Research Paper | *The Asian Journal of Horticulture,* (June, 2010) Vol. 5 No. 1 : 22-25

Effect of biofertilizers and nitrogenous fertilizer on growth, flowering and yield of annual white chrysanthemum (*Chrysanthemum coronarium* L.) under middle Gujarat agroclimatic conditions

R.V. PANCHAL, N.S. PAREKH, **A.B. PARMAR AND** H.C.PATEL

Accepted : ***January, 2010***

ABSTRACT

The present investigation entitled "Effect of biofertilizers and nitrogenous fertilizer on growth, flowering and yield of annual white chrysanthemum (*Chrysanthemum coronarium* L.) under middle Gujarat condition" was conducted at College Horticulture Nursery, Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand during 2007-2008. The treatments comprising two biofertilizers (*Azospirillum* and *Azotobacter*) and five levels of nitrogen (100, 125, 150, 175 and 200 kg N/ha) including control (200 kg N/ha) were tried in Randomized Block Design with three replications. The results revealed that application of 175 Kg N/ha + *Azospirillum* + *Azotobactor* (T_{13}) produced significantly maximum plant height (96.23 cm), number of branches per plant (50.59), plant spread (79.08 cm in North - South direction and 78.79 cm in East - West direction), Relative growth rate (0.032 g/g/day), leaf area index (21.32cm^2) and harvest index (4.32%). The plants under the same treatment required significantly minimum days for first flower initiation (37.00 days), also produced maximum number of flowers per plant (161.28) and recorded maximum flower diameter (7.37 cm) as well as weight of individual flower (3.26 g). Significantly maximum flower yield per plant (569.55 g) as well as per hectare (22.56 t) was recorded in the same treatment. The treatment T_4 (150 Kg N/ha + *Azospirillum*) produced flowers with maximum shelf life (4.33 days).

See end of the article for authors' affiliations

Correspondence to:

A.B. PARMAR
Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

Key words : Biofertilizer, *Azospirillum, Azotobacter,* Annual white chrysanthemum

Annual chrysanthemum (*Chrysanthemum coronarium* L.) is one of important commercial cultivated flower crop growing in India as well as in Gujarat. It is a winter season annual and propagated by seeds producing white and yellow colour blooms, which are used for garland making as well as a bedding plant. It also used for making garlands, veni and for decorations during religious and social functions. Nutrition plays an important role for higher quality of chrysanthemum flowers. The biofertilizers may help in improving soil fertility by way of accelerating biological nitrogen fixation from atmosphere. It helps in solubilization of the insoluble nutrient already present in soil, decomposition of plant residues, stimulating plant growth and development. Therefore, the present investigation on "Effect of biofertilizers and nitrogenous fertilizer on growth, flowering and yield of annual white chrysanthemum (*Chrysanthemum coronarium* L.) under middle Gujarat condition" was carried out.

MATERIALS AND METHODS

A field trial was conducted at College Horticulture Nursery, Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, Anand during 2007-2008. The experiment was laid out in Randomized Block Design (RBD) with 14 treatments. All treatments were replicated thrice. The details of experimental treatments were as under: T_1 : 200 kg N/ha (control), T_2 : 100 kg N/ha + *Azospirillum,* T_3 : 125 kg N/ha + *Azospirillum,* T_4 : 150 kg N/ha + *Azospirillum,* T_5 : 175 kg N/ha + *Azospirillum,* T_6 : 100 kg N/ha + *Azotobacter,* T_7 : 125 kg N/ha + *Azotobacter,* T_8 : 150 kg N/ha + *Azotobacter,* T_9 : 175 kg N/ha + *Azotobacter,* T_{10} : 100 kg N/ha + *Azospirillum*+ *Azotobacter,* T_{11} : 125 kg N/ha + *Azospirillum* + *Azotobacter,* T_{12} : 150 kg N/ha + *Azospirillum* + *Azotobacter,* T_{13} : 175 kg N/ha + *Azospirillum* + *Azotobacter,* T_{14} : 200 kg N/ha + *Azospirillum* + *Azotobacter.* The seedlings of annual white chrysanthemum were transplanted in the plot at the spacing of 45 x 45 cm. A light irrigation was given immediately after transplanting for better establishment of seedlings in the field. Biofertilizers *i.e. Azotobacter, Azospirillum* and combination of *Azotobacter* and *Azospirillum* were applied by seedling dipping method. Slurry of *Azotobacter* (5ml/lit) and *Azospirillum* (5ml/lit) and *Azotobacter* (5ml/lit) + *Azospirillum* (5ml/lit) was prepared and roots of the seedlings were dipped in this solution for 15 minutes as per the treatments and

transplanted in the field.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarised under following heads:

Effect on growth parameters :

The results showed in Table 1 revealed that the treatment T_{13} (application of 175 Kg N/ha + *Azospirillum* + *Azotobactor*) recorded the maximum plant height (44.96, 76.79 and 96.23 cm), produced maximum branches per plant (23.66, 34.38 and 50.59, respectively) at 45, 90 and 135 DAT, respectively. It also recorded maximum plant spread (57.20 cm, 60.82 cm and 79.08 cm, respectively in North-South directions) (55.39, 59.17 and 78.79 cm, respectively in East-West direction), respectively at 45, 90 and 135 DAT. The highest RGR at 90 DAT (0.049 g/g/day) whereas, maximum RGR at 135 DAT was observed (0.032 g/g/day), maximum harvest index (4.32%) in the same treatment. This treatment also registered maximum LAI at 45, 90 and 135 DAT (7.90 cm^2, 17.15 cm^2 and 21.32 cm^2, respectively). The better plant growth observed in the present investigation may be attributed to the fact that *Azotobacter* is free living bacteria and has specific role in fixing atmospheric N in soil which enhances the soil fertility. Application of nitrogen encourages the formation of new cells, cell division and cell elongation. Thus results in vigorous growth of root system which ultimately helps in better absorption and utilization of nutrients from soil solution as well as applied nitrogen and biofertilizers which reflected in terms of better overall plant growth. These findings are in accordance with the results of Chauhan (2005) in chrysanthemum ; Mathew and Singh (2003) and Suthar (2005) in marigold, Nandre *et al.* (2002) and Panchal (2006) in china aster ; Gadagi *et al.* (2004) and Parmar (2006) in gaillardia. The same trend with respect to effect of chemical nitrogenous fertilizer application was reported by Joshi and Barad (2002) and Singh *et al*. (2002) in marigold.

Effect on flowering and yield parameters :

It is evident from the results (Table 3) that application of 175 Kg N/ha + *Azospirillum* + *Azotobactor* (T_{13}) remarkably took minimum days (37.00) for first flower initiation and recorded maximum flower diameter (7.37 cm), weight of individual flower (3.26 g), maximum number of flowers per plant (161.28), flower yield per plant (569.55 g) as well as per hectare (22.56 t) in the same treatment. The increase in flower yield might be

Table 1 : Effect of biofertilizers and nitrogenous fertilizer on different growth parameters of annual white chrysanthemum (*Chrysanthemum coronarium* L.) at different growth stages

