

Original Research Article

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Effect of Integrated Nutrient Management on Floral Parameters and Soil Nutrient Status in Chrysanthemum (*Chrysanthemum morifolium* Ramat.)

Geeta Pandey*, Rakesh Kumar, Santosh Kumar and Ajit Kumar

Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

*Corresponding author

ABSTRACT

Keywords

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Cultivar Prof. Harris performed better in terms of flower diameter (10.00 cm), fresh and dry weight (57.9 and 15.97 g) of cut flower, whereas cultivar Sunil showed longer flower stem length (48.66 cm), water uptake (90.78 ml) and vase life (20.41 days). Application of 75% recommended dose of fertilizer and vermicompost coupled with dual inoculation of Azotobacter and VAM proved most effective in enhancing the flower stem length (53.68 cm), more flower diameter (11.97 cm) and enhanced vase life of flowers (22.70 days). The highest water uptake (93.51ml) and maximum available nitrogen (184.23 kg/ha), phosphorus (28.53 kg/ha) and potassium content (192.26 kg/ha) was recorded in treatment with application of 75% RDF + Azotobacter + VAM + vermicompost (T15).

Introduction

Chrysanthemum (*Chrysanthemum morifolium* Ramat.), which occupies a prominent place in ornamental horticulture, is one of the commercially exploited flower crops belongs to the family Asteraceae and is known as “Queen of East”. It is native to the northern hemisphere and is widely distributed in Europe and Asia. However, it is believed that, its origin is China. The plant grows erect and tall making it suitable for border planting, cut flowers and loose flower for garland making, general decoration, hair adornments and religious function. It is also grown in pots for flower shows. Out of the various factors affecting the growth and flowering of

chrysanthemum, balanced nutrition is very important. Chrysanthemum is a heavy feeder of nutrients specially nitrogen and phosphorus (Nalawadi, 1982). At present, these nutrients are supplied through chemical fertilizers. But due to rising cost, indiscriminate and continuous use of chemical fertilizers in intensive cropping system, there is imbalance of nutrients in soil which has an adverse effect on soil health, yield and quality of crop (Sunitha and Hunje, 2010). Therefore, the integrated use of nutrients is the need of hour. Integrated Nutrient Management (INM) concept is one of the eco-friendly approaches. INM is the better option for the improvement of physical, chemical and biological properties of soils (Das *et al.*, 2015). INM holds great

promise in exhibiting the growing nutrient demands of intensive farming like floriculture and maintaining productivity at its optimum with holistic improvement in the quality of resource base, which is very much important in-case of cut and bulbous flowers (Wani *et al.*, 2017). Hence, an attempt was made to reduce the amount of nitrogenous, phosphatic and potassic fertilizers by substituting with organic manures and biofertilizers (*Azotobacter* and PSB).

The use of INM in varying combinations was reported to be beneficial for increasing yield and quality of flowers. Hence, the adoption of this practice will be proved advantageous for the farmers. Keeping this in view, the present investigation was undertaken to study the influence of integrated nutrient management on floral parameters of chrysanthemum and nutrient status in the soil.

Materials and Methods

The present experiment was conducted at Model Floriculture Centre, G.B.P.U.A. & T., Pantnagar, Uttarakhand during July, 2008 to February, 2010. The treatments consisted of two chrysanthemum cultivars *viz.*, Prof. Harris (C₁) and Sunil (C₂), and different combination of inorganic and organic fertilizers *viz.*, control (T₁-100% Recommended dose of fertilizer- RDF), T₂ -VAM + *Azotobacter*+ vermicompost; T₃ -75% N + *Azotobacter* + full dose of P & K; T₄ - 50% N + *Azotobacter* + full dose of P & K; T₅ -75% P + VAM + full dose of N & K; T₆ -50% P + VAM + full dose of N & K; T₇ -75% RDF + vermicompost; T₈ -50% RDF + vermicompost; T₉ -75% RDF + *Azotobacter* + vermicompost; T₁₀ -50% RDF + *Azotobacter* + vermicompost; T₁₁ -75% RDF + VAM + vermicompost; T₁₂ -50% RDF + VAM + Vermicompost; T₁₃ - 75% N and P +*Azotobacter* + VAM + full dose of K; T₁₄ - 50% N and P + *Azotobacter* + VAM + full dose of K; T₁₅ -75% RDF + *Azotobacter* +

