Effect of rooting media on flowering and yield of bidhan marigold varieties under shade net house condition

ABSTRACT

An experiment was carried out in factorial concept with two factors *i.e.*, varieties at two levels and rooting media at eight levels thus making 16 combinations which were replicated twice. The effect of varieties, rooting media and their interactions were found to be significant with regard to days taken for first flower bud initiation, days taken for full flower opening, *in situ* longevity, days taken for 50% flowering, days taken for 100% flowering, duration of flowering, flower diameter, weight of 10 flowers, shelf life of flowers, number of flowers/plant and flower yield/plant under shade net house condition.The variety Bidhan Marigold 1 recorded the earliest flower bud initiation (41.25 days), earliest days for full flower opening (7.50 days), lowest number days for 50 per cent flowering (48.90 days), earliest days for 100 per cent flowering (73.0 days), maximum duration of flowering (29.37 days), greatest flowerdiameter (3.21 cm), highest average weight of 10- flowers (7.18 g), highest shelf life of flowers (9.5 days), maximum number of flowers per plant (88.83) and highest flower yield per plant (437.75).Whereas, the variety Bidhan Marigold 2 recorded the maximum days for *insitu* longevity (19.16 days) under shade net house condition.

Keywords: Marigold, Bidhan Marigold Varieties, Bud initiation, Flower opening, Duration, Yield, Polybags, Shade net house.

INTRODUCTION

"Marigold (*Tageteserecta*L.) is one of the most important commercial flower crops grown in India. The crop is said to be native of Mexico. It belongs to the family *Asteraceae* and propagated by seed and terminal cuttings.Marigold flowers are extensively used as loose flowers for making garlands, beautification, religious offerings, social functions and other purposes such as pigment & oil extraction and therapeutic uses. Apart from these uses, marigold is widely grown in gardens and pots for display purpose. The crop also finds industrial application in several areas like preparation of natural dyes and essential oils. It is a highly suitable bedding plant and also used as trap crop against nematodes and pests in some crops. It is found in different colors and fragrances but yellow is the most common flower color" (Sieverding, 1991; Vijay et al., 2018).

"Rooting media is essential for improvement in rooting percentage and hence the selection and combination of media components assumes greater significance for success in vegetative propagation" (Laubscher, 1990)."Moisture holding capacity and optimum aeration have been regarded as the most essential characteristics for rooting medium. The medium used for rooting of cuttings should be also firm so as to hold the plant/cutting in position.Therefore, an ideal rooting medium should be porous enough to allow good aeration

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and should possess high water holding ability. The type of rooting medium determines to some extent, the nature of roots which are produced on the cutting and consequently its survival. Thus medium for rooting has gained lot of importance in propagation of marigold. The rooting media has been reported toinfluence the success of propagation in several crops through vegetative parts.Influence of media in turn was shown to be under the control of its biological properties since the media necessarily happens to be an eco-system" (Sieverding, 1991).

"As the rhizospheric eco-system has a bearing on the rooting property of crop, a natural inquisitiveness is quite justifiable on the significance of former's influence on later's performance during major part of cropping period. One such positive rhizospheric eco-system component is mycorrhiza. Mycorrhiza is the mutualistic symbiosis (non-pathogenic association) between soil borne fungi and the roots of higher plants" (Sieverding, 1991).

MATERIAL AND METHODS

Experiment was carried out at College farm, College of Horticulture, Dr. Y.S.R. Horticultural University, Venkataramannagudem, West Godavari District of Andhra Pradesh during *rabi*, 2017-2018. Experiment was laid out in completely randomised design with factorial concept. Factor one (Varieties) consisted of two levels one being Bidhan Marigold-1 (V_1) and another Bidhan Marigold- 2 (V_2) and factor two consists of 8 levels of rooting media M_1 – soil, M_2 – soil + mycorrhiza, M_3 – soil : vermicompost (1:1) v/v + mycorrhiza, M_4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza, M_5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza, M_6– soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza, M_7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza and M_8– soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza. Thus, there were 16 treatment combinations and were repeated twice.

