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EFFECT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS APPLIED ALONE OR IN COMBINATION ON GROWTH AND YIELD OF SUNFLOWER (*Helianthus annuus* L.)

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SUMMARY

Field experiments have been conducted to study the effect of organic and inorganic sources of nutrients applied alone or in combination on the growth and yield of sunflower. Application of a recommended dose of fertilizer (62.5:75:62.5 kg NPK ha^{-1}) coupled with 10 t ha^{-1} of farmyard manure has recorded highest seed and stalk yields of sunflower. Growth and yield parameters were also favorably influenced by the application of the recommended dose of fertilizer coupled with farmyard manure. Seed oil content was not influenced by the application of organic or inorganic sources of nutrients.

Key words: sunflower, organic source, inorganic source, fertilizer, seed yield, seed oil content

INTRODUCTION

Sunflower is an important oilseed crop of India. Despite its recent introduction, it has replaced the traditional oilseed crops of India such as groundnut and rape-seed-mustard.

Being a deep-rooted crop, the sunflower responds well to the fertilizer level. Nimbal and Doddamani (1993) reported that sunflower has responded up to 62 kg N, 75 kg P and 62 kg K ha^{-1}, whereas Susheel Kumar *et al*. (1995) found an increase in growth and yield parameters of sunflower up to 80 to 120 kg N ha^{-1} and 60 to 90 kg P_2O_5 ha^{-1}. Of late it has been reported that continuous use of inorganic sources of nutrients has led to soil health deterioration resulting in stagnation or reduction in productivity of crops (Biswas and Bendi, 1989). Evidently there is a need to reduce the use of inorganic sources of nutrients. It appears from the pub-

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lished literature that no systematic study has been carried out to assess the effect of organic sources of nutrients. Hence, the present investigation was conducted to study the effect of organic and inorganic sources of nutrients on the growth and yield of sunflower.

MATERIALS AND METHODS

A field experiment was conducted under irrigated conditions at the Main Research Station, University of Agricultural Sciences, Bangalore, India, during *rabi* seasons of 1995 and 1996. The soil was a sandy loam of medium fertility with pH of 6.2. The soil contains 0.5% O.C., 365 kg ha^{-1} available nitrogen, 18.50 kg ha^{-1} of Bray's No.l P_2O_5 and 142.50 kg ha^{-1} of available K_2O. The experiment was laid out in a randomized complete block design in three replicates. The gross plot size was 5 x 5 m. There were eight treatments (Table 1) which included various combinations of inorganic fertilizers with organic sources such as farmyard manure (FYM), enriched FYM (EFYM) and bio-fertilizers. Apart from these, there were also treatments that included substitution of nitrogen with organic sources of nutrients.

Table 1: Treatment details

Symbol	Details
T1	Recommended dose of fertilizer (RDF) (62.5:75:62.5 kg NPK ha^{-1})
T2	RDF + 10 t FYM ha^{-1}
T3	50% RDF + 10 t FYM ha^{-1}
T4	Enriched FYM (equivalent to N of 10 t FYM)
T5	Vermicompost (equivalent to N of 10 t FYM)
T6	50% RDF + 50% N through vermicompost
T7	50% N + 100% PK + 10 t FYM ha^{-1}
T8	50% RDF + P-solubilizer (*Phosphobacterin*)

Nitrogen (N) content in the different organic sources was determined each year and the amount of material required for substituting a specified amount of recommended N was calculated. N contents ranged from 0.84 to 0.88% in FYM and EFYM and from 1.48 to 1.52% in vermicompost. The P and K contents were in the range of 0.8-0.6% and 1.00-1.03% in FYM and 0.68-0.72% in EFYM, respectively. The vermicompost contained 0.26-0.29% P and 0.07-0.08% K. These organic materials were spread uniformly in their respective plots and incorporated in the soil to the depth of 8-10 cm about three weeks before sowing. About 10 kg ha^{-1} of phosphobacterin (P-solubilizer) containing bacterial load of 108 microbes g^{-1} of carrier was applied uniformly and incorporated at the time of FYM application. Sunflower Cv KBSH-1 was sown in the furrows opened at 60 cm distance. Plant-to-plant spacing was 30 cm. Standard production practices were adopted for sunflower cultivation.

