Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.5456

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (1):** 1148-1153 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Yield and Benefit: Cost Ratio of African marigold Influenced by Pinching and Growth Regulator

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Received: 16.08.2017 | Revised: 20.09.2017 | Accepted: 26.09.2017

ABSTRACT

The investigation was aimed to find out the suitable combination of pinching time and foliar application gibberellic acid on African marigold during summer month at Main garden, Department of Horticulture, Dr. PDKV, Akola with two factors viz., Factor A consist of four levels of pinching (i.e. no pinching, pinching at 15 DAT, pinching at 22 DAT and pinching at 30 DAT) and factor B consist of four levels of gibberellic acid (i.e. 100 ppm, 200 ppm, 300 ppm and control) revealed that plant pinched at 15 days after transplanting recorded maximum flower yield , gross, net monetary returns with higher B:C ratio. The foliar application of gibberellic acid 300 ppm recorded maximum flower yield, gross, net monetary returns with higher B:C ratio. Among the treatment combinations pinching at 15 days after transplanting and foliar application of gibberellic acid 300 ppm recorded maximum flower yield, gross, net monetary returns with higher B:C ratio in African marigold.

Key word: *gibberellic acid, pinching, foliar application, gross, net, monitory, African marigold*

INTRODUCTION

The traditional art and modern science of growing the flower to perfection, has become an ever expanding dynamic industry in the field of agriculture particularly horticulture from the last two decades. Besides its aesthetic and religious offerings today, it is a lucrative profession with higher potential for returns. In past year flowers were not of much economic importance.

Today floriculture is recognized as a lucrative business since it has potential per unit area than most of the field crops and even horticultural crops both for domestic market and export.

Among the commercially important flowers, marigold (*Tagetes erecta* L.) a member of Asteraceae family is one of the most important annual flowers, cultivated commercially in India for garland making and religious offering purposes. It occupies special importance due to hardiness, easy culture and low pest and disease attack, wider adoptability to varied agro-climatic condition.

In India, the present area under marigold is more than 17,600 hectares with production of 2,22,000 metric tones[1]. It is cultivated almost all part of India.

Cite this article: Badge, S. and Panchbhai, D.M., Yield and Benefit: Cost Ratio of African marigold Influenced by Pinching and Growth Regulator, *Int. J. Pure App. Biosci.* **6(1):** 1148-1153 (2018). doi: http://dx.doi.org/10.18782/2320-7051.5456

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Maharastra alone occupies around 2800 hectares under cultivation. Although a recent upsurge in the cultivation of marigold is evident, large efforts towards the manipulating agrotechquies. The pinching helps to emerge side branches and produce more number of good quality uniform size flowers with higher yield[16]. Gibberellin is helpful for transformation of dwarf plants in to tall ones by increasing cell elongation. Effect of pinching by manually and using gibberellic acid was ascertained for improving the yield and economics production of African marigold during summer month. But comparative studies involving the use of pinching and gibberellic acid are scarce. Keeping these points in view the present experiment was carried out to during summer season.

MATERIAL AND METHODS

Field experiment was conducted during summer season of the year 2010-11 and 2011-12 at main garden, University Department of Horticulture, Dr. P.D.K.V., Akola which extends of $22^0$42' N attitude and $77^0$02' E longitude, 307.42 meters above mean sea level and comes under subtropical zone. During growth period mean maximum temperature (34.1^0C), minimum (13.1^0C) temperature, and relative humidity (29.75%) was recorded.

The experiment comprised with sixteen treatment combinations of factor A with four pinching times viz., P_0 - no pinching, P_1 - pinching at 15 DAT, P_2 - pinching at 22 DAT and P_3 - pinching at 30 DAT and factor B with foliar application of four concentrations of gibberellic acid viz., G_0 - control, G_1 – GA_3 100 ppm, G_2 - GA_3 200 ppm and G_3 - GA_3 300 ppm. The experiment was laid out in Factorial randomized block design with three replications.

One month old uniform and healthy seedling were transplanted in the month of January, 2011 and 2012 at the spacing of 45 cm x 30 cm. The recommended dose of fertilizers ($N:P_20_5:K_20$ @ 100:50:25 kg ha^{-1}) were applied in the form of urea, single supper phosphate and muriate of potash. Full dose of single supper phosphate and muriate of potash and half dose of urea was applied at the time of transplanting and remaining half dose of urea was applied one month after transplanting.