VAM + vermicompost and T₁₆ -50% RDF + *Azotobacter*+ VAM + vermicompost. Four week old rooted cutting of chrysanthemum were transplanted at a spacing of 30x40 cm. Nitrogen, phosphorus and potassium (100 %, 75 %, and 50 %) were applied along with vermicompost (1kg/ha), *Azotobacter* and VAM as per treatment. *Azotobacter* was applied in the form of slurry by dipping the cuttings for 30 minutes before transplanting. Whereas, VAM @ 2 g/plant was applied at the time of transplanting in the holes made for transplanting the cutting.

The experiment was laid out in Factorial Randomized Block Design (RBD) with three replications. Data on various flowering parameters *viz.*, flower stem length, flower diameter, fresh and dry weight of cut flower, water uptake by cut flower, vase life and available N,P and K in the soil were recorded and statistically analyzed.

Results and Discussion

It is evident from the data presented in Table 1 that cultivar Prof. Harris performed better in terms of flower diameter (10.00 cm), fresh and dry weight (57.9 and 15.97 g) of cut flower, whereas cultivar Sunil showed longer flower stem length (48.66 cm), water uptake (90.78 ml) and vase life (20.41 days). This might be due to genotypic differences between both the cultivars due to which they respond differently. Further significant influence of different treatment combinations of reduced doses of inorganic fertilizers along with organic fertilizers on various floral parameters and soil nutrient status was observed. The treatment 75% RDF + *Azotobacter* + VAM + vermicompost (T₁₅) proved most effective in enhancing the flower stem length (53.68 cm) followed by T₁₃ (51.23 cm), T₅ (49.96 cm), T₁₁ (48.49 cm) and T₁ (46.36 cm). Whereas, minimum mean stem length (36.04 cm) was observed in VAM + *Azotobacter* +

vermicompost (T₂). The enhancement in length of flower stem is also attributed to an increase in level of growth promoting substances particularly gibberellins due to presence of organic fertilizers. Gibberellins accelerate concentrations of hexose sugars (mainly glucose) and acid invertase activity, and increased concentrations of these are the major factors influencing elongation. Similar findings have also been reported by Nandre *et al.*, (2005) in China aster and Mukesh Kumar (2015) in chrysanthemum.

Flower diameter (10 cm) of cv. Prof. Harris was more in comparison to cv. Sunil (9.44 cm). Diameter of flower was significantly increased by integrated use of nutrients from different sources as compared to control. However, application of 75% RDF+ Azotobacter + VAM + vermicompost (T₁₅) produced maximum flower diameter (11.97 cm). This may be due to *Azotobacter* which provides more amounts of nitrogen by fixing it through atmosphere. The positive effect of vermicompost on flower diameter has been reported in marigold by Mashaldi (2000) and Ajit Kumar (2002); Deshmukh *et al.*, (2008) in gaillardia; Angadi (2010) and Verma *et al.*, (2011) in chrysanthemum; Mukesh Kumar, (2015) in chrysanthemum while, VAM + Azotobacter + vermicompost (T₂) resulted in minimum flower diameter (7.23 cm). Fresh (57.90 g) and dry weight (15.97 g) of cut flower was greater in cv. Prof. Harris in comparison to cv. Sunil. Application of 75% RDF + Azotobacter + VAM + vermicompost (T₁₅) recorded maximum fresh (60.91 g) and dry weight (17.44 g) of cut flower. This increase in dry weight may be ascribed due to effects of plant growth regulators, high rate of photosynthates from vegetative parts to the reproductive parts, which subsequently might have resulted in higher fresh weight and dry matter accumulation. These findings are in line with the results reported in marigold by Mukesh Kumar *et al.*, (2006), Sudhir *et al.*,

(2009) in chrysanthemum and Chaitra and Patil (2007) in China aster. While, minimum fresh (52.37 g) and dry weight (12.87 g) was recorded with application of VAM + Azotobacter + vermicompost (T₂).