Growth characteristics such as plant height, total dry matter production and leaf area were recorded 30 and 60 days after sowing (DAS). Leaf area was measured

with the help of a leaf area meter (LiCOR-3000). Capitulum (head) diameter was recorded at harvest. Seed and stalk yields were also recorded. Seed oil content was assessed by Nuclear Magnetic Resonance Spectrometer (NMR, model Minispec 20 pi).

The data were subjected to the analysis of variance as per method outlined by Panse and Sukatme (1978). The least significant difference (LSD) has been provided for the data presented. The level of significance used in "F"-test was at 0.05. The notation NS was used to indicate non-significance.

RESULTS AND DISCUSSION

Plant height, total dry matter production and leaf area of sunflower differed significantly in both years at 60 DAS due to application of organic and inorganic sources of nutrients (Table 2). However, plant height and total dry matter production at 30 DAS were not influenced by the various treatment combinations. It is apparent from the Table 2 that the application of RDF (62.5:75:62.5 kg NPK ha^{-1}) coupled with 10 t FYM ha^{-1} was superior, followed by the application of RDF, with respect to plant height, total dry matter production and leaf area. The results were in conformity with the finding of Gushevilav and Palaveeva (1991), who showed that the application of FYM coupled with NPK resulted in increased growth parameters of sunflower. Relatively shorter plants with less canopy cover (leaf area) were recorded with the application of vermicompost equivalent to N content of 10 t FYM and in the treatment which received 50% RDF + P-solubilizer in both years.

Table 2: Effect of organic and inorganic sources of nutrients alone and in combination on plant height, total dry matter production and leaf area of sunflower

Treatment	Plant height (cm)				Total dry matter (g/plant)				Leaf area (cm^2)			
	80 DAS		60 DAS		80 DAS		60 DAS		80 DAS		60 DAS	
Year	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996
T1	10.8	11.2	103.0	106.2	3.2	3.8	19.7	22.4	299	340	1012	1050
T2	12.0	12.0	12.6	114.6	118.2	3.6	4.3	21.4	25.2	320	380	1023
T3	11.0	11.8	98.0	102.0	2.8	3.4	18.1	21.4	256	306	1010	1040
T4	10.0	10.8	86.8	90.6	3.1	3.6	18.0	20.8	247	286	967	1002
T5	10.0	10.9	85.5	88.9	2.9	3.6	16.0	18.9	246	283	877	940
T6	10.5	11.2	87.0	91.4	3.0	3.9	17.2	19.9	250	301	927	959
T7	11.5	12.6	83.6	88.2	2.9	3.4	15.7	18.2	247	289	788	830
T8	10.7	11.4	81.6	86.1	3.0	3.6	14.2	17.6	26.3	310	869	920
F test	NS	NS	*	*	NS	NS	*	*	*	*	*	*
LSD ($P \leq 0.05$)	*	*	5.30	4.90	*	*	0.04	0.06	7	8	40	40

Capitulum (head) diameter, seed and stalk yield were favorably influenced by the application of different combinations of organic and inorganic sources of nutrients (Table 3). Contrarily to this, seed oil content was not influenced by the treatment combinations. Highest seed yields of 2250 and 2247 kg ha^{-1} in 1995 and

1996, respectively, were recorded with the application of RDF (62.5:75:62.5 kg NPK ha^{-1}) coupled with 14 t FYM ha^{-1} followed by the application of RDF only (1883 and 1860 kg NPK ha^{-1} in 1995 and 1996, respectively). On an average there was 22% increase in seed yield by the application of RDF + 14 t FYM ha^{-1} over the application of RDF alone indicating the beneficial effects of FYM in increasing the seed yield. Similar results were also obtained in groundnut by Kadam and Desai (1983) and Nandhagopalan (1985) and in rice by Hegde (1992). Stalk yield also followed a trend similar to that of seed yield. The increase in seed and stalk yields may be attributed to favorable growth parameters such as total dry matter production and leaf area and yield parameters such as capitulum diameter. The application of vermicompost equivalent to N content of 14 t FYM has recorded lowest seed and stalk yields followed by the application of 50% RDF + P-solubilizer. The lowest yield in these treatments may be attributed to the inability of either vermicompost or 50% RDF + P-solubilizer to supply the nutrients required for normal growth of sunflower. This phenomenon is better indicated by the lower growth parameters such as total dry mater production and leaf area and yield parameters such as capitulum diameter in these two treatments. Seed oil content was not influenced by any of the treatment combinations, however, the seed oil content ranged from 46.6 to 48.2%. The results are in disagreement with the findings of Ujjanaiah *et al.* (1995).

