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Effect of organic manures on growth and flowering of marigold cv. Pusa Narangi

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ABSTRACT

Pot experiment was conducted in the screen house of the Department of Horticulture, CCS Haryana Agricultural University, Hisar to study the effect of different organic manures on growth and flowering of marigold cv. Pusa Narangi. In this experiment three doses of nitrogen (60, 120 and 180 ppm) were added through FYM, biogas slurry, poultry manure, vermicompost, neem cake and urea. All the growth parameters (plant height, plant spread, number of branches and stem diameter) and flowering parameter (duration of flowering) of marigold increased, while number of days taken for flower bud formation and first flowering decreased with the addition of all the organic manures, except neem cake as compared to urea.

Key words : Marigold, organic manure, growth, flowering, nitrogen

INTRODUCTION

Marigold (*Tagetes erecta*) produces large sized attractive blooms which are common in households for making garland and for decoration during religious and social functions. The excellent keeping quality of flowers and attractive colours make them popular. It can be grown on a wide range of soil and climatic conditions. It is well established that nutrition plays an important role in the improvement of flowering and yield of marigold. Its production can be enhanced with the application of manures and fertilizers. Organic manures contain plenty of plant nutrients (macro as well as micro nutrients) and their application increase the organic matter content and improve soil physical properties. They also provide food for the soil micro-organism which in-tern help to convert unavailable plant nutrients into available form. Farmyard manure, compost and green manures are widely used in the horticultural crops due to their rich nutrient as well as organic matter content. The effect of different sources of organic manures has been tested on some fruit trees, vegetables and ornamental plants. The soil applications of 5-10% FYM increased growth and yield characteristics of marigold (Parkash, 2000).

MATERIALS AND METHODS

For this study, a bulk of soil sample was collected from village Ludash, situated five kilometers on the western side of CCS Haryana Agricultural University, Hisar. The soil was sieved and analysed for different physico-chemical properties. Five kilograms air dried bulk soil was filled in each earthen pots lined with polythene. Required amount of organic manures (equivalent to 60, 120 and 180 ppm of nitrogen) *viz.,* FYM, biogas slurry, vermicompost, poultry manure and neemcake were weighed and mixed thoroughly with the five kilogram soil and then filled back in the polythene lined pots. The seeds of marigold *cv.* Pusa Narangi were procured from the Department of Horticulture, CCS Haryana Agricultural University, Hisar. The seeds were sown in the raised nursery bed in the Research Area, Department of Horticulture, CCS Haryana Agricultural University, Hisar. One month after sowing nursery, plants of equal size were transplanted in pots which were irrigated a day before planting. After successful establishment of seedlings single plant per pot was retained.

Plant height was measured from ground level to the tip of apical shoot/flower of the tallest shoot with the help of scale. Observations for number of branches (primary branches only), plant spread (average of east/west and north/south) and stem diameter (2.5 cm above the ground level) were measured at maturity stage. Similarly, number of days taken for flower bud formation and first flowering were calculated from the data of transplanting and duration of flowering was also

Table 1. Composition of NPK in organic manures

Nitrogen sources	N (%)	P (%)	K (%)
FYM	1.21	0.45	1.88
Biogas slurry	1.71	0.68	1.72
Poultry manure	2.37	1.18	2.15
Vermicompost	0.82	0.273	1.46
Neemcake	2.21	0.137	2.39
Urea	46.00	-	-

calculated. The data was analyzed with the help of 2-factorial completely randomized design.

RESULTS AND DISCUSSION

Growth parameters : With the addition of all the organic sources of nitrogen *viz.,* FYM, biogas slurry, poultry manure, vermicompost and neem cake, plant height increased in comparison to urea, except neem cake at all the stages of growth i.e., 45, 60, 75 days after transplanting (DAT) and at maturity (Tables 2-5). Other growth parameters such as plant spread, number of branches per plant and stem diameter also increased with the addition of all the organic sources of nitrogen in comparison to urea, whereas, stem diameter was recorded minimum in neem cake.

