ inch of the basal ends of cuttings dipped in solution for upto 2 minutes. In control, the cuttings were dipped in distilled water for the same period of time. After that data on parameters like days to sprouting, sprouting percentage, survival percentage, shoot number, shoot diameter, shoot length, fresh weight of shoot, dry weight of shoot, number of leaves per cutting and total leaf area were recorded and analysed with Randomized Block Design.

Results and Discussion

Days to first sprouting (days)

The outcome of plant growth regulators and sucrose on the days to sprouting was found significant.

Treatment T8 (Sucrose 20 g/l) was found the earliest with 9.00 days. More number of days (19.15) was taken by treatment T13(control). The sprouting in shorter intervals might be due to the better utilization of stored carbohydrates which provided ample energy directly to the cuttings. Sucrose being a good source of carbohydrates might have helped in transportation of auxins leading to sprouting. Chandramouli, (2001) [10]. The above results were in agreement with those of Deepika, *et al*., (2015) [11] in karonda.

Fig-1 Maximum sprouting with sucrose

Fig-2 Minimum sprouting under control

Sprouting percentage (%)

The effect of growth regulators and sucrose on effect of sprouting percentage of cuttings was found significant. The highest (85.72%) sprouting of cuttings was recorded with Sucrose 20 g/l (T8) while the least (68.18%) sprouting percentage was recorded under T13 (Control). Increase in sprouting per cent might be due to the acceleration of cell division and cell elongation due to the presence of carbohydrates in sucrose Correa, *et al*., (2005) [12]. Also, the formation of callus, its proliferation, differentiation of vascular tissue and formation of tissues in higher amounts by sucrose might have led to more sprouting. The research findings of Deepika, *et al.,* (2015) [11] and Dey, *et al*., (2017) [13] in karonda corroborates the present findings.

Survival percentage

The perusal of data shows that IBA and sucrose resulted in significantly higher percentage of survival as compared to PHB, NAA and control. The results of the study showed that survival percentage varied with IBA, PHB, NAA and sucrose levels. Maximum survival (95.12%) was recorded in T7 (Sucrose 10 g/l). Minimum survival percentage (83.38%) was recorded from the cuttings under control after 120 days of planting. The larger carbon skeleton provided by the carbohydrate present in sucrose might have resulted in higher availability of building blocks Correa, *et al*., (2005) [12]. The energy provided by the treatment of sucrose might have led to better absorption of nutrients and moisture from soil leading to better growth developed capacity due to which the cuttings withstand for a longer period resulting in better survival. The research findings of Kareem, *et al*., (2016)[14] in guava, Kaur, (2016) [3] in Pomegranate *cv*. Ganesh, Shukla, *et al*., (2004)[15] in pomegranate cultivars, Chakraborty, *et al*.,(2018)[16] and Kaur, (2019)[17] in grapes, Deepika, *et al*., (2015) [11] and Dey, *et al*., (2017) [13] in karonda corroborates the present findings.

Number of leaves per cutting

It is evident from the results that the maximum number of leaves per plant after 120 days (65.00) were observed under T8 -sucrose 20g/l. On the other hand, the treatment of IBA was next to sucrose in producing leaves with maximum (51.33) in T2 IBA 2000 ppm while the minimum (23.00) were obtained in T13 Control. The formation of more sprouts with sucrose might have led to larger number of leaves. Increase in leaf number might be also due to the vigorous root formation in the cuttings due to more absorption of nutrients and thereby producing more leaves Stancato, *et al*., (2003) [18]. Similar findings have also been reported by Kepinski and Leyser, (2005)[19], Siddiqui and Hussain, (2007)[20] in Ficus and Kishorbhai, (2014)[21] in fig, Kaur, (2019)[17] in grapes, Dey, *et al*., (2017)[13] and Deepika, *et al*., (2015)[11] in karonda.

Total leaf area (cm^2)

The data pertaining to total leaf area per cutting stated that different concentrations of growth regulators and sucrose had significant effect on leaf area. The results of the study showed that the maximum leaf area (357.42 cm^2) had been achieved in T8 (sucrose 20 g/l) while the least (121.07 cm^2) was noted under T13 (control) after 120 days. Under IBA treatment T2 (2000 ppm) escalated over the other concentrations. The number of green leaves is the most important growth character that has direct impact on total leaf area. The increase in total leaf area might be due to the vigorous growth of cuttings with sucrose leading to more leaf area and vice versa. The research study of Kishorbhai, (2014) [21] in fig, Devi, *et al*., (2016) [22] in Phalsa and Kaur, (2016) [3] in Pomegranate *cv*. Ganesh are in support with the present findings. Kaur, (2019) [17] in grapes also reported the same.

