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EFFECT OF PHOSPHORUS AND POTASSIUM ON SEED QUALITY AND SEED YIELD OF AFRICAN MARIGOLD

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ABSTRACT

An experiment to study the effect of phosphorus and potassium on seed quality and seed yield of African marigold was carried out at Horticulture Section, College of Agriculture, Nagpur, during January 2013 to May 2013 with sixteen treatment combinations in factorial randomized block design. The treatments comprised of four levels each of phosphorus and potassium @, 0, 25, 50 and 75 kg ha^{-1}. 100 kg ha^{-1} of nitrogen was applied as a common dose for all the treatments and phosphorus and potassium were applied as per the treatments. The results of present investigation revealed that, individual application of 75 kg ha^{-1} each of phosphorus and potassium produced significantly maximum longevity of intact flower, weight of seed flower^{-1} and test weight of seed with respect to quality parameters and maximum number of seeds flower^{-1}, seed yield plant^{-1}, seed yield plot^{-1} and seed yield hectare^{-1} with respect to seed yield parameters. Combined application of treatment 75 kg ha^{-1} phosphorus and 75 kg ha^{-1} potassium had given better seed quality and more seed yield than other treatments . The interaction effects were also significant with respect to number of seeds flower^{-1} and seed yield plant^{-1}, plot^{-1} and hectare^{-1}. For these parameters the best treatment combination was 75 kg P ha^{-1} + 75 kg K ha^{-1} it was followed by 75 kg P ha^{-1} + 50 kg K ha^{-1} and 50 kg P ha^{-1} + 75 kg K ha^{-1}.

(Key words: African marigold, phosphorus, potassium, longevity of flower, seed quality, seed yield)

INTRODUCTION

The total area under floriculture crops in India was around 191 thousand hectare with the production of 1031 thousand metric tonnes of loose flowers and 69027 lakh number of cut flowers (Anonymous, 2012).

In India Marigold is one of the most commonly grown flowers and used extensively on religious and social functions in different forms. Marigold is native of Central and South America especially Mexico and it belongs to family 'Asteraceae'. The African marigold (*Tagets erecta* L.) is hardy annual, about 90 cm tall, erect and produces branches. The florets, single to fully double, are of large size with globular heads. The flower colour varies from lemon yellow or yellow, golden yellow or orange. Because of its size, shape and colour, the African marigold is popular among the people.

Among the chemical fertilizers, phosphorus and potassium are the important fertilizers which are essential for the growth and flowering of marigold. Phosphorus has a great role in energy storage and transfer. Phosphorus is a constituent of nucleic acid, phytin and phospho –lipids, it is important component of seed and it promotes early flowering and good quality of the plants (Das, 2009). Potassium helps in formation of proteins and chlorophyll which are important for photosynthesis and it increases the quality of flower (Das, 2009). In marigold, these fertilizers can also manipulate seed quality and seed yield of the plant. Hence, in order to find out the optimum doses of phosphorus and potassium fertilizers under Nagpur conditions for enhanced flower longevity, seed quality and seed yield, the present investigation was under taken.

MATERIALS AND METHODS

The present investigation was carried out at Horticulture section, College of Agriculture Nagpur during January 2013 to May 2013 to study the effect of phosphorus and potassium on growth and flowering of African Marigold. The research was carried out on the variety African double orange. Sixteen treatment combinations with four levels of phosphorus (0, 25, 50 and 75 kg ha^{-1}) and four levels of potassium (0, 25, 50 and 75 kg ha^{-1}) were tested in factorial randomized block design with three replications. The seeds of marigold were sown in the nursery beds in the month of December. Marigold seedlings of uniform size were transplanted 30 days after sowing at the spacing of 45 cm x 30 cm in the month of January, 2013. Half of the recommended dose of 100 kg N ha^{-1} and full doses of phosphorus and potassium were supplied as per the treatments and were applied at the time of transplanting. The remaining 50 kg N ha^{-1} was applied at 30 days after transplanting. Package of practices including irrigation were adopted as per recommendation.

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Five plants were selected randomly from each plot for recording various seed quality parameters *viz*., longevity of intact flower, weight of seed flower and test weight of seed and seed yield parameters like number of seeds flower^{-1}, seed yield plant^{-1}, seed yield plot^{-1} and seed yield hectare^{-1}. Data were statistically analysed in FRBD (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

The data presented in table 1 revealed that, different levels of phosphorus and potassium had significant effect on all quality and seed yield parameters of African marigold .