The parameters are days taken for first flower bud initiation, days taken for full flower opening, *In situ* longevity, days taken for 50% flowering, days taken for 100% flowering, duration of flowering, flower diameter, weight of 10 - flowers, shelf life of flowers, number of flowers/plant and flower yield/plant under shade net condition. Theseobservationswererecordedfromthepolybags containing different rooting media combinations.The experimental data pertaining to all the characters studied were subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1997).

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Figure 1: Generalviewofexperimentunder shade net condition

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RESULTS AND DISCUSSION

1. Days taken for first flower bud initiation

It is evident from the data presented in the (Table 1), that there were significant variations among the varieties, rooting media and their interactions with regard to days taken for first flower bud initiation in polybags.

In polybag, the variety Bidhan Marigold 1 recorded the earliest flower bud initiation (41.25 days) than Bidhan Marigold 2 (38.62 days).Among the rooting media, the earliest flower bud initiation (38.5 days) was recorded by M_6– soil : vermicompost : coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza which was on par with M_8– soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza (38.5 days) followed by M_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (39.5 days).Maximum delay was observed for flower bud initiation planted in M_1 – soil (41.5 days).

It is directly correlated with the earliest bud formation in this medium. It can also be attributed to the higher vegetative growth and leaf number per plant in this medium which contributed significantly to accumulation of photosynthates and in turn inducing optimum growth, early bud formation and eventually the flowering.Seyedi*et al*. (2012), who carried out experiment on "effect of growing media on Asiatic hybrid lilies concluded that cocopeat as medium amendment owing to its appropriate physical and chemical properties probably makes better growth of plants to decrease days from planting to reproductive stage. Earliness in flowering can be attributed to enhanced vegetative parameters with bio-inoculation of mycorrhizae as explained earlier. This may be ascribed to easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinins to the axillary buds resulting in breakage of apical dominance as explained in the previous paragraphs. Ultimately, these facts might have resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase".

2. Days taken for full flower opening

In polybag (Table 1), the variety Bidhan Marigold 2 recorded the maximum days for full flower opening (8.81 days) than Bidhan Marigold 1 (7.50 days).Among the rooting media, the maximum number of days for full flower opening (11 days) was recorded by M_8 – soil : vermicompost : coco peat :saw dust (1:1:1:1) v/v+ mycorrhiza followed by M_6 – soil : vermicompost : coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza (10 days) andM_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (9 days). Minimum number of days was observed for full flower opening planted in M_1 – soil (6 days).

3. *In situ* longevity

In polybag (Table 1), the variety Bidhan Marigold 2 recorded the maximum days for *insitu* longevity (19.16 days) than Bidhan Marigold 1 (18.67 days).Among the rooting media, the maximum days for *in situ* longevity(22 days) was recorded by M_8– soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza which was on par with M_6 – soil : vermicompost : coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza (20.60 days) andM_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (20.58 days). The least number of days was observed for *in situ* longevity on those planted in M_1 – soil (15.02 days).

4. Days taken for 50 per cent flowering

Bidhan Marigold 1 recorded the lowest number days for 50 per cent flowering (48.90 days) than Bidhan Marigold 2 (51.55 days) in polybag (Table 2).Among the rooting media,the lowestnumber of daysfor 50 per centflowering (48.31 days) was recorded by M_8 – soil : vermicompost : coco peat :saw dust (1:1:1:1) v/v+ mycorrhiza followed by M_6 – soil : vermicompost : coco peat :rice husk (1:1:1:1) v/v+

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mycorrhiza(49.28days)followedbyM_4–soil:vermicompost:cocopeat(1:1:1)v/v+ mycorrhiza (50.23 days).Maximum delay was observed for 50 per cent flowering planted in M_1 – soil. (51.18 days).

