

Original Research Article

<https://doi.org/10.20546/ijcmas.2021.1002.088>

Effect of Plant Growth Regulators on Rooting Parameters of Grape Rootstock

J. M. Shriram, R. A. Patil*, B. N. Ralebhat, N. Sumitha,
T. S. Ghangale* and S. B. Shinde

Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani (MS), India

*Corresponding author

ABSTRACT

The present investigation entitled “Effect of Plant Growth Regulators on Rooting and Growth of Grape Rootstock” was undertaken at the Instructional-cum-Research Farm, College of Agriculture, Osmanabad, Dist. Osmanabad. The experiment was laid out in Factorial Randomized Block Design (FRBD) with two factors first factor was Rootstock Variety with five level viz. Dogrigde, Salt Creek, 1613 C, 110 R and 99 R and second factor was plant growth regulators level (IAA- 100ppm, IAA- 200 ppm, IBA- 100 ppm and IBA- 200 ppm). Total 20 treatment combinations tried were replicated thrice. The cuttings of rootstocks were treated with plant growth regulators as per treatments and it was conducted in first week of November 2019. The observations on root character of grape rootstock were recorded. The root characters of grape rootstock were significantly influenced by different level of rootstock variety and plant growth regulators. The results revealed that all the root character of grape rootstock cutting i.e. Maximum callus diameter (32.99 mm), Rooting percentage (74.03 %), length of longest root (20.11), number of primary roots (19.00) and root diameter (1.11 mm) were noted under the treatment T₀. The significantly maximum fresh weight of root (1.66 g) and dry weight of root (0.89 g) were noted under the treatment T₁. So, it can be concluded from above study that, for better rooting performance the plant growth regulator (IAA) with concentration (100 ppm) is suitable.

Keywords

Rootstocks, IAA and IBA

Article Info

Accepted:
07 January 2021
Available Online:
10 February 2021

Introduction

Grape (*Vitis venifera* L.) is one of the most delicious, refreshing fruit. Considering the advantages, demands for the crop is increasing day by day and is gaining much importance in the fruit industry. The grape vine is generally propagated by vegetative method such as hard wood cutting. Vegetative propagation is preferred because the plants

propagated by this method produce fruits early, give more yield and true to type and quality fruit every year. The treatments of cuttings with plant growth regulators play an important role in regeneration of plants from cuttings. Reports on the systematic investigation on the propagation of grape from cuttings are very scanty. Therefore, it is felt necessary to undertake the study on propagation of grape vines by using different

concentration of growth regulators for quicker multiplication in nursery.

Grapes are one of the commercially important fruit crops in India and are cultivated on approximately 138'000 hectares, with an annual production of 22920.1'000 (MT). It is well known for its delicacy and is a good source of minerals like calcium, phosphorous, iron and vitamins. Grape is cultivated on an area of 138'000 hectares worldwide with an annual production of 2920.1'000 (MT). Spain, France, Italy and USA being the leading grape producing countries in the world. (Anonymous, 2018). Maharashtra, Tamil Nadu, Karnataka, Punjab and Andhra Pradesh are the major grape growing states of India (Anonymous, 2018). In Maharashtra highest Area and Production of grape is 105.50'000 ha and Production 2286.44 metric tons (Anonymous, 2018).

Grapes are commercially propagated through hardwood cuttings (Weaver, 1976). Cuttings are made from shoots that are one season old and have three to four nodes. They are planted in the media to induce rooting before being transplanted in the field. Dog ridge is one of the commercially important rootstock and is known for its drought tolerance. It is a more vigorous variety and Thompson Seedless grafted onto this rootstock is known to produce more vegetative growth at the cost of reproductive growth, thus reducing the yield per unit area. The rooting ability of rootstocks varies with the species, IBA concentration, and the biochemical composition of the mother vines (Satish *et al.*, 2007).

Plant growth regulators are the organic chemical compounds, which modify or regulate physiological processes in an appreciable measure in the plants when used in small concentrations. They are readily absorbed and move rapidly through the tissues when applied to different parts of the

plant. They are specific in action. The plant naturally produces plant hormones or phytohormones and they move from the site of production to the site of action. The most commonly employed growth regulators are Indole Butyric Acid (IBA) and Indole Acetic Acid (IAA) and Gibberellic Acid (GA3) is used for stem elongation (Hartman, 1997). Auxins were the group of growth regulators to be discovered in the late 1800's by Charles Darwin. Auxins play a major role in stem elongation and apical dominance.

