International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(3): 255-260

Received: 21-03-2021
Accepted: 24-04-2021

Intjar Singh Dawar
M.Sc. Student, Department of Horticulture (Fruit Science), JNKVV- College of Agriculture, Jabalpur, Madhya Pradesh, India

TR Sharma
Professor, Department of Horticulture, JNKVV - College of Agriculture, Jabalpur, Madhya Pradesh, India

OP Nagar
M.Sc. Student, Department of Horticulture (Fruit Science), JNKVV- College of Agriculture, Jabalpur, Madhya Pradesh, India

Shreesty Pal
M.Sc. Student, Department of Horticulture (Fruit Science), JNKVV- College of Agriculture, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Intjar Singh Dawar
M.Sc. Student, Department of Horticulture (Fruit Science), JNKVV- College of Agriculture, Jabalpur, Madhya Pradesh, India

Influence of different PGR and growing media for growth and development of marcottage in pomegranate (*Punica granatum* L.) c.v. bhagwa

Intjar Singh Dawar, TR Sharma, OP Nagar and Shreesty Pal

Abstract
The present investigation entitled "Effect of different Growing Media for Growth and Development of Marcottage in Pomegranate (*Punica granatum* L.) c.v. Bhagwa" was conducted at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, J.N.K.V.V., Jabalpur (M.P.) during the year 2018-2019. The experiment was laid out in Factorial Randomized Block Design with three replications. Among different treatments Soil + Vermicompost + Azospirillum + IBA 5000 ppm was most effective in growth parameters at 60, 90 and 120 DAT with number of old leaves per layer (46.20, 40.80 and 8.27), number of newly emerged leaves per layer (25.53, 33.13 and 70.80), number of newly emerged branches per layer (5.40, 5.87 and 7.60) and progressive height of layer (11.72, 17.68 and 24.41 cm) respectively, other growth parameters such as number of total leaves per layer (26.93, 57.33 and 88.60 cm), length of leaves (5.75, 6.13 and 6.60 cm), width of leaves (2.72, 2.47 and 2.57 cm), leaf area index (6.33, 13.62 and 23.29) and leaf area duration (7534.19, 18918.69 and 35168.73). It may be concluded that Soil + Vermicompost + Azospirillum + IBA 5000 ppm can be applied for suitable marcottage in pomegranate at "kaymore plateau and satpura hils'' agro climatic zone of Madhya Pradesh.

Keywords: Pomegranate (*Punica granatum* L.), vermicompost, growing media azospirillum, pseudomonas, growth, width, duration

Introduction
Pomegranate (*Punica granatum* L.) is an ancient favourite table fruit of tropical regions of the world and it belongs to the family Punicaceae having chromosome no. 2n = 18. Plant is deciduous in desert regions, but in coastal areas may lose only a portion of its leaves in winter. Pomegranate comes under the fruit type "Balusta" and its edible part is juicy seed coat i.e. Arils. Pomegranate is a non-climacteric fruit and it prefers well drained sandy loam to deep loamy soil types with hot and dry climatic condition during flowering and fruit development. It has been spread to other countries from Iran, its main producer and exporter in the world (Alikhani *et al*. 2011) [2].

India ranks first in pomegranate production in the world but it has only (7%) share of total world exports. The total area under cultivation of pomegranate in India is 220 thousand hectare and production is around 2795 thousand MT with productivity of 10.3 MT per hectare and in Maharashtra the cultivated area under this crop is 90 thousand hectare and production is 945 thousand MT (Anon., 2014) [1]. Propagation through hard wood cuttings is also the best and less expensive method (Upadhyay and Badyal 2007) [20] but commercially air-layering is one of the most successful method in pomegranate propagation and has the advantage of being able to reproduce plants with better rooting than cuttings. The demand for planting material is also increasing in major pomegranate growing parts of the world. The pomegranate is propagated through cutting or layering on commercial scale but the rooting and survival success is very less. Although stem cutting are difficult to root, the use of plant growth regulators (PGRs) helps to induce roots in cuttings (Panwar *et al*. 2001, Saroj *et al*. 2008 and Bhosale *et al*. 2009) [4]. Meagre work has been carried out with application of bio-fertilizer with PGR's, therefore the experiment entitled on "Studies on Marcottage in *Pomegranate* (*Punica granatum* L.) protecting plants from phytopathogens by controlling or inhibiting them, improving soil structure and bio-remediating the polluted soils by sequestering toxic heavy metal species and degrading xenobiotic compounds (like pesticides) (Ahemad 2012, Hayat *et al.* 2010, Rajkumar *et al.* 2010 and Braud *et al*. 2009).