Number of shoots per cutting

Throughout the study it was examined that after 120 days of planting maximum number of shoots (9.00) and (9.00) were registered from the cuttings treated with T8- Sucrose 20g/l and T2- IBA 2000 ppm. On the other hand, minimum number of shoots pertaining to 2.00 were reported under control T13. The increase in nutrient uptake might have affected the cell division in the vascular cambium, cell expansion and control of differentiation into different types of cambial which led to better growth in terms of vigorous roots resulting in increase in number of shoots Devi, *et al*., (2016) [22]. It might also be due to the greater number of roots and vigorous growth of the plant. The research findings of Khajehpour, *et al*., (2014)[23] in olive, Thota., (2012)[24] in fig, Bhat, *et al*., (2004)[25], Kaur., (2016) [3]in pomegranate *cv.* Ganesh and Kaur., (2019)[17] in grapes also corroborates the present findings. Dey, *et al*., (2017) [13] and Deepika, *et al*., (2015) [11] also reported the same in karonda.

Average shoot diameter (mm)

According to the data regarding shoot diameter maximum shoot diameter (2.61 mm) was measured from the shoots at 120 days after planting in the treatment T8 (sucrose 20 g/l) respectively. The least diameter measuring 1.77 mm was recorded in T6 -PHB 1000 ppm and under T13- control. The maximum shoot diameter observed in cuttings might be attributed to an increase in cell activity, more synthesized food material and photosynthates resulting in better root development which in turn, might have resulted in better shoots with more shoot diameter Devi, *et al*., (2016) [22]. The results are in line with the findings of Kaur, (2016) [3] in pomegranate *cv*. Ganesh and Thota, (2012) [24] in fig. Kaur, (2019) [17] in grapes also reported the same.

Average shoot length (cm)

It was noticed that the treatment of sucrose at varying concentrations enhanced the shoot length as compared to IBA concentrations. Maximum shoot length 18.50 cm was measured in T8 (Sucrose 20g/l). Minimum shoot length (3.95 cm) was observed under control T13. The better performance with the use of sucrose could be explained by the higher availability of biosynthetic building blocks generating more energy provided by the carbohydrate present in sucrose Correa, *et al*., (2005) [12]. The lengthy shoots formed on cuttings might be attributed to the well-developed root system in such cuttings tending to the promotion of shoots

Table-1 *Effect of growth regulators and sucrose on sprouting, survival and leaf parameters of pomegranate cuttings cv. Kandhari*

Treatment	Days to first sprouting	Sprouting percentage (%)	Survival percentage (%)	Number of leaves per cutting	Total leaf area (cm^2)
T_1 IBA 1000 ppm	12.00	84.11	92.38	38.00	219.20
T_2 IBA 2000 ppm	10.33	85.03	92.97	51.33	264.57
T_3 IBA 3000 ppm	11.67	84.90	93.26	43.33	233.43
T_4 PHB 500 ppm	12.67	78.10	83.40	25.67	127.55
T_5 PHB 750 ppm	10.80	79.17	84.76	32.00	193.59
T_6 PHB 1000 ppm	10.00	80.00	85.43	29.00	153.31
T_7 Sucrose 10 g/l	12.33	85.09	95.12	53.00	299.16
T_8 Sucrose 20 g/l	9.00	85.72	93.63	65.00	357.42
T_9 Sucrose 30 g/l	11.69	85.17	93.22	60.67	319.31
T_{10} NAA 1000 ppm	15.00	82.54	86.88	34.00	181.55
T_{11} NAA 2000 ppm	16.33	82.98	88.12	48.00	258.44
T_{12} NAA 3000ppm	17.00	82.56	87.96	37.67	198.15
T_{13} Control	19.15	68.18	83.38	23.00	121.07
Mean	12.92	81.81	89.27	41.59	225.13
CD (5%)	0.47	0.34	0.45	3.39	4.19

Table-2 *Effect of growth regulators and sucrose on shoot parameters of pomegranate cuttings cv. Kandhari*

