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Nutrient recycling potential of IFS on yield attributes and yield of irrigated sunflower *(Helianthus annuus* L.)

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Abstract: On Farm Research was conducted to study the nutrient recycling potential of IFS on irrigated sunflower. The livestock components of IFS were milch cows (2 + 1), goat (10 + 1) and guinea fowl (20 Nos.). The treatments were 100% recommended dose (RDF) of NPK (40: 20: 20 kg N: P_2O_5: K_2O ha^{-1}), 100% + FYM (12.5 t ha^{-1}), 100, 75 and 50% RDF (40: 20: 20, 30:15:15 and 20:10:10 kg N: P_2O_5: K_2O ha^{-1}) along with 100 and 50% Available Organic Manure (5.8 and 2.9 t ha^{-1}) from IFS components. Organic manure obtained from the livestock components of IFS were 3.8, 1.9 and 0.1 tonnes from milch cows, goat and guinea fowl respectively on dry weight basis. The yield attributes *viz.*, head diameter, total number of seeds $head^{-1}$, number of filled seeds $head^{-1}$, hundred seed weight, seed and stalk yield were higher with 40: 20: 20 kg N: P_2O_5: K_2O ha^{-1} + 5.8 t ha^{-1} AOM from IFS components. The grain yield obtained by addition of 5.8 t ha^{-1} of AOM was on par with 12.5 t ha^{-1} FYM.

Key words: Sunflower, IFS, INM, RDF, Available Organic Manure (AOM).

Introduction

A rapid increase in food grain production over the last three decades was at the cost of corresponding increase in the removal of nutrients from the soil. The removal of major nutrients (NPK) at the present level of crop production has been estimated as 125 kg ha^{-1} whereas the annual addition is hardly 75 kg ha^{-1} resulting on the depletion of nutrient reserves from the soil (Tandon, 1990). The recent price hike on fertilizers with the withdrawal of subsidy coupled with low purchasing power of the farming community have again renewed interest in *in situ* recycling of resources throughout the world. Hence, there is a need to develop Integrated Nutrient Management (INM) using organic manures and inorganic fertilizer. At present the availability is 558 mt of FYM, 1662 mt of cattle manure, 22 mt of goat and sheep manure and 136.8 mt of poultry manure (Mahimairaja, 2000). A judicious integration of one or more enterprises of livestock will help in effective recycling of the wastes and thus improving the crop yield, its quality and also soil fertility on a long term basis. Sunflower is an important oil yielding crop and because of inadequate use of fertilizers, its seed yield is below average. In order to achieve sustained production of sunflower, Integrated Nutrient Management (INM) of plant nutrients through Integrated Farming System (IFS) is the need of the hour. Hence, the present study was undertaken.

Materials and Methods

A field experiment was carried out in farmer's field at Chinnamathampalayam village, Periyanayakanpalayam block in Coimbatore

Table 1. Quantity of available organic manure (tonnes) from IFS components

Livestock components	Quantity of AOM (tonnes)	
	On wet weight basis	On dry weight basis
Cattle (2 + 1)	113	3.8
Goat (10+1)	3.9	1.9
Guinea fowl (20 Nos.)	0.5	0.1
Total	15.7	5.8

Table 2. Nutrient content of livestock manures (on dry weight basis)

Particulars	Macronutrient (%)			Micronutrient (ppm)		
	N	P	K	Zn	Cu	Mn
Farm yard manure	0.53	0.48	0.62	118	118	415
Cattle manure	1.26	0.80	1.14	208	208	148
Goat manure	1.82	0.91	0.86	2573	2573	6423
Guinea fowl manure	2.56	2.56	1.40	76	76	193

district, Tamil Nadu, India during *Adipattam* (July-Aug) of 2004. The farm is situated in the Western agro-climatic zone of Tamil Nadu at 11°N, 77°E and 426.7 m above MSL. The soil of the experimental field was sandy loam in texture belonging Typic Ustochrepts. The soil was low in organic carbon (0.53 %), low in available nitrogen (160.0 kg ha^{-1}), medium in available phosphorus (14.5 kg ha^{-1}) and medium in available potassium (185.0 kg ha^{-1}) with pH and EC of 7.92 and 0.74 dS m^{-1}, respectively. Mechanical analysis showed 17.2, 3.1, 32.1 and 45.2% clay, silt, fine and coarse sand respectively. Sunflower variety CO 4 (85 days) was chosen for the experiment. Livestock components included in IFS were Jersey cows (2 milch cow + 1 calf), goat (10 female + 1 male), guinea fowl (20 Nos) for one hectare unit.

Before the start of the experiment, the voids produced by livestock components were collected daily and quantified. Subsequently, the manure was composted and available quantity was worked out on dry weight basis. This available quantity of organic manure obtained from livestock components were utilized for one hectare crop area as per different treatment schedules. The data on quantity of organic manure obtained in a year and nutrient content was presented in Table 1 and 2. Family labourers were utilized for collecting the manure and labour cost was accounted while working out the cost of cultivation.