Materials and Methods

Experimental site

The experiment was conducted at Fruit Research Station, Imalia, Department of Horticulture, College of Agriculture, J.N.K.V.V., Jabalpur, Madhya Pradesh, India. The experiment was conducted during the year 2018-2019. The experimental site was situated at 23.9ºN latitude and 79.58ºE longitude and an altitude of 411.78 meters above Mean Sea Level (MSL).

Selection of plants

For the experiment, select a plant that is uniform vigour and size. For air layering, we select a plant that is one year old and has a healthy branch and a panicle thickness. Forty five layers were prepared; the average length of branches was 40 cm for each treatment. A total of 15 shoots under each treatment were selected for layering. In all 900 layers were prepared for the study.

Preparation of lanolin past of growth regulators

The IBA quantity of 0.25, 0.50 and 0.75 gm of IBA were weighed on electronic weighing balance, respectively. This quantity of IBA dissolved in about 10 cc absolute alcohol and solution was mixed with desired quantity of lanoline paste.

Preparation of rooting media

1 kg soil was taken by removing small stones and pebbles, Soil and Vermicompost were mixed in the ratio of 1:1 by volume, Soil + Vermicompost + Bio-fertilizer (Azotobacter Or Azospirillum Or Pseudomonas) were mixed thoroughly in the ratio of 500gm:500gm:2gm by volume and then in all these water is added and mixed thoroughly to develop a friable medium.

Method of treatment

One-year old branches about pencil thickness were selected. A ring of bark about 2.5-3 cm in length was removed from selected shoot just below the bud without injuring the under lying wood. Then lanolin paste of IBA was applied and the respective rooting media was applied evenly around the cut portion as per the treatments then wrapped with polythene film and then tied with the help of jute rope.

Wrapping material

Transparent polythene (200 gauges) was used as wrapper. The size of the polythene wrapper was 25×20 cm^2.

Details of experiment

In the present investigation fifteen healthy branches were selected under each treatment and replicated three times to form the Randomized Complete Block Design.

Detachment of air layers

After 75 days after air layering of the shoots were detachments. Shoots were detached by making a cut just below the lower end of the ringed surface with a sharp scatter. The polythene covers were removed gently and the successful air layers were planted in well-prepared polybags as per the layout plan.

Observations recorded

Prior to detachment

Out of 15 layers in each treatments and replication were tagged to take the observations.

Days to root appearance

The number of days taken for first root appearance in layering's from the day of layering was recorded by observing tagged shoots from each treatment under each replication.

Rooting percentage (%)

The number of rooted air layers was counted before detachment of air layered from the mother plants. The data was compiled successfully and rooting percent was calculated after 75 days of layering by following formula:

$$\text{Rooting (\%)} = \frac{\text{No. of rooted air layered plant}}{\text{Total no. of air layers of treatment}} \text{X } 100$$

Number of primary and secondary roots

Numbers of primary and secondary roots of detachment layers were counted and average numbers of primary and secondary roots were computed.

Length of primary and secondary root (cm)

The length of primary and secondary root was measured with the help of scale in cm from base up to tip and average length of primary and secondary roots were computed and presented in cm.

Diameter of primary and secondary root (mm)

The diameter of the primary and secondary root was measured in mm with the help of Vernier caliper and average diameter of primary and secondary roots were computed and presented in mm.

Growth parameter (After transplanting)

Rooted layers were planted in polybags which was filled with soil, river sand and well decomposed FYM in the ratio of 1:1:1. These packets were arrange in three sets of each treatment following observation were recorded.

Success percentage of air layers (%)

After 60 and 90 days of transplantation in polybags the success percentage was calculated by following formula:

$$\text{Success percentage of air layers (\%)} = \frac{\text{Total no. of success layer}}{\text{Total no. of layered planted}} \text{X } 100$$

Survival percentage of air layers (%)

After 120 days of transplantation in polybags the survival percentage was calculated by using following formula:

$$\text{Survival percentage of air layers (\%)} = \frac{\text{Total no. of survival layer}}{\text{Total no. of layered planted}} \text{X } 100$$

Height of layers (cm)

The progressive height was measured at 60, 90 and 120 days after planting in polybags with the help of meter scale and average height of layers were computed and presented in cm.

