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EFFECT OF GRADED LEVELS OF NITROGEN AND PHOSPHORUS ON UPTAKE AND YIELD IN GARLAND CHRYSANTHEMUM (*Chrysanthemum coronarium* L.)

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ABSTRACT
Total uptake of nitrogen by garland chrysanthemum was found maximum by the application of nitrogen at 150 kg ha^{-1} and phosphorus at 100 kg ha^{-1} individually and also in combination. The studies on individual plant parts like leaf, stem and flower was also in favour of the above dose in both *kharif* and *rabi* seasons. The uptake of phosphorus was highest by the application of nitrogen at 150 kg ha^{-1} and phosphorus at 100 kg ha^{-1} individually and also in combination. Trend in the individual plant parts followed the same. The combination of nitrogen at 150 kg ha^{-1} and phosphorus at 100 kg ha^{-1} was found at par with nitrogen at 200 kg ha^{-1} and phosphorus at 100 kg ha^{-1}. In case of nitrogen uptake this treatment combination was significantly superior to the combination of nitrogen at 150 kg ha^{-1} and phosphorus at 150 kg ha^{-1} whereas, in case of phosphorus uptake the difference was not significant.

KEYWORDS: Garland chrysanthemum, Graded levels, Uptake and Yield.

INTRODUCTION

Attention towards floriculture and ornamental horticulture has been increasing in the modern India with the improvement in living standards. Aesthetic sense in human being led him to search for several plant species with beautiful flowers / foliage and in general attractive appearance. Flowers like roses, chrysanthemums, carnations, jasmine, gladiolus, anthuriums and orchids were established as commercial flowers and their production technology has become sophisticated. In the recent past, few flowers like golden rod, gaillardia, daisy, *desi* rose and annual chrysanthemum become additions to traditional Indian floriculture in limited areas, requiring increasing attention by research and development system in the country. It is necessary to develop adaptive technology for such crops, so that they are cultivated economically with higher returns. Garland chrysanthemum, botanically known as *Chrysanthemum coronarium* L., is an annual under the chrysanthemum group of flowers. It is different from plurannual or florist chrysanthemum in many aspects. The crop is relatively short durated and less photosensitive; thus capable of coming up throughout the year. It is more hardy, vigorous and grows taller. Its flowers are in various shades of yellow, white, having single or double forms (Desai, 1962). They are hermaphrodite. The plant is self-fertile and seed propagated. In India, the crop has been naturalized and locally called 'Bijli' in Nagpur (Meshram *et al.,* 2008), 'Baboona' in Haryana (Mishra *et al.,* 2002) 'Guldhak' in Punjab, 'Market' in Delhi and 'Gendi' in Uttar Pradesh area (Arora, 1990).

MATERIAL AND METHODS

The present study was carried out at Floriculture unit of Main Agricultural Research Station, Department of Horticulture, University of Agricultural Sciences, Dharwad, during the years 2007-2009. The objective of study was to evaluate the effect of graded levels of nitrogen and phosphorus on yield and quality parameters of garland chrysanthemum (*C. coronarium* L.). The experimental area had a medium red soil having sandy clay texture with a pH of 7.2. The soil is moderately fertile. There were 16 treatments consisting of 4 levels each of Nitrogen *viz.,* $\mathbf{N_0}$ (0 kg ha^{-1}), $\mathbf{N_1}$ (100 kg ha^{-1}), $\mathbf{N_2}$ (150 kg ha^{-1}) and $\mathbf{N_3}$ (200 kg ha^{-1}) and Phosphorous *viz.,* $\mathbf{P_0}$ (0 kg ha^{-1}), $\mathbf{P_1}$ (100 kg ha^{-1}), $\mathbf{P_2}$ (150 kg ha^{-1}) and $\mathbf{P_3}$ (200 kg ha^{-1}) with a constant level of Potassium (100 kg ha^{-1}). The experiment was laid out in 4^2 factorial randomized block design with three replications. The gross plot size was 3.0 x 2.1 m and the net plot size was 2.7 x 1.8 m. The spacing adopted was 30 cm both between rows and plants within a row.

