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Full Length Research Article

Impact of Plant Growth Regulator and Rooting Media on Shoot Characters of Cuttings of Grape (*Vitis vinifera* L.)

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Abstract

The experiment entitled "Impact of plant growth regulator and rooting media on shoot characters of cuttings of grape (*Vitis vinifera* L.)" was carried out during 2020-2021 and 2021-2022 at Grape Field Choudhary Farm Bahadari, Mandsaur (M.P.). The present experiment was laid down in randomized block design (Factorial) with three replication and twenty treatment combinations. In these treatments five concentrations auxin levels was used i.e., Control G_0, 1000 ppm IBA G_1, 2000 ppm IBA G_2, 3000 ppm IBA G_3 and 4000 ppm IBA G_4. Four types of rooting media i.e., Soil M_0, Soil + Vermicompost (1:1) M_1, Sand + Vermicompost (1:1) M_2 and Soil + Sand + Vermicompost (1:1:1) M_3. The observations were recorded days taken to start sprouting, days taken to 50% sprouting, percentage of success of cutting, no. of shoots per cutting, no. of leaves per shoot and total no. of leaves per cutting. Application of PGR the better result of shoot growth was observed in the treatment of G_4 (4000 ppm IBA) such shoot characters like days taken to start sprouting (11.24), days taken to 50% sprouting (16.24), percentage of success of cutting (75.31), no. of shoots per cutting (2.63), no. of leaves per shoot (12.66) and total no. of leaves per cutting (38.49), application of rooting media the maximum growth of shoots was observed in treatment M_3 (soil + sand + vermicompost (1:1:1) such shoot characters days taken to start sprouting (12.61), days taken to 50% sprouting (17.60), percentage of success of cutting (73.07), no. of shoots per cutting (2.21), no. of leaves per shoot (12.46) and total no. of leaves per cutting (33.01). In the combined application of PGR and rooting media the shoot growth of different characters days taken to start sprouting (11.11), days taken to 50% sprouting (16.26), percentage of success of cutting (77.18), no. of shoots per cutting (2.83), no. of leaves per shoot (13.14) and total no. of leaves per cutting (42.88) was found in M_3G_4 (soil + sand + vermicompost (1:1:1) + 4000 ppm IBA).

***Key words*:** *Vitis vinifera*, Cuttings, IBA, Rooting media, Shoot characters

Grape (*Vitis vinifera* L) is the most demandable and remunerative horticultural crop belongs to the family Vitaceae. As per classification it has 12 genera and approx. 60 species and divided into two sub-genera, *Euvitis Planch*. (2n=38) and *Muscadinia Planch*. (2n=40) [1]. Botanically it is a self-pollinated diploid species. This crop is widely grown in temperate, subtropical and tropical regions of the globe. Botanically, the grapevine is hardy and liana (a climbing plant) with spreading and deep root system. Feeder roots are located up to 25 cm deep and horizontally up to 60–120 cm away from trunk. Trunk is a major stem of vine on which whole framework is based. After pruning, succulent current season's growth arises from buds called as 'shoots', which when become woody, mature and dormant are called as 'canes'. Leaves of grape vine are cordate shaped and palmately lobed. Grape is a refreshing fruit, rich in sugars, acids, minerals, vitamins and tannins. Major constituents of fruits are carbohydrates (15.00%), minerals (0.2-0.6%), organic acids (0.3-1.5%), nitrogenous compounds (0.03-0.70%), iron (0.0030.0017%/100g), calcium (0.004-0.025%), potassium (0.15-0.25%), vitamin A (180 micro gram), vitamin B complex (391-636 mg/100g), vitamin C (1.0-12.5 mg/100g) [2]. Predominant sugar in grape berries is fructose followed by glucose and sucrose. Tartaric and mallic acids constitute 90% or more of total acidity of fruits. The mature berry contains 12-27% sugar. TSS in different variety ranges from 12-18%. Fresh juice contains 0.2-1.0% tartaric acid. The red, blue, purple and black grapes are owing to pigment known as anthocyanin. During ripening grape develop some volatile compound like methyl anthranilate which emits a special aroma, for *Vinifera* varieties [3].

