J. Soils and Crops 31 (1) 134-138, June 2021

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

EFFECT OF MEDIA AND GA_3 ON GROWTH OF ADENIUM (*Adenium obesum*)

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ABSTRACT

The present investigation was conducted to find out the effect of media and GA_3 on growth of adenium (*Adenium obesum*) at Research Farm of Horticulture Section, College of Agriculture, Nagpur in 2019-2020. The experiment was laid out in factorial completely randomized design (FCRD) with six levels of media [Sand, Sand: FYM (1:1), Soil: Sand (1:1), Soil: Sand: FYM (2:1:1), Soil: Vermicompost (1:1) and Cocopeat] and five concentrations of GA_3 [GA_3 @ 0 ppm (Control), GA_3 @ 100 ppm, GA_3 @ 200 ppm, GA_3 @ 300 ppm and GA_3 @ 400 ppm] with thirty treatment combinations replicated thrice.The results revealed that maximum root length (7.10 cm), root collar diameter (1.30 cm), length of leaf (7.80 cm), leaf area (16.50 cm^2), fresh weight (24.33 g), dry weight (6 g), plant height (17.62 cm), stem girth (2.30 cm) was recorded in treatment combination of Sand: FYM (1:1) andGA_3 @ 200 ppm.

(Key words: Adenium, ornamental plant, media, GA_3, plant growth)

INTRODUCTION

Adenium obesum is a popular houseplant and bonsai in temperate regions. It requires a sunny location and minimum indoor temperature in the winter of 10°C. The plant grows well in rocky and sandy soil (Hossain *et al.*, 2017) and requires xeric watering for growth and survival just like cacti. *A. obesum* is typically propagated by seed or stem cutting. The numerous hybrids are propagated mainly by grafting on to rootstock. *Adenium obesum* also propagated through in vitro using plant tissue culture. *Adenium obesum* when propagated with seed, gives broader caudex than that of grafting on to the rootstock and in vitro using plant tissue culture. Broader the caudex gives an attractive look to theAdenium plant. This plant had gained the 'Royal Horticultural Society's Award of Garden Merit'.

Media is a very necessary factor for growing seeds and plants as it provides nutrition. Media are of so many types i.e. sand, soil, silt, vermicompost, cocopeat, vermiculite, perlite, sawdust, FYM, leaf mould and a combination of them as a mixture. Media provide initial support and favorable condition for growing seedlings. A good media has some characteristics as it should have neutral pH, should not shrink extensively when it dried, free from diseases and high concentration of salts, enough to hold propagating material and supply nutrition to the propagules, etc. Gibberellic acid (GA_3) is nothing but the plant hormone. GA_3 has several effects on plant development and growth. They can stimulate rapid stem and root growth and induce mitotic division of leaves.

MATERIALS AND METHODS

The field investigation was conducted at Research Farm, Horticulture Section, College of Agriculture, Nagpur from July, 2019 to January, 2020. The present experiment was laid out in Factorial Completely Randomized Design with 30 treatment combinations replicated thrice.Nagpur is situated at $20^0$10' North latitude and $79^0$19' East longitudes at the elevation of 321.26 meters above mean sea level (MSL.) Nagpur is characterized by hot, dry summer and fairly cold winter. The area shows a wide fluctuation in temperature.

Adenium seeds were collected from matured pods of adenium from MaharajBagh Garden, Telankhedi Garden and Satpuda Botanical Garden, Horticulture Section, College of Agriculture, Nagpur during the month of March-May, 2019. The seeds were cleaned by separating out all feathers. All the floating seeds were discarded and only the healthy seeds were taken for use in these studies. Seeds were allowed to soak with concentration of GA_3[GA_3 @ 0 ppm (Control), GA_3 @ 100 ppm, GA_3 @ 200 ppm, GA_3 @ 300 ppm and GA_3 @ 400 ppm]. Treated seeds were sown in 2-3 cm dip in media. Timely and suitable plant protection measures were applied to protect the plants from pest and disease incidence. The

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plants were protected from rotting by drenching of Bavistin @ 2 g 5 lit water.