The quality of cut stems depends on the various post harvest parameters. In the experiment, among the various treatments, water uptake (90.78 ml) and vase life (20.41days) was recorded maximum in cv. Sunil as compared to cv. Prof. Harris. Application of 75% N and P + Azotobacter + VAM + full dose of K proved (T₁₃) to be most effective in improving the vase life of flowers (22.70 days). Water uptake was also recorded to be highest (93.51ml) under this treatment. Similar beneficial effects on vase life have been also reported by Mahadik *et al.*, (2017) in chrysanthemum, Moghal *et al.*, (2006) in China aster, Parmar (2006) in rose and Dalve *et al.*, (2008) in gladiolus; Mukesh Kumar (2015) in chrysanthemum whereas, lowest water uptake (86.29 ml) and vase life (16.27 days) was found in treatment combination of VAM + Azotobacter + vermicompost (T₂).

As far as, effect of integrated use of chemical fertilizers, biofertilizers and vermicompost on soil nutrient status is concerned, the integrated nutrient management resulted in improved soil nutrient status. Pooled data of both the years reveals that irrespective of the effect of treatments available nitrogen content in the soil was recorded highest (178.17 kg/ha) in cv. Prof. Harris while, lowest (176.83 kg/ha) nitrogen content was recorded in cv. Sunil. Among treatments, application of 75% RDF + Azotobacter + VAM + vermicompost (T 15) resulted in maximum (184.23 kg/ha) nitrogen content in the soil followed by T 13 (183.43 kg/ha), T 3 (182.54 kg/ha), T 9 (182.32 kg/ha) and T5 (179.90 kg/ha). Whereas, minimum (169.09 kg/ha) available nitrogen content was recorded under T2 (VAM + Azotobacter + vermicompost).

Table.1 Effect of integrated nutrient management on flowering and post-harvest attributes of chrysanthemum (pooled over two years)

Treatment	Flower stem length (cm)	Flower diameter (cm)	Fresh weight of cut flower (g)	Dry weight of cut flower (g)	Water uptake by cut flower (ml)	Vase life (days)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
Cultivars									
Prof. Harris	37.98	10.00	57.90	15.97	88.92	17.83	178.17	23.72	187.72
Sunil	48.66	9.44	55.64	15.06	90.78	20.41	176.83	23.48	188.92
C.D. at 5 %	0.150	0.119	0.173	0.148	0.117	0.127	0.129	ns	0.793
Fertilizer combination									
T ₁	46.36	10.18	57.60	15.85	90.41	19.68	176.26	23.86	189.20
T ₂	36.04	7.23	52.37	12.87	86.29	16.27	169.09	17.01	177.73
T ₃	46.08	10.63	58.59	16.66	90.85	20.49	182.54	23.55	189.76
T ₄	38.17	8.30	54.96	14.64	88.16	17.50	174.75	21.52	187.56
T ₅	49.96	11.14	59.17	16.97	91.75	21.47	179.90	26.08	191.15
T ₆	40.10	9.22	55.83	14.97	89.34	18.22	179.43	22.01	188.99
T ₇	44.60	10.03	56.16	15.30	89.79	18.65	175.66	24.74	190.22
T ₈	36.70	7.83	54.52	14.23	87.60	16.94	172.31	21.04	185.82
T ₉	44.19	10.43	57.72	16.06	90.33	19.80	182.32	25.46	189.70
T ₁₀	36.80	8.18	54.79	14.26	88.15	17.22	173.94	20.29	185.42
T ₁₁	48.49	11.44	58.82	16.82	91.60	20.83	177.08	26.56	190.66
T ₁₂	38.75	9.59	55.29	14.83	88.99	17.70	173.23	23.51	186.71
T ₁₃	51.23	10.73	59.77	17.15	93.51	22.70	183.43	27.52	191.62
T ₁₄	39.91	8.87	55.62	14.76	88.70	17.95	177.50	22.69	188.03
T ₁₅	53.68	11.97	60.91	17.44	92.80	21.52	184.23	28.53	192.26
T ₁₆	42.08	9.79	56.22	15.49	89.40	19.68	178.35	23.17	188.69
C.D. at 5 %	0.424	0.339	0.489	0.419	0.333	0.359	0.366	0.895	0.224