Treatments	Plant height (cm)			Number of branches per plant			Plant spread (cm)					
	45 DAP	90 DAP	135 DAP	45 DAP	90 DAP	135 DAP	45 DAP		90 DAP		135 DAP	
							E-W	N-S	E-W	N-S	E-W	N-S
T_1	28.93^{h}	58.68^{e}	83.35^{d}	12.52^{f}	21.70^{h}	36.49^{e}	43.59^{d}	45.60^{c}	49.42^{c}	49.67^{c}	61.13^{c}	60.12^{d}
T_2	30.37^{gh}	62.24^{de}	84.54^{cd}	13.80^{ef}	23.32^{gh}	38.39^{de}	44.01^{cd}	48.67^{bc}	49.46^{c}	49.54^{c}	64.10^{bc}	60.46^{d}
T_3	32.03^{fgh}	63.64^{de}	85.95^{bcd}	14.21^{ef}	24.23^{fgh}	39.80^{cde}	46.53^{bcd}	50.27^{bc}	49.46^{c}	50.19^{c}	64.59^{bc}	61.55^{d}
T_4	35.50^{defg}	67.74^{abcde}	86.81^{abcd}	16.30^{de}	27.30^{cdefg}	42.42^{abcde}	48.93^{abcd}	51.33^{abc}	52.43^{bc}	52.16^{bc}	67.41^{bc}	65.01^{cd}
T_5	36.84^{cdef}	68.28^{abcd}	87.31^{abcd}	15.54^{de}	28.19^{bcdefg}	42.68^{abcde}	48.27^{abcd}	51.27^{abc}	51.84^{c}	52.49^{bc}	67.20^{bc}	64.76^{cd}
T_6	33.36^{efgh}	65.23^{cde}	86.24^{bcd}	15.36^{de}	25.35^{efgh}	40.39^{bcde}	47.93^{bcd}	51.15^{abc}	50.83^{c}	51.56^{bc}	67.01^{bc}	64.12^{cd}
T_7	34.62^{efg}	66.42^{bcde}	86.74^{abcd}	14.26^{ef}	26.25^{defg}	41.59^{abde}	46.67^{bcd}	51.13^{abc}	49.76^{c}	50.82^{bc}	66.81^{bc}	62.40^{d}
T_8	36.95^{cdef}	68.42^{abcd}	87.43^{abcd}	17.81^{cd}	29.08^{abcdef}	42.78^{abcde}	49.00^{abcd}	51.40^{abc}	52.21^{bc}	54.03^{abc}	68.77^{abc}	66.43^{bc}
T_9	38.05^{bcde}	69.12^{abcd}	87.67^{abcd}	19.39^{bc}	29.79^{abcde}	44.67^{abcde}	49.13^{abcd}	51.47^{abc}	52.93^{abc}	54.05^{abc}	69.53^{abc}	66.49^{bcd}
T_{10}	40.82^{abcd}	71.06^{abcd}	93.17^{abcd}	20.97^{ab}	30.91^{abcd}	47.27^{abcd}	50.47^{abcd}	51.53^{abc}	54.84^{abc}	56.96^{ab}	71.91^{ab}	67.36^{bcd}
T_{11}	41.47^{abc}	73.41^{abc}	94.21^{abc}	22.18^{ab}	32.10^{abc}	48.38^{abc}	51.00^{abc}	51.80^{ab}	55.09^{abc}	56.96^{ab}	73.23^{ab}	71.18^{abc}
T_{12}	42.95^{ab}	74.78^{abc}	94.42^{abc}	23.35^{a}	33.35^{ab}	49.37^{ab}	51.07^{abc}	53.73^{ab}	55.74^{ab}	59.78^{a}	74.40^{ab}	74.55^{ab}
T_{13}	44.96^{a}	76.79^{a}	96.23^{a}	23.66^{a}	34.38^{a}	50.59^{a}	55.39^{a}	57.20^{a}	59.17^{a}	60.82^{a}	78.79^{a}	79.08^{a}
T_{14}	44.94^{a}	75.40^{ab}	94.92^{ab}	23.50^{a}	34.33^{a}	49.81^{a}	52.87^{ab}	54.13^{ab}	58.51^{ab}	60.07^{a}	78.35^{a}	78.58^{a}
'F' test	*	*	*	*	*	*	*	*	*	*	*	*
S.E.±	1.61	2.85	2.91	0.83	1.55	2.64	2.11	1.77	1.90	1.98	3.12	2.40
C.V. %	7.47	7.19	5.65	7.94	9.40	10.43	7.45	5.95	6.22	6.31	7.77	6.17

* indicate of significance of value at P = 0.05

Table 2 : Effect of biofertilizers and nitrogenous fertilizer on relative growth rate (g/g/day), leaf area index (cm^2) and harvest index (%) at different growth stages of annual white chrysanthemum (*Chrysanthemum coronarium* L.)

Treatments	Relative growth rate (g/g/day)		Leaf area Index (cm^2)		Harvest index
	90 DAP	135 DAP	90 DAP	135 DAP	(%)
T_1	0.021^{j}	0.019^{f}	11.36^{e}	13.35^{h}	3.00^{d}
T_2	0.026^{i}	0.020^{ef}	12.27^{de}	14.15^{gh}	3.04^{d}
T_3	0.029^{h}	0.021^{def}	12.39^{de}	15.05^{fgh}	3.12^{d}
T_4	0.035^{d}	0.023^{bcdef}	14.07^{bcd}	16.66^{cdefg}	3.22^{d}
T_5	0.031^{g}	0.025^{abcdef}	13.39^{cde}	16.46^{cdefg}	3.33^{d}
T_6	0.030^{gh}	0.022^{cdef}	13.56^{cde}	15.82^{defgh}	3.15^{d}
T_7	0.029^{gh}	0.022^{cdef}	13.32^{cde}	15.45^{efgh}	3.21^{d}
T_8	0.033^{f}	0.027^{abcde}	14.33^{bcd}	17.41^{bcdef}	3.34^{cd}
T_9	0.034^{ef}	0.028^{abcde}	15.22^{abc}	17.15^{cdef}	3.77^{bc}
T_{10}	0.034^{e}	0.029^{abc}	15.30^{abc}	18.07^{bcde}	3.78^{b}
T_{11}	0.036^{d}	0.029^{abcd}	15.89^{abc}	18.34^{bcd}	3.89^{ab}
T_{12}	0.041^{c}	0.030^{ab}	16.31^{ab}	19.08^{ab}	4.09^{ab}
T_{13}	0.049^{a}	0.032^{a}	17.15^{a}	21.32^{a}	4.32^{a}
T_{14}	0.043^{b}	0.031^{ab}	16.38^{ab}	20.07^{ab}	4.15^{ab}
'F' test	*	*	*	*	*
S.E.±	0.0034	0.00236	0.77	0.78	0.13
C.V. %	17.59	16.02	9.26	7.89	6.27