One of the most well-known uses of auxin is for the rooting of cutting for plant propagation. Shoot tips of many plant species when dipped or coated with small amount of auxin develop roots more quickly and higher numbers. To find out the suitable plant growth regulator for profuse rooting and better growth of grape rootstock.

Materials and Methods

The experiment was conducted at the polyhouse of College of Agriculture, Osmanabad during 2019 – 2020. The poly bags experiment was laid out in factorial randomized block design (FRBD) with three replication. The experiment comprised of twenty treatment combinations of five root stocks namely Dogridge, salt creek, 1613 C, 110 R and 99 and two growth regulators namely Indole Acetic Acid (IAA) and Indole Butyric Acid (IBA) with two concentrations of each plant growth regulators were used i.e. IAA at 100 ppm and 200 ppm and IBA at 100 ppm and 200 ppm. The hardwood cuttings of grapes rootstock. The average length and diameter of the cuttings used for rooting was 25-30cm and 0.87 cm, respectively.

The basal end of all the cuttings was given a slanting cut to expose maximum absorbing surface for effective rooting. The required quantities of growth regulators were prepared

through stock solution with their different concentrations i.e.(IAA 100ppm, 200 ppm and IBA 100 ppm, 200 ppm). Forty polybags were taken for each treatment in each replication. Four small holes were on each bag, for proper drainage. The basal 3-4 cm portion of hard wood cuttings was treated with solutions (IAA and IBA) by prolong dip method for 24 h and were allowed to dry for 15 minutes and then planted in polythene bags filled with sand and cocopeat mixture as per treatments. Forty cuttings were used per treatment per replication.

Results and Discussion

Callus diameter

Results (Table 1) as regards root character callus diameter of rootstock cuttings. Maximum callus diameter (32.99 mm) was obtained in 1613 C rootstock treated with 100 ppm IAA and minimum callus diameter (19.61 mm) was obtained in dog rigde rootstock treated with 200 ppm IBA. The data on Callus diameter was significant under the all treatment. This might have clear from the above result that the increases in Callus diameter of cutting.

The application of auxins like IAA and IBA might to be attributed to more number of roots because auxin favoured cell division and their elongation and helped in better root development there by resulting in better shoots with more shoot diameter. It was also due to higher cell activity, more synthesized food material and photosynthates hence more shoots with more stem diameter, callus diameter and root diameter as stated by Abhinav *et al.*, (2016) in Grape. Similar results were reported by Dhua *et al.*, (1980) in jackfruit, Shepherd and Winston (2000) in Bougainvillea, Singh and Singh (2011) in Bougainvillea, Damar *et al.*, (2014) in pomegranate.

Number of primary roots/ cutting

Results (Table 2) as regards root character number of primary roots/ cutting of rootstock cuttings. Maximum number of primary roots/ cutting (19.00) was obtained in 1613 C rootstock treated with 100 ppm IAA and minimum number of primary roots/ cutting (13.73) was obtained in 110 R rootstock treated with 100 ppm IAA. The data on number of primary roots/ cutting was significantly under the all treatment.

This might have due to enhanced hydrolysis of carbohydrates caused by auxin treatment opined that auxins would bring about various physiological changes, but the mechanism by which these changes are brought about this is not fully understood except for the effect on cell elongation. The more number of roots per cutting under optimum concentration of IAA may be attributed to the increased rate of respiration, accumulation of higher level of amino acids at their bases in the auxin treated cuttings than untreated cuttings as stated by Ghosh *et al.*, (2017) in phalsa. Similar results were reported by Rajarama (1997) in pomegranate, Abhinav *et al.*, (2016) in Grape, Yasser (2015) in pomegranate.

Length of longest root/ cutting

Results (Table 3) as regards root character length of longest roots/ cutting of rootstock cuttings. Maximum length of longest roots/ cutting (20.11) was obtained in 1613 C rootstock treated with 100 ppm IAA and minimum length of longest roots/ cutting (13.81) was obtained in 99 R rootstock treated with 200 ppm IBA. The data on length of longest roots/ cutting was significantly under the all treatment. This might have caused hydrolysis and translocation of carbohydrates and nitrogenous substances in the cellular level at the base of cuttings and resulted in accelerated cell elongation and cell division

under favourable environmental condition as stated Ghosh *et al.*, (2017) in phalsa. Similar results were reported by, Jadhav (2007) in phalsa, Rolaniya *et al.*, (2018) in grape, Rawat *et al.*, (2004) in grape.