The fertilizers *viz.,* urea for nitrogen, single super phosphate for phosphorous and muriate of potash for potassium were weighed as per the calculated quantities according to each of the treatment combinations mentioned above. Full dose of phosphorous and potassium along with half dose of nitrogen was applied basally to each specified plot. The remaining half dose was given at 30 days after transplanting. Observations were recorded on flower yield per plant, cost of cultivation, gross returns and net returns both during *kharif* and *rabi*. The data recorded on flower yield were analyzed by the ANOVA technique as described by Panse and Sukhatme (1967). The treatment means were compared using the critical difference values calculated at 5 per cent level of significance.

RESULTS AND DISCUSSION

Nutrient uptake

The observations on uptake of nitrogen and phosphorus, as well as the content of them in various plant parts and in soil after crop harvest are presented in the table numbers 1to 5.

Uptake of nitrogen

Uptake of nitrogen differed significantly by varying the doses of nitrogen, phosphorus and their interactions in the leaves, stem and flower during both seasons (Table 1). Maximum uptake of nitrogen in leaf was observed by the treatment of N_2 (23.91 kg ha^{-1} and 25.23 kg ha^{-1}), P_1 (20.42 kg ha^{-1} and 21.56 kg ha^{-1}) and by the combination N_2P_1 (28.01 kg ha^{-1} and 29.57 kg ha^{-1}) during *kharif* and *rabi* seasons. However, N_2P_1 was on par with N_3P_1 (26.29 kg ha^{-1} and 27.75 kg ha^{-1}) during both seasons. In stem, the highest uptake of nitrogen was observed by the treatment of N_2 (40.01 kg ha^{-1} and 33.30 kg ha^{-1}), P_1 (42.24 kg ha^{-1} and 35.15 kg ha^{-1}) and by the combination N_2P_1 (44.45 kg ha^{-1} and 46.93 kg ha^{-1}) during *kharif* and *rabi* seasons. Treatment combination of N_2P_1 was on par with N_3P_1 (43.39 kg ha^{-1} and 45.80 kg ha^{-1}) during both seasons. The highest uptake of nitrogen in flowers was observed by the treatment of N_2 (9.41 kg ha^{-1} and 9.94 kg ha^{-1}), P_1 (7.93 kg ha^{-1} and 8.37 kg ha^{-1}) and by the combination N_2P_1 (11.02 kg ha^{-1} and 11.63 kg ha^{-1}) during *kharif* and *rabi* seasons.

Total uptake of nitrogen by the plants varied significantly among different levels of nitrogen and phosphorus and their interactions in both the seasons. During *kharif*, maximum nitrogen uptake was recorded by N_2 (73.33 kg ha^{-1}), P_1 (61.65 kg ha^{-1}) and by the combination N_2P_1 (83.48 kg ha^{-1}). N_2 and P_1 were followed by N_3 (68.40 kg ha^{-1}) and P_2 (51.99 kg ha^{-1}). N_2P_1 was on par with N_3P_1 (79.58 kg ha^{-1}), but significantly superior to N_2P_2 (72.89 kg ha^{-1}). During *rabi*, maximum nitrogen uptake was recorded by N_2 (75.19 kg ha^{-1}), P_1 (63.23 kg ha^{-1}) and by the combination N_2P_1 (85.65 kg ha^{-1}). N_2 and P_1 were followed by N_3 (70.08 kg ha^{-1}) and P_2 (53.31 kg ha^{-1}). N_2P_1 was on par with N_3P_1 (81.60 kg ha^{-1}), but significantly superior to N_2P_2 (74.78 kg ha^{-1}).

TABLE 1: Physical and chemical properties of soil from experimental site

Particulars	Value obtained	Method adopted
A. Physical properties		
Clay (%)	32.70	Hydrometer method (Piper, 1966)
Silt (%)	9.50	Hydrometer method (Piper, 1966)
Fine sand (%)	31.24	Hydrometer method (Piper,1966)
Coarse sand (%)	26.56	Hydrometer method (Piper, 1966)
Bulk density (Mg m^{-3})	0.89	Core sampler method (Dastane, 1967)
B. Chemical properties		
Available N (Kg ha^{-1})	265.00	Alkaline potassium permanganate method (Subbaiah and Asija, 1956)
Available P_2O_5 (Kg ha^{-1})	10.80	Olsen's method (Jackson, 1967)
Available K_2O (Kg ha^{-1})	245.00	Flame photometer (Sparks, 1996)
Soil reaction (pH)	7.20	Potentiometric method (Sparks, 1996)

