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EFFECT OF DIFFERENT ROOTING MEDIA ON FLOWERING AND YIELD OF BIDHAN MARIGOLD VARIETIES IN THE OPEN FIELDS OF WEST GODAVARI DISTRICTS OF ANDHRA PRADESH INDIA

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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/plants, flower yield/plot, flower yield/plot and flower yield/hectare. The variety Bidhan Marigold 1 recorded the minimum days for full flower opening (5.79 days), maximum duration of flowering (30.26 days), highest average weight of 10 - flowers (7.18 g), highest shelf life of flowers (9.62 days), superior performance of number of flowers per plant (91.30 flowers per plant), highest flower yield per plant (437.75), flower yield per plot (15.29) and highest flower yield per hectare (15.29 t) whereas, the variety Bidhan Marigold 2 recorded the earliest flower bud initiation (37.96 days), maximum days for *in situ* longevity (20.22 days), lowest number of days for 50% flowering (48.01 days) under open field conditions of West Godavari districts of Andhra Pradesh.

Keywords: Marigold, Bidhan Marigold Varieties, Bud initiation, Flower opening, Duration, Yield.

Introduction

Marigold (*Tagetes erecta* 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 and 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.

Rooting media are 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 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 to influence 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.

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, flower yield/plant, flower yield/plot and flower yield/hectare. The experimental data pertaining to all the characters studied were subjected to statistical analysis of variance technique as described by Panse and Sukhatme (1997).



Plate 1 : General view of experiment in open field

Results and Discussion

1. Days taken for first flower bud initiation

Under open field (Table 1), the variety Bidhan Marigold 2 recorded the earliest flower bud initiation (37.96 days) than Bidhan Marigold 1 (40.64 days). Among the rooting media, the earliest flower bud initiation (37.88 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 (37.99 days) followed by M_4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (38.89 days). Maximum delay was observed for flower bud initiation planted in M_1 – soil (40.88 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 open field (Table 1), the variety Bidhan Marigold 2 recorded the maximum days for full flower opening (7.64 days) than Bidhan Marigold 1 (5.79 days). Among the rooting media, the maximum days for full flower opening (10 days) was recorded by M₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza followed by M₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (9 days) and M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (8 days). Minimum days were observed for full flower opening planted in M₁ – soil. (5 days).

3. *In situ* longevity

In open field (Table 1), the variety Bidhan Marigold 2 recorded the maximum days for *in situ* longevity (20.22 days) than Bidhan Marigold 1 (19.64 days). Among the rooting media, the maximum days for *in situ* longevity (23.26 days) was recorded by M₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (21.66 days) and M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (21.29 days). Minimum days were observed for *in situ* longevity planted in M₁ – soil (15.98 days).

4. Days taken for 50 per cent flowering

Bidhan Marigold 2 recorded the lowest number days for 50 per cent flowering (48.01 days) than Bidhan Marigold 1 (50.78 days) in open field (Table 1.1). Among the rooting media, the lowest number of days for 50 per cent flowering (47.31 days) was

recorded by M₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza followed by M₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (48.45 days) followed by M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (48.88 days). Maximum delay was observed for 50 per cent flowering planted in M₁ – soil. (50.20 days).

5. Days taken for 100 per cent flowering

Among the rooting media (Table 1.1), the earliest days for 100 per cent flowering (67.01 days) was recorded by M₈ – soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ – soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (67.27 days) followed by M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (71.67 days) in case of open field transplanted cuttings. Maximum delay was observed for 100 per cent flowering planted in M₁ – soil. (75.86 days).

6. Duration of flowering (days)

In open field (Graph 1), the variety Bidhan Marigold 1 recorded the maximum duration of flowering (30.26 days) than Bidhan Marigold 2 (26.85 days).

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 *et al.* (2011) found an improvement in flower quality and longevity in cut stems of Asiatic hybrid grown on new amendments over the traditional substrate.

7. Flower diameter (cm)

Among the rooting media, M₈–soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza (3.29 cm) at parity with M₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza (3.21 cm) and M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (3.19 cm) was recorded in open field transplanted cuttings (Graph 2).