Number of branches

After 60, 90 and 120 days after transplanting in polybags the number of branches were counted and average numbers of branches were computed.

Number of leaves
At the time of layering planted in polybags, the number of leaves were counted after that progressive number were counted at 60, 90 and 120 days after transplanting.

Length and width of leaves (cm)
The mean length and width of leaves per air layers measured at 60, 90 and 120 days of planting in polybags.

Leaf area index
LAI expresses the ratio of leaf surface considerably to the ground area occupied by the plant or a crop stand worked out as per specification of Gardner *et al.* (1985).

Leaf area duration (LAD) (cm^2 days)
Leaf Area Duration expresses the magnitude and persistence of leaf area of leafiness during the period of crop growth. It reflects the extent of period of crop growth, seasonal integral of light interaction and corrected with yield.

Results and Discussion

Growth parameter at 60, 90 and 120 days (After transplanting)

Number of old leaves
The results on the number of old leaves are shown in Table 2. The maximum number of old leaves per layer 46.20, 40.80 and 8.27 was noted under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Number of newly emerged leaves
The result of the number of newly emerged leaves is given in Table 2. The maximum number of newly emerged leaves 25.53, 33.13 and 70.80 per layer was obtained under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm.

Number of new emerged branches
The data is regarding number of new emerged branches in Table 2. The maximum number of newly emerged branches of 5.40, 5.87 and 7.60 per layer was recorded under treatment combination of M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm). Similar findings are also reported by Bibha *et al.* 2017 and Manga *et al.* 2017 findings supports that the increase in number of leaves and sprouts were by the application of IBA.

Progressive height of layer (cm)
The results is regarding the progressive height of layer is represented in the Table 2. The maximum height per layer 11.72, 17.68 and 24.41 was noted under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Number of total leaves per layer
The data regarding number of total leaves per layer is represented in the Table 3. The maximum number of total leaves 26.93, 57.33 and 88.60 per layer was recorded under treatment combination of M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Length of leaves (cm)
The results on the length of leaves are represented in the Table 3. The maximum length of leaves 5.75, 6.13 and 6.60 cm was recorded under treatment combination of M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Width of leaves (cm)
The results on the width of leaves are represented in the Table 3. The maximum width of leaves 2.72, 2.47 and 2.57 cm was observed under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Leaf area index
The result on the leaf area index is represented in the Table 4. The maximum leaf area index 6.33, 13.62 and 23.29 was recorded under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm). The presence of bio inoculants Azospirillum which increased the uptake of nutrients by the roots and increased the chlorophyll content and efficiency of photosynthesis (Mustafa *et al.* 2017 and Khalid *et al.* 2017) [10, 13].

Leaf area duration
The result on the leaf area duration is represented in Table 5. The maximum leaf area duration 7534.19, 18918.69 and 35168.73 was noted under treatment combination M_4P_2 (Soil + Vermicompost + Azospirillum + IBA 5000 ppm).

Table 1: Effect of PGR and growing media on number of total leaves per layer at 60, 90 and 120 DAT

Treatments details		60 DAT	90 DAT	120 DAT
T_1	Soil (control)	14.47	29.07	60.33
T_2	Soil + VC	15.07	30.80	62.20
T_3	Soil + VC + *Azotobacter*	18.00	31.00	62.93
T_4	Soil + VC + *Azospiriillum*	18.73	34.87	63.40
T_5	Soil + VC + *Pseudomonas*	20.67	35.60	66.13
T_6	Soil + IBA (2500 ppm)	22.00	36.67	67.00
T_7	Soil + VC + IBA (2500 ppm)	14.67	39.87	69.87
T_8	Soil + VC + *Azotobacter* + IBA (2500 ppm)	15.80	40.60	71.40
T_9	Soil + VC + *Azospirillum* + IBA (2500 ppm)	18.20	30.73	60.00
T_{10}	Soil + VC + *Pseudomonas* + IBA (2500 ppm)	21.07	30.60	63.27
T_{11}	Soil + IBA (5000 ppm)	21.53	34.27	64.47
T_{12}	Soil + VC + IBA (5000 ppm)	20.73	35.47	65.00
T_{13}	Soil + VC + *Azotobacter* + IBA (5000)	22.27	48.93	72.27
T_{14}	Soil + VC + *Azospirillum* + IBA (5000)	26.93	57.33	88.60
T_{15}	Soil + VC + *Pseudomonas* + IBA (5000)	23.93	50.47	80.80
T_{16}	Soil + IBA (7500 ppm)	18.13	39.27	68.60
T_{17}	Soil + VC + IBA (7500 ppm)	17.47	39.93	66.40
T_{18}	Soil + VC + *Azotobacter* + IBA (7500 ppm)	16.67	41.28	62.47
T_{19}	Soil + VC + *Azospirillum* + IBA (7500 ppm)	16.87	31.87	65.13
T_{20}	Soil + VC + *Pseudomonas* + IBA (7500 ppm)	17.20	31.13	69.00
SE (m)±		0.85	1.14	0.85
C.D. at 5%		2.44	3.28	2.44

