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Megha B Nirgulkar
PG Student of Soil Science and Agricultural Chemistry, College of Agriculture, Nagpur, Maharashtra, India

VP Babhulkar
Assistant Professor, College of Agriculture, Gadchiroli, Maharashtra, India

N Sanjuna Reddy
PG Student of Soil Science and Agricultural Chemistry, College of Agriculture, Nagpur, Maharashtra, India

Kajal D Bhoyar
Research Scholar, Soil Science and Agricultural Chemistry, College of Agriculture, Nagpur, Maharashtra, India

Corresponding Author:
Megha B Nirgulkar
PG Student of Soil Science and Agricultural Chemistry, College of Agriculture, Nagpur, Maharashtra, India

Effect of nitrogen and phosphorus on quality parameter and uptake of NPK by African marigold

Megha B Nirgulkar, VP Babhulkar, N Sanjuna Reddy and Kajal D Bhoyar

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Abstract
This research was conducted to investigate the Effect of nitrogen and phosphorus on quality parameter and uptake of NPK by African marigold, during '*Kharif*' season 2019-2020 at Horticulture Section, College of Agriculture, Nagpur. The fertilizers applied as per the treatments to evaluate the quality parameters and uptake of nitrogen, phosphorus and potassium by African marigold flower and plant. The experiment was laid out in factorial randomized block design with sixteen treatment with replicate thrice. The treatments comprised of four levels of nitrogen *viz.* N_1 -0 kg ha^{-1}, N_2 -80 kg ha^{-1}, N_3 -100 kg ha^{-1}, N_4 -120 kg ha^{-1} and four levels of phosphorus *viz.* P_1 -0 kg ha^{-1}, P_2- 40 kg ha^{-1}, P_3 -50 kg ha^{-1}, P_4-60 kg ha^{-1}. The maximum test weight and germination% were significantly found superior with the treatment combination of N_3P_3 (100 kg N ha^{-1} with 50 kg P ha^{-1}). In respect of uptake of NPK by African marigold flower and plant increased with individual application of N_3 (100 kg N ha^{-1}) and P_3 (50 kg P ha^{-1}) and also improved significantly with the combined application of N_3P_3 (100 kg N ha^{-1} with 50 kg P ha^{-1}).

Keywords: African marigold, nitrogen, phosphorus, potassium, uptake

Introduction
African marigold is one of the important and popular commercial flowers grown mainly for making garlands, other decorative purposes and also used for religious offering, pharmaceuticals, foods supplement and coloring agent for cosmetics. Marigold is large consumer of macronutrients but nutrients become deficient in soil due to intensive cultivation and inappropriate farming practices which results in low yield of plant and aborted seeds therefore, at present essential nutrients are provided through chemical fertilizers. The use of these fertilizers improves physical and chemical properties of soil in terms of productivity and thus, gives better results for plant seed yield. Seed is basic and initial source for flower production. The most crucial issue is to supply good quality seed to growers for producing better seeds physically and genetically that can be preserved from harvest to next sowing season.

Nitrogen plays a vital role in metabolic activities of plants. It is one of the very important major plant nutrients which directly affect the plant growth and flowering behaviour. It is constituent of nucleic acid, protoplasm and might have increased carbohydrates synthesis, amino acid etc. from which the phyto-harmones like auxins, gibberellins and cytokines have been synthesizes resulting plant growth (Verma and Kumar 2018) [12], whereas, phosphorus has very important role in energy storage or structural integrity. It plays a vital role in photosynthesis, respiration, energy storage and cell division. It promotes early root formation and growth. Phosphorus improves the quality of flower. It stimulating early flowering (Kumar., 2015) [5]. Suitable combination of fertilizers consequently leading to increase vegetative growth, production of healthy plants having maximum number of shoots and leaves which have a good effect on quality flower and seed production.

Material and Methods
The present investigation was carried out to study the effect of nitrogen and phosphorus on quality parameter and uptake of NPK by African marigold during '*kharif*' season 2019-2020 at

Horticulture Section, College of Agriculture, Nagpur (20° 10' N and 79° 19' E, 321.26 m above MSL). Nagpur is characterized by hot, dry summer and fairly cold winter. The area shows wide fluctuation of temperature. The soil of experimental site was medium black in colour with good drainage.

