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Effect of integrated nutrient management practices on soil fertility and yield of sunflower in Cauvery deltaic region of Tamilnadu

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Abstract
Field experiments were conducted at Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar, during Feb - May' 2011 and Jul – Oct' 2011, to study the effect of Integrated Nutrient Management on soil fertility and yield of sunflower. The results indicated that considerable increase in yield attributes (number of seed^{-1} capitulum, number of filled grains^{-1} capitulum), seed yield, organic carbon, microbial population and NPK availability at the end of the cropping season with the combined application of 100 % RDF along with vermicompost @ 2.5 t ha^{-1} (T_3). This was followed by (T_7) 50% RDF along with vermicompost @ 2.5 t ha^{-1}.

Keywords: Sunflower, Vermicompost, Press mud, water hyacinth

Introduction

India is amongst the largest producer and consumer of vegetable oil in the world. Indian vegetable oil economy is the fourth largest in the world next to USA, China and Brazil. India occupies a premier position in global oil seed scenario accounting for 19 percent in area and 9 per cent in production and plays the second important role in the agricultural economy, next only to food grains in terms of area and production. In India, it is cultivated in 1.85 million hectares with an annual production of 1.16 million tonnes and productivity of 639 kg ha^{-1} (Directorate of Oilseeds Research, 2009) [7]. Among the oil seeds crops sunflower has been proved to be highly promising for round - the – year cultivation under different agro – climatic regions owing to its thermo-photo-insensitivity and can fits well in crop rotation any time. In Tamil Nadu, sunflower cultivation has gained importance for the past two decades and currently 0.29 lakh hectares are under cultivation with an annual production of 0.34 lakh tonnes and per hectare productivity of 1288 kg ha^{-1}. However, yield is still lower when compared to the average productivity of major sunflower producing countries in the world (2100 kg ha^{-1}). Despite sunflower is being cultivated mostly under marginal and sub-marginal land that too under moisture deficit situation, improper choice of cultivar, lack of improved agronomic crop management are other reasons delineated for poor sunflower productivity in Tamil Nadu. The objective of maximizing yield, maintaining soil productivity and ecological balance can be met by the balanced use of inorganic fertilizer and organic sources of nutrients.

Use of organic manures with fertilizers can take care of the widening N:P:K ratio and emerging problems of micronutrient deficiencies. Integrated nutrient management aims at a judicious combination of organic sources for meeting the nutrient needs of crop and cropping system and is of great interest for sustaining high productivity in today's agriculture (Blaise and Prasad, 2005; Hedge, 1998) [3, 8]. In intensive cropping system, which has higher turnover of nutrients, poor recycling of organic sources and application of high analysis fertilizer causes deficiency of several micro nutrients in soil and also leads to environmental pollution (Kumar, 2008) [9]. It is recognized that neither chemical fertilizer nor organic manure alone can be used for sustainable production. Hence the present study was undertaken to know the effect of FYM, vermicompost and inorganic fertilizers on growth and yield of cotton under rice fallow conditions.

Materials and method

A field experiment was conducted at Experimental farm, Annamalai University during Feb - May' 2011 and Jul – Oct' 2011 for sunflower cultivation. Experiment was laid out in Randomized Block Design with three replications using variety CO4. The treatments includes Control (No fertilizer and organic manure) (T_1), 100 % Recommended dose of fertilizer (T_2), 100% RDF + Vermicompost @2.5 t ha^{-1} (T_3), 100% RDF + FYM @ 12.5 t ha^{-1} (T_4), 100% RDF + Water hyacinth compost @ 5 t ha^{-1}(T_5), 100% RDF + Pressmud @ 10 t ha^{-1} (T_6), 50%

RDF + Vermicompost @2.5 t ha^{-1}(T_7), 50% RDF + FYM @ 12.5 t ha^{-1} (T_8), 50% RDF + water hyacinth compost @ 5 t ha^{-1} (T_9), 50% RDF + Pressmud @ 10 t ha^{-1} (T_{10}). Sunflower seeds were sown with a spacing of 45x15cm. The variety was raised under optimum conditions of agronomic practices and plant protection measures in the field. The soil was clay in texture having pH 6.7, EC 0.34 ds/m, low in available N (246.50 kgha^{-1}) medium in available P (18.5 kgha^{-1}) and high in available K (280.75 kgha^{-1}). Observations on yield attributes (number of seed^{-1} capitulum, number of filled grains^{-1} capitulum), seed yield and higher Organic carbon, microbial population and NPK availability were taken on five randomly selected peg marked plants in periodical intervals.

Results and discussion

Yield attributes (Table. 1)

The data on yield attributes and yield indicate that application of 100% RDF and vermicompost @ 2.5 t ha^{-1} (T_3) increased significantly in both the years (Table). This was followed by 50% RDF with vermicompost @2.5 t ha^{-1} (T_7). The increased in seed yield because of vermicompost application was attributed to higher number of number of seed^{-1} capitulum, and number of filled grains^{-1} capitulum and yield. This could be ascribed to higher nutrient uptake and subsequent greater production of photosynthates (Anup Das *et al*., 2006) [1]. Further, the rate of availability of nutrients in T_3 wherein, manures were used in conjunction with fertilizers might be well in tune with the crop requirement to reflect in terms of increased yield of sunflower. Similar improvement in yield attributes with conjunctive use of fertilizers and manures was reported by Manivannan *et al*. (2009) [10]. Moreover, organics like vermicompost supplies some micronutrients besides major nutrients and Azatobactor secretes some beneficial growth promoting substances (eg IAA, GA etc.) and vitamins (eg riboflavin, thiamine, etc), which might have helped in higher boll retention and improved boll weight. Similar findings were also indicated by Reddy *et al*. (2007) [13].