Uptake of phosphorus

Uptake of phosphorus in the leaves, stem and flower differed significantly among the different doses of nitrogen, phosphorus and their interactions during both seasons (Table 2). Maximum uptake of phosphorus in leaf was observed by the treatment of N_2 (2.93 kg ha^{-1} and 2.79 kg ha^{-1}), P_1 (2.51 kg ha^{-1} and 2.38 kg ha^{-1}) and by the combination N_2P_1 (3.44 kg ha^{-1} and 3.27 kg ha^{-1}) during *kharif* and *rabi* seasons. However, N_2P_1 was on par with N_3P_1 (3.23 kg ha^{-1} and 3.07 kg ha^{-1}) during both seasons. In stem, the highest uptake of phosphorus was observed by the treatment of N_2 (5.44 kg ha^{-1} and 5.75 kg ha^{-1}), P_1 (4.77 kg ha^{-1} and 5.04 kg ha^{-1}) and by the combination N_2P_1 (5.90 kg ha^{-1} and 6.23 kg ha^{-1}) during *kharif* and *rabi* seasons. Treatment combination of N_2P_1 was on par with N_3P_1 (5.87 kg ha^{-1} and 6.20 kg ha^{-1}) during both seasons. The highest uptake of phosphorus in flowers was observed by the treatment of N_2 (1.88 kg ha^{-1} and 1.98 kg ha^{-1}), P_1 (2.14 kg ha^{-1} and 2.26 kg ha^{-1}) and by the combination N_2P_1 (2.14 kg ha^{-1} and 2.26 kg ha^{-1}) during *kharif* and *rabi* seasons. The treatment combination of N_2P_1 was on par with N_2P_2 (2.05 kg ha^{-1} and 2.16 kg ha^{-1}) and N_3P_1 (1.97 kg ha^{-1} and 2.08 kg ha^{-1}) during both seasons. Significant variations were noticed with respect to total uptake of phosphorus among different treatments. During *kharif*, maximum uptake was recorded by N_2 (10.25 kg ha^{-1}), P_1 (8.94 kg ha^{-1}) and by the combination N_2P_1 (11.48 kg ha^{-1}). N_2 was at par with N_3 (9.63 kg ha^{-1}), but significantly superior to N_1 (7.17 kg ha^{-1}). P_1 was followed by P_2 (51.99 kg ha^{-1}). The combination of N_2P_1 was on par with N_3P_1 (11.07 kg ha^{-1}), N_2P_3 (10.14 kg ha^{-1}) and N_2P_2 (10.25 kg ha^{-1}) but, significantly superior to N_3P_3 (9.47 kg ha^{-1}). During *rabi*, maximum phosphorus uptake was recorded by N_2 (10.52 kg ha^{-1}), P_1 (9.18 kg ha^{-1}) and by the combination N_2P_1 (11.76 kg ha^{-1}). N_2 was on par with N_3 (9.89 kg ha^{-1}), but significantly superior to N_1 (7.38 kg ha^{-1}). P_1 was followed by P_2 (7.91 kg ha^{-1}). The combination N_2P_1 was on par with N_3P_1 (7.91 kg ha^{-1}), N_2P_2 (10.52 kg ha^{-1}) and N_2P_3 (10.40 kg ha^{-1}), but significantly superior to N_3P_3 (9.71 kg ha^{-1}).

Nitrogen content in plant parts

Nitrogen content differed significantly by varying the doses of nitrogen, phosphorus and their interactions in the leaves, stem and flower during both seasons (Table 3). Maximum content of nitrogen in leaf was recorded by the treatment of

N_3 (3.92% and 3.99%), P_3 (3.35% and 3.42%) and by the combination N_3P_3 (4.01% and 3.99%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (3.84% and 3.91%). However, N_3P_3 was on par with lower levels till N_2P_0 (3.58% and 3.65%) during both seasons but significantly superior to still lower doses. In stem, the highest content of nitrogen was showed by the treatment of N_3 (10.81% and 10.92%), P_3 (3.02% and 3.08%) and by the combination N_3P_3 (3.61% and 3.68%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (3.45% and 3.52%) while P_3 was on par with P_2 (3.56% and 3.00%). However, N_3P_3 was on par with lower levels till N_2P_0 (3.22%) in *kharif* and N_3P_o (3.44%) in *rabi*, but significantly superior to still lower doses. The highest uptake of phosphorus in flowers was observed by the treatment of N_3 (2.64% and 2.70%), P_3 (2.26% and 2.31%) and by the combination N_3P_3 (2.71% and 2.76%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (2.59% and 2.64%). However, N_3P_3 was on par with lower levels till N_3P_0 (2.53% and 2.58%) during both seasons but significantly superior to still lower doses.