Diameter of root (mm)

Results (Table 4) as regards root character diameter of root rootstock cuttings. Maximum diameter of root (1.11 mm) was obtained in 1613 C rootstock treated with 100 ppm IAA and minimum diameter of root (0.62 mm) was obtained in 99 R rootstock treated with 100 ppm IBA. The data on diameter of root was

significantly under the all treatment. The might to be attributed to more number of roots because auxin favoured cell division and their elongation and helped in better root development there by resulting in better shoots with more shoot diameter. It was also due to higher cell activity, more synthesized food material and photosynthates hence more shoots with more stem diameter, callus diameter and root diameter as stated by Abhinav *et al.*, (2016) in Grape. Similar results were reported by Damar *et al.*, (2014) in pomegranate, Hakim *et al.*, (2018) in pomegranate.

Table.1 Effect of growth regulators on different rootstocks on callus diameter (mm)

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	23.82	28.03	26.92	19.61	24.59
V ₂	22.49	21.85	21.51	27.68	23.38
V ₃	32.99	26.75	25.54	25.47	27.68
V ₄	22.99	24.09	30.65	26.95	26.17
V ₅	25.47	28.11	25.63	25.45	26.16
Mean G	25.55	25.76	26.05	25.03	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.27	0.24	0.55		
C.D. at 5%	0.79	0.71	1.58		
F test	S	S	S		

Table.2 Effect of growth regulators on different rootstocks on number of primary roots per cuttings

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	15.06	14.13	15.86	17.80	15.71
V ₂	15.26	15.33	18.20	14.86	15.91
V ₃	19.00	16.00	16.00	15.93	16.73
V ₄	13.73	15.93	17.00	18.13	16.20
V ₅	17.13	17.33	15.33	14.66	16.11
Mean G	16.04	15.74	16.48	16.28	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.19	0.17	0.39		
C.D. at 5%	0.56	0.50	1.13		
F test	S	S	S		

Table.3 Effect of growth regulators on different rootstocks on length of longest root per cutting

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	16.02	15.53	16.31	15.35	15.80
V ₂	19.60	18.91	16.84	16.74	18.02
V ₃	20.11	16.69	18.37	19.38	18.64
V ₄	14.66	19.44	15.90	17.68	16.92
V ₅	17.13	16.70	16.66	13.81	16.07
Mean G	17.50	17.45	16.81	16.59	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.27	0.25	0.55		
C.D. at 5%	0.80	0.71	1.60		
F test	S	S	S		

Table.4 Effect of growth regulators on different rootstocks on diameter of root (mm)

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	0.92	0.78	0.76	0.76	0.80
V ₂	0.88	0.89	0.86	0.78	0.85
V ₃	1.11	0.92	0.97	0.81	0.95
V ₄	0.90	0.83	0.84	0.98	0.89
V ₅	0.87	0.90	0.62	0.74	0.78
Mean G	0.93	0.86	0.81	0.81	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.01	0.01	0.03		
C.D. at 5%	0.05	0.04	0.10		
F test	S	S	S		

Table.5 Effect of growth regulators on different rootstocks on fresh weight of root (g)

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	1.66	1.51	1.48	1.58	1.56
V ₂	1.44	1.48	1.22	1.57	1.43
V ₃	1.48	1.44	1.25	1.53	1.42
V ₄	1.52	1.30	1.31	1.17	1.32
V ₅	1.50	1.18	1.54	1.25	1.36
Mean G	1.52	1.38	1.36	1.42	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.03	0.03	0.07		
C.D. at 5%	0.10	0.09	0.20		
F test	S	S	S		

Table.6 Effect of growth regulators on different rootstocks on dry weight of root (g)

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	0.89	0.74	0.72	0.67	0.75
V ₂	0.61	0.64	0.48	0.63	0.59
V ₃	0.63	0.67	0.46	0.71	0.62
V ₄	0.66	0.65	0.55	0.40	0.57
V ₅	0.61	0.46	0.67	0.52	0.57
Mean G	0.68	0.63	0.58	0.59	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.02	0.02	0.04		
C.D. at 5%	0.04	0.05	0.12		
F test	S	S	S		

Table.7 Effect of growth regulators on different rootstock on rooting percentage (%)

