Original Research Article

Influence of growing media on growth and yield of Marigold (Tagetes Erecta (L.)) under Protected Environment

Abstract

A field experiment was conducted at Agricultural Engineering College and Research Institute, Kumulur, Trichy to study the effect of different growing media (Experimental plot Soil, Soil + Sawdust (2:1) and Soil + Coirpith (2:1)) with three level of irrigation (120 % ETc, 100% ETc and 75% ETc) with three replication on the yield and water use efficiency. Among the treatments Soil + Coirpith (2:1) 100% ETc (T_8) was found superior to all other treatment combination in producing higher yield of marigold flower. Maximum yield was recorded with treatment T_8 which was 27 % higher than the treatment T_2. Similarly highest water usage efficiency was recorded in T_8 (948.65 $kg.ha^{-1}mm^{-1}$). Therefore the study concluded that, the soil + coirpith (2:1) at 100 % ETc would be best growing media as well as optimal irrigation level for growing marigold crop under greenhouse without causing any stress in irrigation and negative effects in plant growth parameters.

Keyword: *Growing media, Irrigation Level, Yield, Water Usage Efficiency, Greenhouse.*

1. Introduction

Today Marigold (Tagetes erecta (L.)) seems to have gained the cultural status of one of the world's most commercially valuable flowers. It accounts for over half of the nation's loose flower production in the Indian subcontinent, used to make garlands, beautification, religious offerings, social functions, and other purposes. Marigold has an advantage over loose flowers in vogue from the point of view of commercial marketing and revenue generation, followed by chrysanthemum, jasmine, tuberose, crossandra and barlery (Bhattacharjee, 2003). It is widely grown for its exquisite blooms, natural dye extraction and essential oils and it has therapeutic qualities. Also marigold is used by physicians to heal and cure basic diseases as part of herbal therapies. The juice obtained from the leaves is used to soothe wounds, carbuncles and earache (Raghava and Saxena, 2001). Therefore, all the above applications today are not only grown as an ornamental cut flower and a landscaped greenery plant but are also commercially grown as an important source of carotenoid pigments. The predominant pigment in flowers is xanthophyll, which accounts for 80-90 per cent of lutein in total. For the poultry industry, marigold carotenoids are the main source of pigment as a feed additive for intensifying the yellow color of egg yolks, broiler skin (Scott *et al.,* 1968). The main demand for marigold today comes from the recent trend towards the use of natural dyes throughout the world. Today's advertising campaigns run by companies ranging from multinational companies to small units stress the fact that natural colors are used on their fabrics as these natural dyes offer several advantages over

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synthetic dyes from the health point of view, safety and eco-friendly in nature (Gurumallesh Prabhu and Raja, 1998). Presently, in India the commercial extraction of marigold carotenoids were carried out in Cochin (Kerala), Hyderabad (Andhra Pradesh), Satyamangalam forest (Tamil Nadu) and Bangalore (Karnataka). It is being regularly exported to Mexico, Peru, USA, Japan, Spain, Romania, Netherlands, Turkey, Poland, Italy, Australia, Canada, Africa etc. In addition to that, cultivation of marigolds (Tagetesspp.) as a rotational crop or in mixed cropping systems for the control of root-knot. (Ploeg 2002, Marahatta 2010) The cultivation of marigold consistently resulted in a yield increase 50% and lowered root-galling of subsequently grown tomato. Yield increases after cultivation of marigolds in root-knot nematode infested soil include 38% in capsicum pepper (Zavaleta-Mejia et al.,1993), 98% in beans (Ijani et al., 2000), and 34% in tomato (Bünte and Müller 1996). Therefore the research was carried out to evaluate the performance of growing media on growth and yield of Marigold under Protected Environment.