Inoculation of bio fertilizers in plants have been known to increase the amount the auxin and cytokinin 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 open field (Table 1.1), 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 M6–soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza which was on par with M8 – soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza (11.11) and followed by M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (9.33). The lowest average weight of 10 flowers (1.51) was recorded on M1 – soil.

9. Shelf life of flowers (days)

In open field (Graph 3), the variety Bidhan Marigold 1 recorded the highest shelf life of flowers (9.62 days) than Bidhan Marigold 2 (9.59 days). Among the rooting media, the highest shelf life of flowers (9.74 days) was recorded by M8– soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza which was on par with M6–soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (9.70 days) followed by M4 – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (9.62 days). The lowest shelf life of flowers was observed for M1 – soil. (9.49 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 open field (Graph 4), the superior performance of Bidhan Marigold 1 (91.30 flowers per plant) as compared to Bidhan Marigold 2 (71.03) was observed. Among the rooting media, the maximum number of flowers per plant (110.22) was recorded by M₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v +

mycorrhiza followed by M₆ – soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (99.1) and followed by M₄–soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (85.75). The minimum number of flowers per plant (62.97) was recorded on M₁ – 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 (Table 2), the variety Bidhan Marigold 1 exhibited highest flower yield per plant (437.75) than Bidhan Marigold 2 (367.75). Among the rooting media, the highest flower yield per plant per (420) was recorded by M₈ – soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ – soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (414) and M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (414). The lowest flower yield per plant (388) was recorded on M₁ – soil.

12. Flower yield per plot (kg)

The variety (Table 2) Bidhan Marigold 1 exhibited highest flower yield per plot (15.29) than Bidhan Marigold 2 (12.87) in open field. Among the rooting media, the highest flower yield per plot (14.73) was recorded by M₈ – soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ – soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (14.49) followed by M₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (14.05). The lowest flower yield per plot (13.59) was recorded on M₁ – soil.