Growth regulator → Rootstock variety ↓	G ₁	G ₂	G ₃	G ₄	Mean V
V ₁	60.38	65.25	60.25	67.97	63.46
V ₂	54.40	62.25	63.36	63.14	60.79
V ₃	74.03	72.92	60.55	65.70	68.30
V ₄	66.14	54.81	66.44	56.70	61.02
V ₅	52.27	60.77	61.88	53.20	57.03
Mean G	61.44	63.20	62.50	61.34	
	Rootstock	Growth regulator	Rootstock X Growth regulator		
S.E.	0.55	0.49	1.11		
C.D. at 5%	1.60	1.43	3.20		
F test	S	S	S		

Fresh weight of root (g)

Results (Table 5) as regards root character fresh wt. of root (g) of rootstock cuttings. Maximum fresh wt. of root (g) (1.66 g) was obtained in dogrigde rootstock treated with 100 ppm IAA and minimum fresh wt. of root (g) (1.17 g) was obtained in 110 R rootstock treated with 200 ppm IBA. The data on fresh wt. of root (g) was significantly under the all treatment. This might have clear from the above result that the increases in Fresh weight of root of cutting. The application of auxins like IAA and IBA might be the higher fresh weight and dry weight of the roots might be

attributed to higher root length which accumulates more stored carbohydrates and more number of roots increased their volume per cutting of the roots in cuttings as stated by Ghosh *et al.*, (2017) in phalsa. Similar results were reported by Rolaniya *et al.*, (2018) in grape, Rawat *et al.*, (2004) in grape, Galavi *et al.*, (2013) in grape, Akhtar *et al.*, (2015) in rose, Hakim *et al.*, (2018) in pomegranate, Yasser (2015) in pomegranate.

Dry weight of root (g)

Results (Table 6) as regards root character dry wt. of root (g) of rootstock cuttings.

Maximum dry wt. of root (g) (0.89 g) was obtained in dogrigde rootstock treated with 100 ppm IAA and minimum fresh wt. of root (g) (0.40 g) was obtained in 110 R rootstock treated with 200 ppm IBA. The data on dry wt. of root (g) was significantly under the all treatment. This might have to the higher fresh weight and dry weight of the roots might be attributed to higher root length which accumulates more stored carbohydrates and more number of roots increased their volume per cutting of the roots in cuttings as stated by Ghosh *et al.*, (2017) in phalsa. Similar results were reported by Rolaniya *et al.*, (2018) in grape, Rawat *et al.*, (2004) in grape, Hakim *et al.*, (2018) in pomegranate, Yasser (2015) in pomegranate.

Rooting percentage (%)

Results (Table 7) as regards root character rooting percentage (%) of rootstock cuttings. Maximum rooting percentage (%) (74.03 %) was obtained in 1613 C rootstock treated with 100 ppm IAA and minimum rooting percentage (%) (52.27 %) was obtained in 99 R rootstock treated with 100 ppm IAA. The data on rooting percentage (%) was significantly under the all treatment. The might have to the application of auxins has been found to stimulate cambial activity thereby resulting the mobilization of reserve food material to the site of root initiation. Natural and synthetic auxins when applied exogenously to the stem cuttings generally increase the development of pre-existing root primordial increases the more number of roots per cutting which further helps in sprouting and growth. The enhanced hydrolytic activity in presence of applied IBA might be responsible for the increased percentage of rooted cuttings. High carbohydrate and low nitrogen have been reported to favour root formation as stated by Ghosh *et al.*, (2017) in phalsa. Similar results were reported by Singh and Tomar (2015) in phalsa, Rajarama (1997)

in pomegranate, Singh *et al.*, (2013) in *Thujacompecta*, Singh and Singh (2002) in bougainvillea.

From the above discussion, it may concluded that various levels of rootstock variety and plant growth regulators had a large impact on the rooting characters of grape rootstock. So, it can be concluded from above study that, for better rooting performance the plant growth regulator (IAA) with concentration (100 ppm) is suitable were found to be the best treatment may be recommended for the commercial vegetative propagation of grape rootstock cuttings.

References

- Anonymous, 2018. National Horticulture Board.nhb.gov.in.
- Abhinav, Burman, R. N., Kanpure, S. R., Anjanawe, A., Haldar, R. P., Patel., Singh, T. and Yadav, S. K. 2016.Effect of biofertilizers and growth regulators on rooting and growth of hard wood cutting of grapevine (*Vitis vinifera* L.) cv. Thompson seedless *Res. Environ. Life Sci.* 9(12) 1522-1525.
- Akhtar.,Gulzar., Jaskani., Jafar, M., Sajjad, Y. and Akram, A. 2016.Effect of Antioxidants, Amino Acids and Plant Growth Regulators on *in vitro* Propagation of *Rosa centifolia*. *Iran J Biotech.* 14(1):e115.
- Damar, D., Barholia, A. K., Lekhi, R. and Haldar, A. 2014.Effect of growth regulators and biofertilizers on survival of pomegranate (*Punica granatum* L.) Stem cuttings *Plant Archives.* Vol. 14 No. 347-350.23.
- Dhua, R. S., Sen, S. K. and Bose, T. K. 1980.Propagation of Jackfruit (*Artocarpus hetrophyllus*) by stem cuttings. *Punjab Hort. J.*, 10: 84-89.
- Galavi, M., Karimian, M. A. and Mousavi, S. R. 2013. Effects of Different Auxin