* indicate of significance of value at P = 0.05

Table 3 : Effect of biofertilizers and nitrogenous fertilizer on flowering and yield parameters of annual white chrysanthemum (*Chrysanthemum coronarium* L.)

Treatments	Days taken for first flower initiation	Flower diameter (cm)	Individual flower weight (g)	Shelf life of flower (days)	Number of Flowers per plant	Flower yield per plant (g)	Flower yield per hectare (t)
T_1	48.00^{a}	5.72^{c}	2.50^{e}	3.33^{def}	120.63^{g}	287.15^{e}	16.24^{c}
T_2	46.67^{ab}	6.26^{bc}	2.68^{de}	3.47^{def}	124.11^{fg}	300.40^{e}	16.39^{c}
T_3	45.00^{abc}	6.27^{bc}	2.72^{cde}	3.83^{abcd}	126.63^{efg}	321.49^{e}	16.46^{c}
T_4	42.33^{abcd}	6.43^{bc}	2.81^{cd}	4.33^{a}	135.37^{cdefg}	376.13^{cde}	17.00^{c}
T_5	42.15^{abcd}	6.59^{b}	2.82^{cd}	3.70^{bcde}	133.11^{cdefg}	359.33^{cde}	17.64^{bc}
T_6	44.00^{abc}	6.28^{bc}	2.74^{cde}	3.50^{cdef}	130.51^{defg}	341.34^{de}	16.61^{c}
T_7	42.67^{abcd}	6.31^{bc}	2.80^{cd}	3.50^{cdef}	129.33^{efg}	333.41^{de}	16.58^{c}
T_8	42.00^{bcd}	6.64^{ab}	2.88^{cd}	4.00^{ab}	140.13^{bcdef}	418.29^{bcd}	17.56^{bc}
T_9	42.08^{bcd}	6.66^{ab}	2.90^{cd}	4.04^{ab}	142.20^{bcde}	437.26^{bc}	18.00^{abc}
T_{10}	41.33^{bcd}	6.79^{ab}	2.91^{cd}	3.23^{ef}	147.72^{abcd}	491.37^{ab}	21.06^{abc}
T_{11}	40.33^{cd}	6.83^{ab}	2.94^{bcd}	3.17^{f}	150.49^{abc}	512.68^{ab}	19.77^{abc}
T_{12}	40.00^{cd}	6.84^{ab}	3.00^{abc}	3.17_{f}	154.93^{ab}	543.37^{a}	20.89^{abc}
T_{13}	37.00^{d}	7.37^{a}	3.26^{a}	3.00^{f}	161.28^{a}	569.55^{a}	22.56^{a}
T_{14}	39.67^{cd}	6.89^{ab}	3.22^{ab}	2.47^{g}	155.78^{ab}	552.11^{a}	22.33^{ab}
'F' test	*	*	*	*	*	*	*
S.E..±	1.72	0.22	0.09	0.15	5.37	27.83	1.43
C.V. %	7.02	5.84	5.62	7.24	6.67	11.55	13.41

* indicate of significance of value at P = 0.05

due to the fact that phytohormones are produced by the biofertilizers, which stimulated root growth and induced changes in root morphology, which in turn affected the assimilation of the nutrients. The increase in flower production could be ascribed to accelerated growth parameters like number of branches etc. registered under the present investigation. The results of the present study are in conformity with those of Mathew and Singh (2003)

and Suthar (2005) in marigold; Nandre *et al.* (2002) and Panchal (2006) in china aster; Parmar (2006) in gaillardia; Chauhan (2005) in chrysanthemum.

Authors' affiliations:
R.V. PANCHAL, N.S. PAREKH AND H.C. PATEL,
Department of Horticulture, B.A. College of Agriculture, Anand Agricultural University, ANAND (GUJARAT) INDIA

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