Grapevines are very easy to grow from cuttings [4]. It is well known that in comparison to soft wood cuttings, grapes are generally propagated through hardwood cuttings [5]. The main reasons are due to its highest success rate [6] without the use of

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special rooting technique, least expensive and easiest method of vegetative propagation [7-8]. Cuttings can also be made from the stem, modified stem, roots or leaves [4].

Grapes are very easy to grow from cuttings. With proper care, a dormant cutting can be started in the spring and by fall will give a vine large enough to bear a cluster or two of fruit the next season. The important factors are proper care and preparation of the cuttings. Grapes can be grown from two types of cuttings, dormant or hardwood, and green cuttings. Dormant cuttings are the easiest to handle, but green cuttings work in situations when it isn't possible to use hardwood, such as for grapes that don't root easily from dormant cuttings, or when green cuttings are all that are available [4]. In respect of all horticultural crop asexual propagation or vegetative methods of propagation or techniques are practiced to multiply plants of for better performance and to improve their economic importance. These vegetative propagation methods are including layering, cutting, grafting, *etc*. The method of propagation varies crop to crop and we select multiplication methods on the basis of simplicity, rate of success, cost and length of time to get successful complete plant. Grapes are commonly multiplied by vegetative propagation method, particularly the T-budding method is the most suitable method of propagation. Layering is of common use in difficult to root types like Muscatine.

MATERIALS AND METHODS

The experiment was carried out in 2019-20 and 2020-21 at Grape Field Choudhary Farm Bahadari, Mandsaur (Madhya Pradesh). The experiment was laid down in factorial randomized block design with three replication and twenty treatment combinations. In these treatments five concentrations auxin levels was used i.e., Control G_0, 1000 ppm IBA G_1, 2000 ppm IBA G_2, 3000 ppm IBA G_3 and 4000 ppm IBA G_4. Four type of rooting media i.e., Soil M_0, Soil + Vermicompost (1:1) M_1, Sand + Vermicompost (1:1) M_2 and Soil + Sand + Vermicompost (1:1:1) M_3 and the twenty treatment combinations viz., M_0G_0 (Soil + Water), M_0G_1 (Soil + 1000 ppm IBA), M_0G_2 (Soil + 2000 ppm IBA), M_0G_3 (Soil + 3000 ppm IBA), M_0G_4 (Soil + 4000 ppm IBA), M_1G_0 (Soil + Vermicompost + Water), M_1G_1 (Soil + Vermicompost + 1000 ppm IBA), M_1G_2 (Soil + Vermicompost + 2000 ppm IBA), M_1G_3 (Soil + Vermicompost + 3000 ppm IBA), M_1G_4 (Soil + Vermicompost + 4000 ppm IBA), M_2G_0 (Sand + Vermicompost + Water), M_2G_1 (Sand + Vermicompost + 1000 ppm IBA), M_2G_2 (Sand + Vermicompost + 2000 ppm IBA), M_2G_3 (Sand + Vermicompost + 3000 ppm IBA), M_2G_4 (Sand + Vermicompost + 4000 ppm IBA), M_3G_0 (Soil + Sand + Vermicompost + Water), M_3G_1 (Soil + Sand + Vermicompost + 1000 ppm IBA), M_3G_2 (Soil + Sand + Vermicompost + 2000 ppm IBA), M_3G_3 (Soil + Sand + Vermicompost + 3000 ppm IBA), M_3G_4 (Soil + Sand + Vermicompost + 4000 ppm IBA). The observations of shoots characters were recorded i.e., days taken to start sprouting, days taken to 50% sprouting, percentage of success of cutting, no. of shoots per cutting, no. of leaves per shoot and total no. of leaves per cutting.

RESULTS AND DISCUSSION

Days taken to start sprouting

The minimum days taken to start sprouting (11.24 days) of cutting was observed under the treatment G_4 (4000 ppm IBA), whereas, the maximum days taken to start sprouting (14.18 days) of cutting was observed under control (G_0). It is might be due to the increases in sprouts might be due to better utilization of stored carbohydrates, nitrogen, increased level of auxin and other factors with the help of growth regulators, the auxin treatments stimulate the hydrolysis of nutritional reserves and their mobilization of sprouting [9]. Chandramouli [10] observed that the increase in IBA concentration significantly reduced the number of days to first sprouting of cuttings and earliness in sprouting might be due to better utilization of stored carbohydrates, nitrogen and other factors with the help of growth regulators. Similarly, Mali [11] reported that 750 ppm IBA had taken minimum time for sprouting followed by 500 ppm IBA. The results of present findings are in agreement with the results obtained by Sawant [12-13] in kartoli crop and Rajarama [14] in pomegranate and Garande *et al.* [15] in grape rootstocks. Padekar *et al*. [16] also reported similar result.

