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Study of Plant Growth Regulator and Rooting Media on Growth and Survival Percent of Cuttings of Grape (*Vitis vinifera* L.)

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Abstract

The present investigation entitled "Study of plant growth regulator and rooting media on growth and survival percent 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 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 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. Observations of Growth Characters i.e., Leaf area index (LAI), Leaf area duration (LAD), Crop growth rate and survival percent of cuttings (CGR). Result obtained that in the pooled basis the maximum growth was observed in PGR application of G_4 (4000 ppm IBA) found better in all the growth characters such as leaf area index 60 DAS and 120 DAS (0.282 and 0.326), Leaf area duration (2436.63), crop growth rate (0.192) and survival percent of cuttings (81.22%), application of rooting media the maximum growth was observed in the treatment M_3 (Soil + Sand + Vermicompost (1:1:1) in all growth characters such as leaf area index 60 DAS and 120 DAS (0.269 and 0.316), leaf area duration (2345.87), crop growth rate (0.180) and survival percent of cuttings (80.37%). In combined application of PGR and rooting media the result was analyzed in pooled basis in all characters of growth. The maximum growth of different characters such as leaf area index 60 DAS and 120 DAS (0.313 and 0.360), leaf area duration (2711.28), crop growth rate (0.229) and survival percent of cuttings (86.27%) was found in M_3G_4 (Soil + Sand + Vermicompost (1:1:1) + 4000 ppm IBA).

***Key words*:** Grape, Cuttings, LAI, CGR, Auxin

Plants differ in their response to the different propagation techniques. The success in propagation depends upon how much attention is given to the technique most suitable for a particular plant species. In case of fruit crops, for better propagation results are achieved with asexual propagation /vegetative propagation techniques. Application of these techniques in fruit crops result and economic importance are greater than seed propagation. Other then, its gives uniform crop with a short juvenile phase; so, plants flower early. It is also necessary for propagation of fruit cultivars that naturally have no viable seeds. Grapes is one of the most important fruit crops, accounting for about one quarter of the fruit production of the world. It is grown throughout the temperate regions, especially in warm sunny climates with mild winters and dry periods during fruit ripening. 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.

While cutting, which is physiologically a piece of root/ stem or leaf a single bud or an eye, or a very small piece of meristem, is considered as a method of asexual propagation with numerous advantages. Many new plants can be produced in limited space from few stock plants. It is inexpensive, rapid and simple and doesn't require the special techniques necessary in grafting and budding. Generally, Plant growth regulators (PGR) are the organic substance compounds, which starts or regulate or modify 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. The most commonly employed growth regulators are Indole Butyric Acid (IBA) and Indole Acetic Acid (IAA), Naphthenic Acetic Acid (NAA) and

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Gibberellic Acid (GA_3) is used for stem elongation [1]. 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.

MATERIALS AND METHODS

The experiment was carried out in 2020-2021 and 2021-2022 at Grape Field Choudhary Farm Bahadari, Mandsaur (M.P.). 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 G0, 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) M3 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 Growth Characters i.e., Leaf area index (LAI), Leaf area duration (LAD), Crop growth rate and survival percent of cuttings (CGR).

The followings data are given by the formula:

$$\text{Survival percentage of cuttings} = \frac{\text{No. of survived cuttings}}{\text{Total No. of planted cuttings}} \times 100$$

Leaf area index (LAI)

$$LAI = \frac{A}{P}$$

Where,
A = Leaf area (in cm^2)
P = Ground area (in cm^2)

Leaf area is calculated by automatic leaf area recorder

Leaf area duration (LAD)

$$LAD = \frac{(LA1 + LA_2)}{2} \quad (t_2 - t_1)\ (cm^2.day)$$

Crop growth rate (CGR)

$$CGR = \frac{W_2 - W_1}{P\ (t_2 - t_1)} \quad (g/cm^2/day)$$

Where,
P = ground area (cm^2)
W1 = dry weight per unit area at t_1
W2 = dry weight per unit area at t_2
T1 = first sampling
T2 = second sampling

RESULTS AND DISCUSSION

Leaf area index (LAI) at 60 and 120 days

The maximum leaf area index 60 and 120 days (0.282 and 0.326 Days) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (0.252 Days) and G_2 (2000 ppm IBA) (0.233 and 0.300 Days) while, the minimum leaf area index 60 and 120 days (0.198 and 0.241 days) was observed under control (G_0) respectively. This might be due to higher concentration of auxin leads to the best aerial growth [2].

