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Improving productivity of sunflower (*Helianthus annuus* L.) by using different organic and inorganic sources of nutrients

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Abstract
A Field experiment was conducted during June to September of 2013 at Experimental Farm of the Department of Agronomy, Annamalai University, Annamalai Nagar to improve the productivity of sunflower by using different organic and inorganic sources of nutrients. The results indicated that combined application of RDF + vermicompost @ 5 t ha^{-1} + foliar application of $MnSO_4$ 0.5 per cent on 40 and 60 DAS significant increase in growth attributes (plant height, LAI and DMP), yield attributes (Capitulum diameter, total numbers of seeds $capitulum^{-1}$, number of filled seeds $capitulum^{-1}$ and 100 seed weight) and yield of sunflower, and it was followed by RDF + pressmud @ 10 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 percent on 40 and 60 DAS. The least growth and yield parameters and yield were recorded with control.

Keywords: vermicompost, pressmud, micro nutrient, sunflower

Introduction

In spite of cultivation of number of oilseed crops, country meets 50 per cent of its domestic requirements through import. At present the annual edible oil requirement of the country is about 18.24 mt of which only 8.04 mt is met by local production and rest 9.34 mt is being imported. Sunflower seeds contains about 48 – 53 per cent edible oil. Sunflower oil is a rich source of linoleic acid (64 per cent) which is good for heart patients. The oil is also used for manufacturing hydrogenated oil. Sunflower can play an important role in meeting out the shortage of edible oils in the country. The total world production of sunflower during 2012-2013 amounts to approximately 36.36 million tonnes (40.29 million tons in 2011-2012). In India, during 2012-13 sunflower is cultivated in area of 2.34 m.ha with a production of 11.61 lakh tonnes with average productivity of 615 kg ha^{-1}. The existing yield is very low, mainly because of the suboptimal soil fertility.

The lower productivity of sunflower is mainly due to lack of high yielding varieties, its cultivation on marginal lands with inadequate nutrients leads to poor seed setting and also continuous use of inorganic fertilizer deteriorates soil health and also which makes unproductive for next season. Hence, there is an urgent need to augment oilseed production on sustainable basis to meet out the needs of the expanding demand.

Imbalanced fertilizer application, accelerated soil loss and exclusion of organic sources combined with over use of nitrogen aggravate the problems of secondary and micronutrients deficiencies besides adversely affecting the soil biota. Therefore, there is a felt necessity to evaluate suitable agronomic strategies with emphasis on eco friendliness to accomplish the twin objectives of achieving the sustained production and maintaining the soil fertility over a longer period. One of the major practices to achieve sustainability is to partially substitute the chemical fertilizers with suitable organic manures. They are considered as the promising renewable nutrient rich sources and can be served as substitute to cut down the cost of chemical fertilizer inputs and to increase the productivity of sunflower.

Research evidences have also shown that improper filling of seeds and poor germination of sunflower seeds could also decline sunflower yield considerably. However, these constraints may be mitigated by providing appropriate quantity of essential macro and micro nutrients by way of foliar nutrition. Among the various micronutrients, Manganese is an essential nutrient that required for the Hill reaction – the water splitting and oxygen evolving system in photosynthesis and its deficiency exhibits interveinal chlorosis wherein the leaves becomes pale green or purplish red with prominent green veins which would shed prematurely (Nusrat Jabeen and Rafiq Ahmad, 2011). Hence the present study was undertaken to know about the effect of FYM, vermicompost, pressmud and inorganic fertilizers on growth and yield of sunflower.

Materials and Methods

Field experiment was conducted at Experimental Farm, Annamalai University, during June to September of 2013 for sunflower cultivation. The experiment was laid out in randomised block design with three replications using hybrid Sunbred. The treatments includes Control (no fertiliser and organic manure) (T_1), Recommended dose of fertilizer (RDF) (T_2), RDF+ farm yard manure (FYM) @ 12.5 t ha^{-1}(T_3), RDF + vermicompost @ 5 t ha^{-1}(T_4), RDF+ pressmud @ 10 t ha^{-1} (T_5), RDF+ water hyacinth compost @ 5 t ha^{-1}(T_6), RDF+ farm yard manure @ 12.5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS(T_7), RDF + vermicompost @ 5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS(T_8), RDF+ pressmud @ 10 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS(T_9) and RDF+ water hyacinth compost @ 5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS(T_{10}). The seeds were sown with a spacing of 60 x 30 cm. The soil of the crop field was clay in texture having pH 6.7, EC 0.34dsm, low in available N (246.50 kg ha^{-1}) medium in available P (18.50 kg ha^{-1}) and high in available K (280.750 kg ha^{-1}). Observations on growth attributes, yield attributes and seed yield were taken on five randomly selected peg marked plants at periodical intervals.

