Production efficiency and profitability of sunflower as influenced by chemical fertilizer and organic manures

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Abstract

Field experiments were carried out at the Annamalai University, Experimental Farm, Department of Agronomy, Annamalai Nagar, Tamil Nadu to study the production efficiency and profitability of sunflower as influences by chemical fertilizer and organic manures for two season during Feb – May (2010) and July – Sep (2010). The experiment was laid out in a randomized black design with ten treatments and replicated thrice. The treatments were T_1- control (no fertilizer and no organic manure), T_2- recommended dose of nitrogen, T_3 - 75% RDN +FYM @ 12.5 t ha^{-1}, T_4 - 75%RDN + pressmud @ 10 t ha^{-1}, T_5 - 75% RDN + sewage sludge @ 2.5t ha^{-1}, T_6 - 75% RDN + sugarcane trash compost @ t ha^{-1}, T_7 - 75% RDN + FYM vermicompost @ 2.5 t ha^{-1}, T_8 - 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}, T_9 -75% RDN + sewage sludge vermicompost @ 2.5 t ha^{-1}, T_{10} – 75% RDN + sugarcane trash vermicompost @ 2.5 t ha^{-1}. The results revealed that crop raised with pressmud vermicompost in two seasons had significant influence on the seed yield of sunflower. Plots received with pressmud vermicompost @ 2.5 t ha^{-1} along with 75 % RDN registered higher values of itrogen use efficiency, apparent nitrogen recovery percentage and production efficiency. Also the same treatment recorded higher values of gross return, net retune and return per rupee invested. The least values were recorded in absolute control (no organic and chemical fertilizers). From the results of the field trials, it may be inferred that combined application of 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1} to sunflower may be an eco-friendly, economically viable and biologically active system that can be advocated to the farmers of tail end area of Cauvery Deltaic Zone of Tamil Nadu.

Keywords : Sunflower, Vermicompost, production efficiency, nitrogen use efficiency, gross return, net retune and return per rupee invested.

Introduction

Sunflower (*Helianthus annuus* L.), an important oilseed crop, contains a good percentage of oil (48-53), protein (14-19), crude fibre (16-27), ash (2-3), soluble sugar (7-9) and hull (21-27). Indian vegetable oil economy is the fourth largest in the world, accounting for about 14.5 per cent of the world's oil seeds area and 6.65 per cent of the production and plays the second important role in the agricultural economy, next only to food grains in terms of area and production (Petcu *et al.*, 2010). This occupies an area of 27.86 m.ha with 27.98 mt of production registering productivity level of 1004 kg ha^{-1}. About 14 million persons are engaged in production and another one million in processing of oil seeds (Anon., 2009). Sunflower is an important oilseed crop for its premier oil and manifold uses of both industrial and pharmaceutical importance. Its cultivation has gained momentum due to its special features like short duration, photoperiod insensitivity, drought tolerance adaptability to wide range of soil and climatic

situations lower seed rate high content of quality cooking oil and high seed multiplication ratio (Thimmegowda *et al.*, 2007).

Nitrogen is the key to any fertilizer management programme by which yield potential can be achieved in modern sunflower cultivars. The recommendation of nitrogen use thus needs attention. Despite growth in nitrogen use, research over the past 20-30 years has showed that nitrogenous use efficiency of different N fertilizers are generally low or decreasing. Poor utilization of nitrogenous fertilizer by sunflower is thought to be largely due to different losses of nitrogen. The use of inorganic fertilizer to sustain cropping was found to increase yield only for some few years but on long-term, it has not be effective and leads to soil degradation (Satyanarayana *et al.*, 2002). Sustainable production of a crop can not be maintained by using the chemical fertilizer alone and similarly it is not possible to obtain high yield by using only organic manure (Kumar and Goh (2000). This implies that the need of integrated nutrient management for sunflower production. Therefore the combined use of organic manures and inorganic fertilizers help in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients, enhancing efficiency of applied nutrients and providing favorable soil physical conditions. INM practices are a holistic management system, which promotes sustainable agriculture and enhances agro-ecosystem health. Organic manures like FYM, pressmud and vermicompost deserves priority for sustained production and better utilization in intensive crop cultivation. Vermicompost is a rich source of enzymes, antibiotics, immobilised micro flora and growth hormones like gibberellins which regulate the growth of plants and microbes (Banik and Ranjita Bejbaruah, 2004).