Phosphorus content in plant parts

There were significant differences in phosphorus content among the various doses of nitrogen, phosphorus and their interactions in the leaves, stem and flower during both seasons (Table 4). Maximum content of phosphorus in leaf was observed by the treatment of N_3 (0.48% and 0.49%), P_3 (0.41% and 0.42%) and by the combination N_3P_3 (0.49% and 0.50%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (0.47% and 0.48%). The combination N_3P_3 was on par with lower levels till N_3P_0 (0.46% and 0.47%) during both seasons but significantly superior to still lower doses. In stem, the highest content of phosphorus was observed by the treatment of N_3 (0.49% and 0.50%), P_3 (0.45% and 0.46%) and by the combination N_3P_3 (0.50% and 0.51%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (0.47% and 0.48%) while P_3 was on par with P_2 (0.44% and 0.44%). However, N_3P_3 was on par with lower levels till N_3P_0 (0.47% and 0.48%) in both seasons, but significantly superior to still lower doses. The highest uptake of phosphorus in flowers was observed by the treatment of N_3 (0.54% and 0.55%), P_3 (0.48% and 0.49%) and by the combination N_3P_3 (0.55% and 0.56%) during *kharif* and *rabi* seasons. N_3 level was on par with N_2 (0.52% and 0.53%). P_3 level was significantly superior to P_2 (0.48%) during *kharif* but at par with the same (0.49%) during *rabi*. However, N_3P_3 was on par with lower levels till N_3P_0 (0.52% and 0.53%) during both seasons but significantly superior to still lower doses.

Nutrient content in the soil after crop harvest

The contents of nitrogen and phosphorus after crop harvest are tabulated in table 5.

Nitrogen content in soil

Nitrogen content increased significantly with increase in nitrogen dose, maximum content was recorded by N_3 (186.22 kg ha^{-1} and 195.53 kg ha^{-1}) followed by N_2 (174.14 kg ha^{-1} and 182.85 kg ha^{-1}) during *kharif* and *rabi* (Table 6). It also varied due to phosphorus doses, but not significantly, maximum being recorded by P_3 (163.29 kg ha^{-1} and 171.45 kg ha^{-1}) followed by P_2 (162.10 kg ha^{-1} and 170.20 kg ha^{-1}) during both seasons. Among the interactions, the combination of N_3P_3 recorded the maximum nitrogen content (189.54 kg ha^{-1} and 199.02 kg ha^{-1}) during *kharif* and *rabi* significantly superior to all combinations with N_0 and N_1.

Phosphorus content in soil

The phosphorus content in the soil after the experimentation did not show significant variations among the different treatments. Phosphorus content increased numerically with increase in nitrogen dose, maximum content (7.53 kg ha^{-1} and 9.15 kg ha^{-1}) being recorded by N_3 followed by N_2 (7.24 kg ha^{-1} and 8.57 kg ha^{-1}) during *kharif* and *rabi*. The variations due to phosphorus doses were also non-significant, maximum numerical value being recorded by P_3 (7.15 kg ha^{-1} and 8.69 kg ha^{-1}) followed by P_2 (7.05 kg ha^{-1} and 8.56 kg ha^{-1}) during both seasons. Among the interactions, the combination of N_3P_2 recorded the maximum phosphorus content (8.14 kg ha^{-1} and 9.92 kg ha^{-1}) during both the seasons.