Table 3: Effect of organic and inorganic sources of nutrients alone and in combination on seed oil content, seed and stalk yield of sunflower

Treatment	Diameter of capitulum (cm)		Seed oil content (%)		Seed yield (kg ha^{-1})		Stalk yield (kg ha^{-1})	
Year	1995	1996	1995	1996	1995	1996	1995	1996
T1	14.08	16.30	47.0	48.2	1833	1860	2917	2935
T2	14.18	16.90	47.0	47.3	2250	2247	3033	3053
T3	14.10	15.80	46.6	47.0	1677	1693	2420	2439
T4	13.05	14.60	46.7	46.9	1654	1671	2540	2562
T5	12.66	14.10	46.6	47.3	1469	1484	2333	2348
T6	13.25	14.80	46.8	48.0	1608	1632	2623	2641
T7	13.00	14.09	47.8	48.2	1562	1578	2687	2703
T8	12.50	13.30	46.8	47.3	1490	1505	2595	2594
F test	*	*	NS	NS	*	*	*	*
LSD ($P \leq 0.05$)								

CONCLUSIONS

Based on this study it can be concluded that the application of FYM along with recommended fertilizer helps in increasing the seed yield of sunflower significantly compared with the application of the recommended NPK fertilizers alone. The application of either vermicompost equivalent to N content of 10 t FYM or 50% RDF

+ P-salubilizer was not sufficient to supply the requirement for normal growth of sunflower.

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EFECTO DE FUENTES ORGANICAS E INORGANICAS DE SUSTANCIAS NUTRITIVAS APLICADAS EN PARTICULAR Y EN COMBINACIONES SOBRE EL CRECIMIENTO Y EL RENDIMIENTO DE GIRASOL (*Helianthus annuus* L.)

RESUMEN

El efecto de fuentes organicas e inorganicas de sustancias nutritivas aplicadas en particular y en combinaciones sobre el crecimiento y el rendimiento de girasol era estudiado en los experimentos de campo. Con la adicion de la dosis de fertilizante recomendada (62,5:75:62,5 kg NPK ha^{-1}) en combinacion con 10 t ha^{-1} de estiercol fueron alcanzados los mas altos rendimientos de semillas y tallos de girasol. Los parametros de crecimiento y rendimiento se mostraron positivos bajo la influencia de aplicacion de la dosis de fertilizante recomendada en combinacion con el estiercol. El contenido de aceite en las semillas no reaccionaba a la aplicación de sustancias ni organicas ni inorganicas.

EFFET DES ENGRAIS DE SOURCE S ORGANIQUE ET INORGANIQUE ADMINISTRÉS ISOLÉMENT OU EN COMBINAISON SUR LA CROISSANCE ET LE RENDEMENT DU TOURNESOL *(Helianthus annuus* L.)

RÉSUMÉ

L'effet sur la croissance et le rendement du tournesol de l'utilisation des engrais de sources organique et inorganique administrés isolément ou en combinaison a été étudié dans des champs expérimentaux. L'administration de la dose recommandée de fertilisant (62.5:75:62.5 kg NPK ha^{-1}) en combinaison avec 10 t ha^{-1} de fumier de ferme a donné le plus grand rendement en graines et en tiges de tournesol. Les paramètres de croissance et de rendement ont

aussi été favorablement influencés par l'administration de la dose de fertilisant recommandée en combinaison avec du fumier de ferme. L'administration d'engrais de sources organique ou inorganique n'a pas eu d'effet sur le contenu d'huile dans la graine.