International Journal of Humanities
and Social Sciences (IJHSS)
ISSN(P): 2319-393X; ISSN(E): 2319-3948
Vol. 5, Issue 1, Dec-Jan 2016, 39-44

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

GROWTH CHARACTERS AS EFFECTED BY ORGANIC, INORGANIC AND BIOFERTILIZER IN AFRICAN MARIGOLD

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ABSTRACT

A field experiment was conducted during the year 2011-2013 with the objectives of studying the influence of different sources of nutrient that comprised of organic inorganic and biofertilizer on stem girth and plant spread in African marigold cv. Sirakole. The experiment was laid out in Randomized Block Design which consisted of 15 treatments, each replicated thrice during Kharif, Rabi and Summer season. The results of the study revealed that various nutrient management practices had significant influence on growth characters in all three seasons. Stem girth and number of branches of plants was highest in the plants supplied with 25% organic and 75% inorganic fertilizer along with biofertilizers in kharif season and desirable in rabiseason. Pooled over the seasons indicated that plants receiving nutrient combination of poultrymanure (25%RDN)+ 75% RDʻNPʼ + biofertilizers exhibited highest stem girth and number of branches of plants in rabi season.

KEYWORDS: Integrated Nutrient Management, Kharif Season, Summer Season, Vermicompost, Poultry Manure, Recommended Dose of Fertiilizer

INTRODUCTION

Marigold is one of the commercially exploited flower crops that belong to the family Asteraceae and genus Tagetes. Marigold, which is also known as “Tagetes” is of Indian origin, although it appears that its natural home is Mexico, compared to other flowering annuals, marigold is easily adaptable to various conditions of growing and has fairly good keeping quality. It is propagated by seeds and comes up well in all types of soil. It is a hardy annual plant and attains more than 150 cm height within its life span of four to four and half months. The flowers of these species are generally large in size with bright shades, ranging from yellow to orange and are the best for combination in any flower arrangement. Marigold is grown for cut flowers, making garlands, decoration during pooja and several religious functions, besides its use in landscape gardening.

Marigold is a heavy feeder of nutrients, at present these nutrients are supplied through chemical fertilizers. The indiscriminate and continuous use of chemical fertilizers in intensive cropping system has led to an imbalance of nutrients in soil which has an adverse effect on soil health and affecting the seed yield. Therefore, integrated use of nutrients is the need of the hour. The use of organic manures like farm yard manure and vermicompost along with balanced use of chemical fertilizers improves the physico-chemical properties of soil besides increasing the efficiency of applied fertilizers.

MATERIALS AND METHODS

The present experiment was conducted in marigold for two consecutive cropping and three growing season (Kharif, Rabi and Summer) at the Krishi Vigyan Kendra farm , Jajpur of OUAT, Bhubaneswar during the period 2011-12 and 2012-13.The experiment was laid out in randomized block design with pooled over the season with three replications. Fifteen treatments combinations comprising Recommended dose of fertilizer (RDF), Vermicompost (VC), Poultrymanure (PM) and Biofertilizer (BF) were used in the experiment. The detail of the treatments are : T_1 - Control, T_2 - RDF, T_3 - PM(25% RDN) +75% RDʻNP' , T_4 -VC(25% RDN) +75% RDʻNP' , T_5 - BF + 75% RDʻNP', T_6 - PM (50% RDN) +50% RDʻNP' , T_7 - VC (50% RDN) +50% RDʻNP' , T_8 – VC (25% RDN) +BF + 75% RDʻNP' , T_9 - PM (25% RDN) + BF+75% RDʻNP' , T_{10} - PM(12.5% RDN) +VC (12.5% RDN) +75% RDʻNP' , T_{11} - PM(12.5% RDN) +VC (12.5% RDN)+ BF+75% RDʻNP' , T_{12} - PM (50% RDN) + BF +50% RDʻNP' , T_{13} – VC(50% RDN) + BF+50% RDʻNP' , T_{14} - PM(25% RDN) +VC(25% RDN) +50% RDʻNP' , T_{15} - PM (25% RDN) +VC (25% RDN)+ BF +50% RDʻNP'. Well decomposed farm yard manure (FYM) @ 25t / ha was thoroughly incorporated in all the experimental plots during the final land preparation. Vermicompost and Poultry manure were applied at 20 days prior to transplanting and biofertilizers like *Azospirillum* and phosphate solubilizing bacteria were applied at 10 kg/ha at the time of transplanting after well decomposed with FYM as per the treatment .The recommended dose of chemical fertilizers at the rate of 200 kg N and 200 kg P2O5 per hectare were also applied as per the treatment schedule along with a common dose of 200 kg K2O to all the experimental plot except T1. Data on stem girth and number of primary branches were taken from 5 plants in every plot. Stem girth and number of primary branches were observed after 30 DAT, 60 DAT,90 DAT and 120 DAT. The data were complied properly and analyzed statistically.