Treatment	No of shoots per cutting	Average shoot diameter(mm)	Average shoot length(cm)	Fresh weight of shoot(g)	Dry weight of shoot(g)
T_1 IBA 1000 ppm	4.00	2.25	13.00	0.73	0.33
T_2 IBA 2000 ppm	9.00	2.36	14.01	1.18	0.74
T_3 IBA 3000 ppm	8.00	2.48	13.50	1.13	0.69
T_4 PHB 500 ppm	5.00	2.00	6.86	0.43	0.19
T_5 PHB 750 ppm	5.33	2.04	9.25	0.56	0.27
T_6 PHB 1000 ppm	5.00	1.77	6.90	0.28	0.12
T_7 Sucrose 10 g/l	4.00	2.41	14.83	0.82	0.39
T_8 Sucrose 20 g/l	9.00	2.61	18.50	1.38	0.92
T_9 Sucrose 30 g/l	7.00	2.42	18.20	1.35	0.86
T_{10} NAA 1000 ppm	3.00	2.47	10.76	0.89	0.48
T_{11} NAA 2000 ppm	6.00	2.38	10.00	1.27	0.73
T_{12} NAA 3000ppm	4.00	1.80	9.75	0.87	0.42
T_{13} Control	2.00	1.77	3.95	0.27	0.09
Mean	5.49	2.21	11.50	0.86	0.48
CD (5%)	2.89	0.40	0.47	0.43	0.03

due to the presence of adequate mobilization of water and nutrients from the soil or substrate to the growing apices leading a faster growth rate of the newly formed shoots Pratima and Rana, (2011) [26]. These results are in agreement with the findings of Kaur, (2016)[3] in pomegranate cv. Ganesh and Khajehpour, *et al.*, (2014)[23] in olive and Kishorbhai, (2014)[21] in fig. Kaur, (2019)[17] in grapes and Deepika, *et al.*, (2015)[11] in karonda also viewed the same in their studies.

Fresh weight of shoots (g)

The data revealed that there was a significant difference among the treatments. Maximum fresh weight (1.38 g) was depicted by T8 (sucrose 20g/l) while the minimum fresh weight (0.27g) was recorded under T13- Control. These results might be due to the well-developed root system in such cuttings promoting shoot growth by adequate mobilization of water and nutrients from the soil to the growing apices. Kaur., (2019) [17] also reported the same in grapes.

Dry weight of shoots (g)

Highest dry weight of shoots (0.92g) was found in T8 (sucrose 20g/l) followed by T9 (0.86) while the least (0.09 g) was observed under control. These results might be attributed to the well-developed root system in such cuttings which might have promoted shoot growth by ensuring adequate amount of nutrients and water from the soil to the roots and shoots. Pratima and Rana, (2011) [26] in kiwi fruit and Kaur, (2019) [17] in grapes reported the same.

Conclusion

As an outcome of the results of the present study it can be concluded that the sprouting and establishment of cuttings of pomegranate cv. Kandhari was highly achieved with the treatment of various concentrations of sucrose and IBA. Sucrose 20g/l and IBA@ 2000 ppm applied as quick dip were found to be the most efficacious and can be employed for the commercial vegetative propagation of pomegranate by cuttings.

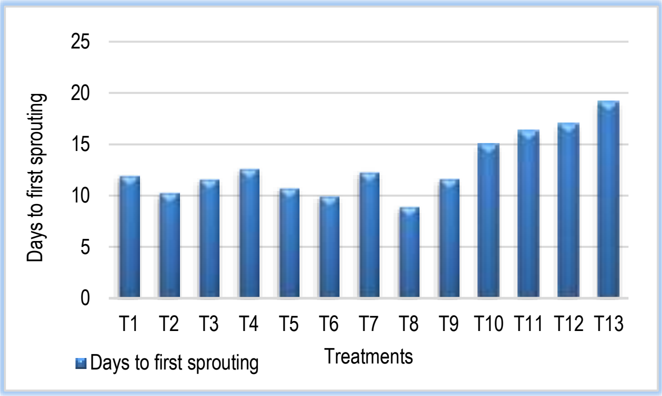

Fig-3 Effect of plant growth regulators and sucrose on number of days to first sprouting

