Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 1879-1882
Received: 25-09-2017
Accepted: 27-10-2017

MK Mahadik
Ph. D. Scholar, Department of Horticulture, Dr. P.D.K.V., Akola, Maharashtra, India

SR Dalal
Head, Section of Horticulture, College of Agriculture, Dr. P.D.K.V., Akola, Maharashtra, India

SM Wararkar
Ph. D. Scholar, Department of Horticulture, Dr. P.D.K.V., Akola, Maharashtra, India

UH Patil
Ph. D. Scholar, Department of Horticulture, Dr. P.D.K.V., Akola, Maharashtra, India

Correspondence
MK Mahadik
Ph. D. Scholar, Department of Horticulture, Dr. P.D.K.V., Akola, Maharashtra, India

Dry matter production and nutrients composition of chrysanthemum in relation to integrated nutrient management

MK Mahadik, SR Dalal, SM Wararkar and UH Patil

Abstract
A field investigation entitled "dry matter production and nutrients composition of chrysanthemum in relation to integrated nutrient management." was carried out at Floriculture Unit, Department of Horticulture, Dr. P.D.K.V., Akola. In which application of biofertilizers (i.e. Azotobactor and PSB @ 5 kg ha^{-1})and 50% RDF (150:100:100 kg ha^{-1} of NPK) + 10 t ha^{-1} VC (50% N through VC) recorded significantly maximum dry matter production and nutrient composition (both macro *viz*., nitrogen, phosphorus and potassium as well as micro *viz*., zinc, copper, iron and manganese) of chrysanthemum plants.

Keywords: Chrysanthemum, composition, dry matter, nutrients, production, relation.

Introduction
Chrysanthemum (belongs to family Asteraceae) is most important cut as well as loose flower crops in our country. Various cultural practices are adopted in chrysanthemum for increasing yield and among them; INM plays an important role in influencing the growth, yield and quality of flowers. INM encourages better uptake of mineral nutrients by plants which resulted in more number of branches as well as leaf area on plant and there by more flowers $plant^{-1}$ ultimately more dry matter accumulation (Patanwar *et al*. 2014) [12]. Requirement of a crop for a nutrient is decided by its rooting behavior and mining ability, the native soil status, the potential yields, the targeted yields and nutrient management. Since chrysanthemum forages deeper (45 cm) into the soil and are thus, efficient in availing the native soil nutrients like P & K. An INM is the most efficient and practical way to mobilize all the available, accessible and affordable plant nutrient sources in order to plants can accumulate maximum dry matter and various nutrients in order to produce maximum yield of better quality flowers.

Materials and methods
The experiment was carried out in Split Plot Design fourteen treatment combinations. The treatments comprised of two levels of biofertilizers i.e. with biofertilizers (Azotobacter and PSB @ 5 kg ha^{-1}) and without biofertilizer in main plot and seven combination of organic and inorganic fertilizers including one treatment of recommended dose of fertilizers *viz*., 100% RDF (300:200:200 kg ha^{-1}), 75% RDF + 15 t ha^{-1} FYM (25% N through FYM), 50% RDF + 30 t ha^{-1} FYM (50% N through FYM), 75% RDF + 5 t ha^{-1} VC (25% N through VC), 50% RDF + 10 t ha^{-1} VC (50% N through VC), 75% RDF + 1.5 t ha^{-1} NC (25% N through NC) and 50% RDF + 3 t ha^{-1} NC (50% N through NC); during the winter season of the years 2014-15 and 2015-16, at Department of Horticulture, Dr. PDKV, Akola and replicated for three times. The observations on dry matter production and nutrient composition were recorded by drying individual plant along with its roots and flowers from respected treatment plots when it was at full bloom stage but just prior to its oldest flower gets shriveled. The nutrients (major nutrients *viz*., nitrogen, phosphorus and potassium; micronutrients *viz*., zinc, copper, iron and manganese) composition of plants were analyzed by utilizing various instruments e.g. Kjelplus apparatus as suggested by Tandon (1993) [17], spectrophotometer at 420 nm wavelength as suggested by Chopra and Kanwar (1978) [3], flame photometer as suggested by Piper (2010) [13] and atomic absorption spectrophotometer as suggested by Mclaren and Crawford (1950) [10].

The data on various parameters during the course of investigation was statistically analysed as per the method suggested by Panse and Sukhatme (1995) [11].

Results and discussion

Effect of bio fertilizers

The total dry matter production (g $plant^{-1}$) and nutrients (both macro and micro nutrients) composition of chrysanthemum plant (Table 1 and 2) were significantly influenced by application of biofertilizers.