5. Days taken for 100 per cent flowering

. In polybag (Table 2), the variety Bidhan Marigold 1 recorded the earliest days for 100 per cent flowering (73.0 days) than Bidhan Marigold 2 (74.0 days).Among the rooting media, the earliest days for 100 per cent flowering (68 days) was recorded by M_8 – soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza which was on par with M_6– soil : vermicompost : coco peat :ricehusk (1:1:1:1) v/v+ mycorrhiza (68 days) followed by M_4– soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (73 days).Maximum delay was observed for 100 per cent flowering planted in M_1 – soil. (77.0 days).

6. Duration of flowering (days)

In polybag, the variety Bidhan Marigold 1 recorded the maximum duration of flowering (29.37 days) than Bidhan Marigold 2 (26 days).Among the rooting media, the longest duration of flowering (31.0 days) was recorded by M_6– soil :vermicompost : coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza which was on par with M_8– soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza (30.0 days) followed by M_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (29.0 days).Minimum was observed for duration of flowering planted in M_1 – soil. (25.5 days).

Similar effect of media was observed in the open field also. Duration of flowering can be correlated to number of flowers per plant. Growing of marigold varieties in vermicompost + cocopeat based media produced maximum number of flowers per plant which lasted for longer duration in comparison to plants raised on other media producing less number of flowers per plant. These results are also supported by the findings of Wazir *et al*. (2009) in alstroemeria, who observed that maximum duration of flowering in two consecutive flushes were obtained in crop grown on medium containing sand + soil + cocopeat + vermicompost + FYM (1:1:1:1,v/v).Prisa*etal*.(2011) foundanimprovementinflowerqualityand longevity in cut stems of Asiatic hybrid grown on new amendments over the traditionalsubstrate.

7. Flower diameter (cm)

In polybag, the variety Bidhan Marigold 1 recorded the greatest flowerdiameter (3.21) than Bidhan Marigold 2 (2.53).Among the rooting media, thegreatestflowerdiameter(3.16)wasrecordedbyM_8– soil:vermicompost:cocopeat: sawdust(1:1:1:1)v/v+mycorrhizawhichwasonparwithM_6–soil:vermicompost: coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza (3.10) andM_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (3.09).Minimum was observed forflower diameter planted in M_1 – soil. (2.35).

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Inoculation of bio fertilizers in plants have been known to increase the amount the auxin and cytokynin in the flowers that lead to improved quality parameters *viz.*, diameter of flower as disclosed in chrysanthemum (Palagani*et al.*, 2013), gladiolus (Kumar *et al*., 2013 a & b).

8. Weight of 10 - flowers (g)

In polybag (Table 2), the variety Bidhan Marigold 1 exhibited highest average weight of 10- flowers (7.18 g) than Bidhan Marigold 2 (6.66 g). Among the rooting media, the highest average weight of 10- flowers (12.12 g) was recorded by M_6 – soil : vermicompost : coco peat :rice husk (1:1:1:1) v/v+ mycorrhiza which was on par with M_8 – soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza (11.11) and followed by M_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (9.34). The lowest average weight of 10 flowers (3.07) was recorded on M_1 – soil.

9. Shelf life of flowers (days)

In polybag, the variety Bidhan Marigold 1 recorded the highest shelf life of flowers (9.5 days)than BidhanMarigold2(9.45days).Amongtherooting media, the highest shelf life of flowers (9.6 days) was recorded by M_8 – soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza which was on par with M_6 – soil : vermicompost : coco peat :ricehusk (1:1:1:1) v/v+ mycorrhiza (9.56 days) followed byM_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (9.5 days).The lowest shelf life of flowers was observed for M_1 – soil. (9.35 days).

Cocopeat based media would have maintained a higher water content in media which leading to enhanced longevity and vase life of flowers. These findings are in agreement with those of Bhatia *et al.* (2004) observed that the soil + FYM + coco peat was found as the best medium for enhancing the vase life in carnation cv. Sunrise. Jawaharlal *et al.* (2001) studied that coco peat in combination with FYM increased inflorescence longevity in anthurium. Dien (2003) noted that the coco peat + sawdust + sand (1:1:1 v/v) was found superior with respect to vase life (13.4 days) in gerbera and the same was also noticed by Gupta *et al.* (2004). Further, improved vase life of flowers in bio fertilizers inoculated flowers might be due to presence of ethylene inhibitors or due to cytokinins which delayed senescence of the florets as reported in gerbera (Barreto and Jagtap, 2002).