Regarding pinching treatments, 4-5 cm terminal portion of growing tip was nipped out as per treatment time i.e. 15, 22 and 30 days after transplanting. Hand atomizer was used to spray the gibberellic acid. The foliar application of gibberellic acid was applied through two sprays, first spray was done on 15 day and second spray was applied 30 days after transplanting as per treatment concentration. Observations yield parameters were recorded. Also the economic was worked out. The statistical analysis was carried out to know the variance for each parameters and effect of treatments using standard procedure.

RESULTS AND DISCUSSION

Effect of pinching:

Fresh weight of flower (table 1) was recorded significantly maximum (7.58, 7.22 and pooled mean7.40g respectively) in no pinching treatment followed by pinching at 15 and 22 days after transplant treatment. Minimum weight of flower (6.47, 6.05 and pooled mean 6.26g respectively) was recorded at 30 days after transplanting treatment during both the year and pooled mean too. This might be due to efficient utilization of the biomass for limited number of flowers produced in the un pinched plant. These results are in line with the finding of Srivastava *et al*.[14], Khandelwal *et al*.[4], in marigold

The perusal of data of two years regarding yield parameters presented in table 1 revealed that, number of flower $plant^{-1}$ (31.10, 34.10 and pooled mean 32.60, respectively), yield $plant^{-1}$ (228.30, 235.31 and pooled mean 231.80g respectively) and yield of $hectare^{-1}$ (16.90, 17.43 and pooled mean17.16 t, respectively) was registered under the treatment pinching at 15 DAT followed by pinching at 22 DAT and pinching at 30 DAT. Whereas, minimum number of flower $plant^{-1}$ (24.35, 25.01 and pooled mean 24.68 respectively), yield $plant^{-1}$ (184.54, 180.55 and 182.55 g, respectively) and $hectare^{-1}$

(13.66, 13.37 and pooled mean 13.51 t, respectively) were recorded in no pinching treatment. This might be due to pinching remove the apical dominance which may help to produce more number of auxiliary shoot and vigorous branching which might have favored the production of maximum number of better quality flower. The results are in agreements with Pushkar and Singh [8],in marigold who reported that pinching of marigold plant at 30 DAT was more effective for increasing yield of marigold flower.

The economics of marigold cultivation revealed from table 2 that treatment pinching at 15 days after transplanting recorded highest gross returns (Rs 171692/- ha^{-1}) and net returns (101005/- ha^{-1}) with highest benefit cost (B:C) ratio (2.42) as compared to the other pinching treatments. Whereas, no pinching treatment recorded minimum gross (Rs 135199/- ha^{-1}) and net returns (Rs 66933/- ha^{-1}) with minimum benefit cost (B:C) ratio (1.91). This might be due to the fact that, the pinching treatment had produced the maximum flower yield ha^{-1} and finally resulted into the maximum gross and net monetary returns. These results are in conformity with the findings of Maharnor *et al*. in African marigold.

Effect of Gibberellic acid

Data presented in table 1 revealed that fresh flower weight of (7.56, 7.09 and pooled mean7.32g, respectively), number of flower $plant^{-1}$ (31.74, 33.17 and pooled mean 32.45), flower yield $plant^{-1}$(239, 235.16 and pooled mean 237.55 g, respectively) and ha^{-1} (17.77, 17.41 and pooled mean 17.59 t, respectively) were registered maximum in the treatment 300 ppm gibberellic acid followed 200 and 100 ppm gibberellic acid. Whereas, minimum fresh weight of flower (6.73, 6.18 and pooled mean 6.45g, respectively), number of flower $plant^{-1}$ (24.65, 28.29 and 26.47, respectively), flower yield $plant^{-1}$(165.0, 174.81 and 170.56 g respectively) and ha^{-1} (12.28, 12.94 and 12.61 t, respectively) was recorded in control treatment. An increase in the yield of flower of $hectare^{-1}$ might be due to the fact that, gibberellic acid treated plants might have produced more vegetative growth in terms of plant height and leaf area. This might have resulted into the production and accumulation of more photosynthates which would have diverted to the sink resulting into more yield of flower yield $hectare^{-1}$ in African marigold. These results are in close conformity with the results of Ramdevputra *et al.*[13], and Ramesh Kumar *et al.*[11], in marigold.