The research was carried out on variety African double orange. Sixteen treatment combinations with four levels of nitrogen 0, 80, 100, 120 kg ha^{-1} and phosphorus 0, 40, 50 and 60 kg ha^{-1} were tested in factorial randomized block design with three replications. The different combinations of nitrogen and phosphorus as: T1 – 0 kg N ha^{-1} + 0 kg P ha^{-1} (N_1P_1), T2 – 0 kg N ha^{-1} + 40 kg P ha^{-1} (N_1P_2), T3 – 0 kg N ha^{-1} + 50 kg P ha^{-1} (N_1P_3), T4 – 0 kg N ha^{-1} + 60 kg P ha^{-1} (N_1P_4), T5 – 80 kg N ha^{-1} + 0 kg P ha^{-1} (N_2P_1), T6 – 80 kg N ha^{-1} + 40 kg P ha^{-1} (N_2P_2), T7 – 80 kg N ha^{-1} + 50 kg P ha^{-1} (N_2P_3), T8 – 80 kg N ha^{-1} + 60 kg P ha^{-1} (N_2P_4), T9 – 100 kg N ha^{-1} + 0 kg P ha^{-1} (N_3P_1), T10 –100 kg N ha^{-1} + 40 kg P ha^{-1} (N_3P_2), T11 –100 kg N ha^{-1} + 50 kg P ha^{-1} (N_3P_3), T12 –100 kg N ha^{-1} + 60 kg P ha^{-1} (N_3P_4), T13 – 120 kg N ha^{-1} + 0 kg P ha^{-1} (N_4P_1), T14 – 120 kg N ha^{-1} + 40 kg P ha^{-1} (N_4P_2), T15 – 120 kg N ha^{-1} + 50 kg P ha^{-1} (N_4P_3) and T16 – 120 kg N ha^{-1} + 60 kg P ha^{-1} (N_4P_4). The seeds of African marigold were sown in the nursery beds in the month of July. African marigold seedlings of uniform size were transplanted 27 days after sowing at the spacing of 45 cm x 30 cm in the month of August, 2019. Half dose of nitrogen and full dose of phosphorus as per treatments were applied as a basal dose at the time of transplanting of seedlings and remaining half dose of nitrogen was given one month after transplanting and recommended dose of K were applied at the time of transplanting. Package of practices including irrigation were adopted as per recommendation.

Ten flowers plant^{-1} were selected at random for taking observations on flower quality parameters, i.e. test weight of 1000 seeds, weight of seeds flower^{-1} (g) and germination% While the plant samples were collected and analysed for calculating NPK uptake by African marigold flower and plant. Data were statistically analysed in FRBD (Panse and Sukhatme, 1967) [8].

Results and Discussion

Effect of nitrogen and Phosphorus on quality parameters

The data presented in table 1 revealed that the maximum test weight of seeds (1000 seeds) was observed in treatment (N_4) where, nitrogen applied @120 kg ha^{-1} gave (6.59 g) which was followed by the treatment (N_3) i.e. nitrogen applied @ 100 kg gave (6.21 g), also maximum weight of seeds per flower (0.217 g) was observed in treatment (N_4) where nitrogen applied @ 120 kg ha^{-1} which found at par with the treatment (N_3) i.e. nitrogen applied @ 100 kg recorded (0.199 g) ha^{-1}, whereas Maximum germination (88.65%) of seeds was observed in treatment (N_4) where nitrogen @ 120 kg ha^{-1} applied which was found at par with the treatment (N_3) i.e. application of nitrogen @ 100 kg ha^{-1} recorded (87.60%) germination. This might be due to nitrogen which helped in improving the protein synthesis and resulted in production of bolder and healthy seeds. Similar observations were also reported by Saman and Kirad, (2013) [9] that, the application of nitrogen @ 150 kg ha^{-1} recording significantly maximum test weight in calendula, Moon *et al.,* (2018) [6] reported that, the application of nitrogen @ 150 kg ha^{-1} recording significantly maximum weight of seeds flower^{-1} in gaillardia, Tembhare *et al.,* (2016) [11] reported that, the application of nitrogen @ 200 kg ha^{-1} recording significantly maximum germination per cent.