1. Plant height : With the addition of all organic sources of nitrogen *i. e.,* FYM, biogas slurry, poultry manure, vermicompost and neem cake at all the stages of growth i.e., 45, 60, 75 DAT and at maturity, the plant height increased significantly in comparison to urea except neem cake (Table 2,3,4,5). The mean plant height in the different sources of nitrogen varied significantly at 45 DAT (Table 2-4) and at maturity (Table 5). Better performance of all the organic manures in comparison to urea with respect to growth parameters may be because of the fact that the addition of organic manures enhances the supply of macro and micronutrients to the plants, increased organic matter content of the soil which in term improves soil physical properties. Brown, 1938 reported that the presence of micronutrients in the organic matter, especially of iron, credited with definate role in the formation of chlorophyll in plants. This subsequently promotes higher photosynthetic efficiency and mobilization of nutrients for better growth. The higher differences in the growth parameters between urea and organic manures were because the soil used was sandy in nature, deficient in organic carbon, N and P. Yadav and Singh (1997) also reported significant improvement in plant height and number of branches with the

Table 2. Effect of different sources of organic matter on plant height (cm) after 45 DAT of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	10.3	11.5	13.3	11.7
Farmyard manure	15.5	20.5	21.5	19.2
Biogas slurry	37.5	35.0	34.5	35.7
Poultry manure	47.2	45.8	46.7	46.6
Vermicompost	39.0	38.8	35.8	37.9
Neem cake	11.3	12.0	14.3	12.6
Mean	26.8	27.3	27.7	

CD at 5%
Sources of Nitrogen : 1.4
Level of Nitrogen : NS* (non significant)
Sources of Nitrogen X Level of Nitrogen : 2.4

Table 3. Effect of different sources of organic matter on plant height (cm) after 60 DAT of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	13.0	13.5	16.3	14.3
Farmyard manure	26.5	28.3	31.5	28.8
Biogas slurry	38.0	39.0	40.5	39.2
Poultry manure	49.0	55.5	57.5	54.0
Vermicompost	36.5	40.5	41.5	39.5
Neem cake	13.0	15.5	17.0	15.2
Mean	29.3	32.1	34.1	

CD at 5%
Sources of Nitrogen : 1.6
Level of Nitrogen : 1.1
Sources of Nitrogen X Level of Nitrogen : NS

increasing level of FYM, whereas plant spread was found non-significant at all the levels. Similarly, Sindhu *et al.* (2001) observed that the application of FYM (5 and 10%) improved the growth parameters of marigold *viz.,* plant height, number of branches and plant spread. The increasing rate of plant height of marigold was recorded maximum (16.72%) between 45 to 60 DAT. Among all the organic sources the maximum plant height was recorded in poultry manure followed by biogas slurry and vermicompost, FYM neem cake and urea at all the stages of growth. Other growth parameters were also found best in poultry manure, it reported to have some of the growth promoting substances which stimulated the uptake of nutrients (Brown, 1958). Other possible reason is the easy availability of nitrogen leading to balanced C : N ratio, enhancing the vegetative growth and resulting in higher photosynthetic activity. Awang and Ismail (1996) reported higher plant height and faster growth with 14 t ha^{-1} poultry manure/ha, while they

Table 4. Effect of different sources of organic matter on plant height (cm) after 75 DAT of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	14.5	18.0	20.5	17.7
Farmyard manure	28.0	34.0	37.0	33.0
Biogas slurry	39.5	42.0	43.0	41.5
Poultry manure	49.5	57.5	60.0	55.7
Vermicompost	37.5	42.0	42.5	40.7
Neem cake	15.0	16.0	17.5	16.2
Mean	30.7	34.9	36.7	

CD at 5%
Sources of Nitrogen : 2.0
Level of Nitrogen : 1.4
Sources of Nitrogen X Level of Nitrogen : NS

Table 5. Effect of different sources of organic matter on plant height (cm) at maturity (about 110 DAT) of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	19.0	26.3	33.0	26.1
Farmyard manure	29.0	36.0	43.5	36.2
Biogas slurry	41.5	44.5	45.0	43.7
Poultry manure	50.5	62.0	63.5	58.7
Vermicompost	40.0	44.0	44.0	42.7
Neem cake	25.0	25.5	28.0	26.2
Mean	34.2	39.7	42.8	

CD at 5%
Sources of Nitrogen : 1.8
Level of Nitrogen : 1.3
Sources of Nitrogen X Level of Nitrogen : 3.2

observed the shortest height with 100% peat.