During both the years (i.e. 2014-15 and 2015-16) as well as in pooled data, significantly higher (76.65, 72.17 and 74.41 g $plant^{-1}$, respectively) total dry matter accumulation was obtained in treatment M_1 i.e. application of biofertilizers (Azotobacter and PSB @ 5 kg ha^{-1}). Whereas the least dry matter accumulation was noticed in the treatment M_2 (71.35, 65.75 and 68.55 g $plant^{-1}$, respectively). This could be attributed to better flow of various micro and macronutrients along with plant growth substances into the plant system in the plots applied with Azotobacter and PSB. There by it might have favoured for stimulation and production of auxiliary buds resulting in formation of more number of branches. The above results are also corroborated with findings of Pithiya *et al*. (2016) [14] who reported application of Azotobacter and PSB resulted in maximum plant growth in terms of plant height, plant spread and number of primary branches which ultimately resulted in maximum accumulation of dry matter by China aster plants.

Apart from the reasons mentioned earlier, the increase in dry matter production resulted from enhanced growth parameter like plant height, plant spread and number of branches due to application of Azotobacter may also be attributed to the influence of nitrogen, the chief constituent of protein which is essential for formation of protoplasm, which enhances cell division and cell enlargement. Moreover, nitrogen is an important component of amino acids and co-enzymes, which are of considerable biological importance. The mechanisms by which PSB augmented plant growth are through phosphate dissolution and in the biosynthesis of auxins. Also by providing protection against the non-parasitic root pathogens and transforming unavailable mineral and organic compounds into available forms to the plants.

Similarly, the treatment of application of biofertilizers (M_1) resulted in maximum nutrient composition e.g. macro nutrients *viz*. nitrogen (3.02, 3.05 and 3.03 %, respectively), phosphorus (0.40, 0.41 and 0.41 %, respectively) and potassium (3.87, 3.83 and 3.85, respectively) as well as micro nutrients *viz*. zinc (20.29, 20.66 and 20.47 ppm, respectively), copper (5.69, 5.73 and 5.71 ppm, respectively), iron (65.51, 65.02 and 65.27 ppm, respectively) and manganese (102.39, 100.49 and 101.44 ppm, respectively). Whereas the treatment M_2 resulted in minimum nutrient composition in plants e.g. macro nutrients *viz*. nitrogen (2.98, 3.00 and 2.99 %, respectively), phosphorus (0.39, 0.40 and 0.40 %, respectively) and potassium (3.81, 3.77 and 3.79, respectively) as well as micro nutrients *viz*. zinc (19.61, 19.97 and 19.79 ppm, respectively), copper (5.49, 5.53 and 5.51 ppm, respectively), iron (63.24, 63.01 and 63.12 ppm, respectively) and manganese (100.22, 98.35 and 99.28 ppm, respectively) during both the years (i.e. 2014-15 and 2015-16) as well as in pooled data.

This may be attributed to the inoculated PSB which mediated the release of phosphorus from insoluble phosphate and fixation of atmospheric nitrogen by Azotobacter in plants and, in turn, physiological changes of the plants on exposure to action of the inoculated microorganisms. In addition, humic acid and availability of micronutrients under biofertilizers enriched soil had greater influence in stimulating roots and regulating metabolism, speeding up the developmental process of plant which, in turn, resulted in better macro and micro nutrients contents in chrysanthemum plants. Similar findings to this results were also recorded by Kumari *et al* (2014) [7] in chrysanthemum.

Effect of organic and inorganic fertilizers

Dry matter production and composition of nutrients e.g. macro nutrients *viz*., nitrogen, phosphorus and potassium as well as micro nutrients *viz*., zinc, copper, iron and manganese (Table 1 and 2) were significantly influenced by application of organic and inorganic fertilizers.

Significantly, maximum dry matter production (78.19, 78.36 and 78.27 g $plant^{-1}$, respectively) during the year 2014-15 and 2015-16 as well as in pooled data was recorded with the treatment of S_5 which was followed by the treatments S_3 (75.72, 73.54 and 74.63 g $plant^{-1}$, respectively) and S_4 (74.63, 71.29 and 72.96 g $plant^{-1}$, respectively). Whereas, significantly minimum dry matter production was recorded under the treatment S_1 (68.05, 57.37 and 62.71 g $plant^{-1}$, respectively).