Observations on root length (cm) at 60 DAS, root collar diameter (cm) at 60 DAS, length of leaf (cm) at 60 DAS, leaf area (cm^{-2}) at 60 DAS, fresh weight (g) at 60 DAS, dry weight (g) at 60 DAS, plant height (cm) at 150 DAS and stem girth (cm) at 150 DAS were recorded and analyzed statistically as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The data regarding the effect of media and of GA_3 on growth of adenium (*Adenium obesum*) are presented in Table 1 showed that, the effect of media and of GA_3 on growth parameters i. e. root length (cm), root collar diameter (cm), leaf length (cm), leaf area (cm^{-2}), fresh weight (g), dry weight (g), plant height (cm) and stem girth (cm) were found significant except root collar diameter (cm).

Media Sand: FYM (1:1) has significantly maximum (5.42 cm) length of roots and was at par with media Soil: Sand: FYM (2:1:1) (5.38 cm) and it was followed by media Soil: Vermicompost (1:1) (4.14 cm), Sand (3.09 cm), Cocopeat (3.2 cm). The minimum (2.64 cm) length of roots was found in media Soil: Sand (1:1). This might be due to the reason that adenium seedlings need porous and quick-draining media like coarse river sand and FYM mixed in the proportion (1:1). This mixture holds the moisture well and provides good aeration to the root zone to obtain optimum growth. Verma and Singh (2015) in pyrethrum found highest value for length of roots (10.46 cm) in media Vermicompost: Soil: FYM (1:1:1).

The data indicated that GA_3 @ 200 ppm noted the maximum (4.95 cm) length of roots and was followed by GA_3 @ 100 ppm (4.21 cm), GA_3 @ 400 ppm (3.88 cm), GA_3 @ 300 ppm (3.61 cm) and minimum (3.10 cm) length of roots were found in GA_3 @ 0 ppm i.e. control.This is because GA_3 stimulates rapid root growth at optimum concentration has a profound effect and much concentration will have the opposite effect. So GA_3must be used in an optimum concentration. Padhi *et al.* (2018) in gladiolus found that pre-soaking treatment with GA_3 50 ppm was significantly more influencing over distilled water treatment in terms of growth and root characters of gladiolus cormels.

Significantly maximum (7.10 cm) length of roots was noted in the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} which was at par with M_4G_3 {Soil: Sand: FYM (2:1:1) + GA_3 @ 200 ppm} (7.00 cm). Significantly minimum length of roots was recorded i.e. 1.67 cm in the treatment combinations M_1G_4 {Sand + GA_3 @ 300 ppm} and M_3G {Soil: Sand (1:1) + Control}.

This might be due to the combined effect in the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm}, in this treatment maximum length of roots (cm) was observed because sand provide good aeration and drainage to root zone and FYM provide adequate availability of nutrients and GA_3 promote the root growth by activating the cell division in roots. The minimum length of roots was found in treatment combinations M_1G_4 {Sand + GA_3 @ 300 ppm} and M_3G_1 {Soil: Sand (1:1) + Control} because of late germination in that media compared to M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm}.

The data regarding root collar diameter are presented in Table 1 revealed that among all media Sand: FYM (1:1) recorded the maximum (1.10 cm) root collar diameter which was at par with media Soil: Vermicompost (1:1) (1.08 cm), Soil: Sand: FYM (2:1:1) (1.06 cm), Soil: Sand (1:1 cm) (1.03 cm) followed by Cocopeat (0.90 cm). The significantly minimum root collar diameter was found in Sand (0.85 cm).Whereas, data regarding GA_3 indicated that, GA_3 @ 200 ppm noted the maximum (1.15 cm) root collar diameter and it was followed by GA_3 @ 400 ppm (1.05 cm), GA_3 @ 100 ppm (1.01 cm), GA_3 @ 300 ppm (0.98 cm) and minimum (0.81 cm) root collar diameter was found in GA_3 @ 0 ppm i.e. control.

Root collar diameter was found maximum in the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} (1.30 cm) but data was found non-significant.

