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Effect of different concentrations of IBA on rooting of pomegranate (*Punica granatum* L.) cutting

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Abstract
The present experiment entitled "Effects of different concentrations of IBA on rooting of pomegranate (*Punica granatum* L.) cuttings" was conducted at nursery, Horticulture Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.), during the period of 2018-19. The present experiment was conducted to study the effect of growth regulators using four concentrations of IBA and water as control (viz, control, IBA1000, IBA1500, IBA2000, IBA2500) with three replication in a complete randomized design (CRD), under shade net condition. The study revealed that significant differences were existed among the treatments for different rooting and shooting parameters. Among the different treatments the earliest sprouting of cutting as well as significantly highest percentage of success, number of leaves per shoot, length of root, diameter of root, fresh weight of roots, and number of roots per cutting were observed in IBA 2500 ppm followed by IBA 2000ppm. However the performance of cutting in treatment control (T0) was inferior.

Keywords: Pomegranate, IBA, ppm, Lytheraceae, plant growth regulators (PGR), *Punica granatum*

Introduction
Pomegranate (*Punica granatum* L.) belonging to family Lythraceae, is an ancient fruit originated in Persia, Afghanistan and Baluchistan (De Candolle, 1967). Pomegranate is important crop of India and is said to be native to Iran (Persia) have some special botanical characteristics, the tree have a identical bushy shape having multiple-stems, the bushiness in plant is because of suckers routinely arising from the base. The plant has an average height of 5-8 m tall. The plant is normally deciduous in nature. The newly arrived shoots are thin and weepy caring thorns. The color of the leaves is dark green with a shiny appearance and the size of the leaves is small with alternate arrangement. The plant is monoecious with two types of conspicuous flowers which arise in the new grown stems in the spring season, major bloom period is the spring season. The nutritive value of pomegranate fruits is very high and has several health benefits. Pomegranate fruits are rich in vitamin C, potassium and antioxidants. Nutritional value of 100g of edible arils is having 346KJ energy, 18.7 g carbohydrates, 13.7 g sugars, 1.7 g protein, 1.2 g fat, 236 mg potassium, 10 mg vitamin C, 0.07 mg thiamine and 4.0 g dietary fibre. The fruits also have therapeutic values accompanying considerable pharmacological properties like antimicrobial, antiviral and antimutagenic effects (Negi *et al.*, 2003; Seeram *et al.*, 2005) [3, 9].
Pomegranate is propagated by both sexual and asexual means. Rhizogenesis is the most habitually used organogenetic phenomenon in vegetative multiplication of pomrgranate. Pomegranates can be propagated using both softwood or hardwood cuttings, but hardwood cuttings are commercially adopted methods. IBA is the most important plant growth regulators (PGR) generally employed for induction and development of rooting in cuttings.

Materials and Methods
The present investigation was carried out from September 2018 to February 2019 at nursery Horticulture Farm, Collage of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The type of cuttings used was hard wood cuttings of uniform size (15-20 cm long) with5-6 functional buds were taken from vigorous, healthy plants of pomegranate variety

Super Bhagva. The basal portion of the cuttings was treated for 5 minutes with growth regulator IBA (quick deep method). Two third portions of treated cuttings were inserted in the rooting media at slight angle (60º) to the vertical. After planting, the medium was pressed firmly around each cutting and then sprinkled with
water.

Results and Discussion

Days taken to start sprouting of cuttings

Data presented in table 1 shows that there was a significance difference present between the treatments, for the days taken to start sprouting and the days taken for the initiation of sprouting of cuttings ranged from 7.33 days to 12.00 days. The earliest sprouting of cutting was recorded in IBA 2500 ppm (7.33 days) T4 Whereas, late sprouting of cuttings (12.00 days) were recorded under control (T0).