The experiment was laid out in a Randomized Block Design with eight treatments and replicated four times. The treatments

Table 3. Yield attributes and yield of sunflower as influenced by nutrient recycling potential of IFS

Treatments	Head diameter (cm)	Number of seeds head^{-1}	Number of filled seeds head^{-1}	Hundred seed weight weight (g)	Seed Yield (kg ha^{-1})	Stalk yield (kg ha^{-1})
T_1 : 100% RDF NPK (40:20:20 kg N:P_2O_5:K_2O ha^{-1})	15.2	883	707	5.08	1256	4017
T_2 : 100% RDF NPK + FYM 12.5 t ha^{-1}	19.0	1108	1002	6.28	1489	4765
T_3 : 100% RDF NPK + 2.9 t ha^{-1} AOM from IFS components	17.1	970	840	5.68	1363	4356
T_4 : 75% RDF NPK + 2.9 t ha^{-1} AOM from IFS components	16.7	960	814	5.53	1323	4338
T_5 : 50% RDF NPK + 2.9 t ha^{-1} AOM from IFS components	16.3	948	791	5.13	1306	4295
T_6 : 100% RDF NPK + 5.8 t ha^{-1} AOM from IFS components	19.5	1297	1203	6.65	1591	4985
T_7 : 75% RDF NPK + 5.8 t ha^{-1} AOM from IFS components	18.4	1071	963	6.18	1458	4730
T_8 : 50% RDF NPK + 5.8 t ha^{-1} AOM from IFS components	18.1	1042	922	6.08	1422	4698
SEd	0.5	35.0	31.6	0.2	49	132
CD (P=0.05%)	1.1	70.2	63.2	0.4	98	267

RDF : Recommended dose of fertilizer
FYM : Farm yard manure
AOM : Available organic manure
IFS : Integrated farming system

included were 100% recommended dose (RDF) of NPK (40: 20: 20 kg N:P_2O_5: K_2O ha^{-1}), 100% RDF + FYM (12.5 t ha^{-1}), 100, 75 and 50% RDF (40: 20: 20, 30:15:15 and 20:10:10 kg N: P_2O_5: K_2O ha^{-1}) along with 100 and 50% Available Organic Manure (5.8 and 2.9 t ha^{-1}) from IFS components. Full doses of N, P and K fertilizers in the form of urea, single super phosphate and muriate of potash and the calculated quantities of FYM and composted manure obtained from livestock components *viz.*, cattle, goat and guinea fowl were applied and incorporated in the plots before sowing as per the treatment schedule. The yield attributes *viz.*, head diameter, total number of seeds $head^{-1}$, number of filled seeds $head^{-1}$ and hundred seed weight were calculated from the labeled heads. Seed and stalk yields from each net plot area were recorded and expressed in kg ha^{-1}. The data were subjected to statistical analysis as described by Gomez and Gomez (1984).

Results and Discussion

Yield attributes and yield

The yield attributes *viz.*, head diameter, total number of seeds $head^{-1}$, number of filled seeds $head^{-1}$ and hundred seed weight and grain yield were significantly influenced by combined application of organic manures with inorganic fertilizers (Table 3).

Combined application of inorganics with AOM or FYM significantly changed the sunflower yield components and yield compared to inorganic alone. Organic manure collected from the livestock components measuring 5.8 t ha^{-1} could produce better yield components and seed yield than 12.5 t ha^{-1} FYM along with inorganic fertilizer @ 40: 20: 20 kg N: P_2O_5: K_2O ha^{-1}. The AOM 5.8 t ha^{-1} applied to sunflower along with 30: 15: 15 kg N: P_2O_5: K_2O ha^{-1} produced seed yield as that of 100 per cent of inorganics in combination with 12.5 t ha^{-1} FYM.

The higher percentage of N, P and K in organic manure obtained from the livestock components of IFS might have helped in increasing the number of filled seeds $head^{-1}$ and hundred seed weight of sunflower. The enhanced value in yield parameters might be also due to increase in LAI, leading to higher photosynthetic rate and adequate supply of nutrients at the reproductive stage through integration of organics with inorganics. The increased number of filled seeds $head^{-1}$ might be due to the increased supply of P content in the plants during the reproductive phase through organic manure, which in turn resulted in proper seed development and thus increased the seed yield. Similar findings were reported by Devidayal and Agarwal (1998); Kumaran *et al.* (2001) and Paradkar and Desmukh (2004).

The increased yield might be due to significant increase in test weight and number of filled seeds $head^{-1}$. The ready availability of nutrients from inorganic sources especially at early stage of the crop and slower and steady availability of nutrients from organic manure throughout the crop growth period might have contributed for higher yield. Malewar *et al.* (1999) reported that the combined application of FYM and inorganic fertilizers increased the yield of sunflower and cotton by improving the fertility status of the soil. Panneerselvam *et al.* (1997) stated that application of FYM + 30: 120: 40 kg NPK ha^{-1} gave significant increase in yield of soybean compared to inorganic fertilizers alone or no fertilizers/manures.

Based on the experimental results, it could be inferred that for raising sunflower crop in one hectare land area, application of 40:

20: 20 kg N: P_2O_5: K_2O ha^{-1} in combination with 5.8 t ha^{-1} of AOM from the linked livestock components *viz.*, jersey cows (2 milch cow + 1 calf), goat (10 female + 1 male) and guinea fowl (20 Nos) could be resorted for getting higher yield and to maintain soil fertility.

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