Table 2: Effect of PGR and growing media on number of old leaves per layer and newly emerged leaves at 60, 90 and 120 DAT

Treatments details		60 DAT	90 DAT	120 DAT	60 DAT	90 DAT	120 DAT
T_1	Soil (control)	22.67	8.93	2.20	9.13	14.10	15.73
T_2	Soil + VC	22.80	10.33	2.46	9.40	14.53	20.80
T_3	Soil + VC + *Azotobacter*	24.27	11.13	2.733	13.80	17.40	30.67
T_4	Soil + VC + *Azospiriillum*	23.07	12.80	3.40	16.93	18.53	27.27
T_5	Soil + VC + *Pseudomonas*	22.73	14.27	3.60	18.40	20.73	24.20
T_6	Soil + IBA (2500 ppm)	25.53	14.60	4.07	19.60	21.20	27.53
T_7	Soil + VC + IBA (2500 ppm)	34.87	17.47	2.87	17.20	22.33	41.40
T_8	Soil + VC + *Azotobacter* + IBA (2500 ppm)	28.60	19.73	4.40	9.27	20.60	38.47
T_9	Soil + VC + *Azospirillum* + IBA (2500 ppm)	22.73	21.40	3.60	23.07	17.33	52.33
T_{10}	Soil + VC + *Pseudomonas* + IBA (2500 ppm)	34.87	20.27	4.33	18.20	18.20	43.93
T_{11}	Soil + IBA (5000 ppm)	33.47	23.40	4.33	18.87	19.73	15.73
T_{12}	Soil + VC + IBA (5000 ppm)	27.47	24.13	5.07	21.67	15.93	17.53
T_{13}	Soil + VC + *Azotobacter* + IBA (5000)	41.80	39.93	5.73	24.87	29.53	55.73
T_{14}	Soil + VC + *Azospirillum* + IBA (5000)	46.20	40.80	8.27	25.53	33.13	70.80
T_{15}	Soil + VC + *Pseudomonas* + IBA (5000)	44.80	40.07	7.60	25.07	32.00	64.20
T_{16}	Soil + IBA (7500 ppm)	39.87	24.73	4.93	12.60	18.27	35.60
T_{17}	Soil + VC + IBA (7500 ppm)	30.60	26.53	3.73	16.93	16.27	54.00
T_{18}	Soil + VC + *Azotobacter* + IBA (7500 ppm)	31.40	30.20	2.20	13.47	19.33	27.47
T_{19}	Soil + VC + *Azospirillum* + IBA (7500 ppm)	33.53	32.27	3.93	18.60	20.67	57.13
T_{20}	Soil + VC + *Pseudomonas* + IBA (7500 ppm)	35.40	30.93	4.27	19.20	19.73	44.80
SE (m)±		0.56	0.60	0.60	0.97	0.85	2.45
C.D. at 5%		1.62	1.75	1.73	2.78	2.44	7.04

Table 3: Effect of PGR and growing media on number of newly emerged branches and progressive height of layer at 60, 90 and 120 DAT