Number of flowers per plant

The effect of different levels of nitrogen, phosphorus and their interactions was found to be significant on number of flowers per plant during both the seasons (Table 1). In *kharif,* N_2 level recorded the highest number of flowers per plant (26.14) which was significantly superior to N_3 (22.03) whereas, among phosphorus doses, P_1 level was the best with 25.89 flowers per plant followed by P_2 (22.02). Among the interactions, the treatment combination of N_2P_1 recorded the highest number of flowers per plant (30.52), followed by N_2P_2 (27.92) which was on par with N_3P_1 (26.83). In *rabi,* among nitrogen doses, N_2 level was the most productive with 40.52 flowers per plant which was followed by N_3 (34.14) whereas, among phosphorus doses, P_1 level recorded the highest number of flowers per plant (40.13) followed by P_2 (34.13). With regard to interactions, the treatment combination of N_2P_1 had the highest number of flowers (47.31) followed by N_2P_2 (43.27) which was on par with N_3P_1 (41.59).

Flower yield per ha

Different levels of nitrogen, phosphorus and their interactions varied significantly with respect to flower yield per ha during both the seasons (Table 2). During *kharif,* N_2 level recorded the highest flower yield per ha (5.05 t) which was significantly superior to N_3 (3.80 t) whereas, among phosphorus doses, P_1 level was the best with 4.46 t ha^{-1} followed by P_2 (3.48 t). Among the interactions, the treatment combination of N_2P_1 recorded the highest flower yield per ha (6.86 t), followed by N_2P_2 (5.73 t). In *rabi,* among nitrogen doses, N_2 level was the most productive with 8.45 t ha^{-1} which was followed by N_3 (6.36 t) whereas, among phosphorus doses, P_1 level recorded the highest flower yield per ha (7.46 t) followed by P_2 (5.82 t). With regard to interactions, the treatment combination of N_2P_1 recorded the highest flower yield (11.49 t ha^{-1}) followed by N_2P_2 (9.59 t ha^{-1}).

TABLE 2: Nitrogen content (%) in various plant parts as influenced by nitrogen and phosphorus levels in garland chrysanthemum during *kharif* and *rabi*