Seed quality parameters

Significantly highest longevity of intact flower (14.12 days), weight of seeds flower^{-1} (1.24 g) and test weight of seed (4.34 g) were recorded at higher level of phosphorus i.e. 75 kg P ha^{-1} which was found at par with the treatment 50 kg P ha^{-1} (13.66 days, 1.18 g and 4.17 g respectively). This might be due to increase in uptake of nutrients. Phosphorus is a constituent of many energy rich compounds in plants and also involved in active root growth and helps in uptake of other nutrients resulting in increased quality of plant product. Whereas, application of 0 kg P ha^{-1} had resulted in significantly minimum longevity of intact flower (9.80 days), weight of seeds flower^{-1} (0.80 g), and test weight of seed (3.23 g). These results are in close conformity with the results of Swaroop *et al*. (2007) who reported that the weight of the seeds flower^{-1} and 1000 seed weight were maximum with the application of phosphorus at 75 kg hectare^{-1} in marigold.

With respect to potassium the treatment 75 kg K ha^{-1} had provided significantly maximum longevity of intact flower (13.54 days). Maximum weight of seeds flower^{-1} (1.20 g) and test weight of seed (4.21 g) was also recorded in the same treatment which was at par with the treatment 50 kg K ha^{-1} (13.01 days, 1.12 g and 4.06 g respectively), This increase in quality parameters might be due to the effect of potassium, as potassium is involved in synthesis of peptide bond and protein and carbohydrate metabolism and also participates in rapid cell division and differentiation.Whereas, application of 0 kg K ha^{-1} had significantly minimum longevity of intact flower (10.71 days), weight of seeds flower^{-1} (0.91 g) and test weight of seed (3.42 g). These results are in close conformity with the results of Gnyandev (2006) who reported increase in 1000 seed weight and germination percentage with the application of higher dose of fertilizer i,e.150 kg K ha^{-1} in China aster.

The interaction effect due to phosphorus and potassium on seed quality parameters like longevity of intact flower, weight of seeds flower^{-1} and test weight of seed were found to be non significant.

Seed yield parameters

The seed yield parameters like number of seeds flower^{-1} (310.55), seed yield plant^{-1} (10.10 g), seed yield plot^{-1} (202.16 g) and seed yield hectare^{-1} (7.50 q) were found maximum with the individual application of 75 kg P ha^{-1} which was found at par with the treatment 50 kg P ha^{-1} (299.79, 9.56 g, 191.11 g and 7.08 q respectively). This might be due to abundant availability of phosphates in the rooting medium, which is constituent of certain nucleic acids in the plant and plays important role in seed formation. Whereas, application of 0 kg P ha^{-1} had produced significantly minimum number of seeds flower^{-1} (230.45), seed yield plant^{-1} (6.16 g), seed yield plot^{-1} (121.10 g) and seed yield hectare^{-1} (4.51 q). The results were in close conformity with the findings of Swaroop *et al*. (2007) who reported that the seed yield flower^{-1} and plant^{-1} and 1000 seed weight were maximum with phosphorus 75 kg hectare^{-1} in marigold.

Among the different levels of potassium applied, significantly maximum number of seeds flower^{-1} (301.37), seed yield plant^{-1} (9.75 g), seed yield plot^{-1} (194.90 g) and seed yield hectare^{-1} (7.24 q) were found with the individual application of 75 kg K ha^{-1} which was found at par with the treatment 50 kg K ha^{-1} (290.31,9.17 g, 183.26 g and 6.79 q respectively). This might be due to the increased supply of potassium which plays important role in protein synthesis and enhances the maturity of plant parts. Whereas, application of 0 kg K ha^{-1} had produced significantly minimum number of seeds flower^{-1} (245.58), seed yield plant^{-1} (6.75 g), seed yield plot^{-1} (132.95 g) and seed yield hectare^{-1} (4.94 q). These results are in close conformity with Pal and Gosh (2010) who had obtained maximum seed yield plant^{-1} and seed yield hectare^{-1} with the application of 200 kg K hectare^{-1} .

Table 1. Effect of phosphorus and potassium on seed quality and seed yield parameters of African marigold