Although research work on organic wastes with inorganic fertilizer on sunflower crop was in plenty, different vermicompost made from various organic sources in sunflower is almost meager. Therefore, the present investigation was planned to develop a sustainable nutrient management concept to achieve a highly productive and remunerative sunflower crop in Tamil Nadu.

MATERIALS AND METHODS

Field experiments were conducted at the Experimental farm, department of Agronomy, Annamalai University, Annamalai nagar, to study the production efficiency and profitability of sunflower as influenced by chemical fertilizer and organic manures in two season during Feb – May (2010) and July – Sep (2010). The experimental farm is geographically located at 11°24'N latitude, 79° 44'E longitude and +5.79 m above mean sea level. The experimental soil was clay loam in texture with pH 7.9, EC 0.45 dsm^{-1}, organic carbon 0.54 and low N (210 Kg ha^{-1}), medium in P (27 Kg ha^{-1}) and high in K (278 Kg ha^{-1}). The experiment comprising of ten treatments *viz.*, T_1- control (no fertilizer and no organic manure), T_2- recommended dose of nitrogen, T_3 - 75% RDN + FYM @ 12.5t ha^{-1}, T_4 – 75%RDN + pressmud @ 10 t ha^{-1}, T_5 - 75% RDN + sewage sludge @ 2.5t ha^{-1}, T_6 – 75% RDN + sugarcane trash compost @ t ha^{-1}, T_7 – 75% RDN + FYM vermicompost @2.5 t ha^{-1}, T_8 – 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}, T_9 – 75% RDN + sewage sludge vermicompost @ 2.5 t ha^{-1}, T_{10} – 75% RDN + sugarcane trash vermicompost @ 2.5 t ha^{-1}. Organic manures and different source of vermicompost were applied as basal one week before sowing as per treatment schedule. The experiment was laid out in a randomized block design with three replications. The sunflower cultivar CO 4 was chosen for the study. The recommended seed rate of 15 kg ha^{-1} was used for the experiment. The seeds were sown by dibbling with a spacing of 45 X 30 cm. Vermicompost was prepared using heap method. After 3 months, matured vermicompost was applied to experimental plots as per the treatment schedule. A fertilizer schedule of 50 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied. Nitrogen was applied as per the treatment schedule. 50 per cent of recommended N was applied as basal and remaining 50 per cent was applied on 30 DAS. Entire dose of P_2O_5 and K_2O were applied as basal. N, P_2O_5 and K_2O were supplied through urea, single superphosphate and muriate of potash, respectively. All other improved recommended package of practices were followed to sunflower as per the Crop Production Guide .

Five sample plants from each treatment plot were selected at random and tagged for biometric observations. The sunflower heads from the each treatment plot were harvested, threshed, sun dried to attain 14 per cent moisture, weighed and the seed yield was expressed in kg ha^{-1}.

Nitrogen use efficiency (NUE)

In this approach, nitrogen use efficiency was calculated in terms of seed yield kg^{-1} of nitrogen fertilizer applied. It was computed using the formula as given below:

$$NUE = \frac{\text{Seed yield (kg ha}^{-1})}{\text{Amount of nitrogen applied (kg ha}^{-1})}$$

Production efficiency (PE)

The production efficiency is defined as the grain yield obtained per unit of nitrogen adsorbed. It was computed as follows (Yoshida, 1981).

$$PE = \frac{\text{Grain yield in fertilized plot (kg ha}^{-1}) - \text{Grain yield in unfertilized plot (kg ha}^{-1})}{\text{N uptake in fertilized plot (kg ha}^{-1}) - \text{N uptake in unfertilized plot (kg ha}^{-1})}$$

Economic analysis

Gross return

Gross return was calculated using seed yield of sunflower on market price and expressed in Rs ha^{-1}.