Higher availability of nitrogen in soil with the treatment of biofertilizers in combination with vermicompost and chemical fertilizer can be attributed to direct application of chemical fertilizer and release of nitrogen through vermicompost and biological fixation of atmospheric nitrogen by bacterial fertilizers. Vermicompost is a better source of nitrogen and a good carrier material for *Azotobacter* (Ismail, 1995) and vermicompost brought up the population of *Azotobacter*, which might have resulted in higher available nitrogen in the soil.

Pooled data of both the years reveals that the maximum mean available phosphorus content (23.72 kg/ha) in the soil was exhibited by cv. Prof. Harris, whereas available phosphorus content in the soil was found to be minimum (23.48 kg/ha) in cv. Sunil. Among treatments, highest mean available phosphorus content (28.53 kg/ha) in the soil was obtained in T15 (75% RDF+ *Azotobacter*+ VAM + vermicompost) followed by T13 (27.52 kg/ha), T11 (26.56 kg/ha), T5 (26.08 kg/ha) and T9 (25.46 kg/ha). Whereas, lowest (17.01 kg/ha) mean available phosphorus content was recorded under T2 (VAM + *Azotobacter* + vermicompost).

Pooled data of both the years reveals that irrespective of the effect of treatments mean available potassium content in the soil was recorded highest (188.92 kg/ha) in cv. Sunil while, lowest (187.72 kg/ha) mean potassium content was recorded in cv. Prof. Harris. Among treatments, application of 75% RDF + *Azotobacter* + VAM + vermicompost (T15) resulted in maximum (192.26 kg/ha) mean potassium content in the soil followed by T13 (191.62 kg/ha), T5 (191.15 kg/ha), T11 (190.66 kg/ha) and T7 (190.22 kg/ha). Whereas, minimum (177.73 kg/ha) mean available potassium content was recorded under T2 (VAM + *Azotobacter* + vermicompost).

The available phosphorus and potassium content were highest in the treatments with VAM, vermicompost and chemical fertilizers in soil. The build-up of available phosphorus and potassium in the soil could be attributed to the organic acids which were released during microbial decomposition of vermicompost increasing the available phosphorus and potassium in soil (Khan *et al.*, 1994). Application of chemical fertilizer also enhanced the nutrient availability in soil but at lower amount as compared to combined use of nutrients from different sources. The lower values of available NPK in soil can be due to maximum utilization of applied nutrients by the crop, which were in the most available form. Reddy and Reddy (1998) also reported that available NPK content was increased by organic manure in combination with the chemical fertilizers.

Thus, the results have proved that application of 75 per cent NPK from chemical fertilizer along with biofertilizers (*Azotobacter* and VAM) and vermicompost is most effective in enhancing the flowering attributes of chrysanthemum and soil nutrient status as compared to mere application of recommended dose of fertilizers or organic fertilizers. This indicates the possibility of reducing the dose of chemical fertilizers, which is cost effective and eco-friendly for the cultivation of chrysanthemum on sustainable basis. So, it can be concluded that by reducing the levels of chemical fertilizers and optimizing the dose of different organic fertilizers, yield and quality can be improved in ornamental crops without adversely affecting the edaphic and environmental features.

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