13. Flower yield per hectare (t/ha)

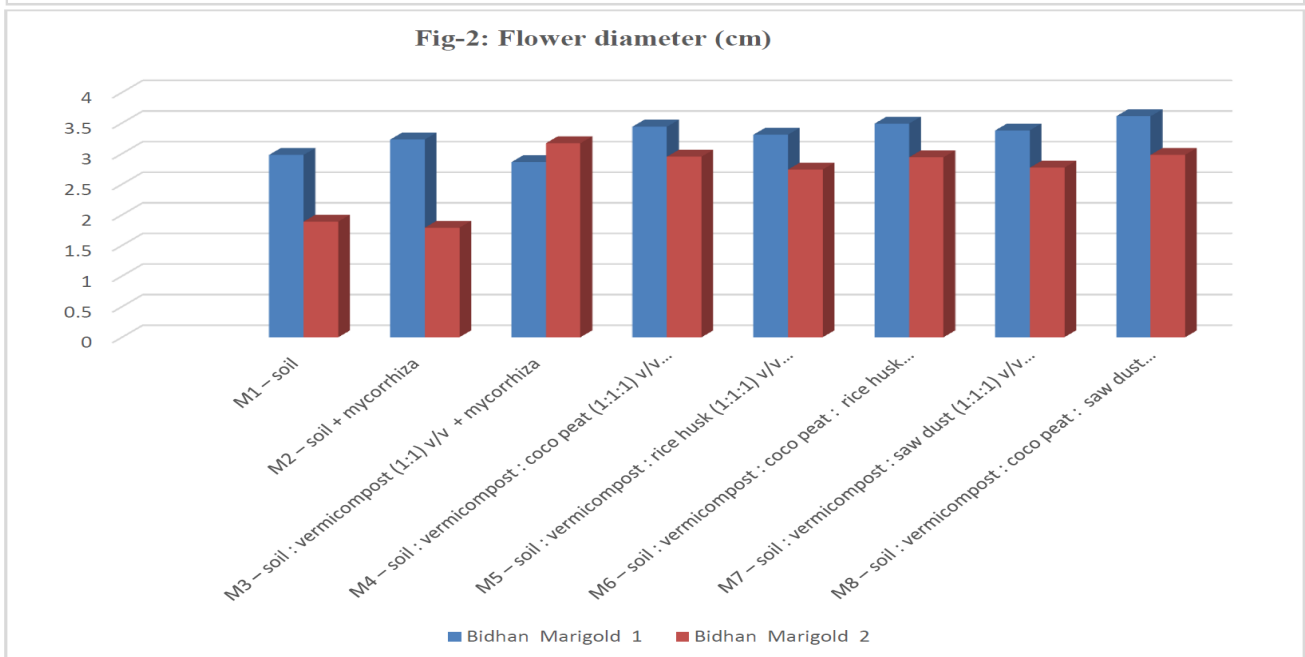
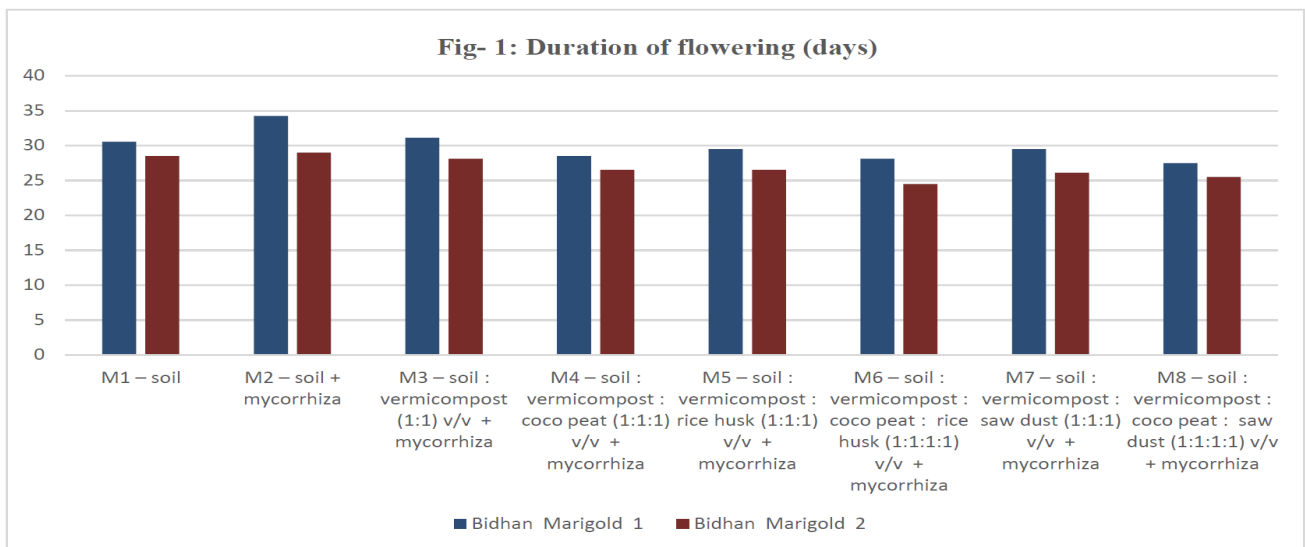
The variety (Table 2) Bidhan Marigold 1 exhibited highest flower yield per hectare (15.29 t) than Bidhan Marigold 2 (12.87 t). Among the rooting media, the highest flower yield per hectare (14.73 t) was recorded by M₈ – soil : vermicompost : coco peat : sawdust (1:1:1:1) v/v + mycorrhiza which was on par with M₆ – soil : vermicompost : coco peat : ricehusk (1:1:1:1) v/v + mycorrhiza (14.49 t) followed by M₄ –

soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza (14.05 t). The lowest flower yield per hectare (13.59 t) was recorded on M1 – 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 minimum days for full flower opening (5.79 days), maximum duration of flowering (30.26 days), highest average weight of 10 - flowers (7.18 g), highest shelf life of flowers (9.62 days), superior performance of number of flowers per plant (91.30 flowers per plant), highest flower yield per plant (437.75), flower yield per plot (15.29) and highest flower yield per hectare (15.29 t) whereas, the variety Bidhan Marigold 2 recorded the earliest flower bud initiation (37.96 days), maximum days for *in situ* longevity (20.22 days), lowest number of days for 50% flowering (48.01 days) under open field conditions of West Godavari districts of Andhra Pradesh.