10. Number of flowers per plant

In polybag, the variety Bidhan Marigold 1 exhibited maximum number of flowers per plant (88.83) than Bidhan Marigold 2 (68.26). Among the rooting media, the

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maximum number of flowers per cutting (98.45) was recorded by M_8– soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza which was on par with M_6– soil : vermicompost : coco peat :ricehusk (1:1:1:1) v/v+ mycorrhiza (93.32) and followed byM_4 – soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (86.0). The minimum number of flowers per plant (60.7) was recorded on M_1 – soil.

Optimum growing conditions provided by the medium amended with vermicompost and cocopeat helped to optimise the plant health resulting in the production of more number of flowers per plant. Vermicompost is a sustainable source of macro and micro nutrients and has a considerable potential for improving plant growth significantly when used as soil amendments in horticultural crops (Sahni*et al.*, 2008). In a similar study on Asiatic hybrid lily 'Navona', Moghadam*et al.* (2012) also reported more number of flowers per spike in medium amended with different doses of vermicompost.

11. Flower yield per plant (g)

In open field, the variety Bidhan Marigold 1 exhibited highest flower yield per plant (437.75) than Bidhan Marigold 2 (367.75). Among the rooting media, thehighest flower yield per plant per(420.5) was recorded byM_8– soil : vermicompost : coco peat :sawdust (1:1:1:1) v/v+ mycorrhiza which was on par with M_6 – soil : vermicompost : coco peat :ricehusk (1:1:1:1) v/v+ mycorrhiza (414.5) andM_4– soil : vermicompost : coco peat (1:1:1) v/v+ mycorrhiza (414). The lowest flower yield per plant (388.5) was recorded on M_1 – soil.

Improved flower yield can be attributed to enhanced vegetative parameters with bio inoculation of VAM as explained. This may be ascribed to easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinins to the axillary buds resulting in breakage of apical dominance as earlier explained. Ultimately, this may have resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase. Further, higher leaf number and number of suckers with mycorrhizal inoculation, resulted in more photosynthesis subsequently higher yield of flowers. These results are in close conformity with Singh *et al.* (2006) in rose.

CONCLUSION

From the present investigation, it was concluded that the variety Bidhan Marigold 1 recorded the earliest flower bud initiation (41.25 days), earliest days for full flower opening (7.50 days), lowest number days for 50 per cent flowering (48.90 days), earliest days for 100 per cent flowering (73.0 days), maximum duration of flowering (29.37 days), greatest flowerdiameter (3.21 cm), highest average weight of 10- flowers (7.18 g), highest shelf life of flowers (9.5 days), maximum number of flowers per plant (88.83) and highest flower yield

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per plant (437.75).Whereas, the variety Bidhan Marigold 2 recorded the maximum days for *insitu* longevity (19.16 days) under shade net condition.

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1.

2.

3.