RESULT AND DISCUSSIONS

Influence of integrated nutrient management practices on stem girth in marigold at different stages of growth in different seasons is depicted in Table 1. It was observed that at 30 DAT and 60 DAT stem girth in marigold was not significantly influenced by various nutrient treatments either during kharif or rabi season but significant influence of treatments on stem girth was visible during summer season. It was maximum under T_3 (poultry manure (25% RDN) + 75% RDʻNP'). On the other hand, minimum value was recorded under control. However, Pooled analysis of data revealed no significant variation in stem girth due to various treatments. However, T_3 recorded the maximum while T_1 recorded the minimum value among various treatments tried.

Similarly no significant variation was noticed in stem girth due to effect of seasons. Nevertheless plants in kharif season exhibited maximum thickness, whereas summer plants had minimum value for the same. Interaction of treatment with season was also not found significant with respect to this parameter. However, T_4 in kharif season recorded maximum stem girth while T_1 in summer had the minimum value for the same.

It was observed from the Table 1.that various nutrient management practices in different seasons influenced the stem girth of the plant significantly at 90 DAT and 120 DAT. During kharif season highest stem girth was recorded in T_{11} which differed significantly from other treatments. In rabi and summer season maximum was also recorded in T_{11}. The lowest value was recorded in control i.e. T_1 which differed significantly from other treatments during rabi season.

Application of 75 % of RDʻNP' in combination with poultry manure, vermicompost and biofertilizer (T_{11}) recorded maximum stem girth in kharif, rabi and summer seasons in plants of marigold which was significantly superior in

kharif season over all other treatments. However, it was statistically comparable with T_9 (75% RDʻNP' + poultry manure + biofertilizer, T_8 (75% RDʻNP'+ vermicompost + biofertilizer) in rabi season. It was seen from the data that 75% RDʻNP' was optimum to increase the stem girth to maximum level when combined with poultry manure, vermicompost and biofertilizer which proved the usefulness of biofertilizer. Stem girth recorded under T_9 was comparable with T_8 but slightly higher as poultry manure in combination with biofertilizer was more effective than vermicompost with biofertilizer. Similar findings have also been reported by Sharma *et al*. (2010) in china aster. On the other hand, the untreated control (T_1) recorded the minimum stem girth among all the treatments tried under three seasons.

The number of primary branches produced per plant did not show any significant variation due to various levels of nutrients applied in any of the growing seasons at 30 and 60 DAT (Table 2). However, pooled analysis over season indicated that significant variation in branch number was observed due to various nutrient management practices during the above mentioned period. Maximum number of branches per plant was recorded in T_3 at 30 and 60 DAT Many of treatments were statistically comparable to each other except control, which recorded the lowest value of at 30 and 60 days respectively.

At 90 DAT significant difference in number of primary branches due to various treatments was observed during summer season. The highest number recorded was in T_{11} and the lowest number in untreated plants. Pooled analysis of data over season showed T_{11} having maximum number of branches followed by T_9,T_8 and T_{15} without having significant variation from each other. On the other hand, the lowest number was recorded in control.

At 120 DAT significant difference in number of primary branches due to various treatments was observed during rabi season. The highest number was recorded in T_{11} during kharif, rabi and summer season, while the lowest number was recorded in control. During this rabi season T_{11} was statistically comparable with T_9,T_8 , and T_{15} ,while T_1 was minimum.

