The Pharma Innovation Journal 2022; 11(5): 1119-1122

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(5): 1119-1122

www.thepharmajournal.com
Received: 10-02-2022
Accepted: 16-03-2022

Bhavana Beniwal
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

Naveen Kumar
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

Harmandeep Kour
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

Navdeep Pathlan
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

Ankush Chhabra
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

Corresponding Author:
Bhavana Beniwal
M.Sc. Students, Department of Horticulture, School of Agriculture, Lovely Professional University, Punjab, India

The influence of plant growth regulators on the rooting of Grapes (*Vitis venifera*) wood cutting cv. Thompson Seedless

Bhavana Beniwal, Naveen Kumar, Harmandeep Kour, Navdeep Pathlan and Ankush Chhabra

Abstract
An experiment was conducted with three plant growth regulators (IAA at 100, 300, and 500ppm concentration levels, GA3 with 50, 100, and 150ppm concentration, IBA at 1000, 2000, and 3000ppm concentrations) and a control treatment. Observations from ten randomly selected plants from each replication were recorded for quantitative characters on root induction and shoot inductions parameters. The cuttings treated with GA3 @ 150ppm (T9) took the least number of days (90 days) for the emergence of the first node while cutting treated with IBA@ 2000 (T5) took the least number of days for the beginnings of the first node, and the opposite for the first emergence of the node. Maximum leaves (22.25), the average number of roots per cutting (30.59), average number of buds per cutting (9.91), the maximum length of longest root (28.29 cm), average root formation zone (28.24cm), the maximum length of longest root (27.84 cm), an average thickness of widest roots (1.79 mm) were discovered 90 days after planting in the treatment that was treated by IBA @ 2000ppm and then by IBA @ 3,000ppm.

Keywords: Cutting, IBA, IAA, GA3, number of roots and root length

Introduction
The grape is a delicious and refreshing fruit. Due to its great benefits, demand for the crop is increasing, becoming increasingly relevant in the fruit industry. The huge percentage of grape production now produced from temperate nations, primarily China, France, and Italy (Food and Agriculture Organization [FAO], 2022) [5]. Grapevines are commonly propagated vegetatively, such as through hardwood cuttings (Waite *et al.*, 2014) [15]. Asexual propagation is used because if the plants reproduced by the hardwood start producing fruits ripen early, every year it gives bigger production and high quality of fruits. Cuttings treated with plant hormones are essential in regenerating plants. However, few innovative research on grape propagation from cuttings. Grapes are one of India's crucial commercial fruit crops. It is known because its deliciousness and excellent commodities such as phosphorus, calcium, vitamins like B1 or B2. Cuttings are made from one-session-old shoots with 3 to 4 vertices in total. Plants are transferred in the media before being transplanted in order to cause rooting.
Cuttings treated with plant growth regulators are essential in regenerating plants from cuttings. Unfortunately, there are few reports on systematic research on grape propagation from cuttings. As a result, it is felt necessary to research grapevine propagation applying several concentrations of plant regulators for faster proliferation in the nurseries. Dog ridge is an important rootstock for grape and it's nature drought resistance. This rootstock promotes higher vegetative development at the expense of reproductive development when Thompson seedless grafted onto it. Another rootstock 110 R is increasing in trend because of its resistance nature for drought and salinity and moderate vigor, which improves bud fruitfulness. St. George is among the most valuable rootstock, resistance for phylloxera, It is moderately resistant to drought in light soils and better sensitivity of water stress in deep soils. The rootstocks' potential to root varies according to plants, the mother vines', IBA concentration, biochemical composition, and mineral constituents (Pushpavathi *et al.*, 2017) [8]. Relevant factors in the emergence of rooted cuttings is the rooting medium. one of the aspects which influences grape cuttings' roots and growth (Abebe, 2017) [1]. Plant hormones are Natural or synthetic chemical substances that change or influence physiological effects on plants when used in low concentrations. When applied to various plant parts, taken up readily and transported via tissues.

They are particular in their actions. Plant hormones, also known as phytohormones, are naturally produced by the plant and move from the manufacturing point to the active site. Charles Darwin discovered a group of growth regulators known as auxins in the late 1800s. Auxins are essential for apical bud dominance and stem lengthening. By use of auxin has been proven to promote callus formation and tissue specialization, as well as complex vascular differentiation (Singh, 2018) [12]. In this research, we studied that the right combination of plant hormones and the right season will rapidly multiply grape hardwood cuttings. The addition of auxin to the cuttings resulted in a significant in the number of roots (Yan *et al.*, 2017) [18]. NAA assisted to accelerate the growth of more fruitful branches (Singh and Bahadur, 2015) [10]

Materials and Methods

The test was conducted at an experimental farm operated by the horticulture department of a Lovely professional university, Phagwara, Punjab. At the Kharif (rainy) season of 2020. The goal was to determine which plant hormones had the best effect on the sprouting of hardwood grape (*Vitis* venifera) cv. Thompson seedless. Statistics analyses were conducted using a randomized block design with three factors and three levels of IAA at 100, 300, and 500 ppm, IBA at 1000, 2000, and 3000 ppm, and GA3 at 50, 100, and 150 ppm, respectively. The IBA-treated cuttings were treated with a quick dip method, whereas the other regulators (IAA and GA3) and the control were treated with a longer dip method. The parameters were measured at 30-day intervals.