The maximum leaf area index 60 and 120 days (0.269 and 0.316 Days) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (0.239 and 0.283 Days) and M_1 [Soil + Vermicompost (1:1)] (0.231 and 0.277 Days). Whereas, the minimum leaf area index 60 and 120 days (0.210 Days) was observed under soil (M_0).

Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum leaf area index 60 and 120 days (0.313 and 0.360 Days), which was at par with M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (0.308 and 0.355 days), whereas the minimum leaf area index 60 and 120 days (0.158 and 0.198 days) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA).

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

Treat.	Leaf area index (LAI) 60 Days			Leaf area index (LAI) 120 Days			Leaf area duration (LAD)			Crop growth rate (CGR)			Survival percent		
	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	0.200	0.196	0.198	0.243	0.239	0.241	1807.89	1777.75	1792.82	0.078	0.076	0.077	66.39	65.29	65.84
G_1	0.220	0.216	0.218	0.268	0.263	0.265	1956.81	1924.20	1940.50	0.100	0.098	0.099	77.19	75.90	76.54
G_2	0.235	0.231	0.233	0.281	0.276	0.279	2058.19	2023.88	2041.03	0.118	0.116	0.117	78.43	77.12	77.77
G_3	0.257	0.252	0.254	0.303	0.297	0.300	2225.89	2188.79	2207.34	0.152	0.149	0.151	80.59	79.25	79.92
G_4	0.285	0.280	0.282	0.329	0.324	0.326	2457.11	2416.16	2436.63	0.194	0.190	0.192	81.91	80.54	81.22
S.Em.±	0.0006	0.0009	0.0010	0.0006	0.0009	0.0012	4.4588	6.7522	8.7220	0.0008	0.0013	0.0009	0.0971	0.1470	0.2962
C.D. at 5%	0.0016	0.0025	0.0029	0.0017	0.0025	0.0033	12.7651	19.3312	24.5668	0.0024	0.0036	0.0025	0.2779	0.4208	0.8343
M_0	0.212	0.208	0.210	0.255	0.251	0.253	1880.92	1849.57	1865.25	0.089	0.087	0.088	73.77	72.54	73.16
M_1	0.233	0.229	0.231	0.279	0.275	0.277	2041.26	2007.24	2024.25	0.107	0.105	0.106	76.45	75.18	75.82
M_2	0.241	0.237	0.239	0.285	0.280	0.283	2116.94	2081.66	2099.30	0.135	0.133	0.134	76.33	75.06	75.69
M_3	0.271	0.266	0.269	0.319	0.314	0.316	2365.58	2326.15	2345.87	0.181	0.178	0.180	81.05	79.70	80.37
S.Em. ±	0.0005	0.0008	0.0009	0.0005	0.0008	0.0010	3.9880	6.0394	7.8012	0.0007	0.0011	0.0008	0.0868	0.1315	0.2649
C.D. at 5%	0.0015	0.0022	0.0026	0.0015	0.0022	0.0030	11.4175	17.2903	21.9732	0.0021	0.0032	0.0022	0.2486	0.3764	0.7462

Leaf area duration (LAD)

The maximum leaf area duration (2436.63) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (2207.34) and G_2 (2000 ppm IBA) (2041.03), while minimum leaf area duration (1792.82) was observed under control (G_0). The maximum leaf area duration (2345.87) was observed under the treatment M3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (2099.30) and M_1 [Soil + Vermicompost (1:1)] (2024.25). Whereas, the minimum leaf area duration (1865.25) was observed under Soil (M_0). Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum leaf area duration (2711.28), followed by the treatment combination M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (2666.06), M_1G_4 (Soil + Vermicompost (1:1) + (4000 ppm IBA) (2518.60), whereas the minimum leaf area duration (1485.60) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA).