Treatments details		60 DAT	90 DAT	120 DAT	60 DAT	90 DAT	120 DAT
T_1	Soil (control)	1.53	1.60	1.80	5.33	11.02	17.00
T_2	Soil + VC	2.00	2.00	2.20	6.06	13.34	19.01
T_3	Soil + VC + *Azotobacter*	2.20	1.80	2.20	8.03	15.04	19.32
T_4	Soil + VC + *Azospiriillum*	1.80	3.00	3.87	9.69	11.71	17.98
T_5	Soil + VC + *Pseudomonas*	1.93	4.60	3.20	5.38	13.71	19.68
T_6	Soil + IBA (2500 ppm)	3.40	3.93	4.60	7.03	13.04	17.66
T_7	Soil + VC + IBA (2500 ppm)	2.27	2.93	3.73	5.62	11.67	18.98
T_8	Soil + VC + *Azotobacter* + IBA (2500 ppm)	4.00	2.07	2.87	6.02	13.62	20.66
T_9	Soil + VC + *Azospirillum* + IBA (2500 ppm)	2.07	3.17	2.27	7.02	11.04	17.98
T_{10}	Soil + VC + *Pseudomonas* + IBA (2500 ppm)	3.87	3.93	1.93	7.77	13.36	17.00
T_{11}	Soil + IBA (5000 ppm)	3.40	3.30	1.87	9.03	14.36	16.69
T_{12}	Soil + VC + IBA (5000 ppm)	3.40	4.47	2.27	7.01	11.34	18.33
T_{13}	Soil + VC + *Azotobacter* + IBA (5000)	4.67	5.40	5.73	10.03	15.69	21.07
T_{14}	Soil + VC + *Azospirillum* + IBA (5000)	5.40	5.87	7.60	11.72	17.68	24.41
T_{15}	Soil + VC + *Pseudomonas* + IBA (5000)	4.73	5.67	6.60	10.71	16.00	21.41
T_{16}	Soil + IBA (7500 ppm)	2.47	2.07	3.07	5.39	11.04	17.33
T_{17}	Soil + VC + IBA (7500 ppm)	3.67	4.33	3.73	6.01	12.66	18.98
T_{18}	Soil + VC + *Azotobacter* + IBA (7500 ppm)	2.07	3.60	4.93	8.03	11.67	19.00
T_{19}	Soil + VC + *Azospirillum* + IBA (7500 ppm)	3.93	3.00	4.07	7.05	13.66	18.34
T_{20}	Soil + VC + *Pseudomonas* + IBA (7500 ppm)	3.33	1.87	3.13	9.02	12.01	19.333
SE (m)±		0.31	0.28	0.26	0.40	0.52	0.43
C.D. at 5%		0.90	0.81	0.76	1.16	1.49	1.25

Table 4: Effect of PGR and growing media on length and width of leaves (cm) at 60, 90 and 120 DAT

Treatments details		60 DAT	90 DAT	120 DAT	60 DAT	90 DAT	120 DAT
T_1	Soil (control)	3.08	3.21	3.99	0.66	1.15	1.27
T_2	Soil + VC	3.23	4.11	4.39	1.02	1.24	1.33
T_3	Soil + VC + *Azotobacter*	3.55	4.45	4.75	1.02	1.29	1.30
T_4	Soil + VC + *Azospiriillum*	4.17	5.16	5.14	1.08	1.20	1.35
T_5	Soil + VC + *Pseudomonas*	4.55	5.22	4.88	1.28	2.09	1.41
T_6	Soil + IBA (2500 ppm)	5.23	5.35	4.32	1.50	2.25	1.50
T_7	Soil + VC + IBA (2500 ppm)	5.12	4.35	5.08	1.26	2.14	1.43
T_8	Soil + VC + *Azotobacter* + IBA (2500 ppm)	5.25	3.47	5.29	1.63	2.07	1.64
T_9	Soil + VC + *Azospirillum* + IBA (2500 ppm)	4.88	3.35	5.29	1.89	1.19	2.01
T_{10}	Soil + VC + *Pseudomonas* + IBA (2500 ppm)	4.30	4.07	4.07	2.00	0.99	2.21
T_{11}	Soil + IBA (5000 ppm)	4.38	3.55	4.16	2.14	2.06	2.28
T_{12}	Soil + VC + IBA (5000 ppm)	4.37	3.30	5.96	2.09	1.95	2.11
T_{13}	Soil + VC + *Azotobacter* + IBA (5000)	5.30	6.11	6.12	2.31	2.31	2.44
T_{14}	Soil + VC + *Azospirillum* + IBA (5000)	5.75	6.13	6.60	2.72	2.47	2.57
T_{15}	Soil + VC + *Pseudomonas* + IBA (5000)	5.33	6.13	6.25	2.39	2.40	2.49