Soil fertility (Table.2)

In respect of organic carbon, T_3 (75% RDF + vermicompost @ 2.5 t ha^{-1}) registered higher organic carbon content in post harvest soil at the end of experimentation in both seasons. This might be due to the build up of humus and higher microbial population by vermicompost and crop residue. This concurs with the views of Ravi and Srivastava (1997) [12] and Patro *et al*. (2005) [11].

Among the INM treatments, T (75% RDN + pressmud vermicompost @ 2.5 t ha^{-1}) registered higher microbial population of bacteria, fungi and actinomycetes in first crop and second crop, respectively. This might be due to addition of organics, which might have regulated soil temperature and available soil moisture and the humus content of soil which have created favourable soil environment for sustenance, rapid multiplication and their activity on nutrient availability (Woods and Schuman, 1986) [15]. In respect of available N, P and K in post harvest soil, among INM treatments 75% RDF + Vermicompost @ 2.5 t ha^{-1} (T3), registered significantly higher N, K in post harvest soil. This might be due to the tendency of vermicompost in amending the soil to retain more of available N and K at end of the experiment, probably due to the presence of more organic matter and higher microbial population. These results are line with the findings of Sudhakar and Kuppuswamy (2007) [14].

Industrial waste, pressmud @ 10 t ha^{-1} along with 75% RDF recorded the maximum available P at the end of the experimentation and this could be attributed to higher phosphorus content and slow release pattern of nutrients from pressmud. Also, this might be due to slow release nature of nutrients from organics. Pressmud has the capacity to form phospho -humic complex with anions replacement of the phosphate by humate ion and the coating of sesquioxide by humus to form a protective cover and thus reducing the phosphate fixing capacity of soil. The results are in consonance with the findings of Dang and Verma (1996) [6] and Bhoite (2005) [4].

In the nutshell, the results have proved sustainability in productivity and soil fertility with INM practices using different sources of organic manures. Adoption of the integrated nutrient management practices to sunflower, consisting of 100% RDF + vermicompost@ 2.5 t ha^{-1} will hold an ecofriendly, agronomically sound and economically viable for tail end areas of Cauvery deltaic zone of Tamil nadu.

Table 1: Effect of integrated nutrient management on yield attributes and yield of sunflower

Treatments	Number of seeds capitulum^{-1}		Number of filled seeds capitulum^{-1}		Seed yield	
	Season I	Season II	Season I	Season II	Season I	Season II
T_1	227.00	224.60	101.25	105.49	670	694
T_2	607.72	533.29	398.21	320.33	1610	1648
T_3	730.29	746.16	590.48	625.42	1824	1890
T_4	537.72	478.60	342.00	248.22	1554	1579
T_5	619.72	548.39	413.61	365.35	1634	1680
T_6	691.21	687.04	519.17	529.61	1747	1804
T_7	701.31	702.16	534.27	549.30	1772	1829
T_8	490.48	395.50	266.60	202.63	1130	939
T_9	525.60	464.48	325.79	207.20	1522	1553
T_{10}	655.25	632.92	466.05	433.93	1693	1741
SEd	9.53	11.31	12.92	16.08	24.10	15.23
CD (P=0.05)	19.51	22.63	25.84	32.17	48.20	30.46

Table 2: Effect of integrated nutrient management on soil fertility

Treatments	Available Nutrients			Available Nutrients			Organic Carbon		Microbial population Season I			Microbial population Season II		
	Season I			Season II			Season I	Season II	Bacteria (10-6)	Fungi (10-4)	Actinomycetes (10-5)	Bacteria (10-6)	Fungi (10-4)	Actinomycetes (10-5)
	N	P	K	N	P	K								
T1	176.82	17.38	246.93	175.82	18.42	252.36	0.43	0.42	15.84	4.95	1.78	16.67	5.21	1.88
T2	200.20	20.85	263.70	209.62	23.38	272.89	0.57	0.60	50.92	15.54	5.38	51.79	16.04	5.85
T3	218.52	27.20	278.18	223.45	29.21	287.95	0.68	0.71	58.42	18.26	6.57	60.76	18.99	6.84
T4	194.22	22.92	260.30	206.14	25.20	269.90	0.54	0.57	49.18	15.00	5.15	49.80	15.53	5.62
T5	202.32	28.32	266.50	211.18	30.22	275.44	0.58	0.61	52.28	16.00	5.54	53.36	16.54	6.00
T6	212.15	29.43	273.00	218.14	31.20	281.87	0.64	0.67	55.68	17.20	6.15	57.25	17.85	6.48
T7	214.28	23.80	274.98	220.14	26.01	284.39	0.65	0.68	56.52	17.65	6.32	58.84	18.35	6.60
T8	185.68	21.80	254.98	199.50	24.20	265.00	0.48	0.47	28.01	9.11	3.15	29.16	9.11	3.28
T9	191.82	24.98	258.54	204.30	27.08	268.68	0.53	0.56	47.87	15.08	4.99	48.22	15.08	5.46
T10	206.92	26.08	269.90	215.04	28.12	278.45	0.61	0.64	54.02	16.62	5.85	55.31	17.20	6.22
SEd	1.57	0.54	1.51	1.52	0.48	1.52	0.01	0.01	0.80	0.26	0.10	0.92	0.28	0.09
CD (P=0.05)	3.24	1.08	2.92	2.98	0.96	2.74	0.02	0.02	1.60	0.52	0.20	1.84	0.56	0.19

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