The mean plant height observed at 45, 60, 75 and at 45 DAT; 29.3, 32.1, and 34.1 cm at at maturity was higher with 180 ppm of N. The application of nitrogen improved the vegetative growth characters of plant because, it enhanced synthesis and accumulation of proteins, aminoacids and enzymes which are responsible for cell division and cell elongation and hence growth of the plant (Yadav and Singh, 1997). Earlier, Ravindran *et al*. (1986) have also recorded significant increase in plant height, number of primary branches and pedicle length in marigold with increasing level of nitrogen. The maximum plant height was observed in poultry manure at 60, 120 and 180 ppm of nitrogen at 45 DAT and 180 ppm of nitrogen through poultry manure at maturity, while minimum plant height was recorded in 60 ppm of nitrogen through urea at 45 DAT and at maturity.

2. Plant spread : The results revealed that with the addition of FYM, biogas slurry, poultry manure, vermicompost and neem cake, plant spread increased significantly in comparison to urea (Table 6). The maximum plant spread was observed in poultry manure followed by vermicompost, biogas slurry, FYM, neemcake and urea. The plant spread increased with the increasing level of nitrogen, significantly. The percent increase in plant spread from 60 to 120 ppm N and 120 to 180 ppm N was 16.76 and 11.28%, respectively. Maximum plant spread (35.0 cm) was observed in poultry manure at 180 ppm N whereas, it was minimum (12.3 cm) in urea at 60 ppm N level. However, the overall performance of plant spread was highest in all the treatment combinations in 180 ppm N followed by 120 ppm and 60 ppm nitrogen through different sources. In marigold, Yadav and Singh (1997) also reported that all the plant growth parameters increased with the level of nitrogen upto 180 ppm of nitrogen while plant spread increased upto 120 ppm N.

3. Number of branches per plant : The number of braches increased in all the organic sources in comparison to urea, except neemcake (Table 7). The maximum number of branches per plant was recorded in poultry manure followed by vermicompost, biogas slurry, FYM, urea and neemcake, respectively. The number of branches per plant increased with the increasing level of nitrogen, significantly. (4.7, 6.7 and 7.7 at 60 ppm, 120 ppm and 180 ppm N, respectively). The maximum branches per plant (18.0) was observed in poultry manure at 180 ppm nitrogen, while minimum number of branches (2.3) were recorded in urea and neemcake at 60 ppm N. The maximum number of branches per plant in all the sources of nitrogen were observed in 180 ppm N followed by 120 ppm and 60 ppm N.

4. Stem diameter : It is evident from the data given in Table 8 that the stem diameter of marigold plant increased with the addition of all the organic sources of nitrogen as compared to urea, except in neemcake when the stem diameter decreased. The thickest mean stem diameter was observed in poultry manure (8.3 mm) followed by vermicompost, biogas slurry, FYM, urea and neemcake. The stem diameter increased significantly with the increasing level of nitrogen. The mean stem diameter was 4.7. 5.5, and 7.1 mm in 60, 120 and 180 ppm nitrogen, respectively. Increase in nutrients availability leads to vigorous plant growth resulting in thicker trunk diameter. The data further revealed that

stem diameter was maximum in poultry manure at 180 ppm N level (10.5 mm), while minimum stem diameter (3.2 mm) was observed in neemcake at 60 ppm N. The overall stem diameter was observed maximum in 180 ppm of nitrogen through all the sources followed by 120 ppm and 60 ppm.

Flowering parameters : Addition of all the organic sources of nitrogen *viz.,* FYM, biogas slurry, poultry manure, vermicompost and neem cake increased duration of flowering of marigold as compared to urea, while number of days taken for flower bud formation and first flowering decreased with the addition of organic manures, except neemcake, as compared to urea.