	Leaf					Stem					Flower				
	Kharif at 65 DAT														
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
	2.01	2.19	2.34	2.51	**2.26**	1.81	1.97	2.11	2.26	**2.04**	1.36	1.48	1.58	1.69	**1.53**
N_0	(8.15)	(8.51)	(8.80)	(9.11)	**(8.64)**	(7.73)	(8.07)	(8.35)	(8.64)	**(8.21)**	(6.69)	(6.98)	(7.22)	(7.47)	**(7.10)**
	2.57	2.75	2.84	2.89	**2.76**	2.31	2.48	2.56	2.60	**2.49**	1.73	1.86	1.92	1.95	**1.86**
N_1	(9.22)	(9.54)	(9.70)	(9.78)	**(9.56)**	(8.74)	(9.06)	(9.20)	(9.28)	**(9.08)**	(7.55)	(7.84)	(7.96)	(8.02)	**(7.84)**
	3.58	3.85	3.92	3.99	**3.84**	3.22	3.47	3.53	3.59	**3.45**	2.42	2.60	2.65	2.69	**2.59**
N_2	(10.90)	(11.31)	(11.41)	(11.52)	**(11.30)**	(10.33)	(10.73)	(10.82)	(10.92)	**(10.70)**	(8.95)	(9.28)	(9.37)	(9.44)	**(9.26)**
	3.75	3.94	3.96	4.01	**3.92**	3.38	3.55	3.56	3.61	**3.52**	2.53	2.66	2.67	2.71	**2.64**
N_3	(11.16)	(11.44)	(11.47)	(11.55)	**(11.41)**	(10.59)	(10.86)	(10.87)	(10.95)	**(10.81)**	(9.15)	(9.38)	(9.40)	(9.47)	**(9.35)**
	2.98	**3.18**	**3.27**	**3.35**	**3.19**	**2.68**	**2.86**	**2.94**	**3.02**	**2.87**	**2.01**	**2.15**	**2.20**	**2.26**	**2.16**
Mean	**(9.94)**	**(10.27)**	**(10.41)**	**(10.54)**	**(10.28)**	**(9.42)**	**(9.73)**	**(9.87)**	**(10.00)**	**(9.75)**	**(8.15)**	**(8.43)**	**(8.53)**	**(8.64)**	**(8.45)**
	S Em		CD at 5%			S Em		CD at 5%			S Em		CD at5%		
N	0.113		0.326			0.098		0.282			0.092		0.265		
P	0.044		0.126			0.030		0.145			0.035		0.102		
N x P	0.206		0.595			0.150		0.563			0.168		0.486		
	Rabi at 85 DAT														
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
	2.05	2.23	2.39	2.56	**2.31**	1.85	2.01	2.15	2.30	**2.08**	1.38	1.51	1.61	1.73	**1.56**
N_0	(8.23)	(8.58)	(8.89)	(9.20)	**(8.74)**	(7.81)	(8.15)	(8.43)	(8.72)	**(8.29)**	(6.74)	(7.06)	(7.29)	(7.55)	**(7.17)**
	2.62	2.81	2.90	2.95	**2.82**	2.36	2.52	2.61	2.65	**2.54**	1.77	1.89	1.96	1.99	**1.90**
N_1	(9.31)	(9.65)	(9.80)	(9.89)	**(9.66)**	(8.83)	(9.13)	(9.29)	(9.37)	**(9.17)**	(7.64)	(7.90)	(8.04)	(8.11)	**(7.92)**
	3.65	3.93	4.00	4.07	**3.91**	3.29	3.53	3.60	3.66	**3.52**	2.46	2.65	2.70	2.75	**2.64**
N_2	(11.01)	(11.43)	(11.53)	(11.63)	**(11.40)**	(10.45)	(10.82)	(10.93)	(11.02)	**(10.81)**	(9.02)	(9.37)	(9.45)	(9.54)	**(9.35)**
	3.83	4.02	4.04	4.09	**3.99**	3.44	3.62	3.64	3.68	**3.59**	2.58	2.71	2.73	2.76	**2.70**
N_3	(11.28)	(11.56)	(11.59)	(11.66)	**(11.52)**	(10.68)	(10.96)	(10.99)	(11.06)	**(10.92)**	(9.24)	(9.47)	(9.51)	(9.56)	**(9.45)**
	3.04	**3.25**	**3.33**	**3.42**	**3.26**	**2.73**	**2.92**	**3.00**	**3.08**	**2.93**	**2.05**	**2.19**	**2.25**	**2.31**	**2.20**
Mean	**(10.04)**	**(10.38)**	**(10.51)**	**(10.65)**	**(10.40)**	**(9.57)**	**(9.84)**	**(9.97)**	**(10.10)**	**(9.85)**	**(8.23)**	**(8.51)**	**(8.62)**	**(8.74)**	**(8.33)**
	S Em		CD at 5%			S Em		CD at 5%			S Em		CD at 5%		
N	0.105		0.302			0.099		0.285			0.093		0.265		
P	0.038		0.109			0.051		0.148			0.037		0.105		
N x P	0.108		0.601			0.197		0.568			0.170		0.491		

Figures in parentheses are arcsine transformed values

TABLE 3: Phosphorus content (%) in various plant parts as influenced by nitrogen and phosphorus levels in garland chrysanthemum during *kharif* and *rabi*