Net return

Net return was calculated by deducting the cost of cultivation from gross returns as detailed below and presented in Rs ha^{-1}.

Net return = Gross return – total cost of cultivation

Return $rupee^{-1}$ invested

Return $rupee^{-1}$ invested was calculated based on gross returns and cost of cultivation as given.

$$\text{Return rupee}^{-1}\text{ invested} = \frac{\text{Gross return (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (1984).

Results and Discussion

Effect of chemical fertilizer and organic manures on seed yield

Among the treatment of 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1} (T_8) significantly registered the higher seed yield of 1825 and 1898 kg ha^{-1} during first and second season, respectively. This might be due to the fact that pressmud 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; James Pitchai *et al*., 2009) and greater microbial diversity and activity resulting in higher plant height, number of seeds $head^{-1}$ and seed yield (Edwards, 2004). The superiority of

inorganic fertilizer along with vermicompost over inorganic fertilizer alone on sunflower was earlier reported by Bhattacharya *et al*. (2001). The treatment control (T_1) registered the lowest seed yield of 495 and 520 kg ha^{-1} during first and second season, respectively.

Effect of chemical fertilizer and organic manures on Nitrogen use efficiency and Apparent N recovery (%) and Production efficiency (PE)

Among the treatments, T_8 (75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}) registered the higher values of nitrogen use efficiency of 20.40 and 21.21 and apparent N recovery (%) of 55.07 and 56.15 per cent and production efficiency with 27.10 and 27.41 during first and second season, respectively. This might be due to increased availability of nitrogen in pressmud vermicompost in the form of mucous, nitrogenous excretory substances which were not present in other organic sources (Viel *et al*., 1987). Nitrogen fixing bacteria were also found to be more in this vermicompost which might have reduced the loss of nitrogen from the soil and increased the use efficiency of inorganic fertilizers applied (Ihseen *et al*., 2003). The least nitrogen use efficiency of 17.50 and 18.22 and apparent N recovery (%) of 31.74 and 32.52 per cent and production efficiency of 23.95 and 23.99 were recorded during first and second season, respectively under T_2 (100% RDN).

Effect of chemical fertilizer and organic manures on Gross return, Net Return and Return rupee^{-1} invested

Among the INM treatments, T_8 (75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}) registered higher gross return of Rs. 54750 and Rs. 56940 and net return of Rs. 36168 and Rs. 38273 during first and second season, respectively. The lowest gross return of Rs. 14850 ha^{-1} and Rs. 15600 ha^{-1} and net return of Rs. 4293 ha^{-1} and Rs. 5104 ha^{-1} was registered in T_1 (No fertilizer and no organic manure) during first and second season, respectively.

In respect of return rupee^{-1} invested, T_8 (75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}) registered highest return rupee^{-1} invested of Rs. 2.95 and Rs. 3.05 during first and second season, respectively. The lowest return rupee^{-1} invested of Rs.1.41 and Rs. 1.49 ha^{-1} was registered in T_1 (No fertilizer and no organic manure) during first and second season, respectively. Plots received with 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1} significantly influenced the growth and yield attributes of sunflower. The growth attributes are directly reflected on increased yield of sunflower. In addition aforesaid treatments offered favourable neutro physiological conditions and enhanced the soil fertility. These might be the reason for increased profitability in the sunflower crop. Similar results were reported by Milap-Chand *et al.*, (2006) Byrareddy (2008).

In the light of economic analysis, it may be inferred that combined application of 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1} to sunflower may be an eco-friendly, economically viable and biologically active system that can be advocated to the farmers of tail end area of Cauvery Deltaic Zone of Tamil Nadu.