The branches are the skeletal structure of the plant and these were significantly influenced by varying sources of nutrients tried. The application of 75 per cent RDNP, poultry manure, vermicompost along with *Azospirillum* and PSB together (T_{11}) again proved to be the best among various treatments so far as production of primary branches were concerned and it was followed by T_9 which received 75 % RDNP along with poultry manure and biofertilizer in kharif, rabi and summer season. This could be attributed to better flow of various micro and macronutrients along with plant growth substances into the plant system in the plots applied with *Azospirillum* and PSB along with both poultry manure, vermicompost and inorganic fertilizers, which might have favoured for stimulation and production of auxiliary buds resulting in formation of more number of branches. The above results also corroborate the findings of Sashikanta in marigold (2005), Pandey in chrysanthemum (2010) , Gayathri and Anubrani (2011) in glory lily and Mishra and Jain (2014) in *A. panniculata*. On the other hand, plants under T_1 produced minimum number of branches, which was comparable with T_2 (RDF). Production of maximum number of branches per plant under T_{11} could be explained by the activities of the bioinoculants *viz*., nitrogen fixation and release of P from insoluble phosphate, production of phyto hormones, etc. with simultaneous uptake of nutrients.

The result indicated that stem girth in marigold was significantly influenced by different planting seasons. It was found significantly thicker plant under kharif planting followed by rabi. On the other hand, significantly thiner plants were produced under summer planting. For the plants under kharif and rabi planting, the growing conditions were more or less similar and favourable while prevalence of higher temperature coupled with high rate of evapo-transpiration during the growth period (March - April) of summer planted crop probably did not allow the plants to grow thicker.

Similar trend was also observed with respect to number of primary branches. It was more in kharif planting followed by rabi planting. However, number of primary branches in kharif was significantly superior to rabi planting. On the other hand, it was minimum under summer planting which differed significantly from other planting season.Favourable growing condition with mild temperature, higher relative humidity and low rate of evapotranspiration prevailing during the growth period of kharif and rabi season planted crop might have resulted in better vegetative growth, whereas, higher temperature coupled with high rate of evapotranspiration during growth period might have become unfavourable for summer planted crop, which resulted in poor vegetative growth of plants.

Effect of planting time on vegetative growth characters of marigold cv. African yellow has been reported by Mohanty *et al.* (1993) and Samantaray *et al.* (1999), who observed that significantly greater plant height, plant spread and number of primary and secondary branches as well as stem thickness either under May or July planting. However, they found no significant difference with respect to above growth parameters under November and January planting.

It was concluded that integrated nutrient management practices involving chemical fertilizers, poultry manure, vermicompost and biofertilizers significantly influenced growth and flowering in marigold cv. Sirakole. Stem girth and number of branches per plant were significantly improved due to application of 75% RDN‘P’ i.e. 150 kg N. 150 kg P/ha in combination with 200 kg potash, vermicompost (12.5 % RDN), poultry manure (25% RDN), FYM (25 t/ha) and biofertilizers @ 10 kg/ha (*Azospirillum* and PSB at 1:1 ratio) in rabi season.

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APPENDICES

Table 1: Effect of Different Sources of Nutrients on Stem Girth of Plants in Marigold in Three Seasons