Days taken to 50% sprouting of cuttings

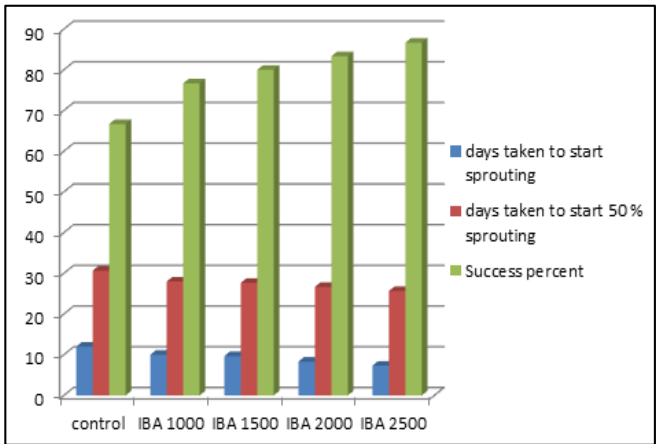
The Data presented in table 1 shows that the days taken to 50% sprouting of cutting ranged from 25.67 to 30.67 days. The minimum days taken to 50% sprouting of cuttings was observed under IBA 2500 ppm (25.67days) T5 followed by IBA 2000ppm (26.67days) T4. Whereas, maximum days taken to 50% sprouting of cuttings (30.67days) were recorded under control T0.

Percentage of success of cuttings

The data presented in table 1 shows that the percentage of success of cuttings ranged from 66.67 to 86.67%. The maximum percentage of success of cutting was observed under IBA 2500 ppm (86.67%) T4 followed by IBA 2000 ppm (83.33%) T3. Whereas, minimum percentage (66.67%) of success of cuttings was recorded under control T0.

Table 1: Effect of different concentrations of IBA on days taken to start sprouting, days taken to start 50% sprouting, success percent. ys taken to start sprouting days taken to start sprouting

Notation	Treatment	days taken to start sprouting	days taken to start 50% sprouting	Success percent
T0	control	12	30.67	66.67
T1	IBA 1000	10	28	76.67
T2	IBA 1500	9.67	27.67	80
T3	IBA 2000	8.33	26.67	83.33
T4	IBA 2500	7.33	25.67	86.67

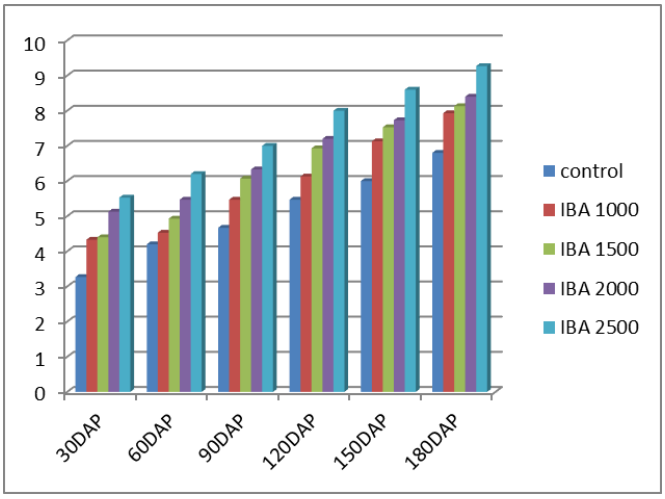


Number of shoots per cutting

The observation was taken at 30, 60, 90, 120, 150 and 180 DAP. At 30DAP shows that the number of shoots per cutting ranged from 3.27 to 5.73. The maximum number of shoots per cutting was observed under IBA 2500 pppm (5.53) T4 followed by IBA 2000 ppm (5.13) T3. Whereas, minimum number of shoots per cutting were observed under Control (3.27) T0. At 60DAP the number of shoots per cutting ranged from 4.20 to 6.20. The maximum number of shoots per cutting was observed under IBA 2500 ppp (6.20) T4, followed by IBA 2000 ppm (5.47) T3. Whereas, minimum number of shoots per cutting were observed under Control (4.20) T0. At 90 DAP the number of shoots per cutting ranged from 4.67 to 7.00 The maximum number of shoots per cutting was observed under IBA 2500 pppm (7.00) T4, followed by IBA 2000 ppm (6.33) T3. Whereas, minimum number of shoots per cutting were observed under Control (4.67) T0. At 120 DAP the number of shoots per cutting ranged from 5.47 to 8.00 The maximum number of shoots per cutting was observed under IBA 2500 pppm (8.00) T4, followed by and IBA 2000 ppm (7.20) T3. Whereas, minimum number of shoots per cutting were observed under Control (5.47) T0. At 150 DAP the number of shoots per cutting ranged from 6.00 to 8.60. The maximum number of shoots per cutting was observed under IBA 2500 pppm (8.60) T4, followed by IBA 2000 ppm (7.73) T3.Whereas, minimum number of shoots per cutting were observed under Control (6.00) T0. At 180 DAP the number of shoots per cutting ranged from 6.80 to 9.27.The maximum number of shoots per cutting was observed under IBA 2500 pppm (9.27) T4, IBA 2000 ppm (8.40) T3.Whereas, minimum number of shoots per cutting were observed under Control (6.80) T0. These results are in close conformity with the findings of Baghel and Saraswat (1989) [1], Rohit *et al.*, (2004) [7].