Significantly maximum test weight of seeds (6.19 g) was recorded in treatment with phosphorus 60 kg which is followed by P @ 50 kg ha^{-1} recorded (6.11 g), the effect due to application of phosphorus on weight of seeds per flower was found non significant, also maximum germination per cent (84.92%) were recorded in treatment (P_4) where phosphorus @ 60 kg ha^{-1} applied which was found at par with (P_3) i.e. application of phosphorus @ 50 kg ha^{-1} recorded (83.93%) germination. This might be due to phosphorus which is an essential part of photosynthesis, it is required for the general health, seed formation and seed development. Similar observations were also reported by Moon *et al*., (2018) [6] that, the application of phosphorus @ 75 kg ha^{-1} recorded significantly maximum test weight and germination% in gaillardia.

Table 1: Test weight (g), weight of seeds flower^{-1} and germination per cent (%) of seeds of African marigold as influenced by nitrogen and phosphorus levels

Treatments	Test weight (g)	Weight of seeds flower^{-1} (g)	Germination per cent (%)
Levels of Nitrogen (kg ha^{-1})			
N_1- 0 kg N ha^{-1}	5.19	0.187	71.03
N_2- 80 kg N ha^{-1}	6.06	0.190	84.28
N_3- 100 kg N ha^{-1}	6.21	0.199	87.60
N_4-120 kg N ha^{-1}	6.59	0.217	88.65
'F' test	Sig.	Sig.	Sig.
SE (m) ±	0.03	0.005	0.55
CD at 5%	0.09	0.015	1.60
Levels of Phosphorus (kg ha^{-1})			
P_1- 0 kg P ha^{-1}	5.81	0.181	61.83
P_2- 40 kg P ha^{-1}	5.96	0.182	78.78
P_3- 50 kg P ha^{-1}	6.11	0.182	83.93
P_4- 60 kg P ha^{-1}	6.19	0.183	84.92
'F' test	Sig.	N.S.	Sig.
SE (m) ±	0.03	0.005	0.55
CD at 5%	0.09	-	1.60
Interaction (Nitrogen X Phosphorus)			
'F' test	Sig.	N.S.	Sig.
SE (m) ±	0.07	0.013	1.36
CD at 5%	0.22	-	3.12

The data presented in table 2 revealed that the combine application of nitrogen @ 120 kg ha^{-1} with phosphorus @ 60 kg ha^{-1} recorded significantly maximum test weight (6.84 g) in (N_4P_4) which was found at par (6.64 g) with treatment (N_3P_3). i.e. application of nitrogen @ 100 kg ha^{-1} with phosphorus @ 50 kg ha^{-1}. the interaction effect due to the application of nitrogen and phosphorus levels on maximum weight of seeds per flower was statistically found non significant, also maximum germination per cent (92.76%) recorded at (N_4P_4) i.e. application of nitrogen @ 120 kg ha^{-1} with phosphorus @ 60 kg ha^{-1} which was found at par (87.63%) with treatment combination (N_3P_3). Similar observation was also reported by Saman and Kirad (2013) [9] that nitrogen 150 kg ha^{-1} and phosphorus 80 kg ha^{-1} had maximum test weight in calendula, Tembhare *et al.,* (2016) [11] reported that, the application of nitrogen @ 200 kg ha^{-1} and phosphorus @ 75 kg ha^{-1} recorded significantly maximum germination per cent of seeds.

Table 2: Interaction effect of nitrogen and phosphorus on test weight (g), weight of seeds flower^{-1} and germination per cent (%) of seed of African marigold