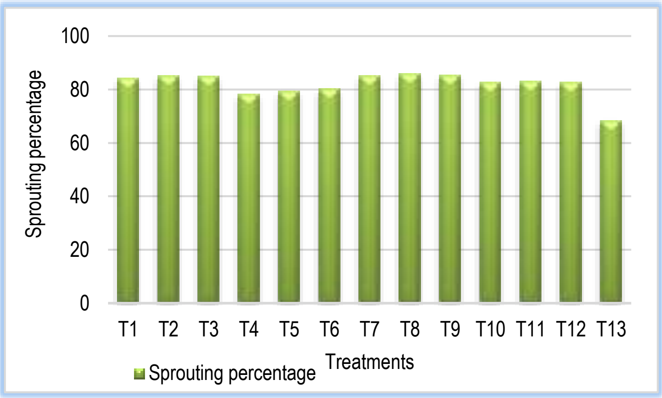

Fig-4 Effect of plant growth regulators and sucrose on sprouting percentage

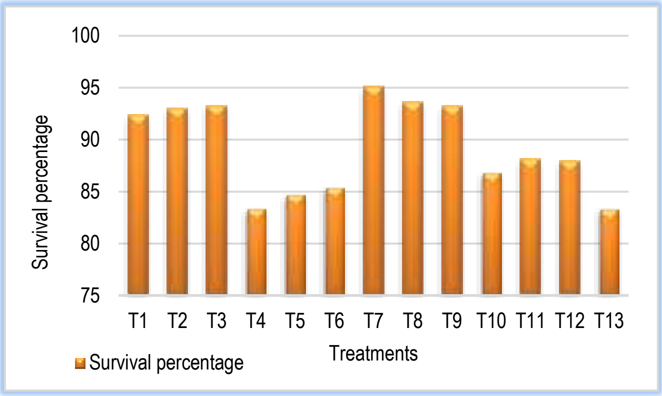

Fig-5 Effect of plant growth regulators and sucrose on survival percentage

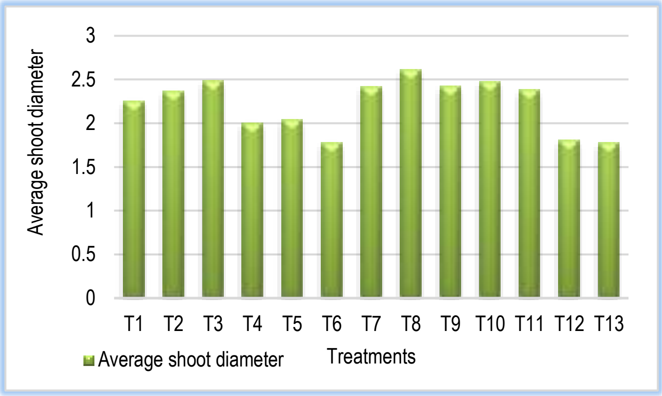

Fig-9 Effect of plant growth regulators and sucrose on average shoot diameter

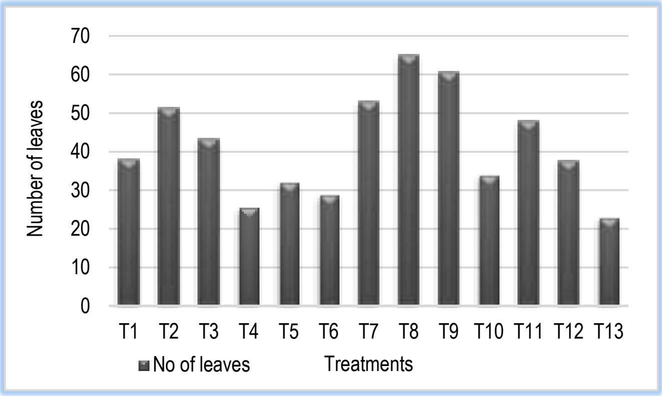

Fig-6 Effect of plant growth regulators and sucrose on number of leaves

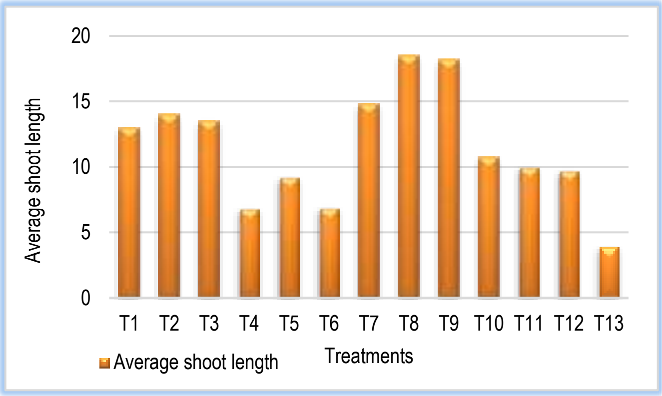

Fig-10 Effect of plant growth regulators and sucrose on average shoot length

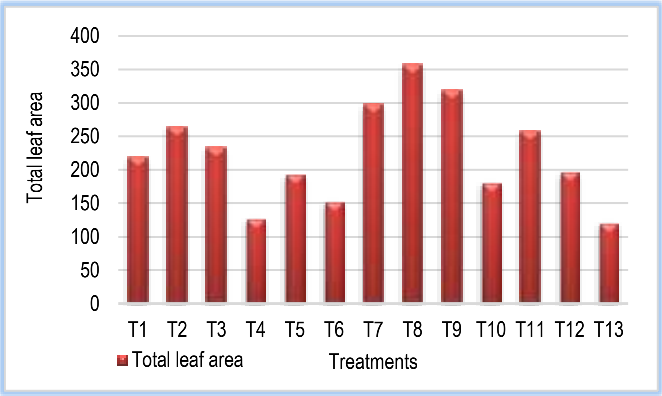