1. Number of days taken for first flower bud formation: The days taken for first flower bud formation decreased significantly in marigold with the addition of different organic source of nitrogen *viz.,* FYM, biogas slurry, poultry manure, vermicompost and neem cake when compared to urea (Table 9). Better performance of all the organic manures in comparison to urea with respect to flowering parameters may be because of the fact that addition of organic manures enhanced the supply of macro and micro-nutrients to plants, increased organic matter content of the soil which in turn improved soil physical properties. Other possible reason may be that organic manures are rich in humus and N-fixing microbes, regulates nitrogen supply to the plants and the production of growth promoters. Kurpuswamy *et al.* (1992) reported that the earliness of flowering with organic manures could be attributed to faster enhancement of vegetative growth and storing sufficient food material for differentiation of bud into flower bud. Lahav (1973) also observed that heavy manuring enhanced growth that resulted into hasten the flowering. The higher difference in flowering parameters between urea and organic manure might be contributed to soil used which was sandy in nature, deficient in organic carbon, N and P. Parkash (2000) reported that the addition of FYM decreased the days taken to first flower bud formation and flower formation while the duration of flowering increased. Evans and Stamps (1996) also reported in marigold that the plant grown in 80% coir pith and 20% perlite substrate reduced the days to flowering. Renuka and Sankar (2001) observed earliness of flowering in tomato with the application of organic manures like FYM + biogas slurry (21.5 days), biogas slurry alone (23.43 days) and vermicompost + FYM (23.6 days). The minimum days taken to first flower bud formation were observed in vermicompost (29.2)

Table 6. Effect of different sources of organic matter on plant spread (cm) of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	12.3	13.2	13.7	13.1
Farmyard manure	13.5	14.2	18.0	15.2
Biogas slurry	16.0	20.0	24.0	20.0
Poultry manure	25.5	32.2	35.0	30.9
Vermicompost	19.5	22.8	24.0	22.1
Neem cake	13.5	14.3	15.7	14.5
Mean	16.7	19.5	21.7	

CD at 5%
Sources of Nitrogen : 1.1
Level of Nitrogen : 0.8
Sources of Nitrogen X Level of Nitrogen : 1.9

Table 7. Effect of different sources of organic matter on number of branches per plant of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	2.3	3.0	3.3	2.9
Farmyard manure	3.5	4.0	5.0	4.2
Biogas slurry	4.0	5.5	6.0	5.2
Poultry manure	10.5	17.5	18.0	15.3
Vermicompost	5.5	7.5	10.5	7.8
Neem cake	2.3	3.0	3.2	2.8
Mean	4.7	6.7	7.7	

CD at 5%
Sources of Nitrogen : 0.7
Level of Nitrogen : 0.5
Sources of Nitrogen X Level of Nitrogen : 1.1

which increased progressively with poultry manure, biogas slurry, FYM, neem cake and urea. Among all the organic sources vermicompost was found to be superior with respect to number of days taken to first flower bud formation and flower formation, while duration of flowering was recorded maximum in poultry manure. Renuka and Sankar (2001) reported that vermicompost was more efficient in maintaining the soil pH near to the neutral, besides keeping lower level of electrical conductivity and bulk density. Duration of flowering in poultry manure could be due to balanced supply of

Table 8. Effect of different sources of organic matter on stem diameter (mm) of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	4.3	4.4	4.8	4.5
Farmyard manure	4.5	5.0	7.1	5.5
Biogas slurry	4.9	5.4	7.1	5.8
Poultry manure	5.5	9.0	10.5	8.3
Vermicompost	5.5	6.0	8.5	6.7
Neem cake	3.2	3.5	4.3	3.7
Mean	4.7	5.5	7.1	

CD at 5%
Sources of Nitrogen : 0.2
Level of Nitrogen : 0.2
Sources of Nitrogen X Level of Nitrogen : 0.4

nutrients and other growth promoting substances as described by Brown (1958). Singh *et al.* (1970) also reported that high carbohydrate content due to the application of poultry manure might be attributed to balanced C : N ratio and increased activity of plant metabolism.