The data from table 2 revealed that, gross returns (Rs 175946/- ha^{-1}), net returns (Rs 104422- ha^{-1}) and B:C (2.45) were obtained maximum in the treatment foliar application of gibberellic acid 300 ppm followed by the treatments foliar application of gibberellic acid 200 and 100 ppm. However, minimum gross returns (Rs 122880/- ha^{-1}), net returns (53426/- ha^{-1}) and B:C (1.81) was recorded in the control treatment. This might be due to the fact that, an application of GA_3 might have improved the yield and quality of African marigold flowers and due to this, the maximum gross and net monetary returns would have been obtained from these treatments. Similar results are recorded by Nair *et al.*[7], in gerbera and Meena *et al.*[6], in brinjal

Interaction effect:

Interaction effect of pinching and foliar application of gibberellic acid in respect of flower yield parameter was recorded non significant (table 2). However, fresh weight of flower, maximum number of flower $plant^{-1}$ flower yield $plant^{-1}$ and ha^{-1} were recorded in treatment combination pinching at 15 days after transplanting and foliar application of 300 ppm gibberellic acid.

Interaction effect of economic of marigold revealed that pinching at 15 days after transplanting and foliar application of 300 ppm gibberellic acid realized highest gross returns (Rs 204860/- ha^{-1}) and net returns (Rs 131246/- ha^{-1}) with highest B:C ratio (2.83) as compared to other treatment combinations. However, minimum gross returns (Rs 114430/- ha^{-1}) and net returns (Rs 45066/- ha^{-1}) with lowest B: C ratio (1.63) were recorded in treatment combination no pinching and no foliar application of gibberellic acid *i.e.* control (P_oG_0).

From the above results, treatment pinching at 15 days after transplanting with foliar application of gibberellic acid 300 ppm obtained the maximum yield with higher C: B ratio.

Table 1 Influenced of pinching and gibberellic acid on growth parameters in African marigold

Treatments	No. of flower plant^{-1}			Wt of flowers (g)			Flower yield plant^{-1} (g)			Flower yield ha^{-1} (t)		
Pinching Time (P)												
P_0– No pinching	24.35	25.01	24.68	7.58	7.22	7.40	184.54	180.55	182.55	13.66	13.37	13.51
P_1– Pinching at 15 DAT	31.10	34.10	32.60	7.34	6.90	7.12	228.30	235.31	231.80	16.90	17.43	17.16
P_2 – Pinching at 22 DAT	27.98	32.21	30.09	7.16	6.42	6.79	200.36	206.75	203.55	14.84	15.31	15.07
P_3- Pinching at 30 DAT	29.69	32.62	31.15	6.47	6.05	6.26	192.05	197.33	194.69	14.22	14.61	14.41
SE (m)±	0.36	0.35	0.25	0.05	0.08	0.05	2.50	2.93	1.96	0.18	0.29	0.19
CD at 5%	1.04	1.03	0.77	0.16	0.25	0.14	7.23	8.47	5.54	0.54	0.84	0.56
Gibberellic acid (G)												
G_0– Control (Water spray)	24.65	28.29	26.47	6.73	6.18	6.45	165.90	174.81	170.36	12.28	12.94	12.61
G_1– GA_3 100 ppm	26.74	29.89	28.31	6.99	6.51	6.75	186.92	194.60	190.76	13.84	14.41	14.12
G_2– GA_3 200 ppm	29.18	32.19	30.68	7.28	6.69	6.98	212.48	215.39	213.93	15.73	15.95	15.84
G_3 – GA_3 300 ppm	31.74	33.17	32.45	7.56	7.09	7.32	239.94	235.16	237.55	17.77	17.41	17.59
SE (m)±	0.36	0.35	0.25	0.05	0.08	0.05	2.506	2.935	1.962	0.18	0.29	0.19
CD at 5%	1.04	1.03	0.77	0.16	0.25	0.14	7.239	8.477	5.545	0.54	0.84	0.56
Interaction effect (A X B)												
P_0G_0	21.23	23.50	22.37	7.279	6.556	6.918	154.501	153.902	154.202	11.44	11.39	11.42
P_0G_1	22.80	24.14	23.47	7.517	7.213	7.365	171.418	174.167	172.793	12.69	12.90	12.80
P_0G_2	25.66	24.98	25.33	7.729	7.366	7.548	188.278	183.030	190.655	14.68	13.57	14.12
P_0G_3	27.33	27.22	27.28	7.833	7.753	7.793	213.990	211.133	212.562	15.84	15.63	15.74
P_1G_0	26.28	30.41	28.35	6.975	6.303	6.640	183.002	191.652	187.327	13.55	14.19	13.87
P_1G_1	29.71	34.40	32.06	7.052	6.633	6.843	209.488	226.091	217.790	15.51	16.74	16.21
P_1G_2	32.03	35.18	33.61	7.622	7.176	7.400	244.130	252.301	248.216	18.08	18.68	18.38
P_1G_3	35.77	36.22	36.00	7.731	7.486	7.609	276.578	271.228	273.903	20.48	20.08	20.28
P_2G_0	25.43	29.10	27.27	6.561	6.056	6.309	166.858	178.277	172.568	12.35	13.20	12.78
P_2G_1	26.33	30.64	28.49	7.131	6.203	6.670	187.901	192.151	190.026	13.91	14.23	14.07
P_2G_2	29.03	33.17	31.11	7.289	6.530	6.910	211.549	216.616	214.083	15.66	16.04	15.85
P_2G_3	30.70	34.38	32.54	7.671	6.910	7.291	235.164	239.179	237.572	17.41	17.77	17.59
P_3G_0	26.03	30.44	28.24	6.118	5.826	5.973	159.274	175.433	167.354	11.79	13.21	12.50
P_3G_1	28.60	32.51	30.56	6.255	6.023	6.139	178.902	185.989	182.446	13.25	13.77	13.51
P_3G_2	30.10	33.93	32.02	6.509	6.116	6.313	195.991	209.612	202.802	14.51	15.52	15.02
P_3G_3	33.36	34.97	34.17	7.014	6.240	6.627	234.036	218.298	226.168	17.33	16.16	16.74
SE (m)±	0.722	0.710	0.518	0.111	0.174	0.102	5.013	5.870	3.924	0.334	0.391	0.281
CD at 5%	-	-	-	-	-	-	-	-		-	-	-