Table 1 Impact of plant growth regulator and rooting media on shoot characters of grape cuttings

Treat.	Days taken to start sprouting			Days taken to 50% sprouting			Percentage of success of cutting			No. of shoots per cutting			Number of leaves per shoot			Total Number of leaves per cutting		
	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled
G_0	14.30	14.06	14.18	19.32	19.00	19.16	58.87	57.89	58.38	0.91	0.89	0.90	10.82	10.64	10.73	13.47	13.24	13.36
G_1	13.65	13.42	13.54	18.60	18.29	18.45	71.86	70.66	71.26	1.75	1.72	1.73	11.35	11.16	11.26	26.51	26.07	26.29
G_2	13.30	13.08	13.19	18.32	18.01	18.16	75.08	73.82	74.45	2.38	2.34	2.36	11.64	11.44	11.54	31.68	31.15	31.42
G_3	12.83	12.61	12.72	17.86	17.56	17.71	74.44	73.19	73.81	2.50	2.45	2.47	11.94	11.74	11.84	34.09	33.52	33.81
G_4	11.33	11.14	11.24	16.38	16.10	16.24	75.95	74.68	75.31	2.65	2.61	2.63	12.77	12.55	12.66	38.81	38.17	38.49
S.Em. ±	0.0155	0.0235	0.0501	0.0153	0.0232	0.0680	0.1020	0.1544	0.2778	0.0100	0.0152	0.0118	0.0143	0.0216	0.0449	0.1383	0.2094	0.1645
C.D. at 5%	0.0445	0.0674	0.1412	0.0438	0.0664	0.1915	0.2919	0.4420	0.7825	0.0287	0.0435	0.0332	0.0408	0.0618	0.1266	0.3959	0.5996	0.4633
M_0	13.49	13.26	13.37	18.38	18.07	18.22	68.13	66.99	67.56	1.76	1.73	1.75	10.92	10.74	10.83	24.65	24.24	24.45
M_1	13.20	12.98	13.09	18.25	17.95	18.10	71.13	69.95	70.54	2.00	1.97	1.99	11.40	11.21	11.30	27.92	27.46	27.69
M_2	12.92	12.70	12.81	18.01	17.71	17.86	72.00	70.80	71.40	2.15	2.11	2.13	11.94	11.74	11.84	29.79	29.30	29.55
M_3	12.72	12.51	12.61	17.75	17.45	17.60	73.68	72.46	73.07	2.23	2.19	2.21	12.56	12.35	12.46	33.28	32.73	33.01
S.Em. ±	0.0139	0.0211	0.0448	0.0137	0.0207	0.0608	0.0912	0.1381	0.2485	0.0090	0.0136	0.0105	0.0127	0.0193	0.0402	0.1237	0.1873	0.1471
C.D. at 5%	0.0398	0.0603	0.1263	0.0392	0.0594	0.1713	0.2611	0.3954	0.6999	0.0257	0.0389	0.0297	0.0365	0.0553	0.1132	0.3541	0.5363	0.4144

The minimum days taken to start sprouting (12.61 days) of cutting was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], which was at par with the treatment M_2 [Sand + Vermicompost] (12.81 Days), whereas, the maximum

Days taken to start sprouting (13.37 days) of cutting was observed under Soil (M_0) respectively. These results in agreement with the findings of Antunes *et al.* [17] and indicate that those cuttings which were planted in media are the first to emerge among other cuttings. This may be attributed to high porosity and higher availability of moisture and nutrients to the cutting in Soil, which enhances the physiological activity of grape cuttings and results in the early emergence of leaves compared to other potting media [18]. The delayed emergence of leaves in soil can be attributed to the fact that although soil possesses the highest reservoirs of nutrients, lower water holding capacity and moisture retention of the said media have failed to prevent grape cuttings from moisture stress and thus delayed the bud initiation process [19].