Table 2: Effect of different concentrations of IBA on number of shoots per cutting

Notation	Treatment	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
T0	control	3.27	4.2	4.67	5.47	6	6.8
T1	IBA 1000	4.33	4.53	5.47	6.13	7.13	7.93
T2	IBA 1500	4.4	4.93	6.07	6.93	7.53	8.13
T3	IBA 2000	5.13	5.47	6.33	7.2	7.73	8.4
T4	IBA 2500	5.53	6.2	7	8	8.6	9.27



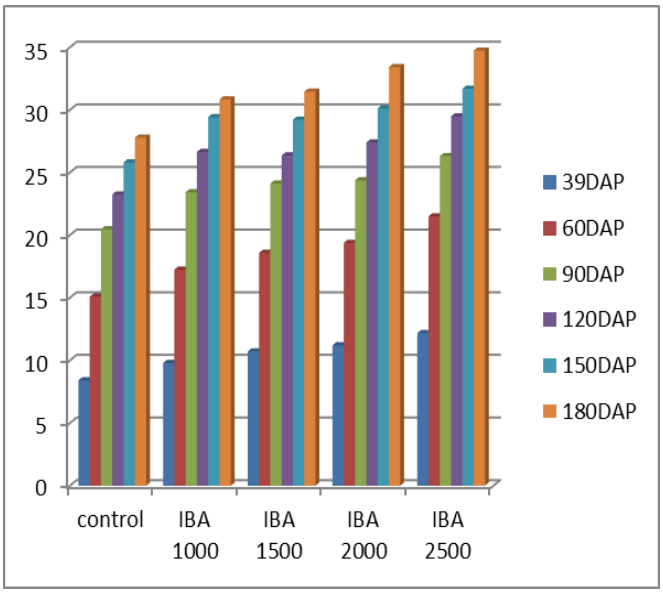
Length of shoots (cm)

Data presented in the table 3 shows that, at 30DAP the length of shoots per cutting ranged from 8.41 to 12.18. The maximum length of shoots per cutting was observed under IBA 2500 pppm (12.18) T4. Whereas, minimum number of shoots per cutting were observed under Control (8.40) T0. At 60, 90, 120, 150, 180 DAP the length of shoots per cutting

ranged from 15.09 to 21.50, 20.47 to 26.31, 23.27 to29.49, 25.80 to31.70, 27.79 to 34.73 respectively. The maximum length of shoots per cutting was observed under IBA 2500 pppm (15.09, 20.47, 26.31, 29.49, 34.73 respectively) T4, followed by IBA 2000 ppm (19.38, 24.38, 27.40, 30.31, 33.42 respectively) T3.Whereas, minimum length of shoots per cutting were observed under per cutting were observed under Control (5.47) T0. At 150 DAP the number of shoots per cutting ranged from 6.00 to 8.60. The maximum number of shoots per cutting was observed under IBA 2500 pppm (8.60) T4, followed by IBA 2000 ppm (7.73) T3.Whereas, minimum number of shoots per cutting were observed under Control (6.00) T0. At 180 DAP the number of shoots per cutting ranged from 6.80 to 9.27. The maximum number of shoots per cutting was observed under IBA 2500 pppm (9.27) T4, followed by IBA 2000 ppm (8.40) T3.Whereas, minimum number of shoots per cutting were observed under Control (6.80) T0. These results are in close conformity with the findings of Baghel and Saraswat (1989) [1], Rohit *et al.*, (2004) [7], Purohit and Shekharappa (1985) [6].

