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Effect of integrated nutrient management on yield, economics and nutrient uptake of garland chrysanthemum (*Chrysanthemum coronarium* L.)

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ABSTRACT : An experiment was conducted during 2009-2010 to study the effect of integrated nutrient management on yield, economics and nutrient uptake of garland chrysanthemum. The present experiment consisted of nine treatments and three replications. Among all treatments, T_9 (*Azospirillum* + PSB + 50% vermicompost equivalent to RDN + 50% recommended NPK) obtained the highest net income and benefit:cost ratio (Rs. 1,95,135/ha and 4.23, respectively) which was closely followed by treatment (T_7) than compared to control. The uptake of N (82.587 kg/ha), P (12.017 kg/ha) and K (79.951 kg/ha) was significantly higher in treatment (T_9) followed by treatment T_7 as compared to control.

KEY WORDS : *Azospirillum*, Garland chrysanthemum, PSB, RDF, Vermicompost

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Garland chrysanthemum (*Chrysanthemum coronarium* L.) is a dicot annual herb and a popular winter season flowering annual crop. It is different from florist chrysanthemum in many aspects. The crop is relatively shorter in duration and photo- insensitive under Dharwad conditions thus capable of coming up throughout the year. The plants are bushy with numerous erect stems bearing multitudes of cheerful yellow or white flowers. The flowers assumed economic importance on account of their varied uses such as cut flowers for vase decorations, loose flowers for making garlands and religious functions.

The quality of flowers is greatly influenced by the quantity of nutrients and sources of nutrients. Chemical fertilizers have become very costly and its indiscriminate use has led to deterioration of soil health. The uses of organic manures in conjugation with fertilizers not only enhances the efficiency of fertilizers but also partly supply nutrients, at the same time improve the soil physical, chemical and biological properties. A very few attempts have been made so far to study the efficiency of integrated nutrient management in flower crops particularly in garland chrysanthemum; hence the present study was carried out. Use of different sources of nutrients in an integrated manner helps to produce sustainable yields with good quality flowers and also maintains soil health.

RESEARCH METHODS

The experiment was carried out at Floriculture unit of New Orchard, Dept. of Horticulture, University of Agricultural Sciences, Dharwad during *Kharif* 2009-2010. The experiment was laid in Randomized Completely Block Design (RCBD) with three replications. There were nine treatments *i.e.* T_1 (Absolute control), T_2 [100% RDF + FYM (20 t/ha)], T_3 (50% VC equivalent to RD'N' + 50% RDF), T_4 (*Azospirillium* + 75% RD'N' + 100% RD'P' and 'K'), T_5 (PSB + 75% RD'P' + 100% RD'N' and 'K'), T_6 (*Azospirillium* + 50% VC equivalent to RD'N' + 50% RDF), T_7 (PSB + 50% VC equivalent to RD'N' + 50% RDF), T_8 (*Azospirillium* + PSB+ 50% RD'N' and 'P' + 100% RD'K') and T_9 (*Azospirillium* + PSB+ 50% VC equivalent to RD'N' + 50% RDF).

One month old seedlings of garland chrysanthemum with uniform growth were transplanted at a spacing of 30 x 30 cm. FYM and vermicompost were added at the time of land

preparation. While, the biofertilizers (*Azospirillum* and PSB) were applied as seedling dip before transplanting. A slurry of 200 g of lignite based culture of *Azospirillum* and PSB were prepared in 1000 ml of water individually. Another slurry with combination of both 100 g *Azospirillum* and 100 g PSB culture was prepared in 1000 ml of water. Thirty days old seedlings of garland chrysanthemum were dipped in the above slurry for 30 minutes and then transplanted.

Whereas, chemical fertilizers were applied twelve days after transplanting according to the treatments. A basal dose of half N, full P_2O_5 and K_2O were applied as per treatments at the time of transplanting through urea, diammonium phosphate and muriate of potash. The remaining half dose of nitrogen was applied thirty days after transplanting. The observations on yield, economics and nutrient uptake of garland chrysanthemum were recorded and analysed statistically as per the method given by Gomez and Gomez (1984).

Analysis of soil N, P, K was done before starting of experiment and also at the final stage of experiment. Where as plant analysis of N, P, K in leaf and stem was done at both 45 and 65 DAP, while in flowers plant analysis was done only at the end of the experiment in Soil science laboratory at UAS, Dharwad by following the standard procedures, micro-Kjeldhal for N estimation, vanadomolybdate for P and using flame photometer for K estimation (Tandon, 1998).

Amount of nutrient taken up by plants was calculated by using the formula given by Rakesh *et al*. (1999).

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)}}{100} \text{ x dry matter}$$

RESEARCH FINDINGS AND DISCUSSION

In general the growth and quality of flowers produced was good in the treatment which received organic along with inorganic fertilizers. Data presented in Table 1 indicated that the yield attributes like number of flowers/plant (42.33), flower yield/plant (86.82 g) and flower yield/ha (9.65 t/ha) were significantly higher in treatment (T_9) receiving *Azospirillum* + PSB + 50 per cent vermicompost equivalent to RDN + 50 per cent recommended NPK. The same treatment also recorded maximum net returns (Rs. 1,95,135/ha) and high B:C ratio (4.23) compared to control.