Treatments	Phosphorus levels														
Nitrogen levels	Test weight (g)					Weight of seeds flower^{-1} (g)					Germination per cent (%)				
	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average
N_1- 0 kg N ha^{-1}	4.72	5.13	5.44	5.47	5.19	0.166	0.169	0.183	0.186	0.187	45.33	72.00	79.70	80.10	71.03
N_2- 80 kg N ha^{-1}	5.98	6.06	6.09	6.13	6.06	0.174	0.187	0.191	0.194	0.190	65.18	78.80	85.76	88.40	84.28
N_3- 100 kg N ha^{-1}	5.14	6.17	6.64	6.72	6.21	0.178	0.186	0.193	0.198	0.199	71.41	80.22	87.63	92.44	87.60
N_4-120 kg N ha^{-1}	5.41	6.51	6.62	6.84	6.59	0.184	0.186	0.190	0.203	0.217	73.42	82.10	88.64	92.76	88.65
Average	5.81	5.96	6.11	6.19		0.181	0.182	0.182	0.183		61.83	78.78	83.93	84.92	
	Interaction (N X P)					Interaction (N X P)					Interaction (N X P)				
'F' test	Sig.					N.S.					Sig.				
SE (m) ±	0.07					0.013					1.36				
CD at 5%	0.22					-					3.12				

The data presented in table 3 revealed that significantly maximum uptake of N (27.50 kg ha^{-1}) in flower was recorded in treatment (N_4) i.e. application of 120 kg nitrogen ha^{-1} but found at par with treatment (N_3) i.e. application of 100 kg nitrogen ha^{-1} where (26.61 kg N ha^{-1}) uptake was observed, also maximum uptake of P in African marigold flower was recorded in the treatment (N_4) i.e. 120 kg nitrogen applied ha^{-1} recorded (14.03 kg ha^{-1}) P uptake which was found at par with the treatment (N_3) i.e. 100 kg nitrogen applied ha^{-1} and recorded (13.35 kg ha^{-1}) P uptake. Whereas maximum uptake of K in African marigold flower was recorded in treatment (N_4) i.e. application of 120 kg nitrogen ha^{-1} gives (23.27 kg ha^{-1}) K uptake which was found at par with treatment (N_3) i.e. application of 100 kg nitrogen ha^{-1} recorded (22.20 kg ha^{-1}) K uptake. Similar observation recorded by Joshi *et al.*, (2012) [3] that, nutrient uptake was maximum under the highest level of nitrogen 200 kg ha^{-1} and decrease in nitrogen level at 60, 90 DAS and at final harvest stage.

Significantly maximum uptake of N (21.48 kg ha^{-1}) in African marigold flower was recorded with (P_4) i.e. an application of 60 kg phosphorus ha^{-1} which was found at par by treatment (P_3) in which 50 kg P applied ha^{-1} where (20.49 kg ha^{-1}) N uptake noticed. Also, maximum uptake of P in flower was observed with the treatment (P_4) i.e. 60 kg phosphorus applied ha^{-1} recorded (13.93 kg ha^{-1}) P uptake which was found at par with the treatment (P_3) i.e. 50 kg P applied ha^{-1} recorded (13.17 kg ha^{-1}) P uptake. Significantly maximum (19.60 kg ha^{-1}) K uptake was recorded with treatment (P_4) i.e. an application of 60 kg phosphorus ha^{-1} However, found at par with treatment (P_3) i.e. application of 50 kg phosphorus ha^{-1} recorded (18.42 kg ha^{-1}) K uptake. Similar result noted by Sonawane *et al.*, (2009) [10] revealed that, application of phosphorus at 75 kg ha^{-1} had recorded maximum uptake of nitrogen, phosphorus and potassium by the china aster plant under Dapoli (Maha.) condition.

Table 3: Uptake of nitrogen, phosphorus and potassium in flower of African marigold as influenced by nitrogen and phosphorus levels

Treatments	Uptake of N by African marigold flower (kg ha^{-1})	Uptake of P by African marigold flower (kg ha^{-1})	Uptake of K by African marigold flower (kg ha^{-1})
Levels of Nitrogen (kg ha^{-1})			
N_1- 0 kg N ha^{-1}	11.36	6.16	10.51
N_2- 80 kg N ha^{-1}	21.94	11.20	16.70
N_3- 100 kg N ha^{-1}	26.61	13.35	22.20
N_4-120 kg N ha^{-1}	27.50	14.03	23.27
'F' test	Sig.	Sig.	Sig.
SE (m) ±	0.47	0.26	0.37
CD at 5%	1.37	0.75	1.08
Levels of Phosphorus (kg ha^{-1})			
P_1- 0 kg P ha^{-1}	13.12	7.31	11.30
P_2- 40 kg P ha^{-1}	17.32	9.65	15.17
P_3- 50 kg P ha^{-1}	20.49	13.17	18.42
P_4- 60 kg P ha^{-1}	21.48	13.93	19.60
'F' test	Sig.	Sig.	Sig.
SE (m) ±	0.47	0.26	0.37
CD at 5%	1.37	0.75	1.08
Interaction (Nitrogen X Phosphorus)			
'F' test	Sig.	Sig.	Sig.
SE (m) ±	1.16	0.64	0.92
CD at 5%	3.36	1.85	2.65