Grape (*Vitis venifera*) hardwood stem cuttings were obtained from plants, and 15cm long and pencil thickness cuttings with the basal region were created. For rooting medium, fine sand and farmyard manure (FYM) at volume ratio 2:1 were prepared well, cleaned for stones or weeds, and thereafter placed in rooting media. Before transplanting in the growing medium, the cuttings were dipped in dilute solutions of 1000 ppm, 2000 ppm, 3000 ppm, and treatment of Indole-3-Butyric acid using the quick dip method for 10 seconds. The cuttings were quickly implanted in plant trainers and planted 7.5cm deep up to the surface within rooting media after treatments. For the other two growth regulators (IAA and GA_3) procedure of taking cuttings and preparing trainers was the same. In the case of IAA and GA_3, the cuttings were dipped in a dilute solution of 100ppm, 300ppm and 500ppm, and for GA_3 @50 ppm, 100ppm and 150ppm, treatment of Indole acetic acid and Gibberellins were using the prolonged dip method. The cuttings were quickly planted in plant trainers at 7.5cm deep up to the surface within rooting media after treatments. Studies are also operated upon to observe the response of plant hormone on the various parameters related to shoot induction and shoot regeneration hardwood cuttings of grape, e.g. average no of leaves/cutting, average no. of buds/ cutting, dry weight of shoots, furthermore, the effect of different plant hormones on the root zone of grapes hardwood cutting, e.g. average no. of roots/cuttings, the average the largest root's lengths, an average diameter of the thickest root, dry weight and fresh weight of the roots. For all quantitative traits, observations were made on ten randomly selected plants from each regulator in each replication. The first emergence of a node, depending on the concentration or growth regulators, the average number of leaves/cutting, and the average number of buds /cutting, shoots' dry weight, which concentration or plant growth regulator is responsible for the first emergence of a root, average root formation zone, average number of roots/cutting, the longest root's length, and the average diameter of the thickest roots, dry roots weight, fresh root weight, and cutting survival percentage.

Results and Discussion

Data regards to the impact of plant hormones on the shoot parameters of grape hardwood cuttings are presented in Table 1. In these three different growth regulators treated, IBA at 2000ppm showed the highest number of shoots/cutting. In the case of the number of buds per cutting, IBA (2000 ppm) showed the best result, followed by 1000ppm and 3000ppm IBA. In the case of IAA, cuttings treated with 500ppm IAA was showed the highest leaves/cutting followed by 100ppm and 300ppm. GA_3 treatment had very little effect on shoot proliferation, but IBA at 2000ppm gave the best results, followed by IAA. Grape hardwood cuttings treated with treatment T5 (2000ppm IBA) give better results in the dry weight of shoots (3.03g), and treatment T1 gives the lowest results. Ahmed *et al*. (2017) [4] found that the greatest number of sprouts/cutting and fresh weight of roots were obtained In NAA (1000 mg L -1). These findings in pomegranate are similar to (Mehta *et al*., 2018) [6]. Similarly, 2000ppm dosage of IBA, the greatest success percentages, number of sprouts/cutting, total number of leaves/cutting, leaf area index, number of roots per cutting, and length of roots were detected by (Burman *et al*. 2016) [2]. Similarly (Singh *et al.*, 2015) [11] estimate that the use of IBA and NAA managed to boost the leaf number/cutting.

Table 1: The Response of Plant harmones on the Shoot Zone of Grape Hardwood Cuttings:

S. No.	First emergence of node	Average no of leaves/cutting			Average no. of Buds/ cutting			Dry weight of shoots
		30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	
T0	19.30	2.9	8.18	9.08	0.8	5.61	7.51	1.66
T1	20.31	3.5	9.39	9.61	0.75	5.71	7.42	0.61
T2	17.70	3.69	10.70	10.92	0.84	6.12	7.68	0.67
T3	16.02	3.70	5.04	15.35	0.96	6.63	8.08	0.79
T4	20.70	6.65	13.45	21.69	1.63	7.22	8.71	1.07
T5	17.30	12.68	18.02	22.25	2.17	8.16	9.91	3.03
T6	20.03	2.89	10.03	12.23	1.85	7.63	9.22	2.37
T7	14.70	2.41	2.74	8.89	0.91	6.61	8.08	0.92
T8	12.01	0.40	4.43	6.43	1.09	6.81	8.39	1.02
T9	9.00	3.73	4.20	4.90	1.45	7.20	8.71	1.05
S.E.	0.43	0.04	0.78	0.25	0.12	0.1	0.1	0.01
C.D.	0.89	0.07	1.62	0.51	0.24	0.22	0.22	0.04