The data regarding length of leaf indicated that media Sand: FYM (1:1) recorded a significantly maximum (6.98 cm) length of leaf which were followed by media Soil: Vermicompost (1:1) (6.45 cm), Soil: Sand: FYM (2:1:1) (5.92 cm), Soil: Sand (1:1) (6.98 cm) and Sand (1.49 cm). Among the all media in this experiment, Cocopeat recorded significantly minimum (1.31 cm) length of leaf among all treatments. This might be due to the reason that the media mixture Sand and FYM (1:1) is porous and quick-draining media and adequate supply of nutrients from FYM. Cocopeat has a very high water holding capacity and due to this the oxygen diffusion rate is very low and leaf growth of the plant is hammered.

The data in Table 1 noted that GA_3 @ 200 ppm found the significantly maximum (4.96 cm) length of leaf and it was followed by GA_3 @ 400 ppm (6.54 cm), GA_3 @ 100 ppm (4.43 cm), GA_3 @ 300 ppm (4.05 cm) and significantly minimum (3.61 cm) length of leaf was noted in control.This might be due to the fact that GA_3 induces mitotic division in the leaves of plants. Also, it stimulates the shoot growth and due to this, the size of leaf has increased.

The data indicated that, the treatment combination of M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} recorded maximum (7.80 cm) length of leaf followed by the treatment combination M_2G_5 {Sand: FYM (1:1) + GA_3 @ 400 ppm} (7.30 cm). Among the all treatment combinations M_2G_5 {Cocopeat + Control} noted significantly minimum (1.03 cm) length of leaf.

From the above results, the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} has good quality media as water holding capacity, nutrients and drainage are good in media mixture of Sand: FYM in the proportion of 1:1 and an adequate proportion of GA_3 helps actively participation in the mitotic division of leaves. Due

to this reason length of the leaf was recorded significantly maximum in this treatment combination.

The data present in Table 1 revealed that, the media Sand: FYM (1:1) recorded a significantly maximum (12.20 cm^2) leaf area and it was followed by media Soil: Vermicompost (1:1) (10.13 cm^2), Soil: Sand: FYM (2:1:1) (8.73cm^2), Soil: Sand (1:1) (3.97 cm^2), Sand (1.53 cm^2). Among all media,Cocopeat recorded a significantly minimum (1.34 cm^2) leaf area. Whereas, the data regarding GA_3noted that GA_3 @ 200 ppm recorded significantly maximum (7.77cm^2) leaf area which was followed by GA_3 @ 400 ppm (7.29cm^2), GA_3 @ 300 ppm (5.89 cm^2) and with GA_3 @ 100 ppm (5.64cm^2). Significantly minimum (4.89cm^2) leaf area noted in control i.e. GA_3 @ 0 ppm. GA_3 @ 100 ppm and control treatment were found at par with each other.

Treatment combination of M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} recorded significantly maximum (16.50 cm^2) leaf area and it was followed by the treatment combination M_2G_5 {Sand: FYM (1:1) + GA_3 @ 400 ppm} and M_5G_3 {Soil: Vermicompost (1:1) + GA_3 @ 200 ppm} i.e. 13.67 cm^2 in both the treatment combinations. Among the all treatment combinations M_1G_5 {Sand + GA_3 @ 400 ppm} recorded the significantly minimum (1.00 cm^2) leaf area. This might be due to the reason that, the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} has good quality media as water holding capacity, nutrients and drainage are good in media mixture of Sand: FYM in the proportion of 1:1 and an adequate proportion of GA_3 helps actively participation in the mitotic division of leaves. Due to this reason the size of the leaf and leaf area was recorded significantly maximum in this treatment combination.

Data regarding fresh weight noted that media Sand: FYM (1:1) (20.82 g) recorded a significantly maximum (19.87 g) and it was followed by media Soil: Sand: FYM (2:1:1). Media Soil: Sand: FYM (2:1:1) and Soil: Vermicompost (1:1) (19.69 g) were at par with each other and Soil: Vermicompost (1:1) followed by media Soil: Sand (1:1) (7.20 g) and Cocopeat (4.47 g). Among all the media, Sand has recorded a minimum (4.33 g) fresh weight and found at par with Cocopeat (4.47 g).Verma and Singh (2015) in pyrethrum found highest value for fresh weight (3.57 g) in media Vermicompost: Soil: FYM (1:1:1).