Table 3: Effect of different concentrations of IBA on length of shoots per cuttings

Notation	Treatment	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
T0	control	8.41	15.09	20.47	23.25	25.81	27.79
T1	IBA 1000	9.8	17.25	23.43	26.65	29.43	30.84
T2	IBA 1500	10.72	18.59	24.12	26.37	29.22	31.46
T3	IBA 2000	11.21	19.38	24.38	27.4	30.13	33.42
T4	IBA 2500	12.18	21.5	26.31	29.49	31.69	34.73

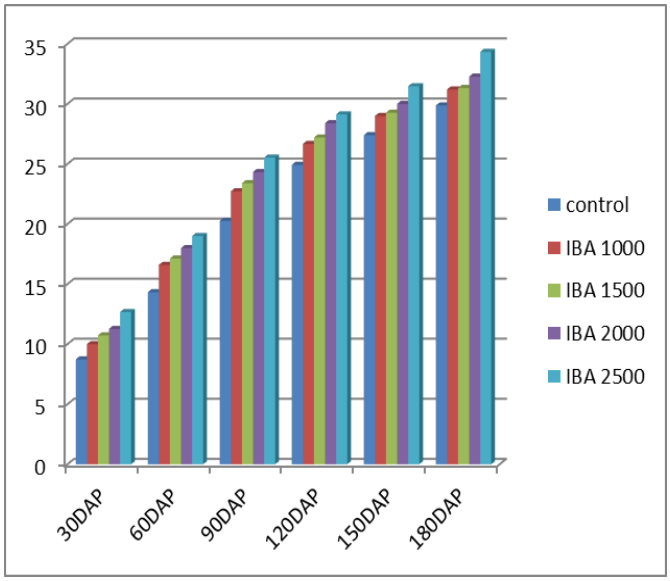


Number of leaves per shoot

Data in table 4 shows that, at 30DAP the number of leaves per shoots ranged from 8.73 to 12.67. The maximum number of leaves per shoots was observed under IBA 2500 ppm (12.67) T4, followed by IBA 2000ppm.Whereas, minimum number of leaves per shoots were observed under Control (8.40) T0. At 60, 90, 120, 150 and 180 DAP the number of leaves on selected shoots ranged from 14.33 to 19.00, 20.67 to 25.53, 24.93 to 29.13, 27.40 to 31.47 and 29.87 to 34.33 respectively. The maximum number of leaves per shoots was observed under IBA 2500 pppm (19.00, 25.53, 29.13, 31.47 and 34.33 respectively) T4, followed by IBA 2000 ppm (18.00, 24.33, 28.40, 30.00 and 32.27 respectively) T3.Whereas, minimum number of leaves per cutting were observed under Control (14.33, 20.27, 24.93, 27.40, 29.87 respectively) T0. These results are in hormony with the findings Panwar *et al.*, (2001) [4] in Pomegranate.

Table 4: Effect of different concentrations of IBA on number of leaves per shoots

Notation	Treatment	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
T0	control	8.73	14.33	20.27	24.93	27.4	29.87
T1	IBA 1000	10	16.6	22.73	26.67	29	31.2
T2	IBA 1500	10.73	17.13	23.4	27.2	29.27	31.33
T3	IBA 2000	11.27	18	24.33	28.4	30	32.27
T4	IBA 2500	12.67	19	25.53	29.13	31.47	34.33