The dry weight (g $plant^{-1}$) showed significant differences amongst various treatments. Significantly, higher total dry weight of plant was recorded with the treatment S_5 (i.e. application of 50% RDF + Vermicompost @ 10 t ha^{-1}) as compared to other treatments. Treatments again clearly showed the beneficial effect of vermicompost and chemical ferilizers. The increase in dry weight may be due to luxurious vegetative growth in terms of plant height, plant spread, number of leaves and number of branches. The increase in dry weight may be ascribed to effects of plant growth regulators as vermicompost rich in beneficial microorganisms, higher rate of supply of photosynthates from vegetative parts to the reproductive parts which subsequently might have resulted in higher dry matter accumulation. These findings are in line with the results reported by Singh *et al*. (2015) [15] who observed maximum dry matter accumulation in case of application of 75% RDF along with vermicompost @ 80 q ha^{-1} in marigold, also similar results in China aster (Chaitra, 2006) [1] and (Chaitra and Patil, 2007) [2] and in chrysanthemum (Patnvar *et al*. 2014) [12] who recorded, increase in plant total dry matter production with the application of vermicompost @ 2.5 t ha^{-1} along with 50 % RDF. This might also be due to the fact that, vermicompost is rich sources of macro and micro nutrients, Fe and Zn might have enhanced the microflora and enzymatic activity which might have augmented the plant growth. The positive effect of vermicompost on plant growth has been also reported in gladiolus (Gangadharan and Gopinath, 2000) [5], in golden rod (Kusuma, 2001) [8] and in chrysanthemum (Verma, 2010) [18] and (Verma *et al*., 2011) [19].

Similarly, during both the years i.e. 2014-2015 and 2015-16 and also in pooled data, the treatment S_5 had recorded significantly maximum nutrient composition e.g. macro nutrients *viz*. nitrogen (3.14, 3.16 and 3.15 %, respectively), phosphorus (0.42, 0.43 and 0.42 %, respectively) and potassium (4.00, 3.96 and 3.98, respectively) as well as micro nutrients *viz*. zinc (21.72, 22.12 and 21.92 ppm, respectively), copper (6.09, 6.13 and 6.11 ppm, respectively), iron (70.09, 68.64 and 69.37 ppm, respectively) and manganese (109.66, 107.62 and 108.64 ppm, respectively). Whereas the treatment S_1 resulted in minimum nutrient composition e.g. macro nutrients *viz*. nitrogen (2.84, 2.86 and 2.85 %, respectively), phosphorus (0.38, 0.39 and 0.38 %, respectively) and potassium (3.65, 3.61 and 3.63, respectively) as well as micro nutrients *viz*. zinc (18.27, 18.61 and 18.44 ppm, respectively), copper (5.12, 5.15 and 5.14 ppm, respectively), iron (58.94, 58.88 and 58.91 ppm, respectively) and manganese (92.01, 90.30 and 91.15 ppm, respectively) during both the years (i.e. 2014-15 and 2015-16) as well as in pooled data.

Plant macro and micro nutrients composition was maximum in the treatment S_5 (50% RDF + vermicompost @ 10 t ha^{-1}) and minimum in the treatment S_1 (100% RDF). This might be due to antagonistic effect of NPK which interfers with the physiological action of another; due to imbalanced dose of N. The maximum nutrients (both macro as well as micro nutrient) composition in in the treatment S_5 was attributed to the better availability and uptake of nutrients facilitated by application of vermicompost. The beneficial effect of vermicompost on nutrient uptake was reported in carnation (Dalawai and Naik (2014) [4]. The results also indicate that, application of vermicompost enhanced the uptake of nutrients in the respected treatments which is in accordance to the observations made by Sonawane *et al*. (2009) [16] in China aster and similar effect of integrated nutrient management on nutrient content of leaves and uptake in chrysanthemum by Muthamizhselvi *et al*. (2006) [9] and in petunia by Hoda and Mona (2014) [6].

Interaction effect

In case of interaction effect (Table 1 and 2) which was found non-significant for various parameters studied in this investigation.