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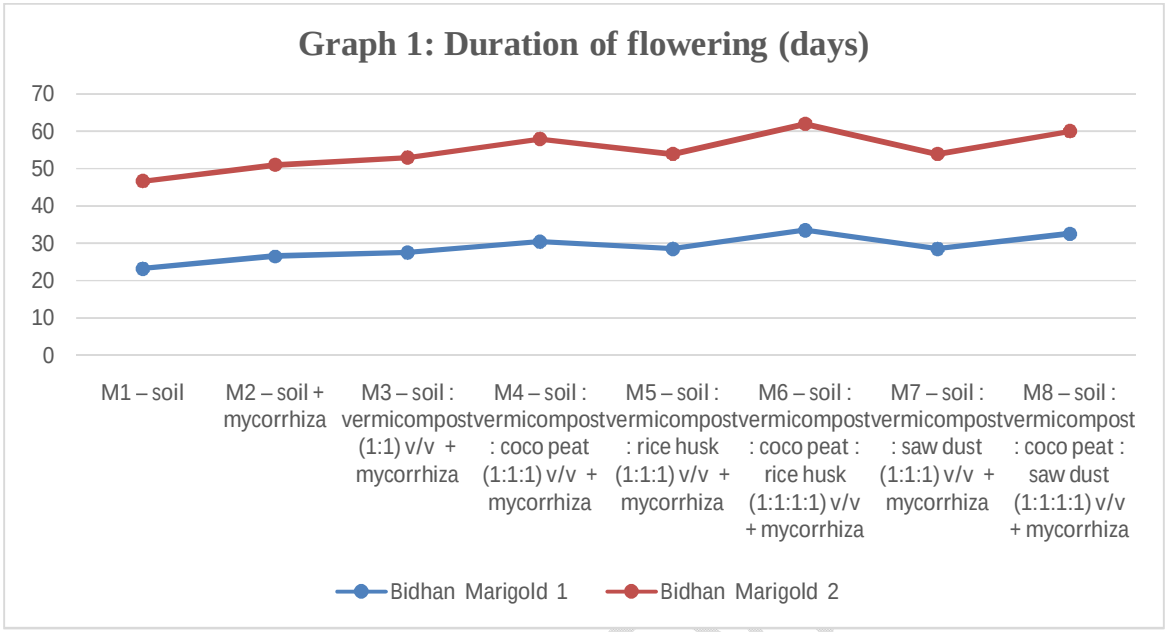