The data present in Table 1 revealed that GA_3 200 ppm recorded significantly maximum (15.67 g) fresh weight which was followed by treatments GA_3 @ 400 ppm (12.70 g) and was at par with GA_3 @ 100 ppm (12.50 g) and GA_3 @ 300 ppm (12.22 g). A significantly minimum (10.56 g) fresh weight was noted in control i.e. GA_3 @ 0 ppm.Similar results were found by Hong-Young Ma *et al.* (2018) in *Leymus chinensis*.They noted that treatment with GA_3 50 µM increased fresh weight by 168.2% in pot condition.

Treatment combination of M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} recorded significantly maximum (24.33 g) fresh weight and was at par with the treatment combinations M_4G_3 {Soil: Sand: FYM (2:1:1) + GA_3 @ 200 ppm} and M_5G_3 {Soil: Vermicompost (1:1) + GA_3 @ 200 ppm} i.e. 24.00 g in both the treatment combinations. Among the all treatment combinations M_6G_4 {Cocopeat + GA_3 @ 300 ppm} noted the significantly minimum (2.67 g) fresh weight. From the above results, the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} was recorded significantly maximum fresh weight it might be due to the fact that Sand and FYM is good quality media for the growth of the plant as it provides nutrient and good aeration to the root zone of the plant. Besides that FYM has good water holding capacity and containing a good amount of nitrogen and organic carbon which is much needed for the growth of biomass of the cell. Due to this, the weight of the plant increased. GA_3 in an adequate concentration stimulates the root and shoot elongation and promote the cell division in plants.

The data regarding dry weight noted that media Sand: FYM (1:1) recorded significantly maximum (5 g) and itwas followed by media Soil: Vermicompost (1:1) (4.70 g), Soil: Sand: FYM (2:1:1) (3.96 g), Soil: Sand (1:1) (2.07 g) and Cocopeat (1.81 g). Among all the media, Sand (1.14 g) recorded significantly minimum dry weight of the adenium plant.Verma and Singh (2015) in pyrethrum found highest value for dry weight (0.87 g) in media Vermicompost: Soil: FYM (1:1:1).

The data present in Table 1 indicated that significantly maximum (3.69 g) dry weight of the plant was recorded in GA_3 @ 200 ppm followed by GA_3 400 ppm (3.17 g) and it was at par with GA_3 @ 300 ppm (3.05 g) and GA_3 @ 100 ppm (3.03 g). Among all treatments, control i.e. GA_3 @ 0 ppm recorded significantly minimum (2.63 g) dry weight of the adenium plant. Similar results were found by Hong-Young Ma *et al.* (2018) in *Leymus chinensis*, they noted that treatment with $GA_3$50 µM increased dry weight by 108.9% in pot condition.

Treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} noted significantly maximum (6 g) dry weight and it was followed by treatment combination M_2G_5 {Sand: FYM (1:1) + GA_3 @ 400 ppm} (5 g). Significantly minimum (0.93 g) dry weight was recorded in the treatment combination M_1G_1 {Sand + Control}.From the above result, the treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} has a good quality of media in which the dry biomass was found maximum and GA_3 promote the cell division which also helps in the growth of the biomass of the plant. Due to this the dry weight in this treatment was quantitatively higher than all other treatment combinations. Nasri *et al.* (2013) found similar results in alstroemeria.They noted that increase in the dry weight of the seedlings due to treatment with GA_3 might be attributed due to increase in cell elongation.

