



Effect of different levels of macro nutrients (NPK) and mulching on growth, quality and yield of chrysanthemum (*Dendranthema grandiflora*) cv. Marigold

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ABSTRACT

The present investigation was conducted to study the effect of different levels of nutrients (NPK) and mulching on various growth and flowering traits of chrysanthemum (*Dendranthema grandiflora* Tzvelev) cv. Marigold. The field experiment was laid out in randomized block design with five treatments and four replications during 2015-16. The treatment consisted of different levels of nutrients and mulching, viz. 75% recommended dose of fertilizer (RDF) with mulching, 100% RDF with mulching, 125% RDF with mulching, 150% RDF with mulching and 100% RDF without mulching (control) and RDF was 120:150:100 kg NPK per ha. Results revealed that application of 150% RDF with mulching resulted in increased plant height (51.78 cm), leaf area (88.62 cm²), plant spread (N-S, 55.07 cm and E-W, 52.39 cm), number of laterals/plant (22.83) and number of suckers (11.17) after 120 days after planting (DAP). The same treatment has influenced early bud initiation (73.05 days), 50% flowering (103.60 days), increased flower diameter (5.44 cm), number of sprays per plant (14.40), highest flower yield per plant (658.35 g), and yield per ha (24.38 t), however, increased shelf life (6.55 days) was recorded from 125% RDF with mulching after 120 days after planting.

Key words: Chrysanthemum, Mulching, Nitrogen, Phosphorus, Potassium

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is one of the most interesting and oldest flower crops in the world. It belongs to the family Asteraceae which is one of the largest families of flowering plants and ranks next to rose and carnation in demand and popularity in the world. It is native to Europe and Asia. The plants are perennial in nature and the flowers are actually composite inflorescence, with two types of florets (disc and ray) arranged on flattened axis called capitulum or head. The flowers are mainly used for making garlands, *veni*, bracelets and for religious offering due to wide variety of colors, shapes, and textures, making them the flower of choice for the mass-market bouquet business (Winogron 1999).

Chrysanthemum is commonly grown on fertile soils, still nutrition is indispensable, because it is a heavy feeder of nutrients. However, it draws the nutrients from a very limited soil depth because of its shallow root system. Though the

quality of flowers is primarily a varietal trait, it is greatly influenced by climatic, geographical and nutritional factors. Application of chemical fertilizers is the most important which directly influence the growth and yield of flower crops (Beniwal *et al.* 2006). A survey of the literature shows that, the choice and dosage of nutrients to be applied depends on the cultivar, initial soil fertility, stage of plant growth, climate etc. A judicious use of fertilizers not only gives high flower yield but also improves the quality and shelf life of flowers (Verma *et al.* 2011, Kumar *et al.* 2016, Sowmya *et al.* 2017).

Mulching is generally practiced in several perennial horticulture crops as a means to conserve soil moisture. Of late, the practice is being extended even to some flowers and vegetable crops. Mulches in general, are found to conserve soil moisture by reducing evaporation, controlling weeds and reduce frequency of irrigation. Degradable mulches improve the soil structure and enrich it with nutrients. Use of mulching have indirectly improves the soil health and plays major role in plant growth and development (Bajad *et al.* 2017, Yohanes *et al.* 2017, Donald and Wahyu 2017).

MATERIALS AND METHODS

The experiment was conducted on chrysanthemum var. Marigold at Regional Horticultural Research and Extension

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Table 1 Influence of different levels of nutrients (NPK) and mulching on various vegetative traits in chrysanthemum cv. Marigold