The data presented in table 4 revealed that the highest uptake of nitrogen in flower was observed in treatment combination (N_4P_4) i.e. application of 120 kg N ha^{-1} with 60 kg P ha^{-1} recorded (34.64 kg ha^{-1}) N uptake which was found at par with the treatment combination (N_3P_3) recorded the (32.16 kg ha^{-1}) nitrogen uptake. The highest uptake of phosphorus (17.36 kg ha^{-1}) in flower was observed under treatment combination (N_4P_4) where, application of 120 kg N ha^{-1} with 60 kg P ha^{-1} has done which found at par with treatment combinations (N_3P_3) i.e. 100 kg N ha^{-1} applied with 50 kg P ha^{-1} recorded (16.04 kg ha^{-1}) P uptake. The highest uptake of K in flower was observed under treatment combination (N_4P_4)

where, application of 120 kg N ha^{-1} with 60 kg P ha^{-1} was made and recorded the maximum K uptake (28.80 kg ha^{-1}), however found at par with treatment combinations (N_3P_3) i.e. 100 kg N ha^{-1} applied with 50 kg P ha^{-1} recorded (26.31 kg ha^{-1}) K uptake. Badole *et al*., (2015) [1] conducted an experiment on effect of N and P on nutrient uptake, yield and quality of china aster and revealed that, the combined application of nitrogen @ 200 kg ha^{-1} and phosphorus @ 75 kg ha^{-1} significant increase uptake of NPK in flower.

Table 4: Interaction effect of nitrogen and phosphorus on uptake of nitrogen, phosphorus and potassium in flower

Treatments	Phosphorus levels														
Nitrogen levels	Uptake of N by African marigold flower (kg ha^{-1})					Uptake of P by African marigold flower (kg ha^{-1})					Uptake of K by African marigold flower (kg ha^{-1})				
	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average
N_1- 0 kg N ha^{-1}	09.78	10.82	11.26	12.58	11.36	5.30	5.90	6.36	7.08	6.16	05.79	9.56	10.70	11.99	10.51
N_2- 80 kg N ha^{-1}	13.38	21.73	24.33	26.34	21.94	6.32	9.43	13.65	14.11	11.20	9.86	12.94	16.30	19.57	16.70
N_3- 100 kg N ha^{-1}	17.32	28.61	32.16	34.38	26.61	7.65	10.80	16.04	17.20	13.35	11.20	19.89	26.31	27.07	22.20
N_4-120 kg N ha^{-1}	19.03	27.12	31.23	34.64	27.50	9.96	12.48	16.63	17.36	14.03	13.18	21.64	23.46	28.80	23.27
Average	13.12	17.32	20.49	21.48		7.31	9.65	13.17	13.93		11.30	15.17	18.42	19.60	
	Interaction (N X P)					Interaction (N X P)					Interaction (N X P)				
'F' test	Sig.					Sig.					Sig.				
SE (m) ±	1.16					0.64					0.92				
CD at 5%	3.36					1.85					2.65				