Data regarding plant height revealed that significantly maximum (14.77 cm) plant height was recorded in media Sand: FYM (1:1) and was followed by media Soil: Sand: FYM (2:1:1) (13.27 cm), Soil: Vermicompost (1:1) (12.64 cm), Soil: Sand (1:1) (7.69 cm) and Sand (5.51 cm). Media cocopeat (4.04 cm) recorded a significantly minimum plant height than all other media.Verma and Singh (2015) in

Table 1. Effect of media and GA_3 on growth of adenium (*Adenium obesium*)

Treatments	Root length (cm)	Root collar diameter (cm)	Length of leaf (cm)	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)	Plant height (cm)	Stem girth (cm)
A) Propagation media								
M_1- Sand	3.09	0.85	1.49	1.53	4.33	1.14	5.13	1.19
M_2- Sand: FYM (1:1)	5.42	1.10	6.98	12.20	20.82	5.00	14.77	1.92
M_3- Soil: Sand (1:1)	2.64	1.03	3.79	3.97	7.20	2.07	7.69	1.66
M_4- Soil: Sand: FYM (2:1:1)	5.38	1.06	5.92	8.73	19.87	3.96	13.27	1.79
M_5- Soil: Vermicompost (1:1)	4.14	1.08	6.45	10.13	19.69	4.70	12.64	1.78
M_6- Cocopeat	3.02	0.90	1.31	1.34	4.47	1.81	4.04	1.37
SE (m) ±	0.12	0.03	0.05	0.12	0.28	0.06	0.08	0.03
CD at 5 %	0.33	0.09	0.15	0.35	0.73	0.17	0.23	0.08
B) GA_3 concentrations								
G_1- Control (water soaking)	3.10	0.81	3.61	4.89	10.56	2.63	7.53	1.36
G_2- GA_3 100 ppm	4.21	1.01	4.43	5.64	12.50	3.03	9.92	1.68
G_3- GA_3 200 ppm	4.95	1.15	4.96	7.77	15.57	3.69	11.25	1.92
G_4- GA_3 300 ppm	3.61	0.98	4.05	5.89	12.22	3.05	9.09	1.54
G_5- GA_3 400 ppm	3.88	1.05	4.57	7.39	12.70	3.17	9.66	1.57
SE (m) ±	0.11	0.03	0.05	0.11	0.24	0.06	0.07	0.03
CD at 5 %	0.30	0.08	0.13	0.32	0.67	0.16	0.21	0.07
C) Interaction (M × G)								
M_1G_1	3.00	0.63	1.13	1.17	3.33	0.93	4.23	1.07
M_1G_2	3.83	0.73	2.00	2.00	4.33	1.08	5.17	1.20
M_1G_3	4.00	1.00	2.13	2.17	5.00	1.33	6.10	1.30
M_1G_4	1.67	0.90	1.20	1.33	4.33	1.07	4.53	1.17
M_1G_5	2.93	0.97	1.00	1.00	4.67	1.30	5.63	1.20
M_2G_1	3.90	0.80	6.00	8.33	18.00	4.50	10.83	1.60
M_2G_2	5.00	1.20	7.00	10.00	20.00	4.60	15.20	2.00
M_2G_3	7.10	1.30	7.80	16.50	24.33	6.00	17.62	2.30
M_2G_4	4.90	1.10	6.80	12.50	21.67	4.90	13.40	1.80
M_2G_5	6.20	1.10	7.30	13.67	20.10	5.00	13.80	1.90
M_3G_1	1.67	0.80	2.60	2.67	4.67	1.50	6.73	1.47
M_3G_2	2.67	1.10	3.43	2.67	7.67	2.20	7.10	1.67
M_3G_3	3.00	1.20	4.23	3.33	8.67	2.30	9.00	1.90
M_3G_4	2.93	0.90	3.07	3.00	7.33	2.17	7.03	1.60
M_3G_5	2.93	1.13	5.60	8.17	7.67	2.20	8.57	1.67
M_4G_1	3.80	0.90	5.40	8.00	17.33	3.47	12.38	1.40
M_4G_2	5.70	1.10	6.10	9.00	19.00	3.90	14.80	2.00
M_4G_3	7.00	1.20	6.37	9.30	24.00	4.20	14.30	2.27
M_4G_4	4.90	0.97	5.43	8.17	19.00	3.90	13.13	1.90
M_4G_5	5.50	1.13	6.30	9.17	20.00	4.33	14.07	1.70
M_5G_1	3.80	1.00	5.50	8.00	17.00	4.33	13.23	1.40
M_5G_2	4.30	1.07	6.90	9.00	19.00	4.07	14.80	1.93
M_5G_3	4.80	1.20	7.33	13.67	24.00	5.83	12.97	2.17
M_5G_4	4.40	1.10	6.50	9.00	18.33	4.77	12.52	1.70
M_5G_5	3.40	1.03	6.00	11.00	20.10	4.50	12.27	1.70
M_6G_1	2.40	0.73	1.03	1.17	3.00	1.03	3.28	1.23
M_6G_2	3.73	0.85	1.13	1.20	5.00	2.30	4.27	1.30
M_6G_3	3.80	1.00	1.87	1.67	8.00	2.50	3.97	1.60
M_6G_4	2.83	0.93	1.30	1.33	2.67	1.50	3.91	1.40
M_6G_5	2.33	1.00	1.20	1.33	3.67	1.70	3.77	1.33
SE (m) ±	0.26	0.07	0.12	0.28	0.58	0.14	0.18	0.06
CD at 5 %	0.75	-	0.33	0.78	1.64	0.38	0.51	0.17