Treatment	Plant height (cm)						Leaf area (cm ²)						Plant spread (cm)									
	60		90		120		30		60		90		120		30		60		90		120	
	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP	DAP
T ₁ :75% RDF (90:112.5:75 kg NPK/ha) with mulching	22.65	31.6	39.80	42.57	34.16	59.78	70.99	74.40	74.69	69.97	16.82	32.18	40.68	42.00	32.92	15.56	29.95	34.31	37.53	29.34		
T ₂ :100% RDF (120:150:100 kg NPK/ha) with mulching	23.20	33.3	41.85	44.48	35.71	61.69	73.17	76.18	77.11	72.04	17.05	34.40	45.04	46.65	35.79	16.95	32.18	37.08	41.83	32.01		
T ₃ :125% RDF (150:187.5:125 kg NPK/ha) with mulching	26.69	36.99	43.94	48.71	39.08	69.33	82.94	83.76	84.86	80.22	18.85	38.76	49.24	50.24	39.27	18.13	35.24	47.95	49.34	37.67		
T ₄ :150% RDF (180:225:150 kg NPK/ha) with mulching	27.03	38.29	46.69	51.78	40.95	75.17	84.75	88.48	88.62	84.26	19	44.30	53.36	55.07	42.93	19.21	39.77	49.60	52.39	40.24		
T ₅ :100% RDF (120:150:100 kg NPK/ha) without mulching (control)	18.75	28.75	37.38	38.43	30.83	55.96	63.27	69.01	71.63	64.97	16.35	32.25	37.25	39.66	31.38	14.94	27.08	31.06	36.67	27.44		
SEm±	1.13	1.06	1.25	1.90		2.07	0.72	3.00	1.60		0.64	1.83	1.46	1.59		1.01	1.76	1.01	1.38			
CD (P=0.05)	3.49	3.26	3.86	5.85		6.38	2.21	9.23	4.92		1.96	5.64	4.51	4.90		3.13	5.44	3.11	4.24			

RDF, Recommended dosage of fertilizer; NPK (RDF), 120:150:100 (kg/ha), DAP, days after planting; P, phosphorous

Centre, University of Horticultural Sciences, Bengaluru Campus, in randomized block design with four replications during 2015-16. The treatment comprising of different levels of nutrition (NPK) with mulching, viz. (T₁) 75% RDF with mulching, (T₂) 100% RDF with mulching, (T₃) 125% RDF with mulching, (T₄) 150% RDF with mulching and (T₅) 100% RDF without mulching (control). The recommended dose of fertilizers for chrysanthemum was given as 120:150:100 kg NPK/ha (Anon. 2014). The farm-yard manure was applied one month before transplanting of rooted cuttings. Black polyethylene sheets (gauge 30 micron thickness) were taken as mulch material, cut according to plot size and spread over the plots as per the treatments. Then split the mulch as per the recommended spacing for planting chrysanthemum rooted cuttings. The chrysanthemum variety Marigold was locally collected from Sri Sai nursery, Shivakote, Bengaluru. Its flowers are pompon type, yellow, suitable for loose flower and garland making.

Thirty days old seedlings were transplanted at spacing of 60 cm × 45 cm in 12 m × 1 m sized mulched bed. Before mulching nitrogen, phosphorous and potassium were applied through urea, single super phosphate and muriate of potash. Half dose of nitrogen and full dose of phosphorous and potassium were applied as a basal dose at the time of transplanting and remaining half dose of nitrogen was applied one month after transplanting as per the treatments. Immediately after transplanting, the experiment plots were irrigated lightly. The regular irrigations were given at an interval of 2-3 days through drip irrigation. Pinching was done at 30 days after transplanting. Five plants were selected randomly from each treatment plot and labeled for recording observations on vegetative growth parameters at 30 days interval from 30 days after planting (DAP) till 120 days after transplanting. Flowering observations were recorded once during the period of flowering. Yield attributes like number of flowers/plant, weight of flowers/plant and yield of flowers/ha were calculated.

RESULTS AND DISCUSSION

Effects of NPK and mulching on various vegetative traits

On the perusal of the data presented in Table 1 indicated significant increase in the plant height, leaf area, plant spread, number of laterals/plant and number of suckers/plant from 30 DAP to 120 DAP. Application of 150% RDF with mulching recorded maximum plant height (27.03 cm, 38.29 cm, 46.69 cm and 51.78 cm, respectively) and leaf area (75.17 cm², 84.75 cm², 88.48 cm² and 88.62 cm², respectively) at 30, 60, 90 and 120 days after planting. Same treatment also showed the highest plant spread N-S (19.0 cm, 44.30 cm, 53.36 cm and 55.07 cm, respectively) and E-W (19.21 cm, 39.77 cm, 49.60 cm and 52.39 cm, respectively) after 30, 60, 90 and 120 days after planting. The next best treatment for these traits was 125% RDF with mulching.