The data presented in table 5 revealed that the uptake of N in plant was significantly influenced by application of different levels of nitrogen. Significantly maximum uptake of N in plant was recorded with (N_4) treatment where 120 kg nitrogen applied ha^{-1} and recorded (45.32 kg ha^{-1}) N uptake, which was found at par with the treatment (N_3) i.e. application of 100 kg nitrogen ha^{-1} recorded (42.37 kg ha^{-1}) N uptake in plant. Also, maximum uptake of P in plant was recorded with treatment (N_4) i.e. application of 120 kg nitrogen ha^{-1} which recorded (13.53 kg ha^{-1}) uptake of P which was found at par with (N_3) i.e.100 kg nitrogen ha^{-1} recorded (12.45 kg ha^{-1}) P uptake. Whereas, significantly maximum uptake of K in plant was recorded with treatment (N_4) i.e. application of 120 kg nitrogen ha^{-1} which recorded (52.18 kg ha^{-1}) uptake of K, found at par with (N_3) i.e.100 kg nitrogen ha^{-1} which recorded (51.16 kg ha^{-1}) K uptake. Similar result recorded by Joshi *et al.*, (2012) [3] reported that, nutrient uptake was maximum under the highest level of nitrogen 200 kg ha^{-1} that is gradual increase in nutrient uptake was recorded with increasing the N fertilizer rate in chrysanthemum, Badole *et al*., (2015) [1] conducted an experiment on effect of N and P on nutrient uptake, yield and quality of china aster and revealed that, the combined application of nitrogen @ 200 kg ha^{-1} and phosphorus @ 75 kg ha^{-1} significant increase uptake of NPK in plant and its total uptake.

Significantly maximum uptake of N (41.92 kg ha^{-1}) in plant was recorded with (P_4) i.e. an application of 60 kg phosphorus ha^{-1} which was found at par with (P_3) i.e. 50 kg P applied ha^{-1} recorded (40.71 kg N ha^{-1}), also significantly maximum uptake of P in plant (12.30 kg ha^{-1}) was recorded with treatment (P_4) i.e. application of 60 kg phosphorus ha^{-1} which was found at par with treatment (P_3) i.e. application of 50 kg phosphorus ha^{-1} recorded (11.91 kg ha^{-1}) P uptake. While significantly maximum uptake of K in plant was recorded with treatment (P_4) i.e. application of 60 kg phosphorus ha^{-1} which recorded (49.58 kg ha^{-1}) uptake of K, which was found at par with treatment (P_3) i.e. application of 50 kg phosphorus ha^{-1} recorded (48.79 kg ha^{-1}) uptake. Erbas *et al*., (2017) [2] conducted an experiment on effect of different phosphorus doses on nutrient concentration as well as yield and quality characteristics of lavadin and resulted that with an increase in the levels of phosphorus the N, P, K concentrations increased. Sonawane *et al.*, (2009) [10] revealed that, application of phosphorus at 75 kg ha^{-1} had recorded maximum uptake of nitrogen, phosphorus and potassium by the china aster.

Table 5: Uptake of nitrogen, phosphorus and potassium in plant of African marigold as influenced by nitrogen and phosphorus levels

Treatments	Uptake of N by African marigold plant (kg ha^{-1})	Uptake of P by African marigold plant (kg ha^{-1})	Uptake of K by African marigold plant (kg ha^{-1})
Levels of Nitrogen (kg ha^{-1})			
N_1- 0 kg N ha^{-1}	28.31	8.27	34.44
N_2- 80 kg N ha^{-1}	31.46	9.42	42.66
N_3- 100 kg N ha^{-1}	42.37	12.45	51.16
N_4-120 kg N ha^{-1}	45.32	13.53	52.18
'F' test	Sig.	Sig.	Sig.
SE (m) ±	2.13	0.40	0.51
CD at 5%	6.15	1.10	1.25
Levels of Phosphorus (kg ha^{-1})			
P_1- 0 kg P ha^{-1}	20.13	7.76	29.72
P_2- 40 kg P ha^{-1}	31.70	9.10	41.35
P_3- 50 kg P ha^{-1}	40.71	11.91	48.79
P_4- 60 kg P ha^{-1}	41.92	12.30	49.58
'F' test	Sig.	Sig.	Sig.
SE (m) ±	2.13	0.40	0.51
CD at 5%	6.15	1.10	1.25

Interaction (Nitrogen X Phosphorus)			
'F' test	Sig.	Sig.	Sig.
SE (m) ±	3.26	0.52	0.72
CD at 5%	9.30	1.50	2.31