Treatment	Leaf					Stem					Flower				
	Kharif at 65 DAT														
	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
	0.25	0.27	0.29	0.31	**0.28**	0.30	0.33	0.35	0.38	**0.34**	0.33	0.36	0.39	0.41	**0.37**
N_0	(2.86)	(2.98)	(3.09)	(3.19)	**(3.03)**	(3.14)	(3.29)	(3.39)	(3.53)	**(3.34)**	(3.29)	(3.44)	(3.58)	(3.67)	**(3.49)**
	0.32	0.34	0.35	0.35	**0.34**	0.39	0.39	0.41	0.43	**0.40**	0.42	0.43	0.45	0.48	**0.45**
N_1	(3.24)	(3.34)	(3.39)	(3.39)	**(3.34)**	(3.58)	(3.58)	(3.67)	(3.76)	**(3.62)**	(3.71)	(3.76)	(3.84)	(3.97)	**(3.84)**
	0.44	0.47	0.48	0.49	**0.47**	0.45	0.46	0.48	0.49	**0.47**	0.50	0.51	0.53	0.54	**0.52**
N_2	(3.80)	(3.93)	(3.97)	(4.01)	**(3.93)**	(3.84)	(3.89)	(3.97)	(4.01)	**(3.93)**	(4.05)	(4.09)	(4.17)	(4.21)	**(4.13)**
	0.46	0.48	0.49	0.49	**0.48**	0.47	0.48	0.50	0.50	**0.49**	0.52	0.53	0.55	0.55	**0.54**
N_3	(3.89)	(3.97)	(4.01)	(4.01)	**(3.97)**	(3.93)	(3.97)	(4.05)	(4.05)	**(4.01)**	(4.13)	(4.17)	(4.25)	(4.25)	**(4.21)**
	0.37	**0.39**	**0.40**	**0.41**	**0.39**	**0.40**	**0.41**	**0.44**	**0.45**	**0.43**	**0.44**	**0.46**	**0.48**	**0.50**	**0.47**
Mean	**(3.49)**	**(3.58)**	**(3.62)**	**(3.67)**	**(3.58)**	**(3.62)**	**(3.67)**	**(3.80)**	**(3.84)**	**(3.76)**	**(3.80)**	**(3.89)**	**(3.97)**	**(4.05)**	**(3.93)**
	S Em			CD at 5%		S Em			CD at 5%		S Em			CD at5%	
N		0.038			0.111		0.024			0.068		0.027			0.079
P		0.013			0.038		0.021			0.061		0.018			0.052
N x P		0.070			0.202		0.048			0.138		0.051			0.148
	Rabi at 85 DAT														
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
	0.26	0.26	0.28	0.32	**0.28**	0.31	0.34	0.36	0.38	**0.35**	0.34	0.37	0.39	0.42	**0.38**
N_0	(2.92)	(2.92)	(3.03)	(3.24)	**(3.03)**	(3.19)	(3.34)	(3.44)	(3.53)	**(3.39)**	(3.34)	(3.49)	(3.58)	(3.71)	**(3.53)**
	0.31	0.35	0.36	0.36	**0.35**	0.39	0.40	0.42	0.44	**0.41**	0.43	0.44	0.46	0.49	**0.45**
N_1	(3.19)	(3.39)	(3.44)	(3.44)	**(3.39)**	(3.58)	(3.62)	(3.71)	(3.80)	**(3.67)**	(3.76)	(3.80)	(3.89)	(4.01)	**(3.84)**
	0.45	0.48	0.49	0.50	**0.48**	0.46	0.47	0.49	0.50	**0.48**	0.50	0.52	0.54	0.55	**0.53**
N_2	(3.84)	(3.97)	(4.01)	(4.05)	**(3.97)**	(3.89)	(3.93)	(4.01)	(4.05)	**(3.97)**	(4.05)	(4.13)	(4.21)	(4.25)	**(4.17)**
	0.47	0.49	0.50	0.50	**0.49**	0.48	0.49	0.51	0.51	**0.50**	0.53	0.54	0.56	0.56	**0.55**
N_3	(3.93)	(4.01)	(4.05)	(4.05)	**(4.01)**	(3.97)	(4.01)	(4.09)	(4.09)	**(4.05)**	(4.17)	(4.21)	(4.29)	(4.29)	**(4.25)**
	0.37	**0.40**	**0.41**	**0.42**	**0.40**	**0.41**	**0.42**	**0.44**	**0.46**	**0.43**	**0.45**	**0.47**	**0.49**	**0.50**	**0.48**
Mean	**(3.49)**	**(3.62)**	**(3.67)**	**(3.71)**	**(3.62)**	**(3.67)**	**(3.71)**	**(3.80)**	**(3.89)**	**(3.76)**	**(3.84)**	**(3.93)**	**(4.01)**	**(4.05)**	**(3.97)**
	S Em			CD at 5%		S Em			CD at 5%		S Em			CD at 5%	
N		0.037			0.105		0.023			0.067		0.028			0.079
P		0.014			0.041		0.019			0.056		0.015			0.045
N x P		0.073			0.212		0.048			0.138		0.051			0.147