Data presented in Table 2 indicated that the application of different doses of macro nutrients with or without mulching significantly affected the number of laterals and suckers/plant. Application of 150% RDF with mulching recorded significant increasing trend in number of laterals/plant (8.37, 16.44, 20.12 and 22.83, respectively) at 30, 60, 90 and 120 days after planting, and maximum number of suckers/plant (11.17) after 120 days of planting. Application of 125% RDF with mulching recorded next best treatment for number of lateral and suckers per plant. However, application of 100% RDF without mulching recorded minimum plant height (38.43 cm), leaf area (71.63 cm²), plant spread (N-S, 39.66 cm and E-W, 36.67 cm), number of laterals (13.01) and suckers (5.28) per plant after 120 days of planting.

Nitrogen is associated in the synthesis of protoplasm and primarily in the manufacture of carbohydrate synthesis and amino acids from which the phytohormones like auxins, gibberellins, cytokinins have been synthesized resulting in increased plant growth (Tisdale and Nelson 1975). Results are in conformity with the findings of Sainath *et al.* (2012), Joshi *et al.* (2013) and Neelima *et al.* (2013) in chrysanthemum.

Table 2 Effect of different levels of nutrients (NPK) and mulching on number of branches/plant and number of suckers/plant in chrysanthemum cv. Marigold

Treatment	Number of laterals/plant (days after planting)					Number of suckers/plant (after 120 DAP)
	30	60	90	120	Mean	
T ₁ :75% RDF (90:112.5:75 kg NPK/ha) with mulching	5.65	10.97	14.09	15.83	11.64	5.88
T ₂ :100% RDF (120:150:100kg NPK/ha) with mulching	6.45	11.94	15.73	17.08	12.80	6.68
T ₃ :125% RDF (150:187.5:125 kg NPK/ha) with mulching	7.13	14.85	18.60	20.68	15.32	9.18
T ₄ :150% RDF (180:225:150 kg NPK/ha) with mulching	8.37	16.44	20.12	22.83	16.94	11.17
T ₅ :100% RDF (120:150:100 kg NPK/ha) without mulching (control)	4.02	7.84	12.13	13.01	9.25	5.28
SEm±	0.78	0.85	0.53	0.72		0.68
CD (P=0.05)	2.39	2.63	1.63	2.22		2.09

RDF, Recommended dosage of fertilizer; NPK (RDF), 120:150:100 (kg/ha), P, phosphorous; N, nitrogen; K, potassium

Phosphorus is one of the major element and being a constituent of nucleoprotein, known to play a leading role in photosynthesis, cell division and tissue formation (Arnon 1959). The increase in vegetative growth by phosphorus has been reported in chrysanthemum (Chezhiyan *et al.* 1986, Chawla *et al.* 2006) and in China aster, (Singh and Sangama 2000). Potassium is necessary for many plant functions, including carbohydrate metabolism, enzyme activation, osmotic regulation and efficient use of water, nitrogen uptake and protein synthesis and translocation of assimilates. Singatkar *et al.* (1995) also reported similar results in gaillardia and Saud (2002) in French marigold.

Along with fertilizers use of black polythene as mulching material enhanced the vegetative growth characters. This may be possible due to soil moisture conservation through modified micro-climatic conditions, optimum soil temperature, prevent weed growth, and reduce evaporation with increased infiltration and mineral nutrient uptake throughout the growing season which stimulate root growth that leads to greater plant growth. Therefore, mulched plants usually grow and mature more uniformly than unmulched plants. These findings are in agreement with results of Reza *et al.* (2011) and Lei Xu (2014) in chrysanthemum; Arora *et al.* (2002) in carnation and Sarmah *et al.* (2014) in gerbera.

Effects of NPK and mulching on flowering traits

Data presented in Table 3 indicated that application of nutrients and mulching significantly influenced different flowering traits, flower yield and shelf-life of chrysanthemum cv. Marigold. Application of 150% RDF with mulching significantly recorded early bud appearance (73.05 days), 50% flowering (103.60 days) and harvesting interval (2.00 days), however, application 125% RDF with mulching recorded next best treatment for first flower bud appearance (76.50 days), 50% flowering (106.13 days) and harvesting interval (2.50 days). The earliness of flowering may be attributed to the easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinins to the axillary buds resulting in breakage of apical dominance. Ultimately, resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase. These results are in agreement with the findings of Vijaykumar and Shanmugavelu (1978), Patel and Chaudhari (2011) in chrysanthemum.