Table 1: Effect of integrated nutrient management on dry matter production and macro nutrients composition of chrysanthemum

Treatments	Dry matter (g plant^{-1})			Nitrogen (%)			Phosphorus (%)			Potassium (%)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Bio-fertilizers (M)												
M_1 – With bio-fertilizers	76.65	72.17	74.41	3.02	3.05	3.03	0.40	0.41	0.41	3.87	3.83	3.85
M_2 – Without bio-fertilizers	71.35	65.75	68.55	2.98	3.00	2.99	0.39	0.40	0.40	3.81	3.77	3.79
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.855	0.819	0.837	0.006	0.006	0.006	0.000	0.000	0.0004	0.009	0.009	0.008
CD at 5%	5.203	4.983	3.287	0.039	0.039	0.025	0.003	0.003	0.0021	0.055	0.054	0.035
Organic and inorganic fertilizers (S)												
S_1 - 100 % RDF	68.05	57.37	62.71	2.84	2.86	2.85	0.38	0.39	0.38	3.65	3.61	3.63
S_2 – 75 % RDF + 15 t ha^{-1} FYM	73.91	68.76	71.33	3.03	3.05	3.04	0.40	0.41	0.40	3.87	3.84	3.85
S_3 – 50 % RDF + 30 t ha^{-1} FYM	75.72	73.54	74.63	3.10	3.12	3.11	0.40	0.41	0.41	3.95	3.91	3.93
S_4 – 75 % RDF + 5 t ha^{-1} VC	74.63	71.29	72.96	3.07	3.09	3.08	0.40	0.41	0.41	3.92	3.88	3.90
S_5 – 50 % RDF + 10 t ha^{-1} VC	78.19	78.36	78.27	3.14	3.16	3.15	0.42	0.43	0.42	4.00	3.96	3.98
S_6 – 75 % RDF + 1.5 t ha^{-1} NC	73.08	66.35	69.72	2.90	2.92	2.91	0.39	0.40	0.39	3.72	3.68	3.70
S_7 – 50 % RDF + 3 t ha^{-1} NC	74.42	67.06	70.74	2.94	2.96	2.95	0.39	0.40	0.40	3.76	3.72	3.74
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.758	0.819	0.322	0.006	0.006	0.003	0.002	0.002	0.0009	0.008	0.008	0.003
CD at 5%	2.212	2.391	0.916	0.018	0.019	0.007	0.006	0.007	0.0026	0.023	0.023	0.009
Interaction (M x S)												
'F' Test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	1.072	1.158	0.644	0.009	0.009	0.005	0.003	0.003	0.002	0.011	0.011	0.006
CD at 5%	-	-	-	-	-	-	-	-	-	-	-	-

Table 2: Effect of integrated nutrient management on micro nutrients composition of chrysanthemum

Treatments	Zinc (ppm)			Copper (ppm)			Iron (ppm)			Manganese (ppm)		
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled
Bio-fertilizers (M)												
M_1 – With bio-fertilizers	20.29	20.66	20.47	5.69	5.73	5.71	65.51	65.02	65.27	102.39	100.49	101.44
M_2 – Without bio-fertilizers	19.61	19.97	19.79	5.49	5.53	5.51	63.24	63.01	63.12	100.22	98.35	99.28
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.094	0.096	0.095	0.025	0.025	0.025	0.286	0.104	0.215	0.211	0.208	0.209
CD at 5%	0.574	0.584	0.374	0.151	0.152	0.098	1.740	0.633	0.845	1.287	1.263	0.822
Organic and inorganic fertilizers (S)												
S_1 - 100 % RDF	18.27	18.61	18.44	5.12	5.15	5.14	58.94	58.88	58.91	92.01	90.30	91.15
S_2 – 75 % RDF + 15 t ha^{-1} FYM	20.24	20.61	20.43	5.68	5.71	5.69	65.31	64.10	64.70	102.56	100.65	101.61
S_3 – 50 % RDF + 30 t ha^{-1} FYM	21.14	21.53	21.33	5.93	5.96	5.95	68.21	67.53	67.87	106.57	104.59	105.58
S_4 – 75 % RDF + 5 t ha^{-1} VC	20.61	20.99	20.80	5.78	5.81	5.80	66.51	66.75	66.63	105.39	103.43	104.41
S_5 – 50 % RDF + 10 t ha^{-1} VC	21.72	22.12	21.92	6.09	6.13	6.11	70.09	68.64	69.37	109.66	107.62	108.64
S_6 – 75 % RDF + 1.5 t ha^{-1} NC	18.58	18.92	18.75	5.21	5.24	5.23	59.97	60.42	60.20	94.89	93.12	94.00
S_7 – 50 % RDF + 3 t ha^{-1} NC	19.08	19.44	19.26	5.36	5.38	5.37	61.60	61.77	61.68	98.04	96.22	97.13
'F' Test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
SE (m) ±	0.103	0.105	0.042	0.030	0.030	0.012	0.339	0.253	0.122	0.277	0.272	0.112
CD at 5%	0.300	0.306	0.121	0.086	0.087	0.035	0.991	0.739	0.348	0.808	0.793	0.318
Interaction (M x S)												
'F' Test	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
SE (m) ±	0.146	0.148	0.085	0.042	0.042	0.024	0.480	0.358	0.244	0.391	0.384	0.224
CD at 5%	-	-	-	-	-	-	-	-	-	-	-	-

Acknowledgement
Authors would like to acknowledge to all the staff and friends from Section of Horticulture, College of Agriculture, Akola for their help during this investigation.