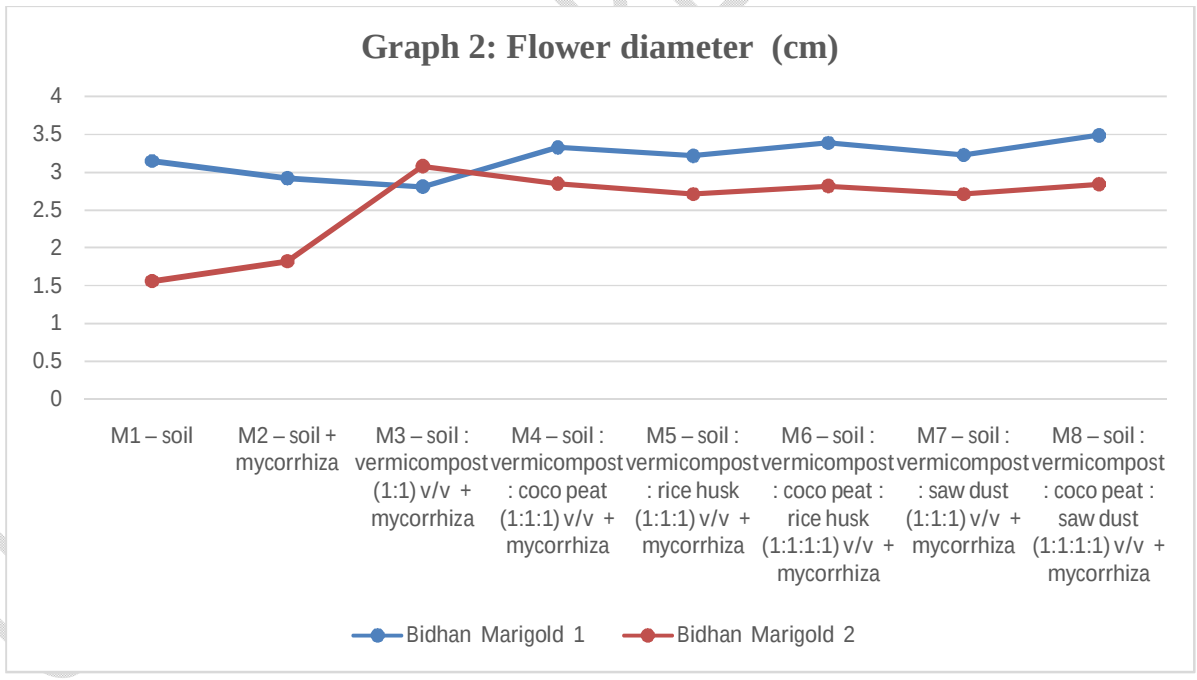
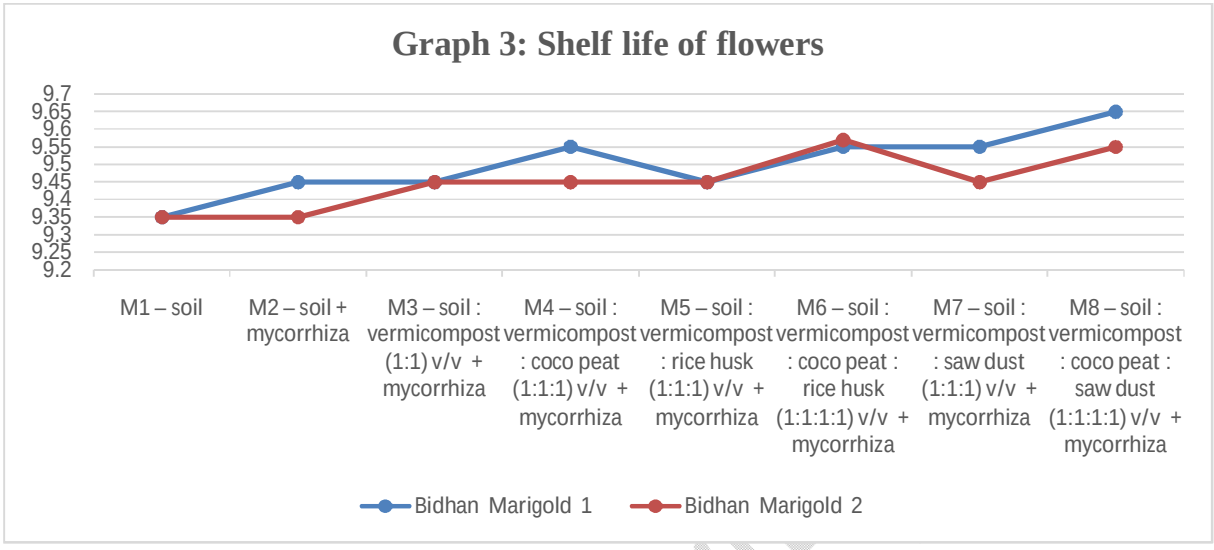
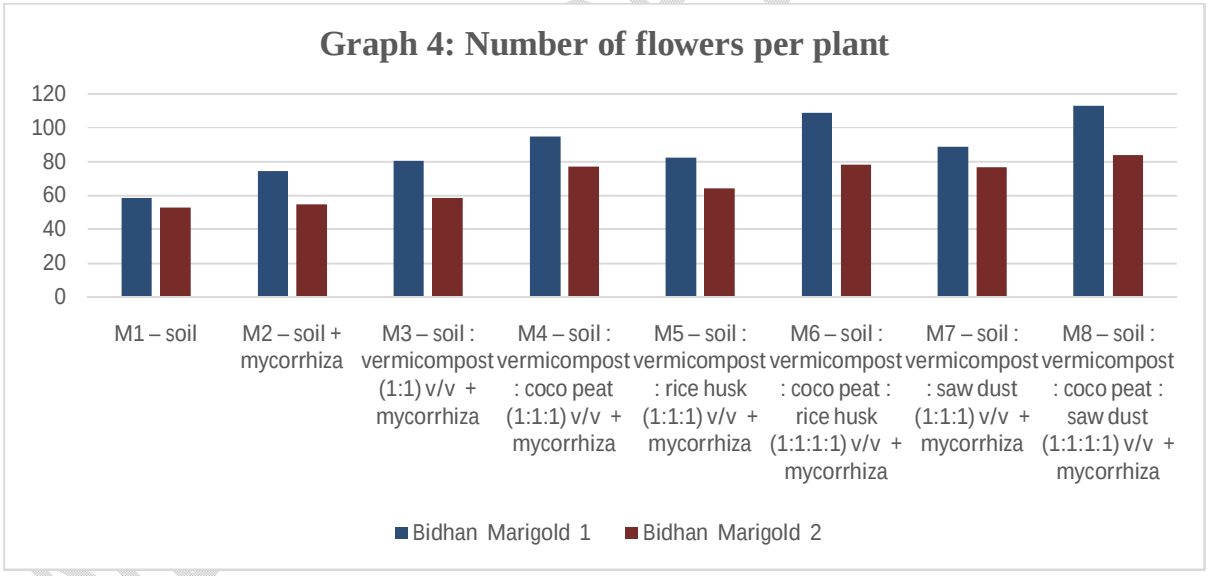