The minimum days taken to start sprouting (11.11 days) was found in treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA), which was at par with the treatment combination M_2G_4 (Sand + Vermicompost) + (4000 ppm IBA) (11.21 Days), M_1G_4 (Soil + Vermicompost) + (4000 ppm IBA) (11.29 Days) and M_0G_4 (Soil) + (4000 ppm IBA) (11.35 Days), whereas the maximum days taken to start sprouting (14.78 days) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA).

Days taken to 50% sprouting

The minimum days taken to 50% sprouting (16.24 days) of cutting was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (17.71 Days), whereas, the maximum days taken to 50% sprouting (19.16 days) of cutting was observed under control (G_0). This might be due to exogenous application of auxins to the cuttings might have brought early breakage of bud dormancy and results in early bud sprouting [20-21].

The minimum days taken to 50% sprouting (17.60 days) of cutting was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (17.86 Days), M_1 [Soil + Vermicompost (1:1)] (18.10 Days), whereas, the maximum was observed under soil (M_0).The minimum days taken to 50% sprouting was found under the treatment combination M_0G_4 (Soil) + (4000 ppm IBA) (16.09 Days), which was at par with the treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) (16.26 days), M_2G_4 (Sand + Vermicompost) + (4000 ppm IBA) (16.26 Days) and M_1G_4 (Soil + Vermicompost) + (4000 ppm IBA) (16.34 Days), whereas the maximum days taken to 50% sprouting (19.93 days) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA). This might be due to addition of sand and vermicompost in equal proportion, which provided favorable conditions for sprouting and rooting. Addition of sand facilitated proper drainage and aeration for exchange of gases. Bates and Tisdal [22] observed that adding coarse sand in sufficient quantity greatly improve the percolation of water through soil. The minimum number of days for sprouting was noticed in cuttings grown in a mixture of black clay and FYM could be attributed to higher degree of fertility and water retaining capacity [23].

Table 2 Combined effect of plant growth regulator and rooting media on shoot characters of grape cuttings