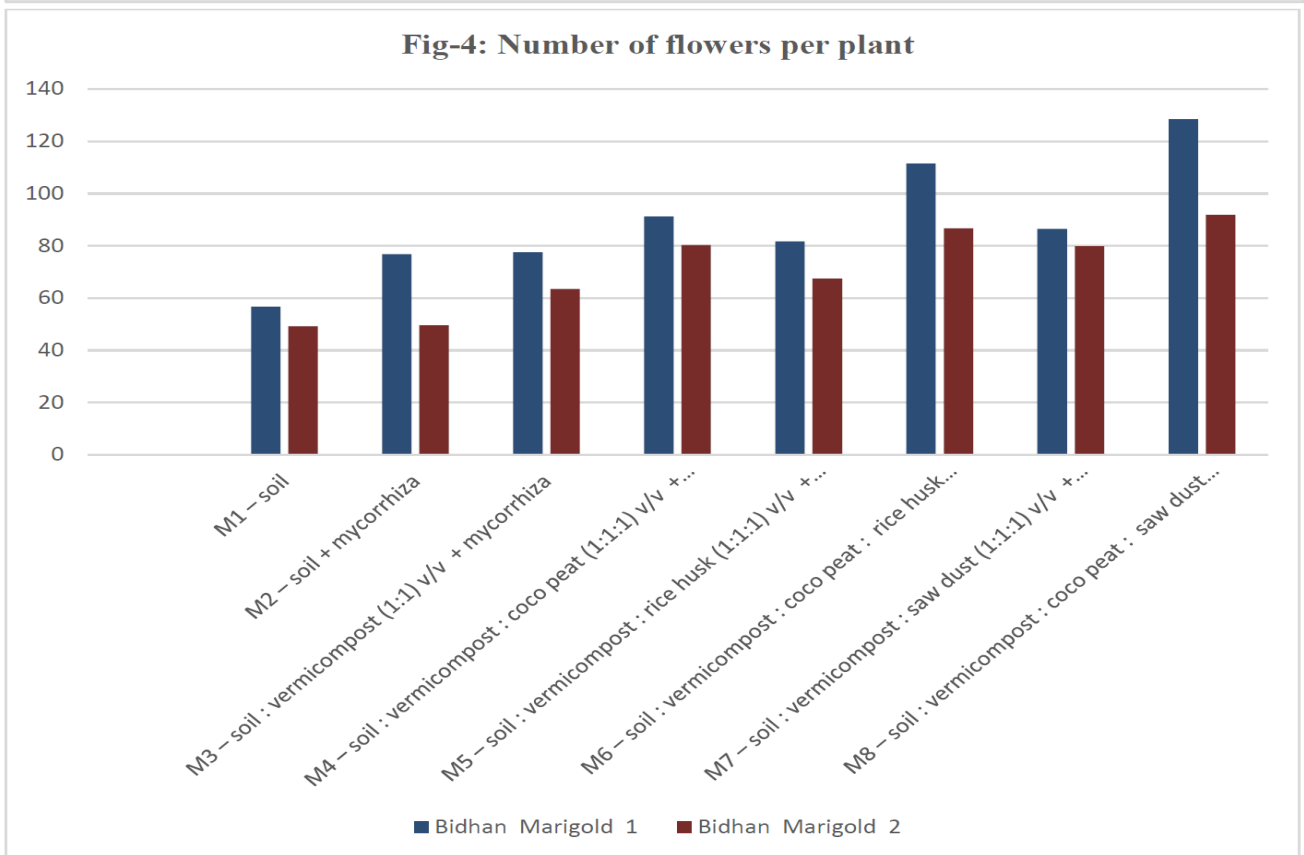
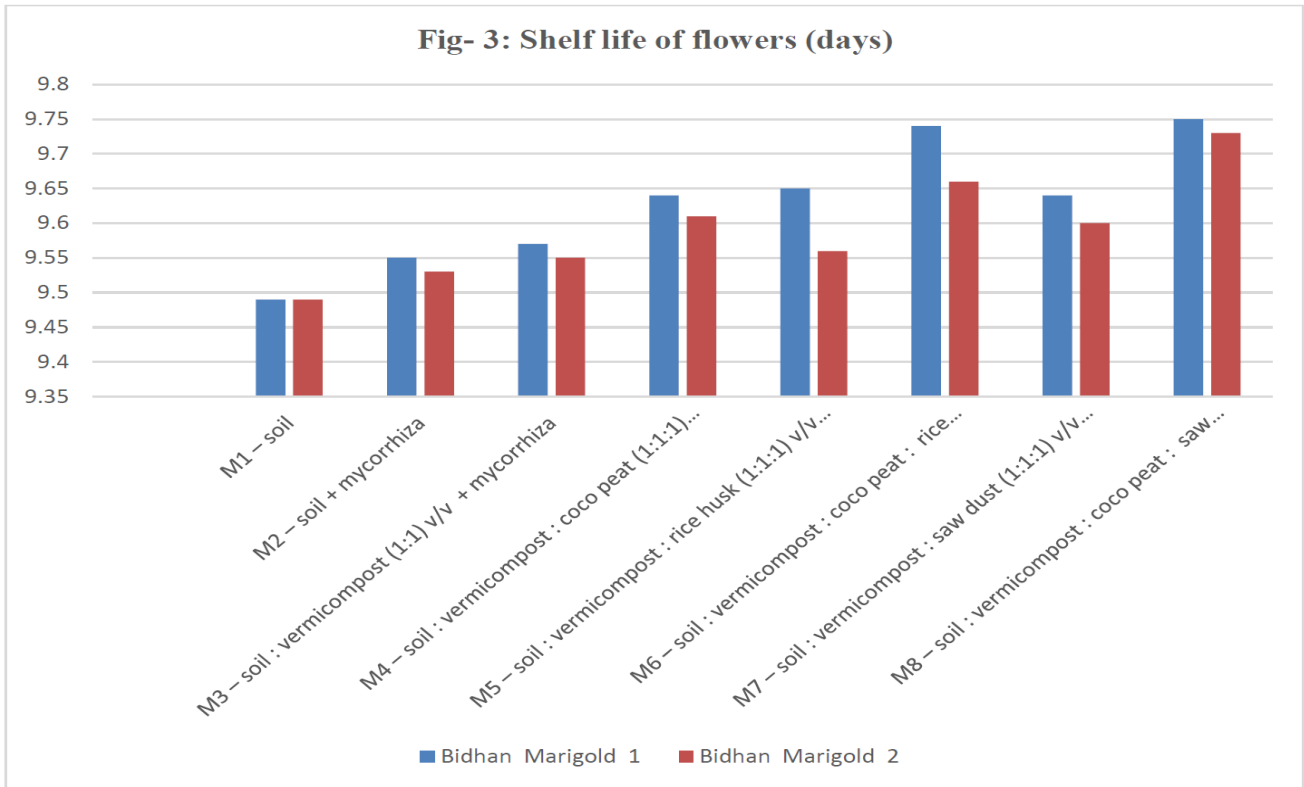