Treatments		30 Days				60 Days				90 Days				120 Days			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
T_1	Control	0.80	0.60	0.50	0.63	1.00	0.90	0.70	0.86	1.19	1.00	0.80	0.99	1.23	1.02	0.90	1.05
T_2	Recommended dose of fertilizer	1.00	0.90	0.70	0.86	1.17	1.01	1.00	1.05	1.27	1.12	1.00	1.13	1.29	1.20	1.14	1.21
T_3	Poultry manure (25% RDN) + 75% RD'NP'	1.17	1.10	1.00	1.09	1.33	1.23	1.23	1.26	1.34	1.31	1.29	1.31	1.38	1.37	1.31	1.35
T_4	Vermicompost (25% RDN) + 75% RD'NP'	1.19	1.11	0.96	1.08	1.34	1.21	1.21	1.25	1.36	1.29	1.24	1.29	1.41	1.31	1.25	1.32
T_5	Biofertilizer + 75% RD'NP'	1.01	0.70	0.74	0.81	1.07	0.97	0.81	0.97	1.15	1.09	1.10	1.08	1.15	1.17	1.12	1.15
T_6	Poultry manure (50% RDN) + 50% RD'NP'	1.05	0.80	0.82	0.89	1.15	0.93	0.92	1.00	1.16	1.15	1.12	1.14	1.28	1.25	1.12	1.22
T_7	Vermicompost (50% RDN) + 50% RD'NP'	1.06	0.80	0.79	0.88	1.15	1.00	0.91	1.02	1.19	1.18	1.10	1.15	1.25	1.19	1.13	1.19
T_8	Vermicompost (25% RDN) + Biofertilizer + 75% RD'NP'	1.09	0.98	0.85	0.97	1.23	1.19	1.20	1.20	1.72	1.48	1.33	1.51	1.81	1.69	1.38	1.63
T_9	Poultry manure (25% RDN) + Biofertilizer + 75% RD'NP'	1.13	0.89	0.83	0.95	1.29	1.19	1.11	1.19	1.79	1.56	1.39	1.58	1.85	1.71	1.41	1.66
T_{10}	Poultry manure (12.5% RDN) + Vermicompot (12.5% RDN) + 75% RD'NP'	1.11	0.87	0.88	0.95	1.27	1.20	1.13	1.20	1.58	1.61	1.35	1.51	1.71	1.63	1.41	1.59
T_{11}	Poultry manure (12.5% RDN) + Vermicompost (12.5% RDN) + Biofertilizer + 75% RD'NP'	1.15	1.01	0.79	0.98	1.31	1.20	1.20	1.23	2.02	1.67	1.47	1.72	2.13	1.83	1.53	1.83
T_{12}	Poultry manure (50% RDN) + Biofertilizer + 50% RD'NP'	1.07	0.93	0.65	0.88	1.19	0.98	0.83	1.00	1.32	1.39	1.28	1.33	1.59	1.45	1.31	1.45
T_{13}	Vermicompost (50% RDN) + Biofertilizer + 50% RD'NP'	1.06	0.90	0.69	0.88	1.23	0.83	0.81	0.95	1.37	1.24	1.18	1.26	1.52	1.39	1.21	1.37
T_{14}	Poultry manure (25% RDN) + Vermicompost (25% RDN) + 50% RD'NP'	1.03	0.79	0.72	0.85	1.19	0.80	0.85	0.94	1.21	1.21	1.20	1.20	1.30	1.29	1.34	1.31
T_{15}	Poultry manure (25% RDN) + Vermicompost (25% RDN) + Biofertilizer + 50% RD'NP'	1.07	0.87	0.76	0.90	1.21	0. 93	0.85	0.99	1.54	1.36	1.31	1.40	1.68	1.59	1.45	1.58
	Mean	1.06	0.88	0.77		1.21	1.03	0.98		1.40	1.31	1.21		1.51	1.41	1.27	
	SEm±	0.19	0.15	0.07		0.13	0.12	0.09		0.15	0.15	3.43		0.03	0.06	0.10	
	CD (5%)	NS	NS	0.21		NS	NS	0.27		0.39	NS	NS		0.10	0.17	0.29	
	Pooled	**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**	
	SEm±	0.13	0.08	0.14		0.10	0.11	0.06		0.08	0.08			0.01	0.02	0.04	
	CD (5%)	NS	NS	NS		NS	NS	0.19		0.30	NS	NS		0.06	0.07	NS	

Table 2: Effect of Different Sources of Nutrients on Number of Primary Branches per Plant of Marigold in Three Seasons