Treat. Comb.	Days taken to start sprouting			Days taken to 50% sprouting			Percentage of success of cutting			No. of shoots per cutting			Number of leaves per shoot			Total Number of leaves per cutting		
	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled	Ist Year 2020-21	IInd Year 2021-22	Pooled
M_0G_0	14.90	14.65	14.78	20.10	19.77	19.93	50.50	49.66	50.08	0.76	0.75	0.75	9.65	9.49	9.57	9.37	9.21	9.29
M_0G_1	14.30	14.06	14.18	19.00	18.68	18.84	70.47	69.30	69.88	1.12	1.10	1.11	10.12	9.95	10.04	21.99	21.62	21.81
M_0G_2	13.80	13.57	13.69	18.70	18.39	18.54	73.93	72.70	73.31	2.19	2.15	2.17	11.05	10.87	10.96	26.20	25.76	25.98
M_0G_3	12.98	12.76	12.87	17.85	17.55	17.70	72.55	71.34	71.95	2.31	2.27	2.29	11.25	11.06	11.16	31.73	31.20	31.47
M_0G_4	11.45	11.26	11.35	16.23	15.96	16.09	73.19	71.97	72.58	2.42	2.38	2.40	12.54	12.33	12.44	33.97	33.40	33.69
M_1G_0	14.50	14.26	14.38	19.40	19.08	19.24	58.10	57.13	57.62	0.94	0.92	0.93	10.57	10.39	10.48	13.12	12.90	13.01
M_1G_1	13.80	13.57	13.69	18.90	18.59	18.74	71.97	70.77	71.37	1.87	1.84	1.85	11.09	10.91	11.00	26.12	25.68	25.90
M_1G_2	13.40	13.18	13.29	18.50	18.19	18.35	75.64	74.38	75.01	2.22	2.18	2.20	11.15	10.96	11.06	28.98	28.50	28.74
M_1G_3	12.92	12.70	12.81	17.98	17.68	17.83	73.69	72.46	73.08	2.37	2.33	2.35	11.15	10.96	11.06	30.72	30.21	30.46
M_1G_4	11.38	11.19	11.29	16.48	16.21	16.34	76.27	75.00	75.63	2.62	2.58	2.60	13.02	12.80	12.91	40.67	39.99	40.33
M_2G_0	14.00	13.77	13.88	19.01	18.69	18.85	61.40	60.38	60.89	0.95	0.93	0.94	10.99	10.81	10.90	12.56	12.35	12.46
M_2G_1	13.40	13.18	13.29	18.50	18.19	18.35	72.01	70.81	71.41	1.98	1.95	1.96	12.05	11.85	11.95	28.49	28.02	28.25
M_2G_2	13.10	12.88	12.99	18.23	17.93	18.08	74.93	73.68	74.31	2.52	2.48	2.50	12.17	11.97	12.07	34.77	34.19	34.48
M_2G_3	12.80	12.59	12.69	17.90	17.60	17.75	75.15	73.90	74.52	2.58	2.54	2.56	12.22	12.02	12.12	35.78	35.18	35.48
M_2G_4	11.30	11.11	11.21	16.40	16.13	16.26	76.50	75.23	75.86	2.72	2.67	2.70	12.25	12.05	12.15	37.37	36.75	37.06
M_3G_0	13.80	13.57	13.69	18.78	18.47	18.62	65.47	64.38	64.92	0.97	0.95	0.96	12.08	11.88	11.98	18.82	18.51	18.66
M_3G_1	13.10	12.88	12.99	18.00	17.70	17.85	72.97	71.75	72.36	2.01	1.98	1.99	12.15	11.95	12.05	29.45	28.96	29.20
M_3G_2	12.90	12.69	12.79	17.84	17.54	17.69	75.80	74.54	75.17	2.59	2.55	2.57	12.18	11.98	12.08	36.78	36.17	36.47
M_3G_3	12.60	12.39	12.50	17.71	17.41	17.56	76.35	75.08	75.71	2.72	2.67	2.70	13.15	12.93	13.04	38.13	37.49	37.81
M_3G_4	11.20	11.01	11.11	16.40	16.13	16.26	77.83	76.53	77.18	2.85	2.80	2.83	13.25	13.03	13.14	43.24	42.52	42.88
S.Em. ±	0.0311	0.0471	0.1003	0.0306	0.0464	0.1360	0.2039	0.3088	0.5556	0.0201	0.0304	0.0236	0.0285	0.0432	0.0899	0.2766	0.4189	0.3290
C.D. at 5%	0.0890	0.1348	0.2824	0.0877	0.1327	0.3829	0.5838	0.8840	1.5650	0.0575	0.0870	0.0664	0.0816	0.1236	0.2532	0.7919	1.1992	0.9265

Percentage of success of cutting

The maximum percentage of success of cutting (75.31%) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_2 (2000 ppm IBA) (74.45%) and G_3 (3000 ppm IBA) (73.81%), while the minimum percentage of success of cutting (58.38%) was observed under control (G_0). It might be due to the rooting co-factors and their balance with nutritive substances and auxin [24-25]. The result maximum percentage of success of cutting (73.07%) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (71.40%), while, minimum was observed under Soil (M_0) respectively. The maximum percentage of success of cutting (77.18%) was found under M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA), followed by M_2G_4 (Sand + Vermicompost) + (4000 ppm IBA) (75.86 %), whereas the minimum (50.08%) was found under the treatment combination M_0G_0.

Number of shoots per cutting

The maximum number of shoots per cutting (2.63) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (2.47) and G_2 (2000 ppm IBA) (2.36). Whereas, the minimum Number of shoots per cutting (0.90) was observed under control (G_0) respectively. It might be due to higher concentration of IBA stimulated higher number of roots with faster growth resulting in better absorption of food material and other necessary minerals, in this way plant will take higher growth which results a greater number of sprouts [26]. IBA promote luxurious growth of root as well as shoots which may have been resulted in the maximum fresh weight of shoot. The similar results were observed by [27-30] conformity with these, they are having better root system, they could absorb sufficient water and other nutrients, which could be excellent in all studied characters. These results are in agreement with the finding of Abdel-Rahman and El-Dsouky [31], Abdel-Rahman and El-Naggar [32] found that combined IBA-bacteria or IBA-AMF treatments were more effective in increasing root and vegetative growth then control or IBA and beneficial microorganisms alone.