The data presented in table 6 revealed that the combine effect (N_4P_4) i.e. addition of nitrogen @ 120 kg ha^{-1} with phosphorus @ 60 kg ha^{-1} recorded maximum uptake of nitrogen (49.02 kg ha^{-1}), found at par with treatment combination (N_3P_3) i.e. addition of nitrogen @ 100 kg ha^{-1} with phosphorus @ 50 kg ha^{-1} recorded (48.22 kg ha^{-1}) N uptake in plant. Whereas, combine effect (N_4P_4) i.e. addition of nitrogen @ 120 kg ha^{-1} with phosphorus @ 60 kg ha^{-1} recorded maximum uptake of P (14.86 kg ha^{-1}), which was found at par with treatment combination (N_3P_3) i.e. addition of nitrogen @ 100 kg ha^{-1} with phosphorus @ 50 kg ha^{-1} recorded (13.63 kg ha^{-1}) P uptake in plant. Also combine effect (N_4P_4) i.e. addition of nitrogen @ 120 kg ha^{-1} with phosphorus @ 60 kg ha^{-1} recorded maximum uptake of K (57.35 kg ha^{-1}), which found at par with treatment combination (N_3P_3) i.e. addition of nitrogen @ 100 kg ha^{-1} with phosphorus @ 50 kg ha^{-1} recorded (55.13 kg ha^{-1}) K uptake in plant. Similar result by Kareem *et al*., (2020) [4] conducted the field experiment on response of marigold (*Tagetes erecta* L.) cv. double eagle to nitrogen and phosphorous application and studied that treatment with combination 200:200 kg ha^{-1} increased in content of N and P in leaves. Badole *et al*., (2015) [1] conducted an experiment on effect of N and P on nutrient uptake, yield and quality of china aster resulted that, the combined application of nitrogen @ 200 kg ha^{-1} and phosphorus @ 75 kg ha^{-1} significant increase in uptake of NPK in flower, plant.

Table 6: Interaction effect of nitrogen and phosphorus on uptake of nitrogen, phosphorus and potassium in plant

Treatments	Phosphorus levels														
Nitrogen levels	Uptake of N by African marigold plant (kg ha^{-1})					Uptake of P by African marigold plant (kg ha^{-1})					Uptake of K by African marigold plant (kg ha^{-1})				
	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average	0 kg ha^{-1} (P_1)	40 kg ha^{-1} (P_2)	50 kg ha^{-1} (P_3)	60 kg ha^{-1} (P_4)	Average
N_1- 0 kg N ha^{-1}	11.89	17.85	28.79	29.73	28.31	5.89	8.04	9.38	9.79	8.27	25.37	33.70	34.62	39.08	34.44
N_2- 80 kg N ha^{-1}	21.04	29.90	31.95	32.98	31.46	7.31	8.91	10.52	10.94	9.42	29.97	38.56	50.96	51.15	42.66
N_3- 100 kg N ha^{-1}	25.65	32.46	48.22	48.98	42.37	8.01	9.55	13.63	13.61	12.45	30.30	43.47	55.13	56.74	51.16
N_4-120 kg N ha^{-1}	29.96	37.62	43.89	49.02	45.32	9.85	11.31	14.12	14.86	13.53	33.26	49.67	54.46	57.35	52.18
Average	20.13	31.70	40.71	41.92		7.76	9.10	11.91	12.30		29.72	41.35	48.79	49.58	
	Interaction (N X P)					Interaction (N X P)					Interaction (N X P)				
'F' test	Sig.					Sig.					Sig.				
SE (m) ±	3.26					0.52					0.72				
CD at 5%	9.30					1.50					2.31				

Conclusion

Application of nitrogen @ 100 kg ha^{-1} recorded significantly maximum test weight, weight of seed flower^{-1}, germination% and uptake of NPK by flower and plant, also application of phosphorus @ 50 kg ha^{-1} recorded significantly maximum test weight, germination% and uptake of NPK by flower and plant. While the combine application of nitrogen @ 100 kg ha^{-1} with phosphorus @ 50 kg ha^{-1} improve the quality parameter i.e., test weight and germination%. While uptake NPK by African marigold flower and plant improved significantly with the combined application of nitrogen @100 kg N ha^{-1} with phosphorus @50 kg P ha^{-1}.

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