Crop growth rate (CGR)

The maximum crop growth rate (0.192) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (0.151) and G_2 (2000 ppm IBA) (0.117). Whereas, the minimum crop growth rate (0.077) was observed under control (G_0). The maximum crop growth rate (0.180) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (00.134) and M_1 [Soil + Vermicompost (1:1)] (0.106). Whereas, the minimum crop growth rate (0.088) was observed under Soil (M_0). Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum crop growth rate (0.229), which was at par with M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (0.224), followed by M_0G_4 (Soil + Vermicompost (1:1) + (4000 ppm IBA) (0.174), whereas the minimum crop growth rate (0.035) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA).

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

Treat. Comb.	Leaf area index (LAI) 60 Days			Leaf area index (LAI) 120 Days			Leaf area duration (LAD)			Crop growth rate (CGR)			Survival percent		
	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	0.159	0.156	0.158	0.200	0.197	0.198	1497.76	1472.80	1485.28	0.035	0.034	0.035	57.75	56.79	57.27
M_0G_1	0.189	0.186	0.187	0.230	0.226	0.228	1703.96	1675.56	1689.76	0.058	0.057	0.058	75.62	74.36	74.99
M_0G_2	0.212	0.208	0.210	0.258	0.254	0.256	1895.76	1864.16	1879.96	0.067	0.066	0.066	77.65	76.36	77.00
M_0G_3	0.231	0.227	0.229	0.278	0.273	0.276	2014.16	1980.59	1997.38	0.109	0.107	0.108	78.58	77.27	77.93
M_0G_4	0.268	0.264	0.266	0.308	0.303	0.305	2292.96	2254.74	2273.85	0.175	0.172	0.174	79.25	77.93	78.59
M_1G_0	0.194	0.191	0.192	0.236	0.232	0.234	1757.96	1728.66	1743.31	0.062	0.061	0.061	66.75	65.64	66.19
M_1G_1	0.217	0.213	0.215	0.268	0.264	0.266	1920.76	1888.75	1904.75	0.074	0.073	0.073	76.97	75.69	76.33
M_1G_2	0.227	0.223	0.225	0.277	0.272	0.275	1985.26	1952.17	1968.72	0.100	0.098	0.099	78.32	77.01	77.67
M_1G_3	0.231	0.227	0.229	0.278	0.273	0.276	2002.56	1969.18	1985.87	0.105	0.103	0.104	79.92	78.59	79.25
M_1G_4	0.294	0.289	0.292	0.337	0.331	0.334	2539.76	2497.43	2518.60	0.195	0.192	0.193	80.31	78.97	79.64
M_2G_0	0.208	0.205	0.206	0.249	0.245	0.247	1889.36	1857.87	1873.62	0.066	0.065	0.065	63.82	62.76	63.29
M_2G_1	0.236	0.232	0.234	0.279	0.274	0.277	2073.76	2039.20	2056.48	0.119	0.117	0.118	77.58	76.29	76.93
M_2G_2	0.246	0.242	0.244	0.294	0.289	0.292	2161.56	2125.53	2143.55	0.151	0.148	0.150	78.65	77.34	77.99
M_2G_3	0.253	0.249	0.251	0.296	0.291	0.294	2198.36	2161.72	2180.04	0.168	0.165	0.167	80.52	79.18	79.85
M_2G_4	0.261	0.257	0.259	0.308	0.303	0.305	2261.66	2223.97	2242.81	0.173	0.170	0.172	81.08	79.73	80.40
M_3G_0	0.237	0.233	0.235	0.286	0.281	0.284	2086.46	2051.69	2069.07	0.148	0.146	0.147	77.25	75.96	76.61
M_3G_1	0.237	0.233	0.235	0.293	0.288	0.291	2128.76	2093.28	2111.02	0.149	0.147	0.148	78.57	77.26	77.92
M_3G_2	0.253	0.249	0.251	0.295	0.290	0.293	2190.16	2153.66	2171.91	0.153	0.150	0.152	79.08	77.76	78.42
M_3G_3	0.311	0.306	0.308	0.358	0.352	0.355	2688.46	2643.65	2666.06	0.226	0.222	0.224	83.35	81.96	82.66
M_3G_4	0.316	0.311	0.313	0.363	0.357	0.360	2734.06	2688.49	2711.28	0.231	0.227	0.229	86.99	85.54	86.27
S.Em. ±	0.0011	0.0017	0.0020	0.0012	0.0018	0.0023	8.9175	13.5045	17.4440	0.0017	0.0025	0.0018	0.1941	0.2940	0.5924
C.D. at 5%	0.0032	0.0049	0.0057	0.0033	0.0050	0.0066	25.5302	38.6623	49.1336	0.0047	0.0072	0.0050	0.5558	0.8417	1.6685