Table 1: Flower parameters as influenced by different rooting media among Bidhan Marigold varieties in open field conditions of West Godavari Districts of Andhra Pradesh

Medium \ Variety	First flower bud initiation			Days taken for full flower opening			In situ 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	41.54	40.23	40.88	5.00	5.00	5.00	15.87	16.09	15.98
M ₂ – soil + mycorrhiza	39.35	40.58	39.96	4.00	7.00	5.50	16.45	15.95	16.20
M ₃ – soil : vermicompost (1:1) v/v + mycorrhiza	41.24	38.57	39.90	6.00	6.00	6.00	16.87	17.09	16.98
M ₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	40.24	37.54	38.89	6.50	9.50	8.00	21.12	21.45	21.29
M ₅ – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	42.54	37.25	39.89	6.00	8.00	7.00	16.85	17.27	17.06
M ₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	39.24	36.53	37.88	9.00	9.00	9.00	21.47	21.85	21.66
M ₇ – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	40.54	37.54	39.04	5.00	10.00	7.50	17.87	18.09	17.98
M ₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	40.47	35.51	37.99	10.00	10.00	10.00	22.85	23.67	23.26
Mean	40.64	37.96	39.30	5.79	7.64	6.71	19.64	20.22	18.80
Factor	S Em+		CD at 5%	S Em+		CD at 5%	S Em+		CD at 5%
Variety (V)	0.63		1.85	0.35		1.55	0.37		1.66
Medium (M)	0.20		0.61	0.87		3.84	1.19		5.26
V x M	0.49		1.44	1.04		4.63	1.34		5.95