T_{16}	Soil + IBA (7500 ppm)	3.21	5.52	5.72	1.89	2.21	2.33
T_{17}	Soil + VC + IBA (7500 ppm)	3.73	5.05	5.89	2.14	2.13	2.31
T_{18}	Soil + VC + *Azotobacter* + IBA (7500 ppm)	4.28	4.33	5.13	2.28	1.95	2.19
T_{19}	Soil + VC + *Azospirillum* + IBA (7500 ppm)	4.21	4.38	5.13	2.25	2.11	2.25
T_{20}	Soil + VC + *Pseudomonas* + IBA (7500 ppm)	4.51	3.45	5.28	2.04	2.15	2.25
SE (m)±		0.21	0.16	0.18	0.10	0.07	0.07
C.D. at 5%		0.60	0.47	0.54	0.29	0.21	0.20

Table 5: Effect of PGR and growing media on leaf area index and duration at 60, 90 and 120 DAT

Treatments details		**60 DAT**	**90 DAT**	**120 DAT**	**60 DAT**	**90 DAT**	**120 DAT**
T_1	Soil (control)	0.46	1.75	5.11	500.82	2114.98	6542.62
T_2	Soil + VC	0.78	2.46	5.70	3956.17	3094.42	7785.58
T_3	Soil + VC + *Azotobacter*	1.02	2.87	6.09	1192.46	3706.09	8538.98
T_4	Soil + VC + *Azospiriillum*	0.95	3.39	6.54	1543.51	4140.40	9465.14
T_5	Soil + VC + *Pseudomonas*	1.90	6.11	7.16	2244.50	7639.06	12648.62
T_6	Soil + IBA (2500 ppm)	2.73	6.97	6.853	3334.22	7582.59	13174.66
T_7	Soil + VC + IBA (2500 ppm)	1.50	5.83	8.01	1906.99	6986.17	13186.54
T_8	Soil + VC + *Azotobacter* + IBA (2500 ppm)	2.16	4.65	9.77	2817.11	6496.25	13748.88
T_9	Soil + VC + *Azospiriillum* + IBA (2500 ppm)	2.68	1.87	10.06	3398.50	4342.37	11368.43
T_{10}	Soil + VC + *Pseudomonas* + IBA (2500 ppm)	2.86	1.93	8.99	3005.47	4568.41	10409.89
T_{11}	Soil + IBA (5000 ppm)	3.20	3.95	9.68	3623.04	6818.63	12998.42
T_{12}	Soil + VC + IBA (5000 ppm)	2.91	3.59	12.82	3857.47	6206.72	15645.27
T_{13}	Soil + VC + *Azotobacter* + IBA (5000)	4.11	10.17	17.39	5836.49	13610.27	26264.21
T_{14}	Soil + VC + *Azospiriillum* + IBA (5000)	6.33	13.62	23.29	7534.19	18918.69	35168.73
T_{15}	Soil + VC + *Pseudomonas* + IBA (5000)	4.29	11.66	19.46	5759.86	15196.75	29647.55
T_{16}	Soil + IBA (7500 ppm)	1.74	7.56	14.48	2209.39	8862.18	21000.05
T_{17}	Soil + VC + IBA (7500 ppm)	2.22	6.78	13.85	2894.46	8587.12	19665.87
T_{18}	Soil + VC + *Azotobacter* + IBA (7500 ppm)	2.56	5.48	10.38	2946.15	7667.91	15116.22
T_{19}	Soil + VC + *Azospiriillum* + IBA (7500 ppm)	2.22	4.61	11.86	2464.81	6015.83	15698.71
T_{20}	Soil + VC + *Pseudomonas* + IBA (7500 ppm)	2.50	3.66	12.99	2980.11	5874.75	15865.72
SE (m)±		0.32	0.31	0.62	670.38	605.37	731.36
C.D. at 5%		0.93	0.90	1.80	1926.68	1739.84	2101.930

Acknowledgement

The author wish to thank the research guide and Head of the Department and staff of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh for providing necessary facility in conducting the experiment. Special thanks to the family members and friends for their unconditional support.