This might be due to the beneficial effect of vermicompost and biofertilizers in combination with recommended dose of inorganic fertilizers which lead to better root proliferation, uptake of nutrients and water and better plant growth. This is in conformity to the findings of Chandrikapure *et al.* (1999) in marigold, Chaitra and Patil (2007) in China aster, Deshmukh *et al.* (2008) in gaillardia and Meshram *et al.* (2008) in annual chrysanthemum. This gives a tremendous scope for the yield improvement in garland chrysanthemum with the integrated nutrient management practices. In addition, this study also throws light on reduction in the quantity of chemical fertilizer application when applied along with biofertilizers and organic manures to get yield at par with recommended dose of inorganic fertilizers. The present investigation shows that among all the treatments, the treatment (T_9) receiving combination of *Azospirillum*, PSB, 50 per cent vermicompost equivalent to RDN and 50 per cent recommended NPK gave highest flower yield of (9.65 t/ha) with the maximum net returns per rupee invested (1: 4.2) (Table 1).

The influence of integrated nutrient management on nitrogen, phosphorus and potash content (%) in leaves, stem and flower presented in Table 2, shows that application of *Azospirillum* + PSB + 50 per cent vermicompost equivalent to RDN + 50 per cent recommended NPK (T_9) registered maximum N, P, K content in both leaves and stem, it was at par with T_7 and T_2. The minimum leaf and stem content of N, P, K was recorded in absolute control. The data on per cent N, P and K content in garland chrysanthemum flowers was markedly influenced by integrated nutrient management. The treatment

Table 1 : Effect of integrated nutrient management on yield attributes and economics of garland chrysanthemum

Treatments	Number of flowers/plant	Flower yield (g/plant)	Flower yield (t/ha)	Net returns (Rs.)	B:C ratio
T_1 – Absolute control	22.87	20.43	2.27	20,600	0.57
T_2 – 100% RDF + FYM (20 t/ha)	35.84	57.71	6.52	1,16,962	2.54
T_3 – 50% VC equivalent to RD'N' + 50% RDF	29.67	42.78	4.70	73,585	1.63
T_4 – *Azospirillium* + 75% RD'N' + 100% RD'P' and 'K'	28.26	38.32	4.2	65,839	1.62
T_5 – PSB + 75% RD'P' + 100% RD'N' and 'K'	31.51	55.25	6.25	1,15,814	2.86
T_6 – *Azospirillium* + 50% VC equivalent to RD'N' + 50% RDF	31.34	51.55	5.73	97,360	2.12
T_7 – PSB + 50% VC equivalent to RD'N' + 50% RDF	38.73	73.34	8.15	1,57,860	3.44
T_8 – *Azospirillium* + PSB + 50% RD'N' and 'P' + 100% D'K'	31.32	44.37	4.93	83,720	3.12
T_9 – *Azospirillium* + PSB + 50% VC equivalent to RD'N'+50% RDF	42.33	86.82	9.65	1,95,135	4.23
S.E.±	0.95	1.52	0.59	-	-
C.D. (P=0.05)	2.85	4.56	1.77	-	-

FYM = Farm yard manure, PSB = Phosphate solubilizing bacterium, VC = Vermicompost,
RDF = Recommended dose of fertilizer (150:100:100 NPK kg/ha).

T_9 recoreded significantly maximum N, P, K content in flowers and it was followed by T_7 and T_2, while control showed least N, P and K content in flowers. The concentration of NPK content in garland chrysanthemum plants decreased as the crop growth advanced. This may be attributed to the dilution effect caused by the increase in plant mass and translocation of nutrient content from vegetative part to reproductive parts. These results are in accordance with Khimani (1991) in gaillardia.

The nutrient uptake by plants and available nutrient status in soil was significantly influenced by all the treatments when compared to control (Table 3). Higher uptake of N (82.587 kg/ha), P (12.017 kg/ha) and K (79.951 kg/ha) was recorded in the treatment (T_9) receiving of *Azospirillum* + PSB + 50 per cent vermicompost equivalent to RDN + 50 per cent recommended NPK. This was closely followed by treatment (T_7) and the lowest uptake of NPK was recorded in control. Highest uptake of nutrients in T_9 might be due to favorable soil physical properties and solubilizing effect of native soil nutrients due to organic acids produced during decomposition of vermicompost and solubilizing effect of micro organisms.