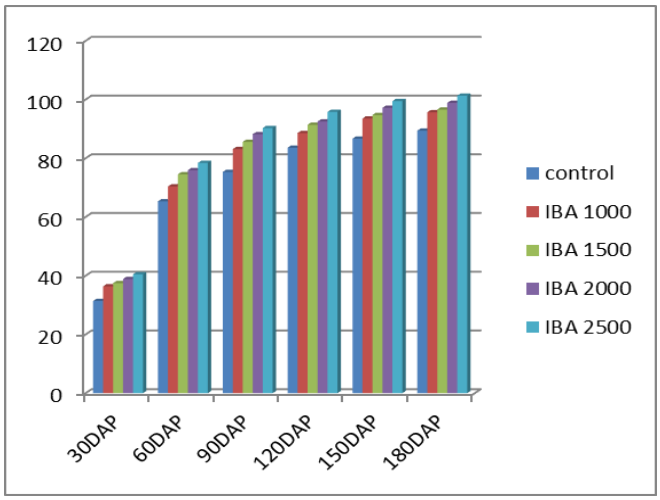


Total numbers of leaves per cutting

The data in table 5 shows that, at 30DAP the total number of leaves per cutting ranged from 31.40 to 40.47. The maximum number of leaves per cutting was observed under IBA 2500 pppm (40.47) T4, followed by IBA 2000ppm (38.87) T5.Whereas, minimum number of leaves per cutting were observed under Control (31.40) T0. At 60 DAP the total number of leaves per cutting ranged from 65.33 to 78.93 The maximum number of leaves per cutting was observed under IBA 2500 pppm (78.40) T4 followed by IBA 2000ppm (75.93) T5.Whereas, minimum number of leaves per cutting were observed under Control (65.33) T0. At 90, 120, 150 and 180DAP the total number of leaves per cuttings ranged from 75.33 to 90.27, 83.60 to 95.80, 86.67 to 99.47 and 89.40 to 101.33 respectively. The maximum number of leaves per cutting was observed under IBA 2500 pppm (78.40, 90.27, 95.80, 99.47 and 101.33 respectively) T4, followed by IBA 2000 ppm (88.20, 92.53, 97.20 and 98.87) T3.Whereas, minimum number of leaves per cutting were observed under Control T0 (75.33, 83.60, 86.67 and 89.40) respectively.

Table 5: Effect of different concentrations of IBA on number of leaves per cuttings

Notation	Treatment	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
T0	Control	31.4	65.33	75.33	83.6	86.67	89.4
T1	IBA 1000	36.4	70.4	83.13	88.6	93.53	95.67
T2	IBA 1500	37.47	74.53	85.6	91.4	94.73	96.6
T3	IBA 2000	38.87	75.93	88.2	92.53	97.2	98.87
T4	IBA 2500	40.47	78.4	90.27	95.8	99.47	101.33

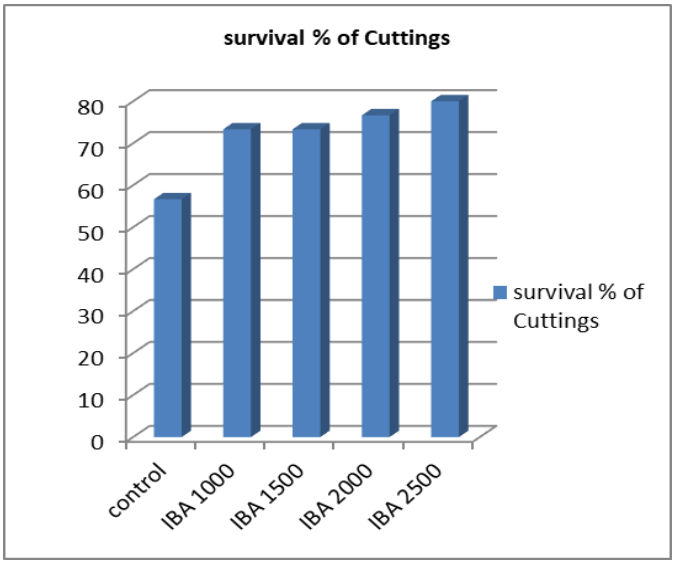


Survival percentage of cuttings

The data presented in table 6 shows that the survival percentage of cuttings ranged from 56.67 to 80.00%. The maximum survival percentage of cutting was observed under IBA 2500 ppm (80.00%) T4 followed by IBA 2000 ppm (76.67%) T3.Whereas, minimum percentage (56.67%) of success of cuttings was recorded under control T0.

Table 6: Effect of different concentrations of IBA on survival % of cuttings

Notation	Treatment	survival % of Cuttings
T0	control	56.67
T1	IBA 1000	73.33
T2	IBA 1500	73.33
T3	IBA 2000	76.67
T4	IBA 2500	80



Number of roots per cutting

The data presented in table 7 shows that the number of roots per cutting ranged from 25.27 to 36.73. The maximum number of roots per cutting was observed under IBA 2500 ppm (36.73) T4 followed by IBA 2000 ppm (25.27) T3. Whereas, minimum percentage (56.67%) of success of cuttings was recorded under control T0. The results are in harmony with the findings of Hakim *et al.*, (2018) in pomegranate, Barde *et al.*, (2010) [2] in pomegranate, Saroj *et al.*, (2008) [8] in pomegranate.