Graph 1: Duration of flowering (days)
70
60
50
40
30
20
10
0
M1 – soil
M2 – soil + mycorrhiza
M3 – soil : vermicompost (1:1) v/v + mycorrhiza
M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza
M5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza
M6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza
M7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza
M8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza
Bidhan Marigold 1
Bidhan Marigold 2


Graph 2: Flower diameter (cm)
4
3.5
3
2.5
2
1.5
1
0.5
0
M1 – soil
M2 – soil + mycorrhiza
M3 – soil : vermicompost (1:1) v/v + mycorrhiza
M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza
M5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza
M6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza
M7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza
M8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza
Bidhan Marigold 1
Bidhan Marigold 2


Graph 3: Shelf life of flowers
9.7
9.65
9.6
9.55
9.5
9.45
9.4
9.35
9.3
9.25
9.2
M1 – soil
M2 – soil + mycorrhiza
M3 – soil : vermicompost (1:1) v/v + mycorrhiza
M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza
M5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza
M6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza
M7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza
M8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza
Bidhan Marigold 1
Bidhan Marigold 2


Graph 4: Number of flowers per plant
120
100
80
60
40
20
0
M1 – soil
M2 – soil + mycorrhiza
M3 – soil : vermicompost (1:1) v/v + mycorrhiza
M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza
M5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza
M6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza
M7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza
M8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza
Bidhan Marigold 1
Bidhan Marigold 2