2. Methodology

The experiment was carried out in a naturally ventilated greenhouse field of Department of Soil and Water Conservation Engineering, Agricultural Engineering College and Research Institute, Kumulur, Trichy during 2017. The experiment was laid out in a split plot design with three replications, consisting of nine treatments i.e., T_1 - 125% of ETc for sandy loam soil, T_2 - 100% of ETc for sandy loam soil, T_3 -75% of ETc for sandy loam soil, T_4 - 125% of ETc for soil + sawdust (2:1), T_5 - 100% of ETc for soil + sawdust (2:1), T_6 -75% of ETc for soil + sawdust (2:1), T_7 - 125% of ETc for soil + coirpith (2:1), T_8 - 100% of ETc for soil + coirpith (2:1), T_9 -75% of ETc for soil + coirpith (2:1). The plot size of experiment was 4.50 m^2 where plants were arranged in row to row and plant to plant spacing of 60 and 45 cm respectively. For the study marigold hybrid maxima yellow F1 was selected and the seeds were sown in plastics plug tray in the mist chamber to get healthy and disease free seedlings of marigold. The observation were recorded on the traits viz, plant height, stem girth, number of branches, plant spread, total flower yield per plant, days to flower bud appear and days to flower bud opening were observed. Flower yield per hectare and water use efficiency were determined. Plant height, stem girth, number of branches and plant spread were measured on 30, 60 and 90 day after transplanting (DAT). Observations were recorded on 5 plants chosen at random in each replication. The data pertaining to the present investigation were statistical analyzed using the standard procedures of the Split Plot Design. The treatment effects were tested at 5% level of significance.

3. Result and Discussion

Plants under soil + coirpith at 100% ETc (T_8) took lesser number of days (28.66 days) to appear flower bud whereas the longest day (34.33 days) was recorded in the treatment T_3 - soil at 75% ETc (Table 1). Lesser number of day (34.33 and 34 days) to flower bud open was observed in the treatments soil + coirpith at 125% ETc and 100% ETc (T_7 & T_8) respectively, whereas the longest day was recorded in soil at 75% ETc (T_3) 41.66 days. Results were similar to Parvej *et al*., (2010) that the microclimate variability inside the polyhouse favoured the growth and development of tomato plant by increased plant height, number of branches plant-1, rate of leaf area expansion and leaf area index over the plants grown in open field. Flowering, fruit setting and fruit maturity in the polyhouse were advanced by about 3, 4 and 5 days, respectively as against the crop grown in open field condition.

Table 1: Effect of growing media on No. of days to flower bud appear and open in different treatments

Treatment	No. of days to flower bud appearance, Days	No. of days to flower bud open, Days
T_1	33.33	38.66
T_2	32.00	38.00
T_3	34.33	41.66
T_4	31.00	37.33
T_5	30.00	36.33
T_6	34.33	39.66
T_7	29.33	34.33
T_8	28.66	34.00
T_9	30.33	35.00
SED	0.38	0.16
CD (0.05)	0.65	0.69

Significantly in 30 days after transplanting highest plant height (40.33 cm), stem girth (2.06 cm), plant spread (24.7 cm), no. of branches per plant (20.33 nos.) was observed in soil + coirpith at 100% ETc (T_8) and lowest plant height (28.60 cm), stem girth (1.13 cm), plant spread (16.33 cm), no. of branches per plant (12.33 nos.) were recorded in the treatment T_3 (Soil at 75% ETc) tabulated in table 2. Similarly same trends were observed in all other observation days (60 and 90 DAT).

Table 2: Effect of growing media on plant height (cm), stem girth (cm), Plant spread (cm) and no. of branches per plant of marigold in the greenhouse