Length of roots (cm)

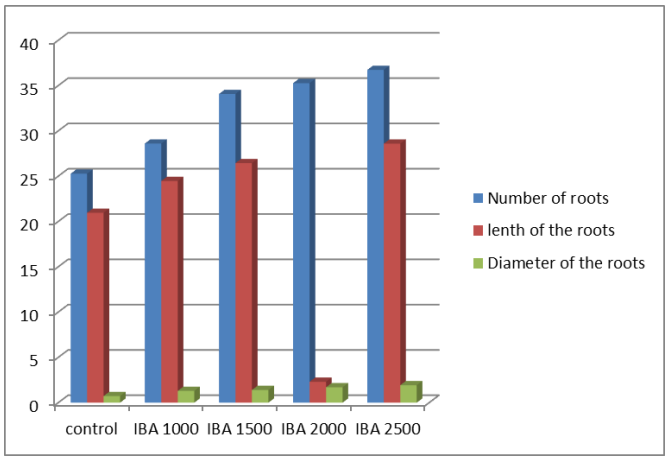
The data presented in table 7 shows that the length of roots ranged from 20.96 to 28.59. The maximum length of roots was observed under IBA 2500 ppm (28.59) T4 followed by IBA 2000 ppm (27.31) T3.Whereas, minimum length of roots (20.96) was recorded under control T0.

Diameter of roots (mm)

The data presented in table-7 shows that the diameter of roots ranged from to 0.73 to 1.93. The maximum diameter of roots was observed under IBA 2500 ppm (1.93) T4, followed by IBA 2000 ppm (1.70) T3. Whereas, minimum diameter of roots (0.73) was recorded under control T0.

Table 7: Effect of different concentrations of IBA on Number of Roots, Length of the roots (cm), Diameter of the roots (mm)

Notation	Treatment	Number of roots	Length of the roots	Diameter of the roots
T0	control	25.27	20.96	0.73
T1	IBA 1000	28.6	24.47	1.3
T2	IBA 1500	34.07	26.44	1.4
T3	IBA 2000	35.27	2.31	1.7
T4	IBA 2500	36.73	28.59	1.93



Fresh weights of roots (g)

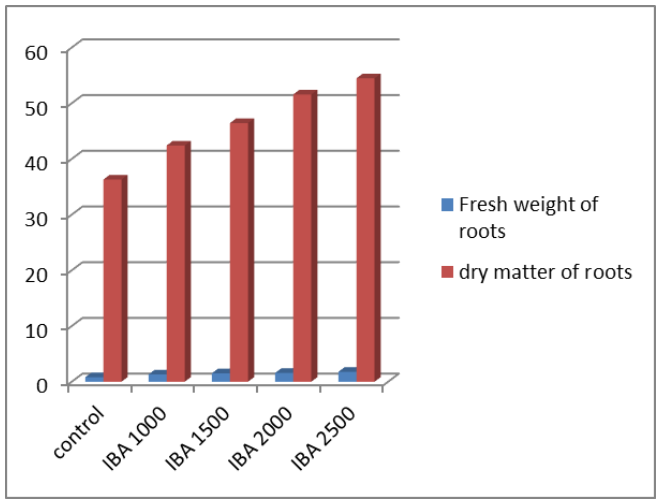
The data presented in table 8 shows that the fresh weight of roots ranged from to 0.81 to 1.78 The maximum fresh weight of roots was observed under IBA 2500 ppm (1.78) T4, followed by IBA 2000 ppm (1.58) T3. Whereas, minimum fresh weight of roots (0.81) was recorded under control T0.

Dry matters of roots (%)

The data presented in table 8 shows that the dry matter of roots ranged from to 36.30% to 54.47% the maximum length of roots was observed under IBA 2500 ppm (54.47%) T4, followed by IBA 2000 ppm (51.57%) T3. Whereas, minimum dry matter roots (36.30%) was recorded under control T0. The result is in harmony with Patil *et al.*, (2001).

Table 8: Effect of different concentrations of IBA on fresh weight and dry matter of roots

Notation	Treatment	Fresh weight of roots	dry matter of roots
T0	control	0.81	36.3
T1	IBA 1000	1.31	42.4
T2	IBA 1500	1.52	46.43
T3	IBA 2000	1.58	51.57
T4	IBA 2500	1.78	54.47



Conclusions

Most of the cuttings shoot and root characters were considerably affected compared to control by the distinct treatments of Growth Regulators. The treatment combinations IBA 2500 ppm was found best for maximum rooting, success & growth of cuttings followed by IBA 2000 ppm under the studied experiment.

Acknowledgment

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