References
1. Chaitra R. Effect of integrated nutrient management on growth, yield and quality of China aster (*Callistephus chinensis* Nees). M. Sc. (Agri.) Thesis Unpub. Submitted to UAS., Dharwad, 2006.
2. Chaitra R, Patil VS. Integrated nutrient management studies in China aster (*Callistephus chinensis* Nees) cv. Kamini. Karnataka J. Agric. Sci. 2007; 20(3):689-690.
3. Chopra SL, Kanwar JS. Analytical agricultural chemistry, Kalyani Publisher, Ludhiana, New Delhi, 1978.
4. Dalawai B, Naik B Hemla. Integrated nutrient management studies in carnation (*Dianthus cariyophyllus* L.) cv. Soto under protected condition. Int. J. Agric. Sci & Vet. Med. 2014; 2(3):18-24.
5. Gangadharan GD, Gopinath G. Effect of organic and inorganic fertilizers on growth, flowering and quality of gladiolus cv. White prosperity. Karnataka J. Agric. Sci. 2000; 11(3):401-405.
6. Hoda E El-Mokadem, Mona S. Effect of bio and chemical fertilizers on growth and flowering of *Petunia hybrida* plants. Am. J. Plant Physiol. 2014; 9(2):68-77.
7. Kumari Anop, Goyal RK, Choudhary M, Sindhu SS. Effect of different nitrogen levels and biofertilizers on growth, yield and nutrient content of chrysanthemum. Ann. Agric. Res. 2014; New Series 35(2):156-163.
8. Kusuma G. Effect of organic and inorganic fertilizers on growth, yield and quality of golden rod. M. Sc. (Hort.) Thesis, Univ. Agric. Sci., Bangalore (India), 2001.
9. Muthamizhselvi M, Arulmozhiyan R, Jawaharlal M, Mani S. Effect of integrated nutrient management on nutrient content of leaves and uptake in Chrysanthemum (*Dendranthema grandiflora* Tzelev.) cv. CO.1. South Indian Hort. 2006; 54(1-6):318-322.
10. Mclaren CA, Crawford MS. Soil science. Society America Journal. 1950; 37:309.
11. Panse VG, Sukhatme PV. Statistical methods for agriculture workers. Publication and Information Division, ICAR, New Delhi, 1995.
12. Patanwar Mridubhashini, Sharma G, Banjare Chetna, Chandravanshi Deepika, Sahu Eshu. Growth and development of chrysanthemum (*Dendranthema grandiflora* Tzvelev) as influenced by integrated nutrient management. 2014; 6(Special issue):459-462.
13. Piper CS. Soil and plant analysis. Scientific Publishers (India) Jodhpur (Raj.), 2010.
14. Pithiya Ila, Varu DK, Vaghasiya M. Study of INM on growth, yield and quality in China aster (*Callistephus chinensis* L.) cv. Phule Ganesh Pink. Green Farming. 2016; 7(3):677-679.
15. Singh P, Prakash S, Kumar M, Malik S, Singh MK, Kumar A. Effect of integrated nutrient management on growth, flowering and yield in marigold (*Tagetes erecta* L.). Annals of Hort. 2015; 8(1):73-80.
16. Sonawane SP, Dabke DJ, Dabke SB, Dhane SS. Effect of nitrogen, phosphorus and FYM on yield and nutrient uptake by China aster (*Callistephus chinensis* Ness). J. Maharastra Agric. Univ. 2009; 34(1):90-91.
17. Tandon HLS. Methods of analysis of soils, plants, water and fertilizers. FAO and Consultation Organization, New Delhi, 1993.
18. Verma SK. Integrated nutrient management studies in chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Raja. M.Sc. (Agri.) Thesis Unpub. Submitted to UAS, Dharwad, 2010.
19. Verma SK, Angadi SG, Patil VS, Mokashi AN, Mathad JC, Mummigatti UV. Growth, yield and quality of chrysanthemum (*Chrysanthemum morifolium* Ramat.) cv. Raja as influenced by integrated nutrient management. Karnataka J. Agric. Sci. 2011; 24(5):681-683.