- (IBA) Concentrations and Planting-Beds on Rooting Grape Cuttings (*Vitis vinifera* L.). *Annual Review & Research in Biology* 3(4): 517-523.
- Ghosh, A., Dey, K., Mani, A., Bauri, F. K. and Mishra, D. K. 2017. Efficacy of different levels of IBA and NAA on rooting of Phalsa (*Grewia asiatica* L.) cuttings. *International Journal of Chemical Studies* 5(6): 567-571.
- Hakim, A., Jaganath, S., Honnabyraiah, M. k., Kumar, S. M., Kumar, S. A., and Dayamani, K. J., 2018. Influence of Biofertilizer and Auxin on Growth and Rooting of Pomegranate (*Punica granatum* L.) Cuttings *Int.J.Curr.Microbiol.App.Sci.* 7(2): 1187-1193.
- Hartmann, H. T., Kester, D. E., Davis, F. T. and Geneve, R. L. Plant Propagation: Principles and Practices, Prentice Hall, Upper Saddle River, NJ, USA, 6th edition, 1997.
- Rawat, T. S., Singh, J. and Verma, V. 2004. Response of grape cuttings (*Vitis vinifera* L.) to plant growth regulators. *Sci. Horti. For* 9:61-65. 10.
- Rajarama, H. A. 1997. Studies on propagation of pomegranate (*Punica granatum* L.) by cuttings. M.Sc. (Agri.) Thesis, *University of Agriculture Sciences, Dharwad*.
- Rolaniya, M. K., Khushbu, M. B. and Sarvanan, S. 2018. Effect of plant growth regulators (IAA, IBA, GA3) on rooting of hardwood cutting of Grape (*Vitis venifera* L.) Thompson seedless. *Journal of Pharmacognosy and Phytochemistry*, SP1:398-400.
- Satish, S., Mohana, D. C., Raghavendra, M. P., Raveesha, K. A., 2007. Antifungal activity of some plant extracts against important seed borne pathogens of *Aspergillus* sp. *Journal of Agricultural Technolo.*
- Shepherd, H. and Winston, S. L. 2000. Effect of IBA on rooting of stem cuttings of *Bougainvillea* cv. Thimma. *Bioved*, 4(1/2): 37-40.
- Singh, A. K. and Singh, V. B. 2002. Influence of wood maturity and auxin on regeneration of bougainvillea cuttings. *Prog. Hort.*, 34(2): 196-199.
- Singh, K. K. and Tomar, Y. K. 2015. Effect of planting time and indole butyric acid levels on rooting of woody cuttings of phalsa (*Grewia asiatica* L.) *HortFlora Research Spectrum*, 4(1): 39-43.6.
- Singh, K. K., Rawat, J. M. S., Tomar, Y. K. and Kumar, P. 2013. Effect of IBA concentration on inducing rooting in stem cuttings of *Thujacompecta* under mist house condition. *HortFloraRes. Spectrum*, 2(1): 30-34.
- Singh, N. and Singh, B. P. 2011. Effect of different concentrations of indole butyric acid (IBA) on sprouting, rooting and callusing potential of bougainvillea stem cuttings. *The Asian Journal of Horticulture*; Vol. 6 No. 1: 229-230.
- Yasser, A. S. 2015. Effect of growth regulators and bio-fertilizers on rooting and growth of pomegranate (*Punica granatum* L.) stem cuttings. *M.Sc.(Hort) Thesis, Univ. Hort. Sci., Bagalkot*.

How to cite this article:

Shriram, J. M., R. A. Patil, B. N. Ralebhat, N. Sumitha, T. S. Ghangale and Shinde, S. B. 2021. Effect of Plant Growth Regulators on Rooting Parameters of Grape Rootstock. *Int.J.Curr.Microbiol.App.Sci.* 10(02): 738-745. doi: <https://doi.org/10.20546/ijcmas.2021.1002.088>