Table 1.1: Flower parameters as influenced by different rooting media among Bidhan Marigold varieties in open field conditions of West Godavari Districts of Andhra Pradesh

Medium \ Variety	Days taken for 50% flowering			Days taken for 100% flowering			Weight of 10 – fresh flowers (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	51.15	49.25	50.20	76.21	75.51	75.86	1.48	1.55	1.51
M ₂ – soil + mycorrhiza	51.24	49.05	50.14	75.01	75.54	75.27	4.51	2.99	3.75
M ₃ – soil : vermicompost (1:1) v/v + mycorrhiza	51.24	48.05	49.64	75.02	74.05	74.53	4.29	3.78	4.03
M ₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	49.54	48.22	48.88	72.31	71.03	71.67	8.82	9.85	9.33
M ₅ – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	50.75	48.35	49.55	74.02	73.11	73.56	7.72	5.23	6.47
M ₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	49.55	47.35	48.45	68.54	66.01	67.27	13.81	10.43	12.12
M ₇ – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	50.55	48.15	49.35	73.21	72.08	72.64	4.05	6.91	5.48
M ₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	48.92	45.71	47.31	67.51	66.51	67.01	11.15	11.08	11.11
Mean	50.78	48.01	49.39	72.72	71.73	72.22	7.18	6.66	6.92
Factor	S Em+		CD at 5%	S Em+		CD at 5%	S Em+		CD at 5%
Variety (V)	0.65		1.91	0.23		0.69	0.12		0.35
Medium (M)	0.20		0.59	0.68		2.00	0.70		2.05
V x M	0.43		1.28	0.84		2.46	0.88		2.58

Table 2: Yield parameters as influenced by different rooting media among Bidhan Marigold varieties in open field conditions of West Godavari Districts of Andhra Pradesh

Medium Variety	Flower yield per plant (g)			Flower yield per plot (kg)			Flower yield per hectare (t/ha)		
	Bidhan arigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean	Bidhan Marigold 1	Bidhan Marigold 2	Mean
M ₁ – soil	417	360	388	14.59	12.60	13.59	14.59	12.60	13.59
M ₂ – soil + mycorrhiza	435	351	393	15.22	12.28	13.75	15.22	12.28	13.75
M ₃ – soil : vermicompost (1:1) v/v + mycorrhiza	430	357	393	15.05	12.51	13.78	15.05	12.51	13.78
M ₄ – soil : vermicompost : coco peat (1:1:1) v/v + mycorrhiza	448	380	414	14.87	13.23	14.05	14.87	13.23	14.05
M ₅ – soil : vermicompost : rice husk (1:1:1) v/v + mycorrhiza	440	353	396	15.40	12.37	13.88	15.40	12.37	13.88
M ₆ – soil : vermicompost : coco peat : rice husk (1:1:1:1) v/v + mycorrhiza	451	378	414	15.68	13.31	14.49	15.68	13.31	14.49
M ₇ – soil : vermicompost : saw dust (1:1:1) v/v + mycorrhiza	425	378	401	15.57	13.23	14.40	15.57	13.23	14.40
M ₈ – soil : vermicompost : coco peat : saw dust (1:1:1:1) v/v + mycorrhiza	456	385	420	15.97	13.49	14.73	15.97	13.49	14.73
Mean	437.75	367.75	402.75	15.29	12.87	14.08	15.29	12.87	14.20
Factor	S Em+		CD at 5%	S Em+		CD at 5%	S Em+		CD at 5%
Variety (V)	16.49		48.39	56.99		16.71	31.09		90.74
Medium (M)	2.39		7.02	81.95		24.03	10.24		29.90
V x M	9.62		28.21	33.20		97.40	26.56		77.54

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