Table 2: Economic of African marigold as influenced by pinching and gibberellic acid (Pooled mean over two year)

Treatments	Total expenditure (Rs. ha^{-1})	Yield (t/ha)	Gross return ((Rs. ha^{-1})	Net return ((Rs. ha^{-1})	Cost: Benefit Ratio
Pinching Time (P)					
P_0– No pinching	70266.50	13.51	135199.00	64933.00	1.91
P_1– Pinching at 15 DAT	70686.00	17.16	171692.00	101005.00	2.42
P_2 – Pinching at 22 DAT	70686.00	15.07	150768.00	80082.00	2.21
P_3- Pinching at 30 DAT	70686.00	14.41	144181.00	75434.00	2.03
Gibberellic acid (G)					
G_0– Control (Water spray)	69454.00	12.61	126159.00	56705.00	1.81
G_1– GA_3 100 ppm	70424.00	14.12	141281.00	70857.00	2.00
G_2– GA_3 200 ppm	70921.00	15.84	158454.00	87533.00	2.22
G_3 – GA_3 300 ppm	71524.00	17.59	175946.00	104422.00	2.45
Interaction effect (P X G)					
P_0G_0	69139.00	11.42	114205.00	45066.00	1.63
P_0G_1	70109.00	12.80	127950.00	57841.00	1.82
P_0G_2	70609.00	14.12	141205.00	70596.00	1.99
P_0G_3	71209.00	15.74	157436.00	86226.00	2.20
P_1G_0	69559.00	13.87	138740.00	69181.00	2.00
P_1G_1	70529.00	16.21	161305.00	90776.00	2.28
P_1G_2	71029.00	18.38	183845.00	112816.00	2.58
P_1G_3	71629.00	20.28	202875.00	131246.00	2.83
P_2G_0	69559.00	12.78	127805.00	58246.00	1.83
P_2G_1	70529.00	14.07	140745.00	70216.00	1.99
P_2G_2	71029.00	15.85	158560.00	87531.00	2.22
P_2G_3	71629.00	17.59	175960.00	104331.00	2.45
P_3G_0	69559.00	12.50	123885.00	54326.00	1.77
P_3G_1	70529.00	13.51	135120.00	64591.00	1.91
P_3G_2	71019.00	15.02	150205.00	79186.00	2.11
P_3G_3	71629.00	16.74	167510.00	95881.00	2.33

Note: Urea- Rs 7 /- per kg, SSP-Rs 7 per kg, MOP- Rs16/- per kg , cost of GA_3 _Rs120 g^{-1},
Labor charges- Rs.120/- daySelling price : Rs 1000/- per qt.

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