With the increase in the level of nitrogen, the days taken to first flower formation decreased. The mean days taken to first flower bud formation were recorded as 36.4, 36.5 and 38.9 in 60 ppm, 120 ppm and 180 ppm of nitrogen, respectively (Table 9). The maximum percent increase in number of days taken to first flower bud formation with respect to level of nitrogen were recorded between 120 to 180 ppm of nitrogen. Increased number of days taken to first flower bud formation and duration of flowering with increasing level of nitrogen is explained on the basis of the fact that the appropriate dose of nitrogen resulted in assimilation of more carbohydrates which resulted in increased vegetative growth. These carbohydrates when translocated to reproductive organs undergo hydrolysis and get converted into reproductive sugars which ultimately helps in increasing the flower parameters (Yadav *et al.*, 2000). Vijayakumar and Shanmugavelu (1978) observed in chrysanthemum that the increase in N levels stimulated early flowering in plants. Hameed and Sekar (1999) reported that the application of nitrogen upto 150 kg/ha showed early flowering in marigold.

2. Number of days taken to first flower formation : The number of days taken to first flower

Table 9. Effect of different sources of organic matter on days taken for first flower bud formation of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	49.0	43.3	41.0	44.4
Farmyard manure	35.3	38.3	45.3	39.7
Biogas slurry	33.0	35.2	41.0	36.4
Poultry manure	30.2	34.0	37.0	33.7
Vermicompost	26.7	29.0	32.0	29.2
Neem cake	44.0	39.2	37.0	40.0
Mean	36.4	36.5	38.9	

CD at 5%
Sources of Nitrogen : 1.8
Level of Nitrogen : 1.3
Sources of Nitrogen X Level of Nitrogen : 3.1

bud formation decreased significantly with the addition of FYM, biogas slurry, poultry manure, vermicompost and neem cake as compared to urea (Table 10).

The minimum number of days taken to first flower formation were recorded in vermicompost at 60 ppm of nitrogen (49.0) which is at par with vermicompost 120 ppm of nitrogen and poultry manure at 60 ppm nitrogen whereas, the maximum were recorded in 60 ppm of nitrogen (78.0) through urea. The numbers of days taken to first flower formation were increased in FYM, biogas slurry, poultry manure and vermicompost with the successive increase in level of nitrogen while it decreased with neem cake and urea.

3. Duration of flowering : It was evident from the Table that the addition of FYM, biogas slurry, poultry manure, vermicompost and neem cake increased the duration of flowering when compared with urea. The mean duration of flowering in marigold was observed as 61.7, 70.3, 70.3, 78.6, 75.8 and 65.4 days in urea, FYM, biogas slurry, poultry manure, vermicompost and neem cake, respectively (Table 11). The maximum duration of flowering was observed in poultry manure followed by vermicompost, biogas slurry, FYM, neem cake and urea. Duration of flowering increased significantly with successive increase in N level *i. e.* 60, 120 and 180 ppm. The mean duration of flowering was recorded as 67.0, 70.4 and 73.2 days in 60, 120 and 180 ppm of nitrogen, respectively. Maximum per cent increase in duration of flowering (5.07%) was recorded

from 60 to 120 ppm of nitrogen. The effect of interaction different sources of nitrogen with their respective level was found non-significant on duration of flowering.

Table 10. Effect of different sources of organic matter on days taken for first flower formation of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	78.0	70.3	67.0	71.8
Farmyard manure	58.3	61.3	67.0	62.2
Biogas slurry	57.3	59.2	64.0	60.2
Poultry manure	51.2	54.0	56.0	53.7
Vermicompost	49.0	51.0	53.0	51.0
Neem cake	75.0	69.2	65.0	69.7
Mean	61.5	60.8	62.0	

CD at 5%
Sources of Nitrogen : 1.9
Level of Nitrogen : NS
Sources of Nitrogen X Level of Nitrogen : 3.4

Table 11. Effect of different sources of organic matter on duration of flowering (days) of marigold

Sources of Nitrogen	Level of Nitrogen (ppm)			Mean
	60	120	180	
Urea	10.3	11.5	13.3	11.7
Urea	59.0	62.5	63.7	61.7
Farmyard manure	66.2	70.0	71.5	70.3
Biogas slurry	67.5	70.3	73.2	70.3
Poultry manure	74.2	77.0	84.7	78.6
Vermicompost	72.0	76.8	78.7	75.8
Neem cake	63.0	65.8	67.5	65.4
Mean	67.0	70.4	73.2	

CD at 5%
Sources of Nitrogen : 1.9
Level of Nitrogen : 1.4
Sources of Nitrogen X Level of Nitrogen : NS

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