Data regards to the impact of plant hormones on the shoot parameters of grape hardwood cuttings are presented in Table 2. Grape hardwood Cuttings were treated with 2000 ppm IBA provided a superior performance of root formation zone, the average length of the longest root. These results correspond to (Singh, K.K. 2018) [12] findings in bougainvillea. The same results found by (Waite *et al.,* 2015) [16], it's could be due to auxin's action, which triggered carbohydrate and nitrogen-containing material decomposition and translocation just at cuttings' roots, resulting in rapid cell enlargement and in a favorable place of cell division. Grape hardwood Cuttings were treated with 2000 ppm IBA provided a superior performance in the average thickness of the thickest roots, and T0 (control) treatments had the lowest average thickness of the thickest roots. In the case of the dry weight of roots, Growing conditions and IBA concentrations owned a substantial influence upon dry weight of roots/cutting; according to this study, it's possible that the increased dry weight of roots is due to the species or favorable environmental circumstances. Treatment T5 (2000 ppm IBA) had a significantly higher dry weight of roots per cutting (0.62 g), while T0 (control) treatments exhibit the lowest average dry weight of roots per cutting (0.06 g). Grape Hardwood cuttings were treated with IBA (2000 ppm) give the maximum fresh weight of roots, and T0 (control) treatment gives the lowest fresh weight of roots (0.06g). Cutting survival percentages were highest when cuttings were treated with 2000 ppm IBA. A higher concentration of GA_3 at 150ppm produced even better results, followed by 50 ppm and 100 ppm. These findings are similar to those of (Wangchu *et al.,* 2017) [17] in guava, (Rajkumar *et al.,* 2016) [9] in pomegranate, (Uddin *et al*., 2020) [14] in grape (Toma, R. S. 2018) [13] in grape, and Akhtar *et al*. (2015) in rose. 500 ppm IAA gives better results, followed by 300 ppm and 100 ppm. As according (Singh and Tomar 2015) [11] in Phalsa, the increase in the number of roots/cutting may have had a serious influence on the fresh weight of the roots.

Table 2: The Response of Plant hormones on the Shoot Zone of Grape Hardwood Cuttings:

S. No.	First emergence of roots	Average no. of roots/cuttings			The longest root's average length			Average diameter of the thickest roots			Roots' dry weight (g)	Fresh weight of roots
		30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90 DAP		
T0	21.02	6.12	12.89	15.88	5.23	8.26	8.96	1.36	1.37	1.37	0.04	0.06
T1	18.04	8.79	12.67	15.28	4.72	7.99	8.39	1.33	1.35	1.38	0.14	0.18
T2	16.63	9.66	13.69	16.26	5.53	10.46	11.46	1.38	1.37	1.39	0.18	0.21
T3	15.03	10.37	15.35	18.24	6.86	11.08	12.18	1.46	1.48	1.44	0.19	0.24
T4	14.05	13.37	22.65	27.68	13.42	23.49	25.45	1.63	1.64	1.63	0.37	0.33
T5	9.02	14.79	24.07	30.59	15.67	26.04	28.29	1.72	1.77	1.79	0.39	0.62
T6	11.31	14.36	23.74	28.76	14.19	23.96	26.14	1.67	1.68	1.64	0.36	0.39
T7	22.70	12.58	18.41	21.85	8.14	14.99	16.15	1.49	1.51	1.52	0.25	0.23
T8	23.04	13.68	19.11	22.99	9.26	16.46	17.76	1.53	1.54	1.56	0.27	0.32
T9	20.00	13.67	20.62	23.95	10.75	17.68	18.99	1.57	1.58	1.59	0.28	0.34
S.E.	0.76	0.15	0.17	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.11
C.D.	1.51	0.31	0.34	0.06	0.05	0.04	0.06	0.03	0.02	0.02	0.02	0.17

Conclusion

In the current study, some of the root and shoot characteristics of cuttings were strongly impacted by the application of different growth hormones compared to the control. However, in this study, the treatment of 2000 ppm IBA was found to be the most effective for greatest success of rooting and growth, of grape cuttings, apart from the treatment of 1000ppm, or 3000 ppm IBA.

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