Figures in parentheses are arcsine transformed values

TABLE 4: Nitrogen and Phosphorus contents in soil after harvest of crop

	Nitrogen content (kg ha^{-1})									
	Kharif					*Rabi*				
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
N_0	127.49	132.82	136.80	137.25	**133.59**	133.86	139.46	143.64	144.11	**140.27**
N_1	145.02	148.25	149.21	150.12	**148.15**	152.27	155.66	156.67	157.63	**155.56**
N_2	172.21	173.26	174.85	176.25	**174.14**	180.82	181.92	183.59	185.06	**182.85**
N_3	182.26	185.55	187.52	189.54	**186.22**	191.37	194.83	196.90	199.02	**195.53**
Mean	**156.75**	**159.97**	**162.10**	**163.29**	**160.53**	**164.58**	**167.97**	**170.20**	**171.45**	**168.55**
	S Em			CD at 5%		S Em			CD at 5%	
N	3.00			8.63		3.15			9.06	
P	5.74			16.53		6.03			17.36	
N x P	10.81			31.14		11.35			32.70	
	Phosphorus content (kg ha^{-1})									
	Kharif					*Rabi*				
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
N_0	5.87	5.92	6.12	6.22	**6.03**	7.08	7.15	7.40	7.52	**7.29**
N_1	6.17	6.40	6.67	7.03	**6.57**	7.46	7.75	8.08	8.53	**7.95**
N_2	6.77	6.97	7.27	7.24	**7.06**	8.21	8.46	8.83	8.80	**8.57**
N_3	6.87	6.98	8.14	8.12	**7.53**	8.33	8.47	9.92	9.90	**9.15**
Mean	**6.42**	**6.57**	**7.05**	**7.15**	**6.80**	**7.77**	**7.95**	**8.56**	**8.69**	**8.24**
	S Em			CD at 5%		S Em			CD at 5%	
N	---			NS		---			NS	
P	---			NS		---			NS	
N x P	---			NS		---			NS	

TABLE 5: Number of flowers per plant and Flower yield per ha as influenced by nitrogen and phosphorus levels in garland chrysanthemum during *kharif* and *rabi*

	Number of flowers per plant					Flower yield per hectare (tonnes)				
					Kharif					
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
N_0	14.45	21.31	18.15	17.35	**17.81**	1.09	1.99	1.54	1.58	**1.55**
N_1	17.38	24.90	21.11	20.81	**21.05**	2.02	4.02	3.11	2.95	**3.03**
N_2	23.01	30.52	27.92	23.12	**26.14**	3.72	6.86	5.73	3.88	**5.05**
N_3	20.16	26.83	20.90	20.22	**22.03**	3.42	4.96	3.52	3.30	**3.80**
Mean	**18.75**	**25.89**	**22.02**	**20.38**	**21.76**	**2.56**	**4.46**	**3.48**	**2.93**	**3.36**
	S Em			CD at 5%		S Em		CD at 5%		
N	0.30			0.91		0.098		0.301		
P	0.28			0.86		0.103		0.318		
N x P	0.60			1.74		0.224		0.647		
	Rabi									
Treatment	P_0	P_1	P_2	P_3	Mean	P_0	P_1	P_2	P_3	Mean
N_0	22.39	33.03	28.13	26.90	**27.61**	1.83	3.32	2.58	2.64	**2.59**
N_1	26.94	38.60	32.72	32.25	**32.63**	3.37	6.74	5.21	4.94	**5.07**
N_2	35.67	47.31	43.27	35.84	**40.52**	6.23	11.49	9.59	6.49	**8.45**
N_3	31.25	41.59	32.39	31.35	**34.14**	5.73	8.30	5.90	5.52	**6.36**
Mean	**29.06**	**40.13**	**34.13**	**31.58**	**33.73**	**4.29**	**7.46**	**5.82**	**4.90**	**5.62**
	S Em			CD at 5%		S Em		CD at 5%		
N	0.46			1.42		0.164		0.504		
P	0.43			1.33		0.153		0.473		
N x P	0.93			2.69		0.375		1.083		

It is interesting to note that there were significant differences due to the interaction between nitrogen and phosphorus levels. The number of flowers per plant was maximum at N150: P100 level during kharif (30.52) and rabi (47.31) seasons when potassium was applied at 100 kg ha-1 (Table 1). This indicates that N150: P100 level is optimum for garland chrysanthemum. The higher number of flowers per plant at this level resulted in higher flower yield per ha closely followed by N150: P150 and N200: P100 levels (Table 1). Similar results were obtained by Mantur (1988) in china aster, Khimani (1991) and Hugar (1997) in gaillardia, Patil (1995) and Ganganagoudar (1997) in golden rod.

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