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Table 1. Effect of INM practices on seed yield, Nitrogen use efficiency (NUE), Apparent N recovery (%) and Production efficiency of sunflower

Treatments	Seed yield (kg ha^{-1})		Nitrogen use efficiency		Apparent N recovery (%)		Production efficiency	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
T_1	495	520	-	-	-	-		
T_2	875	911	17.50	18.22	31.74	32.52	23.95	23.99
T_3	1495	1567	14.59	15.30	38.48	38.33	26.30	26.65
T_4	1627	1689	13.62	14.14	36.07	36.31	26.28	26.94
T_5	1562	1626	18.49	19.24	48.79	48.97	25.89	26.71
T_6	1459	1524	15.78	16.48	41.49	41.37	25.14	26.23
T_7	1716	1778	20.01	20.74	53.43	54.19	26.66	27.06
T_8	1825	1898	20.40	21.21	55.07	56.15	27.10	27.41
T_9	1769	1837	20.17	20.94	54.16	55.14	26.82	27.20
T_{10}	1685	1742	19.95	20.63	52.86	53.52	26.65	27.02
S_{ED}	23.11	25.24	-	-	-	-	-	-
CD(p=0.05)	48.21	50.46	-	-	-	-	-	-

Treatment Details: T_1- control (no fertilizer and no organic manure), T_2- 100% recommended dose of nitrogen alone (RDN), T_3- 75% RDN + FYM @ 12.5t ha^{-1}, T_4 – 75% RDN + pressmud @ 10 t ha^{-1}, T_5 - 75% RDN + sewage sludge @ 2.5 t ha^{-1}, T_6 – 75% RDN + sugarcane trash compost @ 10 t ha^{-1}, T_7 – 75% RDN + FYM vermicompost @ 2.5 t ha^{-1}, T_8 – 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}, T_9 – 75% RDN + sewage sludge vermicompost @ 2.5 t ha^{-1}, T_{10} – 75% RDN + sugarcane trash vermicompost @ 2.5 t ha^{-1}

Table 2. Effect of INM practices on Economics of sunflower

Treatments	Cost of cultivation (Rs. ha^{-1})		Gross return (Rs. ha^{-1})		Net income (Rs. ha^{-1})		Return rupee^{-1} invested	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
T_1	10557	10496	14850	15600	4293	5104	1.41	1.49
T_2	13296	13383	26250	27330	12954	13947	1.97	2.04
T_3	17800	17880	44850	47010	27050	29130	2.52	2.63
T_4	17514	17594	48810	50670	31296	33076	2.79	2.88
T_5	17216	17296	46860	48780	29644	31484	2.72	2.82
T_6	17550	17650	43770	45720	26220	28070	2.50	2.59
T_7	18885	18971	51480	53340	32594	34369	2.73	2.81
T_8	18582	18667	54750	56940	36168	38273	2.95	3.05
T_9	18266	18352	53070	55110	34804	36759	2.91	3.00
T_{10}	18621	18727	50550	52260	31929	33533	2.72	2.79

Treatment Details: T_1- control (no fertilizer and no organic manure), T_2- 100% recommended dose of nitrogen alone (RDN), T_3- 75% RDN + FYM @ 12.5t ha^{-1}, T_4 – 75% RDN + pressmud @ 10 t ha^{-1}, T_5 - 75% RDN + sewage sludge @ 2.5 t ha^{-1}, T_6 – 75% RDN + sugarcane trash compost @ 10 t ha^{-1}, T_7 – 75% RDN + FYM vermicompost @ 2.5 t ha^{-1}, T_8 – 75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}, T_9 – 75% RDN + sewage sludge vermicompost @ 2.5 t ha^{-1}, T_{10} – 75% RDN + sugarcane trash vermicompost @ 2.5 t ha^{-1}