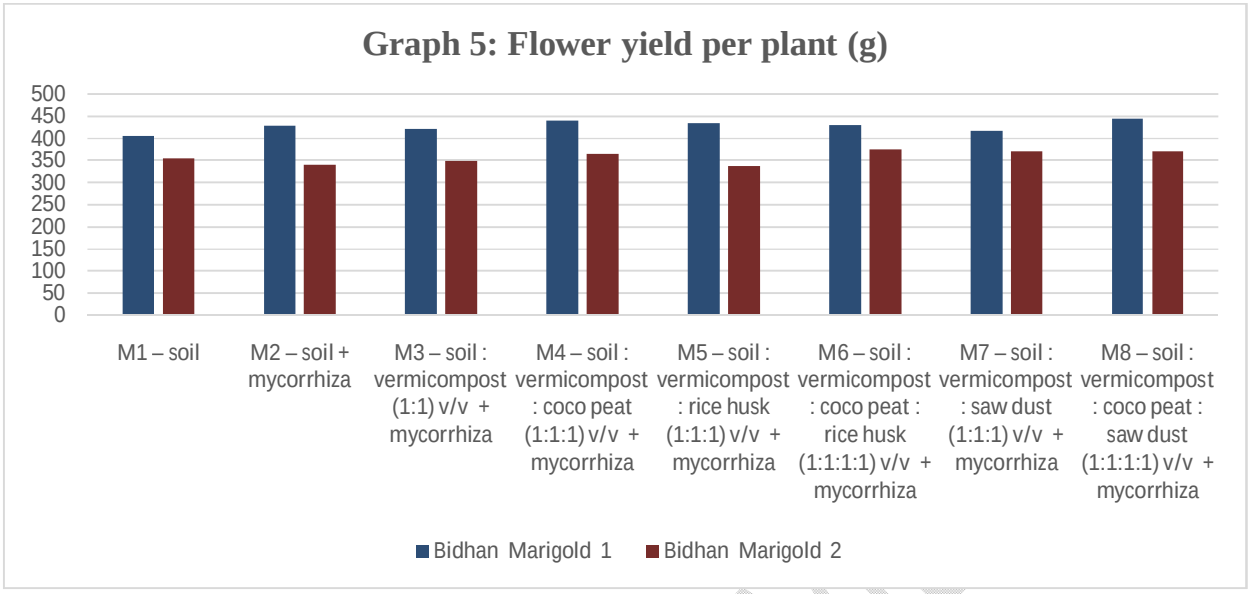


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Table 1: Flower parameters as influenced by rooting media among Bidhan Marigold varieties under shade net house condition

Medium / Variety	Days taken for First flower bud initiation			Days taken for full flower opening			*Insitu* Longevity		
	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M_1 – soil	42	41	**41.5**	6.00	6.00	**6.00**	15.48	14.56	**15.02**
M_2 – soil + mycorrhiza	42	39	**40.7**	5.50	7.00	**6.25**	15.45	16.75	**16.10**
M_3 – soil : vermicompost (1:1) v/v + mycorrhiza	42	39	**40.5**	7.00	6.00	**6.50**	17.45	18.96	**18.21**
M_4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	41	38	**39.5**	7.50	10.50	**9.00**	20.42	20.74	**20.58**
M_5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	40	41	**40.5**	7.00	9.00	**8.00**	18.56	19.74	**19.15**
M_6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	41	36	**38.5**	10.00	10.00	**10.00**	20.74	20.45	**20.60**
M_7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	41	39	**40.0**	6.00	11.00	**8.50**	19.64	19.65	**19.65**
M_8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	40	37	**38.5**	11.00	11.00	**11.00**	21.54	22.45	**22.00**
Mean	**41.25**	**38.62**	**39.93**	**7.50**	**8.81**	**8.16**	**18.67**	**19.16**	**18.91**

Factor	S Em±	CD at 5%	S Em±	CD at 5%	S Em±	CD at 5%
Variety (V)	0.61	1.81	0.34	0.99	0.13	0.37
Medium (M)	0.21	0.61	0.61	1.79	0.79	2.32
V x M	0.48	1.42	0.82	2.42	0.90	2.64

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Table 2: Flower parameters as influenced by rooting media among Bidhan Marigold varieties under shade net house condition

Medium / Variety	Daystakenfor50%flowering			Daystakenfor100%flowering			Weightof10-freshflowers (g)		
	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M_1 – soil	52.44	49.92	**51.18**	77.5	76.5	**77**	1.74	1.66	**3.07**
M_2 – soil + mycorrhiza	52.72	49.05	**50.88**	76.5	75.5	**76**	4.54	2.99	**3.76**
M_3 – soil : vermicompost (1:1) v/v + mycorrhiza	51.91	49.74	**50.82**	75.2	75.2	**75**	4.29	3.78	**4.03**
M_4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	51.25	49.21	**50.23**	73.5	72.5	**73**	8.84	9.85	**9.34**
M_5 – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	51.35	49.55	**50.45**	75.5	74.3	**74**	7.72	5.23	**6.47**
M_6 – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	50.42	48.15	**49.28**	69.5	67.5	**68**	13.81	10.43	**12.12**
M_7 – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	51.59	48.91	**50.25**	74.5	73.5	**74**	4.05	6.92	**5.48**
M_8 – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	49.91	46.71	**48.31**	68.5	67.5	**68**	11.15	11.08	**11.11**
Mean	**51.55**	**48.90**	**50.23**	**74**	**73**	**73**	**7.18**	**6.66**	**6.92**

Factor	S Em±	CD at 5%	S Em±	CD at 5%	S Em±	CD at 5%
Variety (V)	0.62	1.83	0.23	0.69	0.12	0.36
Medium (M)	0.19	0.56	0.69	2.05	0.70	2.05
V x M	0.42	1.24	0.85	2.51	0.88	2.58

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