Similarly higher available nitrogen (206.89 kg/ha), phosphorus (18.99 kg/ha) and potassium (233.10 kg/ha) in soil was obtained when compared to the initial soil values. This might be attributed to the inoculated PSB which mediated the release of phosphorus from insoluble phosphate and fixation of atmospheric nitrogen by *Azospirillum* in plants and in turn, physiological changes of the plants on exposure to action of the inoculated microorganisms. The increased supply of available nitrogen to available soil nutrient pool

Table 2 : Effect of integrated nutrient management on nutrient content (%) in different plant parts of garland chrysanthemum

Treatments	Nutrient content in leaves (%)			Nutrient content in stem (%)			Nutrient content in flowers (%)		
	N	P	K	N	P	K	N	P	K
T_1 – Absolute control	2.546	0.291	2.251	2.312	0.362	2.442	1.553	0.354	1.702
T_2 – 100% RDF + FYM (20 t/ha)	3.432	0.399	3.541	3.134	0.443	3.092	2.214	0.452	2.225
T_3 – 50% VC equi.* to RD'N'+50% RDF	3.081	0.358	3.009	2.855	0.335	2.666	1.967	0.420	2.118
T_4 – *Azospirillium* +75% RD'N'+100% RD'P' and 'K'	2.977	0.300	2.424	2.793	0.315	2.600	1.865	0.413	2.072
T_5 – PSB +75% RD'P'+100% RD'N' and 'K'	3.288	0.398	3.093	3.094	0.423	3.029	2.185	0.450	2.183
T_6 – *Azospirillium* + 50% VC equi.* to RD'N'+50% RDF	3.182	0.377	3.071	2.993	0.401	2.861	2.163	0.446	2.153
T_7 – PSB +50% VC equi.* to RD'N'+50% RDF	3.611	0.410	3.291	3.137	0.461	3.114	2.293	0.461	2.338
T_8 – *Azospirillium* +PSB + 50% RD'N' and 'P'+100% D'K'	3.131	0.372	3.020	2.924	0.392	2.784	2.114	0.424	2.133
T_9 – *Azospirillium* +PSB+50% VC equi.* to RD'N'+50% RDF	3.854	0.481	3.698	3.251	0.472	3.152	2.389	0.493	2.342
S.E. ±	0.23	0.03	0.24	0.17	0.02	0.19	0.15	0.02	0.20
C.D. (P=0.05)	0.68	0.08	0.73	0.50	0.07	0.56	0.45	0.07	0.59

Initial soil values of experimental site = N (272.30 kg/ha) : P (9.72 kg/ha) : K (225.61 kg/ha)
Equi.* = equivalent, FYM = Farm yard manure, PSB = Phosphate solubilizing bacterium,
VC = Vermicompost, RDF = Recommended dose of fertilizer (150:100:100 NPK kg/ha).

Table 3 : Effect of integrated nutrient management on nutrient uptake by plants and available NPK status in soil at harvest of garland chrysanthemum

Treatments	Uptake of nutrients (kg/ha)			Available nutrients (kg/ha)		
	N	P	K	N	P	K
T_1 – Absolute control	29.972	4.434	30.806	101.78	6.18	88.27
T_2 – 100% RDF + FYM (20 t/ha)	65.455	8.918	62.684	188.90	13.58	194.44
T_3 – 50% VC equivalent to RD'N' + 50% RDF	54.963	7.755	51.733	128.58	10.59	128.58
T_4 – *Azospirillium* + 75% RD'N' + 100% RD'P' and 'K'	53.672	6.899	51.558	106.86	9.79	106.86
T_5 – PSB + 75% RD'P' + 100% RD'N' and 'K'	62.391	8.093	62.435	172.43	12.60	176.15
T_6 – *Azospirillium* + 50% VC equivalent to RD'N' + 50% RDF	60.013	7.798	58.717	152.56	12.52	156.20
T_7 – PSB + 50% VC equivalent to RD'N' + 50% RDF	69.929	9.988	68.716	195.22	14.25	195.33
T_8 – *Azospirillium* + PSB + 50% RD'N' and 'P' + 100% D'K'	59.558	7.778	56.197	135.38	11.58	135.38
T_9 – *Azospirillium* + PSB + 50% VC equivalent to RD'N' + 50% RDF	82.587	12.017	79.951	206.89	18.99	223.10
S.E.±	1.79	0.90	1.70	8.56	1.07	5.02
C.D. (P=0.05)	5.36	2.68	5.11	25.66	3.21	15.04

Initial soil values of experimental site = N (272.30 kg/ha) : P (9.72 kg/ha) : K (225.61 kg/ha)
FYM = Farm yard manure, PSB = Phosphate solubilizing bacterium, VC = Vermicompost,
RDF = Recommended dose of fertilizer (150:100:100 NPK kg/ha).

through the organic sources of nutrients during decomposition process. In addition, humic acid formed during decomposition of vermicompost had greater influence in stimulating the roots and speeding up the developmental process of plant which in turn resulted in better NPK content in garland chrysanthemum plant. These results are in accordance with Rajdurai and Beavlah (2000) in African marigold and Chaitra (2006) in china aster.

Conclusion:

There was an improvement in growth and yield parameters with highest net income (Rs.1,95,135/ha) with the application of *Azospirillum*, PSB and 50 per cent vermicompost equivalent to RDN along with 50 per cent RDF. Plant analysis results indicated that the same treatment showed maximum NPK content in different plant parts. Therefore, it can be concluded that there is a possibility of reducing NPK application by 25-50 per cent with the use of biofertilizers and organic manures, thus bringing down the cost of input in the production of garland chrysanthemum under field condition along with improvement in flower quality.

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