	Plant Height (cm)			Stem girth (cm)			Plant spread (cm)			No. of branches per plant		
Treatments	**30 DAT**	**60 DAT**	**90 DAT**	**30 DAT**	**60 DAT**	**90 DAT**	**30 DAT**	**60 DAT**	**90 DAT**	**30 DAT**	**60 DAT**	**90 DAT**
T_1	32.26	41.50	51.90	1.30	2.06	2.40	18.76	23.53	27.36	13.00	17.66	23.00
T_2	34.83	42.90	51.96	1.43	2.16	2.50	20.90	24.90	28.26	14.33	19.00	23.66
T_3	28.60	35.96	46.76	1.13	1.83	2.06	16.33	22.76	25.13	12.33	16.33	19.33
T_4	34.86	44.80	54.36	1.63	2.33	2.63	21.10	25.20	29.53	14.66	20.66	26.00
T_5	35.33	46.20	55.20	1.66	2.33	2.70	21.30	26.16	30.26	15.66	22.00	27.00
T_6	30.76	38.53	47.83	1.23	1.93	2.23	18.60	24.00	28.23	13.33	17.33	21.00
T_7	37.96	48.63	59.00	1.90	2.50	2.96	23.53	27.16	31.93	17.66	24.66	29.66
T_8	40.33	50.73	61.76	2.06	2.80	3.20	24.70	28.83	33.60	20.33	26.00	31.33
T_9	36.33	35.70	57.30	1.80	2.43	2.93	22.90	26.40	31.66	17.00	23.00	29.00
SED	0.08	0.03	0.28	0.00	0.01	0.00	0.15	0.23	0.12	0.03	0.09	0.16
CD (0.05)	0.34	0.14	1.21	0.01	0.05	0.00	0.67	1.01	0.55	0.15	0.421	0.73

Similar results were found by Hashem *et al.,* (2010) that use of white net as greenhouse cover optimized growth and yield of cucumber plant. Moreover, the treatment recorded significantly higher vegetative growth (plant height, number of leaves, total leaves area, and dry weights) and increased yields. The highest vegetative growth was obtained by 100% ETo, as compared to 80% and 120% ETo, respectively. The interaction among water treatment and greenhouse was also significant under white net cover with 100% ETo.

Soil + Coirpith at 100% ETc (T_8) produced the highest flower yield per plant of 1.21 kg whereas the lowest value recorded was 0.75 kg in the treatment T_3 (Soil at 75% ETc) shown in table 3. Results are similar to Anant *et al.,*(2006) that the effect of irrigation levels on growth and yield in tomato is maximum in terms of number of fruits, fruit weight, fruit yield (3.99 kg $plant^{-1}$) and marketable fruit yield (63.83 t ha^{-1}) when irrigation was scheduled at 100 per cent ETo.

Hence, the highest and lowest irrigation water usage efficiency was recorded in T_8 (948.65 $kg.ha^{-1}mm^{-1}$) and T_1 (231.98 $kg.ha^{-1}mm^{-1}$). These results were in agreement with those obtained by Abdrabbo *et al.,* (2009). Yield obtained with 100% applied irrigation level was higher than 120% and 80 % irrigation relative. This result is due to adequate moisture availability in the soil which might have increased various physiological processes, better plant nutrient uptake, higher rates of photosynthesis, which might reflect on more number of fruits and higher fruit weight. The level of 120% ETo had the lowest WUE during the two studied seasons followed by 100 % ETo & 80% ETo.

Table 3: Flower yield, $kg.ha^{-1}$ and water use efficiency, $kg.ha^{-1}mm^{-1}$ in different treatments

Treatments	Yield/plant, kg	Yield, $kg.ha^{-1}$	ETc, mm	WUE, $kg.ha^{-1}mm^{-1}$
T_1	0.83	46111	198.77	231.98
T_2	0.88	48888	159.01	307.45
T_3	0.75	41666	123.04	338.64
T_4	0.94	52222	112.58	463.86
T_5	0.98	54444	90.06	604.53
T_6	0.82	45555	67.55	674.39
T_7	1.10	61111	101.08	604.58
T_8	1.21	67222	70.86	948.65
T_9	1.05	58333	65.65	888.54

Crop grown under treatment T_8 uptake 55 % reduced water when compared with T_2 (Soil 100% ETc). Similar results were found by Lorenzo *et al.,* (2006) that greenhouse shading improved the quality of tomato and increased yield of cucumber, moreover it

reduced crop transpiration and thus water uptake, and improved water use efficiency by 47% and 62% for the tomato and cucumber crops.

4. Conclusion

Based upon present results, it can be concluded that use of growing media significantly increased the growth, yield and yield contributing characters in marigold under the protected environment. Plants under soil + coirpith 100% ETc had higher yield and water use efficiency, these results might be due to adequate moisture availability in the soil which might have increased various physiological processes, better plant nutrient uptake and higher rates of photosynthesis, which might reflect on higher flower weight.

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