In addition, use of polyethylene films as mulch have shortened growing season and enhanced earliness in many flower crops. This is probably due to maintenance of favourable temperatures during growing season and continues availability of applied nutrients and moisture in

Table 3 Influence of different levels of nutrients (NPK) and mulching on various flowering traits, flower yield and vase life in chrysanthemum cv. Marigold

Treatment	Days to first flower bud appearance	Days to 50% flowering	Harvesting interval (days)	Flower diameter (cm)	Number of sprays/plant	Individual flower weight (g)	Number of flowers/plant	100 flower weight (g)	Yield of flowers/plant (g)	Flower yield/ha (tonnes)	Shelf life (days)
T ₁ :75% RDF (90:112.5:75 kg NPK/ha) with mulching	82.27	114.53	3.50	4.72	10.65	5.61	92	561	512.12	19.11	4.93
T ₂ :100% RDF (120:150:100 kg NPK/ha) with mulching	80.49	109.56	3.00	4.88	11.70	5.82	97	582	564.54	20.90	5.53
T ₃ :125% RDF (150:187.5:125 kg NPK/ha) with mulching	76.50	106.13	2.50	5.23	12.20	6.23	103	623	641.69	23.42	6.55
T ₄ :150% RDF (180:225:150 kg NPK/ha) with mulching	73.05	103.60	2.00	5.44	14.40	6.27	105	627	658.35	24.38	5.84
T ₅ :100% RDF (120:150:100 kg NPK/ha) without mulching (control)	87.24	117.77	3.75	4.68	8.13	5.42	85	542	460.70	17.62	4.73
SEm±	1.66	1.51	0.29	0.09	0.73	0.14	0.43	1.98	4.43	0.15	0.30
CD (P=0.05)	5.12	4.67	0.89	0.28	2.24	0.44	1.33	6.09	13.65	0.46	0.91

RDF, Recommended dosage of fertilizer; NPK (RDF),120:150:100 (kg/ha), DAP, days after planting; P, phosphorous; N, nitrogen; K, potassium

soil. Murugan and Gopinath (2001) obtained maximum duration of flowering and advanced flowering in crossandra cv. Saundrya using black polyethylene.

The nutrient levels and mulching significantly affected the flower quality, flower yield and shelf-life. The higher flower yield is a manifestation of other yield contributing quality characters. Flower diameter (5.44 cm), number of sprays/plant (14.40), individual flower weight (6.27 g), maximum number of flowers/plant (105), 100 flower weight (627g), flower weight/plant (658.35 g) and yield of flower/ha (24.38 t) were recorded maximum in plants supplied with 150% RDF with mulching.

Remarkable increase in yield and other flowering parameters may be assigned in two ways, viz. by increasing the number of laterals and leaf area and increasing shoot growth and plant spread, hence, the ultimate size of the plant thereby, increasing the number of potential sites where flowers could develop. The results regarding yield attributes due to interaction of nitrogen, phosphorus and potassium are in consonance with Sainath *et al.* (2012), Joshi *et al.* (2013) and Neelima *et al.* (2013) in chrysanthemum; Kaushik *et al.* (2012) and Lal *et al.* (2015) in African marigold and Monish *et al.* (2008) in China aster. In addition, mulching is helpful for soil moisture conservation through modified micro-climatic conditions, optimum soil temperature, prevent weed growth and reduce evaporation with increased infiltration and mineral nutrient uptake throughout the growing season in the mulched plot.

Abundant supply of all these macro-nutrients at higher level might have accelerated the photosynthetic activities of plants and thus more assimilates might have been available for flowers to develop, resulting in increased flower quality parameters. The results are in conformity with Anuradha *et al.* (1990) and Agrawal *et al.* (2002) in African marigold. Mulching resulted in conservation of soil moisture and made higher availability of applied nutrients by decreasing the intensity of weed infestation. This must be the reason for increase in the quality parameters.

The maximum shelf-life (6.55 days) was recorded in plants supplied with 125% RDF with mulching. The increase in shelf-life might be due to the higher retention of water in the cells of flowers and lower desiccation. Similar beneficial effect of nutrients on shelf-life of flowers has been reported in chrysanthemum (Neelima *et al.* 2013).

On the basis of the results obtained, it can be concluded that the higher dose of 150% RDF with mulching increased the growth, flower quality attributes and yield in chrysanthemum cv. Marigold

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