Fig-7 Effect of plant growth regulators and sucrose on total leaf area

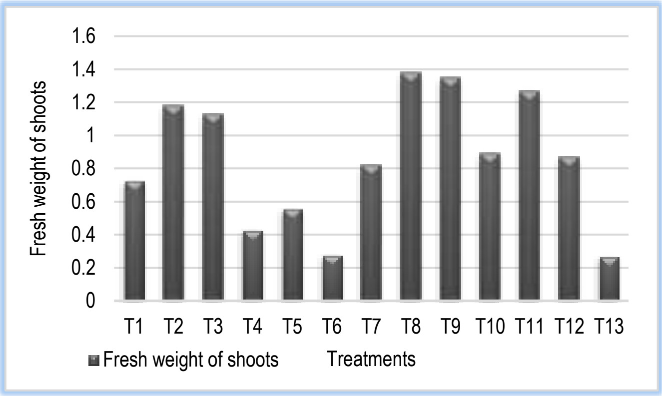

Fig-11 Effect of plant growth regulators and sucrose on fresh weight of shoots

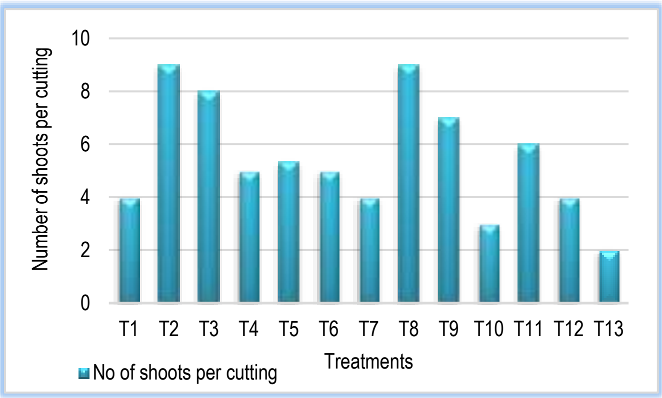

Fig-8 Effect of plant growth regulators and sucrose on number of shoots per cutting

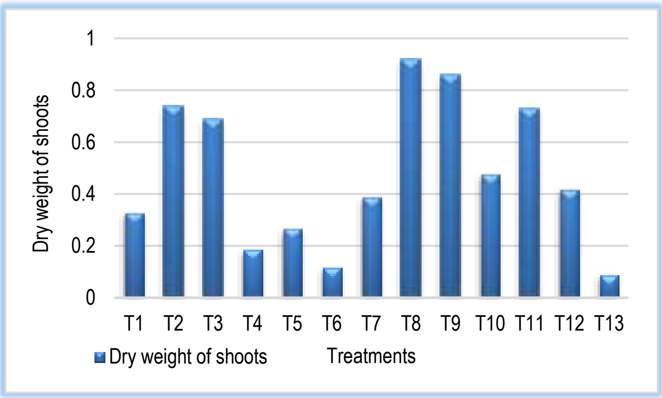

Fig-12 Effect of plant growth regulators and sucrose on dry weight of shoots

Application of research: It will help the growers to raise Kandhari plants of pomegranate through cuttings which on treated with the growth regulators and sucrose will produce good planting material