Treatments	Longevity of Intact flower (days)	Weight of seeds flower^{-1} (g)	Test weight of seed (g)	Number of seeds flower^{-1}	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	Seed yield hectare (q)
Phosphorus							
P_1 – 0 kg P ha^{-1}	9.80	0.80	3.23	230.45	6.16	121.10	4.51
P_2 – 25 kg P ha^{-1}	11.68	1.01	3.66	263.91	7.95	158.80	5.90
P_3 – 50 kg P ha^{-1}	13.66	1.18	4.17	299.79	9.56	191.11	7.08
P_4 – 75 kg P ha^{-1}	14.12	1.24	4.34	310.55	10.10	202.16	7.50
SE (m) ±	0.14	0.01	0.07	1.56	0.19	3.11	0.13
CD (P= 0.05)	0.40	0.04	0.20	4.51	0.55	8.98	0.39
Potassium							
K_1 – 0 kg K ha^{-1}	10.71	0.91	3.42	245.58	6.75	132.95	4.94
K_2 – 25 kg K ha^{-1}	12.00	1.00	3.71	267.44	8.10	162.06	6.01
K_3 – 50 kg K ha^{-1}	13.01	1.12	4.06	290.31	9.17	183.26	6.79
K_4 – 75 kg K ha^{-1}	13.54	1.20	4.21	301.37	9.75	194.90	7.24
SE (m) ±	0.14	0.01	0.07	1.56	0.19	3.11	0.13
CD (P= 0.05)	0.40	0.04	0.20	4.51	0.55	8.98	0.39
Interaction effect							
P x K							
SE (m) ±	0.28	0.03	0.14	3.13	0.38	6.23	0.27
CD (P= 0.05)	–	–	–	9.03	1.11	17.97	0.78

Table 2. Interaction effect of phosphorus and potassium on seed yield parameters of African marigold

Treatment combinations	Number of seeds flower^{-1}	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	Seed yield hectare^{-1} (q)
0 kg P ha^{-1} + 0 kg K ha^{-1}	215.68	5.28	97.20	3.69
0 kg P ha^{-1} + 25 kg K ha^{-1}	226.22	5.96	119.27	4.44
0 kg P ha^{-1} + 50 kg K ha^{-1}	235.94	6.64	132.38	4.92
0 kg P ha^{-1} + 75 kg K ha^{-1}	243.95	6.78	135.53	5.01
25 kg P ha^{-1} + 0 kg K ha^{-1}	230.72	6.10	121.93	4.51
25 kg P ha^{-1} + 25 kg K ha^{-1}	256.95	7.13	142.53	5.28
25 kg P ha^{-1} + 50 kg K ha^{-1}	275.54	8.77	175.47	6.49
25 kg P ha^{-1} + 75 kg K ha^{-1}	292.44	9.79	195.26	7.30
50 kg P ha^{-1} + 0 kg K ha^{-1}	270.28	8.13	162.53	6.02
50 kg P ha^{-1} + 25 kg K ha^{-1}	283.24	9.27	185.23	6.86
50 kg P ha^{-1} + 50 kg K ha^{-1}	317.92	10.14	202.87	7.51
50 kg P ha^{-1} + 75 kg K ha^{-1}	327.74	10.69	213.80	7.91
75 kg P ha^{-1} + 0 kg K ha^{-1}	265.66	7.51	150.13	5.56
75 kg P ha^{-1} + 25 kg K ha^{-1}	303.34	10.06	201.20	7.45
75 kg P ha^{-1} + 50 kg K ha^{-1}	331.86	11.10	222.32	8.25
75 kg P ha^{-1} + 75 kg K ha^{-1}	341.35	11.75	235.00	8.73
Interaction effect				
P x K				
SE (m) ±	3.13	0.38	6.23	0.27
CD (P= 0.05)	9.03	1.11	17.97	0.78

The interaction effect due to phosphorus and potassium on seed yield parameters like number of seeds flower^{-1}, seed yield plant^{-1}, seed yield plot^{-1} and seed yield hectare^{-1} were found significant. The interaction effect of phosphorus and potassium on number of seeds flower^{-1} revealed that maximum and significantly more value (341.45) was obtained under the treatment combination of 75 kg P ha^{-1} + 75 kg K ha^{-1}. It was followed by 75 kg P ha^{-1} + 50 kg K ha^{-1} and 50 kg P ha^{-1} + 75 kg K ha^{-1} and were at par with each other and significantly superior over rest of the treatment combinations. With respect to seed yield plant^{-1}, the maximum seed yield plant^{-1} was obtained under the treatment combination of 75 kg P ha^{-1} + 75 kg K ha^{-1} followed by 75 kg P ha^{-1} + 50 kg K ha^{-1} and 50 kg P ha^{-1}+ 75 kg K ha^{-1}, all the three being at par but significantly superior over rest of the treatment combinations. As far as seed yield plot^{-1} and seed yield hectare^{-1} is concerned, the maximum yield was recorded in the treatment combination 75 kg P ha^{-1} + 75 kg K ha^{-1}. It was followed by 75 kg P ha^{-1} + 50 kg K ha^{-1} being at par with each other. The later treatment was at par with 50 kg P ha^{-1} + 75 kg K ha^{-1} and significantly superior over rest of the treatment combinations.

From the study and given data it can be inferred that, application of 75 kg ha^{-1} each of phosphorus and potassium improved the seed quality and yield parameters of African marigold.

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