Treatments		30 Days				60 Days				90 Days				120 Days			
		Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean	Kharif	Rabi	Summer	Mean
T_1	Control	4.25	3.93	2.36	3.46	7.23	6.24	4.56	5.96	11.51	9.33	5.90	8.90	13.23	11.17	6.91	10.42
T_2	Recommended dose of fertilizer	7.55	7.54	5.37	6.76	12.56	12.44	7.13	10.66	15.40	15.50	8.23	13.03	17.90	17.03	9.30	14.73
T_3	Poultry manure (25% RDN) + 75% RD'NP'	10.97	9.65	6.19	8.86	16.96	15.67	8.83	13.76	18.52	17.20	9.30	15.00	20.10	19.70	10.50	16.77
T_4	Vermicompost (25% RDN) + 75% RD'NP'	10.10	9.17	5.92	8.36	15.45	15.18	8.29	12.90	17.30	16.44	9.10	14.27	19.34	18.30	10.04	15.87
T_5	Biofertilizer + 75% RD'NP'	7.51	7.15	3.20	5.93	12.43	12.26	6.58	10.36	15.55	15.10	8.11	12.90	17.70	16.90	9.20	14.60
T_6	Poultry manure (50% RDN) + 50% RD'NP'	8.43	7.34	3.11	6.26	14.40	12.57	6.71	11.20	17.22	15.80	8.30	13.77	18.90	17.91	9.71	15.50
T_7	Vermicompost (50% RDN) + 50% RD'NP'	7.24	7.63	3.25	6.00	13.59	12.39	6.30	10.70	16.90	15.51	8.42	13.60	18.22	17.20	9.40	14.93
T_8	Vermicompost (25% RDN) + Biofertilizer + 75% RD'NP'	9.28	9.57	5.37	8.00	18.94	14.60	7.48	13.63	21.40	20.23	11.20	17.60	23.01	22.52	12.50	19.33
T_9	Poultry manure (25% RDN) + Biofertilizer + 75% RD'NP'	9.12	8.15	5.18	7.43	14.64	14.21	7.82	12.20	21.52	20.10	11.50	17.70	23.30	22.70	12.92	19.63
T_{10}	Poultry manure (12.5% RDN) + Vermicompot (12.5% RDN) + 75% RD'NP'	9.54	7.83	4.79	7.33	13.92	13.12	6.79	11.23	20.30	19.44	11.11	16.93	22.30	21.96	12.10	18.77
T_{11}	Poultry manure (12.5% RDN) + Vermicompost (12.5% RDN) + Biofertilizer + 75% RD'NP'	9.88	8.90	5.43	8.03	15.11	14.94	8.37	12.76	22.90	21.50	13.20	19.20	25.74	23.80	14.50	21.33
T_{12}	Poultry manure (50% RDN) + Biofertilizer + 50% RD'NP'	8.80	8.21	4.50	7.16	14.70	14.38	7.11	12.03	18.55	18.20	9.41	15.37	20.90	20.82	10.93	17.53
T_{13}	Vermicompost (50% RDN) + Biofertilizer + 50% RD'NP'	8.42	8.90	4.22	7.16	15.19	12.39	6.14	11.16	18.30	19.16	9.50	15.63	20.50	20.20	10.70	17.13
T_{14}	Poultry manure (25% RDN) + Vermicompost (25% RDN) + 50% RD'NP'	8.51	7.28	4.45	6.70	12.74	12.38	5.85	10.26	17.50	16.30	9.63	14.47	19.21	18.02	9.91	15.70
T_{15}	Poultry manure (25% RDN) + Vermicompost (25% RDN) + Biofertilizer + 50% RD'NP'	9.44	9.84	4.17	7.76	14.56	11.85	6.76	11.00	20.31	20.51	10.81	17.20	22.81	21.70	11.80	18.77
	Mean	8.56	8.03	4.45		14.12	12.92	6.93		18.26	17.34	9.57		20.20	19.32	10.69	
	SEm ±	2.18	1.94	1.14		2.14	2.84	2.15		2.31	3.50	1.16		2.22	2.16	3.47	
	CD (5%)	NS	NS	NS		NS	NS	NS		NS	NS	3.37		NS	6.27	NS	
	Pooled	**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**		**Season**	**Treat**	**Tr x S**	
	SEm ±	0.58	1.04	1.81		0.99	1.54	2.67		1.03	1.81	1.68		0.33	0.97	3.14	
	CD (5%)	2.02	2.94	NS		3.45	4.33	NS		3.58	5.10	NS		1.15	2.73	NS	