References

1. Anon. Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture, Govt. of India. Cuttings Horticulture Journal 2017;7(1):41-47.
2. Alikhani L, Ansari K, Jamnezhad M, Tabatabaie Z. The effect of different mediums and cuttings on growth and rooting of pomegranate cuttings. Iran Journal of Plant Physiology 2011;1(3):199-203.
3. Bibha K, Suraj P. Economics of plant prepared through air layers of guava (*Psidium guajava* L.). International Journal of Agriculture Science and Research 2017;7(2):313-318.
4. Bhosale VP, Jadhav RG, Masu MM. Response of different Medias and PGR‟s on rooting and survival of air layers in pomegranate (*Punica granatum* L.) Cv. Sindhuri. The Asian Journal of Horticulture 2009;4(2):494-497.
5. Chawla W, Mehta K, Chauhan M. Influence of plant growth regulators on rooting of litchi (*Litchi chinensis* Sonn.) air layers. The Asian Journal of Horticulture 2012;7(1):160-164.
6. Das AK, Prasad B. Effect of plant growth regulators on rooting and survival of air layering in Litchi. Advance Research Journal of crop Improvement 2014;5(2):126-130.
7. Erdag BB, Emek YC, Aydogan SK. Clonal propagation of *Dorystoech as hastata*via axillary shoots proliferation. Turk Journal Bot 2010;34(3):233-240.
8. Jutta LM, Vertocnik A, Christopher D, Town. Analysis ofindole-3-butyric acid-induced adventitious root formations on Arabidopsis stem segments. Journal of Experimental Botany 2005;56(4):21-25.
9. Kang W, Li-Yuan W, Li-Yun W, Cheng-Cai Z, Hai-Lin L, Li-Qiang T *et al*. Transcriptome Analysis of Indole-3-Butyric Acid-Induced Adventitious Root Formation in Nodal Cuttings of *Camelliasinensis* (L.). Plos One 2014;9(9):107-201.
10. Khalid M, Bilal M, Danial H, Hafiz MNI, Hang W, Danfeng H. Mitigation of salt stress in white clover (*Trifoliumrepens*) by *Azospirillum brasilense* and its inoculation effect. Botanical Studies 2017;5:58.
11. Munde GR, Nainwad RV, Maske SN, Pawar JV. Effect of IBA and other chemicals on air layering in Pomegranate Cv. Bhagwa. BIOINFOLET 2016;13(2A):291-293.
12. Manga B, Jholgiker P, Swamy GSK, Prabhuling G, Sandhyarani N. Studies on effect of month and IBA concentration of air layering in guava (*Psidium guajava* L.) Cv. Sardar. International Journal of Current Microbiology and Applied Science 2017;6(5):2819-2825.
13. Mustafa E, Al-Hadethi A, Ali ST, AL-Dulaimi, Almashhadani BMK. Influence of bio-fertilizers on growth and leaf mineral content in peach transplants. Journal of Agriculture and Veterinary Science 2017;10(9):90-93.
14. Rivka H, Yaacov O. Effect of *Azospirillum brasilense* inoculation on root morphology and respiration in tomato seedlings. BiolFertil Soils 1987;5:241-247.

15. Ram RB, Kumar P, Kumar A. Effect of IBA and PHB on regeneration of pomegranate (*Punica granatum* L.) through stem cuttings. New Agriculturist 2005;16:113-122.
16. Reddy PN, Ray NR, Patel AD, Patel JS. Effect of rooting media and IBA levels on rooting and survival of air layering in fig (*Ficuscarica* L.) Cv. Poona Fig under middle Gujarat agro climatic conditions. The Asian Journal of Horticulture 2014;9(1):1-5.
17. Singh M. Efficacy of plant growth regulators, their concentrations and wrappers on rooting success and survival of air-layered guava twigs (*Psidium gujava* L.). Crop Res., Hisar 2001;21(2):153-156.
18. San Jose MC, Romero L, Janeiro LV. Effect of indole-3-butyric acid on root formation in Alnusglutinosa micro cuttings. Silva Fennica 2012;46(5):643-654.
19. Tyagi SK, Patel RM. Effect of growth regulators on rooting of air layering of guava (*Psidium guajava* L.) Cv. Sardar. Orissa Journal of Horticulture 2004;32(1):58-62.
20. Upadhyay SK, Badyal J. Effect of growth regulators on rooting of pomegranate (*Punica granatum* L.) cutting. Haryana Journal of Horticulture Science 2007;36:58-59.
21. Urmi FF, Malek MA, Ali M, Rahman MS. Effect of operational time and rooting media on success and survivability of air layering in guava. Journal Patuakhali Science and Technology 2016;7:1-10.
22. Vidhyasekaran P. Plant defense activators: precise application technology. Hand-book of Molecular Technologies in Crop Disease Management. New York: Haworth Press 2007.