The maximum number of shoots per cutting (2.21) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 (2.13) and M_1 (1.99) while, minimum number of shoots per cutting (1.75) was observed under Soil (M_0). Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum number of shoots per cutting (2.83), followed by M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (2.70), M_2G_4 (Sand + Vermicompost) + (4000 ppm IBA) (2.70), M_3G_2 (Sand + Vermicompost (1:1) + (2000 ppm IBA) (2.57), whereas the minimum number of shoots per cutting (0.75) was found under the treatment combination M_0G_0. Auxin activated shoot growth which may due to used hydrolysis and translocation of carbohydrates and nitrogenous substances at the base of cuttings and resulted in accelerating cell elongation and cell division [33].

Number of leaves per shoot

The maximum number of leaves per shoot (12.66) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (11.84) and G_2 (2000 ppm IBA) (11.54). Whereas, the minimum number of leaves per shoot (0.90) was observed under control (G_0). This might be due to early initiation of roots, a greater number of roots and higher root length which absorbs more nutrient and water resulted in higher number of leaves after transplanting. The increase in number of leaves under different concentration of IBA was earlier reported by [34]. The increment in vegetative growth characteristics as a result of IBA treatments may be due to the role of IBA on cell division and/or cell elongation [35]. Besides, the stimulatory action of auxin in softening the cell wall, increasing its plasticity leading to cell enlargement of the protoplast by water up take and consequently stimulating the growth [36]. The enhancing effect of *B. subtilis* on the vegetative growth characters obtained in the present investigation was also found by Karakurt *et al.* [37], Erturk *et al.* [38].

The maximum number of leaves per shoot (12.46) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (11.84) and M_1 [Soil + Vermicompost (1:1)] (11.30), whereas, the minimum number of leaves per shoot (10.83) was observed under Soil (M_0). Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum Number of leaves per shoot (13.14), which was at par with the treatment combination M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (13.04), M_1G_4 (Soil + Vermicompost (1:1) + (4000 ppm IBA) (12.91), whereas the minimum number of leaves per shoot (9.57) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA).

Total number of leaves per cutting

The maximum total Number of leaves per cutting (38.49) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (33.81) and G_2 (2000 ppm IBA) (31.42), while minimum total number of leaves per cutting (13.36) was observed under control (G_0).The maximum Total Number of leaves per cutting (33.01) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (29.55) and M_1 [Soil + Vermicompost (1:1)] (27.69). Whereas, the minimum total number of leaves per cutting (24.45) was observed under Soil (M_0). The number of photo synthetically active leaves depends upon the better root and shoot growth, which relies on biological and physical characteristics of the potting media. The bud opening depends upon the biochemical process occurring inside the stem and bud cells; appropriate levels of minerals and nutrients inside the plant allow to form new and to open dormant buds. As by previous results, Compost has increased the number of roots and shoots, which might be a reason to increase the number of leaves in grape cutting [19].

Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum total number of leaves per cutting (42.88), followed by M_1G_4 (Soil + Vermicompost (1:1) + (4000 ppm IBA) (40.33), M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (37.81), M_2G4 (Sand + Vermicompost (1:1) + (4000 ppm IBA) (37.06), whereas the minimum total number of leaves per cutting (9.29) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA). It might be attributed to the better physical and nutritional status of the media [15].

CONCLUSION

It is concluded that treatment G_4 (4000 ppm IBA) was superior found in the different shoot characteristics viz., days taken to start sprouting, days taken to 50% sprouting, percentage of success of cutting, no. of shoots per cutting, no. of leaves per shoot, total no. of leaves per cutting. The treatment of rooting media M_3 (Soil + Sand + Vermicompost (1:1:1) was superior in all the shoot characteristics viz., days taken to start sprouting, days taken to 50% sprouting, percentage of success of cutting, no. of shoots per cutting, no. of leaves per shoot, total

no. of leaves per cutting. Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) was superior in all the shoot characteristics viz., days taken to start sprouting, days taken to 50% sprouting, percentage of success of cutting, no. of shoots per cutting, no. of leaves per shoot, total no. of leaves per cutting.

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