pyrethrum found highest value for plant height (13.90 cm) in media Vermicompost: Soil: FYM (1:1:1).Whereas,GA_3 @ 200 ppm noted the significantly maximum (11.25 cm) plant height and followed by GA_3 100 ppm (9.92 cm), GA_3 @ 200 ppm (9.66 cm) and GA_3 @ 300 ppm (9.09 cm). Among the all GA_3 treatments control (7.53 cm) noted the significantly minimum plant height. Similar results were found by Reshma *et al.* (2017).They noted that maximum length of spike and rachis after spraying with GA_3 200 ppm.

Data about combine effect of media and GA_3on plant height noted that, treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} recorded significantly maximum (17.62 cm) plant height and followed by M_2G_2 {Sand: FYM (1:1) + GA_3 @ 100 ppm} (15.20 cm). The significantly minimum (3.28 cm) plant height was noted in M_6G_1 {Cocopeat + Control}. This might due to the combine effect of media and GA_3 concentration that plant height was significantly maximum in that treatment combination. Media Sand: FYM (1:1) has porous and good drainage and FYM provides an adequate amount of available nutrients to the adenium plant. The proper concentration of GA_3 is also played a key role in the significant influence on plant height. Treatment combination of Cocopeat and GA_3 @ 0 ppm (Control) noted the significantly minimum height of the adenium plant. Cocopeat has a very high water holding capacity and due to this very poor combination of air-water relationship and low oxygen supply in the root zone compared to all other media and seeds were not treated with GA_3, while GA_3 treated seeds induced the plant growth (Awang *et al*.,2009).

Data regarding stem girth noted that, media Sand: FYM (1:1) recorded significantly maximum (1.92 cm) and it was followed by media Soil: Sand: FYM (2:1:1) (1.79 cm).Next to these two media, the media were Soil: Vermicompost (1:1) (1.78 cm),Soil: Sand (1:1) (1.66 cm) and Cocopeat (1.37 cm). Among the all media Sand recorded significantly minimum (1.19 cm) stem girth.Whereas, data regarding GA_3indicated that GA_3 @ 200 ppm noted the significantly maximum (1.92 cm) stem girth followed by GA_3 @ 100 ppm (1.68 cm), GA_3 @ 400 ppm (1.57 cm) and GA_3 @ 300 ppm (1.54 cm). Among the all GA_3 treatments control noted the significantly minimum (1.36 cm) stem girth.

Combine effect of media and GA_3on the stem girth noted that, treatment combination M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} recorded significantly maximum (2.30 cm) stem girth and was at par with M_4G_3 {Soil: Sand: FYM (2:1:1) + GA_3 @ 200 ppm} (2.27 cm). The significantly minimum (1.07 cm) stem girth was noted in M_1G_1 {Sand + Control}.From the above results, it can be indicated that the treatment combination of M_2G_3 {Sand: FYM (1:1) + GA_3 @ 200 ppm} was found significantly better treatment than all the other treatment combinations due to the fact that, propagation media has good water holding capacity and can provide adequate available nutrients to the plant to grow and GA_3 has played the key role in the multiplication of the cell.

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Rec. on 15.12.2020 & Acc. on 28.12.2020