Results and Discussion

Growth Attributes

All the growth parameters of sunflower, viz., plant height, leaf area index and dry matter production were significantly influenced by the organic and inorganic sources of nutrients (Table 1). Application of RDF + vermicompost @ 5 t ha^{-1} + foliar application of $MnSO_4$ 0.5 per cent on 40 and 60 DAS (T_8) had recorded the highest plant height (165.26cm), LAI (4.87) and DMP (4675.69 kg ha^{-1}). This might be due to better performance of INM treatments contributed to the availability of nutrients from vermicompost along with inorganic fertilizer and micro nutrient and it is reflected on increased growth attributes (Ghosh *et al.*, 2013) [4]. Favourable effect of vermicompost on plant height could be attributed to sustained availability of major and micronutrients with different growth hormones like gibberellins, NAA and cytokinin resulting in increased growth parameters. The increase in growth attributes might be due to higher availability of both native and applied nutrients in this treatment along with better source and sink relationship in the crop which has contributed to better dry matter accumulation. This was supported by the findings of Byrareddy *et al.* (2008) [1].

Table 1: Effect of organic and inorganic sources on plant height (cm), LAI and DMP (kg ha^{-1}) in sunflower

Treatments	Growth attributes		
	Plant height (cm)	LAI	DMP (kg ha^{-1})
T_1 – Control	113.13	3.10	2363.6
T_2 – Recommended dose of fertilizer	122.12	3.57	2560.97
T_3 – RDF+ FYM @ 12.5 t ha^{-1}	128.24	3.84	2787.96
T_4 – RDF + vermicompost @ 5 t ha^{-1}	156.23	4.47	3908.83
T_5 – RDF + pressmud @ 10 t ha^{-1}	145.53	4.48	3290.87
T_6 – RDF + water hyacinth compost @ 5 t ha^{-1}	134.43	4.12	2985.34
T_7 – RDF + FYM @ 12.5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	137.34	4.23	3049.65
T_8 – RDF + vermicompost @ 5 t ha^{-1} + foliar application of 0.5 per cent $MnSO_4$ on 40 and 60 DAS	165.26	4.87	4675.69
T_9 – RDF + pressmud @ 10 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	158.77	4.59	3954.13
T_{10} – RDF + water hyacinth compost @ 5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	149.02	4.29	3314.45
S.Ed	2.13	0.08	63.51
CD (p=0.05)	4.47	0.14	132.74

Yield attributes and yield

The data on yield attributes and yield (Table 2) indicate that application of RDF + vermicompost @ 5 t ha^{-1} + foliar application of $MnSO_4$ 0.5 per cent on 40 and 60 DAS (T_8) had marked influence over other treatments. This was followed by RDF + pressmud @ 10 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS (T_9). This could be due to the availability of these nutrients with this treatment might have enhanced the capitulum diameter, number of filled seeds head^{-1} and test weight. The highest yield might be due to effective translocation and storage of photosynthetic assimilates resulted in increased the yield attributes of sunflower Tejeswara Rao *et al.* (2013) [7]. Further, the vermicompost offer a balanced nutritional release pattern to plants, providing nutrients such as available N, soluble K, exchangeable Ca, Mg and P that can be taken readily by plants (Edwards and Fletcher, 1988) and greater microbial diversity and also the availability of the essential micronutrients *viz.*, manganese, and sulphur in the treatment (T_8) right from germination to maturity phase might have increased the rate of photosynthetic production, translocation and accumulation in sink regions resulting in enhanced values of growth and yield attributes. The findings of Radhakrishnan, (2009) [6] and Elankavi (2012) [3] lend support to the present results.

Table 2: Effect of organic and inorganic sources on Capitulum dm (cm), Total no of seeds capitulum^{-1}, No of filled seeds capitulum^{-1}, test weight and yield (kg ha^{-1}) in sunflower

Treatments	Capitulum diameter (cm)	Total number of seeds capitulum^{-1}	Number of filled seeds capitulum^{-1}	Test weight	Seed yield (kg ha^{-1})
T_1 – Control	8.62	473.53	225.15	5.11	650.15
T_2 – Recommended dose of fertilizer	10.89	541.88	345.45	5.28	894.21
T_3 – RDF+ FYM @ 12.5 t ha^{-1}	12.56	617.67	465.26	5.36	1145.26
T_4 – RDF + vermicompost @ 5 t ha^{-1}	18.65	963.67	824.35	5.62	1786.31
T_5 – RDF + pressmud @ 10 t ha^{-1}	17.07	867.13	726.13	5.55	1553.14

T_6 – RDF + water hyacinth compost @ 5 t ha^{-1}	14.29	765.31	610.34	5.48	1381.69
T_7 – RDF + FYM @ 12.5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	15.23	788.12	635.19	5.50	1390.11
T_8 – RDF + vermicompost @ 5 t ha^{-1} + foliar application of 0.5 per cent $MnSO_4$ on 40 and 60 DAS	20.63	1040.65	925.00	5.70	2195.30
T_9 – RDF + pressmud @ 10 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	19.21	976.32	840.33	5.64	1792.45
T_{10} – RDF + water hyacinth compost @ 5 t ha^{-1} + foliar application of $MnSO_4$ @ 0.5 per cent on 40 and 60 DAS	17.44	884.79	745.34	5.57	1646.35
S.Ed CD (p=0.05)	0.37 0.79	13.19 27.59	28.86 60.36	0.01 NS	49.13 102.7

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