Research Category: Pomegranate propagation through cuttings

Abbreviations: IBA-Indole Butyric acid; NAA- Naphthalene acetic acid; T- Treatment

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Study area / Sample Collection: Department of Horticulture (Agriculture), Khalsa College, Amritsar, 143001, India

Cultivar / Variety / Breed name: Kandhari

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Ghani M., Sharma M.K. and Habibi H.K. (2019) *Int J Curr Microbi App Sci*., 8(7), 915-23.
[2] Graham S.A., Hall J., Sytsma K. and Shi S. (2005) *Int J Plant Sci.,* 166(6), 995-1017.
[3] Kaur S. and Kaur A. (2016) *Bio Forum-An Int J*., 8(2), 203-06.
[4] Kandylis P. and Kokkinomagoulos (2020) *Lab Oenology and Alcoholic Beverages, Dept of Food Sci and Tech, School of Agri, Aristotle Uni of Thessaloniki* 156(9), 1-2.
[5] Chater J.M., Merhaut D.J., Preece J.E., Blythe E.K. (2017) *Sci Horti*., 221, 68-72.
[6] Singh K.K. (2017) *Int J Curr Microbio App Sci*., 6(10), 4887-93.
[7] Sarrou E., Therios I., Dimassi-Theriou K. (2014) *Turkish J Botany*, 38, 293-301.
[8] Upadhyay S.K. and Badyal J. (2007) *Haryana J HortSci*., 36(1-2), 58-59.
[9] Dhand A., Kaur V. and Kaur A. (2019) *Int J Curr Micro bio App Sci*., 8(7), 545-51.
[10] Chandramouli H. (2001) *MSc (Agri.) Thesis, University of Agricultural Sciences, Bengaluru, Karnataka* 560065
[11] Deepika K.V., Sharma G., Singh D., Mishra G. (2015) *Int J Farm Sci*., 5(4),139-44.
[12] Correa L.D.R., Paim D.C., Schwambach J., FettNeto A.G. (2005) *Plant Growth Regul*., 45,63-73.
[13] Dey K., Ghosh A., Mani A., Bauri F.K. and Dey A.N. (2017) *J Pharmacognosy and Phytochemistry*, 6(6), 803-06.
[14] Kareem A., Manan A., Saeed S., Rehman S.U., Shahzad U. and Nafees M. (2016) *J Agri and Env for Inter Develop*., 110(2), 197-203.
[15] Shukla H.S. (2004) *Hort J.,* 17(1), 29-34.
[16] Chakraborty S. and Rajkumar M. (2018) *Asian J Sci Tech*., 9, 8418-21.
[17] Kaur G. (2019) *MSc. Thesis. Guru Nanak Dev University, Amritsar*, *Punjab*.
[18] Stancato G.C., Aguiar F.F.A., Kanashiro S. and Tavares A.R. (2003) *Scientia Agricola.,* 56, 185- 90.
[19] Kepinski S. and Leyser O. (2005) *Cur Bio*., 15, 208-10.
[20] Siddiqui M.I. and Hussain S.A. (2007) *Sarhad J Agri*., 23(4), 920-26.
[21] Kishorbhai B.S. (2014) *M.Sc. Thesis, Navsari Agricultural University, Navsari, Gujarat* 396450
[22] Devi J., Bakshi P., Wali V.K., Kour K. and Sharma N. (2016) *The Bioscan*, 11(1), 535-37.
[23] Khajehpour G., Jameizadeh V., Khajehpour N. (2014) *Int J Adv Bio Biom*., 2(12), 2920-24.
[24] Thota S., Madhavi K. and Vani V.S. (2012) *Int J Tropical Agri*., 32, 89-94.
[25] Bhat D.J., Formahan H.L. and Sharma M.K. (2004*) Hort J Birj and Uni., Abstract in Cab Abstracts A.N. 20053087603.*
[26] Pratima P. and Rana V.S. (2011) *Int J of Farm Sci*., 1(2), 30-36.