Survival percent

The maximum Survival percent (81.22%) was observed under the treatment G_4 (4000 ppm IBA), followed by the treatment G_3 (3000 ppm IBA) (79.92%) and G_2 (2000 ppm IBA) (77.77%). Whereas, the minimum Survival percent (65.84 %) was observed under control (G_0). This might be due to the increased length, maximum number of primary roots and early sprouting resulted in more thickness of the roots, perhaps the ability of regenerating further new fibrous roots from main roots, which probably absorb more nutrients and water from the soil under low transpiration losses. The effect of auxin might be slow translocation property or slow destruction of auxin by auxin destroying enzyme system as reported by Debnath and Maiti *et al.* [3]. This was in line with the findings of Ram *et al.* [4] in pomegranate, Shukla *et al.* [5] in peach, Diwaker and Katiyar [6] also reported in Kagzi lime, Singh *et al.* [7] in phalsa.

The maximum Survival percent (80.37%) was observed under the treatment M_3 [Soil + Sand + Vermicompost (1:1:1)], followed by the treatment M_2 [Sand + Vermicompost (1:1)] (75.69%) and M_1 [Soil + Vermicompost (1:1)] (75.82%). Whereas, the minimum Survival percent (73.16%) was

observed under Soil (M_0). Similar result reported in indicate that the highest survival percentage was recorded in Soil + Sand + Vermicompost which can be attributed to the fact that media might have delivered favorable conditions to grape cuttings and supplied sufficient mineral nutrients to grapes cuttings which were needed for enzyme initiation and to enhance the biochemical process as compared to other media and combinations [8]. The survival and growth of stem cutting of any plant chiefly depend upon the quality of roots, the number of roots, and length of roots, the more enhanced quality of roots results in the absorption of food materials and water from the potting media, which in turn increase the survival of cutting [9]. It also increased cuttings' potential to fight against different stresses and prevent cuttings from adverse agro-climatic conditions.

Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) noted maximum Survival percent (86.27%), followed by M_3G_3 (Soil + Sand + Vermicompost (1:1:1) + (3000 ppm IBA) (82.66%), M_2G_4 (Sand + Vermicompost (1:1) + (4000 ppm IBA) (80.40%), M_2G_3 (Sand + Vermicompost (1:1) + (3000 ppm IBA) (79.85%), whereas the minimum survival percent (57.27%) was found under the treatment combination M_0G_0 (Soil) + (0 ppm IBA). It may be attributed to the better physical and nutritional status of the media [10].

CONCLUSION

It is concluded that treatment G_4 (4000 ppm IBA) was superior found in the different growth characters viz., leaf area index at 60 and 120 days (LAI), leaf area duration (LAD) and crop growth rate (CGR), and survival percent of cuttings, in the treatment of rooting media M_3 (Soil + Sand + Vermicompost (1:1:1) was superior in all the growth characters viz., leaf area index at 60 and 120 days (LAI), leaf area duration (LAD) and crop growth rate (CGR), and survival percent of cuttings. Treatment combination M_3G_4 (Soil + Sand + Vermicompost) + (4000 ppm IBA) was superior in all the growth characters viz., leaf area index at 60 and 120 days (LAI), leaf area duration (LAD) and crop growth rate (CGR) and survival percent of cuttings.

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