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Yield, uptake and available nutrient contents as Influenced by Organic and Inorganic Sources of Nitrogen in Soybean-Maize Cropping System.

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ABSTRACT

Effect of different organic sources of nitrogen with inorganic fertilizers on yield, yield attributes, availability and uptake of nutrients in soybean-maize cropping system was studied in a field experiment. Highest soybean yield 12.9 q ha^{-1} was obtained with the application of 75% of recommended dose of nitrogen along with 100% recommended dose of P K through inorganic fertilizers + 25% recommended dose of nitrogen through vermin compost. Availability of nutrients in soil was improved consequently. The uptake of nutrients and available nutrient contents after soybean were improved with treatments that received integrated use of organic manures in combination with recommended dose of nutrients through inorganic fertilizers.

Key words : Farmyard manure, Poultry manure, Recommended dose of fertilizer, Vermicompost.

Soybean (*Glycine max (L.) Merrill*) has been proclaimed as the miracle crop as it plays a greater role in boosting protein and oil production in India. It occupies third place among the oil seed crops in India. Soybean represents nearly 50% of global oil seed production, 28% of global vegetable and marine oil supply and 58% of global protein meal supply (Singh and Bhan 2002). Soybean contains 40% protein and 20% oil. It has got worldwide acceptance because of the protein rich nature and termed as global bean by the agricultural scientists (Xavier Paul Raj, 2002). This is gaining importance as a remunerative crop in black soils of Northern Telangana Zone of Andhra Pradesh, India. Use of organic manures in conjunction with inorganic fertilizers was proved to be useful in sustaining crop yields without deteriorating the quality of soil. Keeping in view the significance of organic manures in maintaining the soil health and soybean as a remunerative alternate crop to cotton in black soils, a study was proposed on the effect of integrated use of organic manures with the inorganic fertilizers on yield, yield attributes availability and uptake of nutrients in soybean–maize cropping system.

MATERIAL AND METHODS

The experiment was carried out at Regional Agricultural Research Station (ANGRAU), Jagtial during *kharif* and *rabi* seasons of 2002-03 and 2003-04. The soil was red sandy loam in texture, medium in organic carbon (0.5%), low in available N (119.82 kg/ha), high in available P_2O_5 (48.06 kg ha^{-1}), fairly rich in available K_2O (242.20 kg ha^{-1}) with neutral in reaction (pH 7.4) and non saline (EC=0.101 dS/m). Soybean (JS-335 variety) was sown in the last week of June with a spacing of 45 X 5 cm. All the cultural practices were followed as per the schedule. The experiment was laid out in a randomized block design comprising 8 treatments where in 50% and 25% recommended dose of fertilizer nitrogen was supplied through different organic manures and replicated thrice. Farm yard manure, poultry manure and vermi compost were used as sources of organic manures which contained 0.5 and 4.1, 2.1% N, 0.2, 1.21 and 1.18 % P_2O_5 and 0.3, 1.92 and 1.10 % K_2O respectively. In case of RDF, nitrogen was applied in 2 splits in the form of urea, while entire dose of P and K were applied as basal in the form of single super phosphate and muriate of potash, respectively. Soil samples were collected before sowing and after harvest of crop. The plant samples were collected at 25,50 and 75 DAS for dry matter estimation and were used for plant analysis. Based on the content of nutrients and dry matter yield the uptakes of nutrients were computed.

RESULTS AND DISCUSSION

Pods /plant: The number of pods / plant is an important parameter which governs the yield of the crop. The number of pods /plant was

Table 1. Effect of treatments on yield, yield attributes of soybean in soybean-maize cropping system.

Treatments		Pods/ Plant60 DAS *	1000 Seed Weight (g) *	Seed Yield (q/ha) *	% Increase Over Control	Specific Gravity *
Control (0:0:0)	T1	52	124.65	8.22	-	0.87
RDF (40:50:40) Kg/ha	T2	60	138.28	9.22	12.16	0.86
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	T3	64	140.86	8.78	6.81	0.86
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	T4	68	143.56	9.14	11.19	0.87
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	T5	66	141.96	8.97	9.12	0.86
75% RDFN through inorganic fertilizers + 25% RDFN through FYM	T6	68	148.56	9.58	16.54	0.86
75% RDFN through inorganic fertilizers + 25% RDFN throughVC	T7	72	155.39	12.9	56.93	0.87
75% RDFN through inorganic fertilizers + 25% RDFN through PM	T8	68	152.53	9.68	7.76	0.87
SE (d)		0.12	1.31	0.56		0.001
CD (p=0.05)		NS	3.78	1.91		NS

* Mean of two years

Table 2. Effect of treatments on availability of major nutrients in soil after harvest of soybean in soybean-maize cropping system.* mean of two years

Treatments	Available N (Kg N ha^{-})*		Available P (Kg P_2O_5 ha^{-}) *		Available K (Kg K_2O ha^{-})*	
	1year	2year	1year	2year	1year	2year
Control (0:0:0)	120.11	120.41	18.83	20.26	195.51	240.31
RDF (40:50:40) Kg/ha	120.92	123.19	39.14	37.90	236.69	241.70
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	125.62	122.91	30.94	37.30	205.22	241.30
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	126.01	124.71	38.06	38.90	228.63	242.50
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	124.81	123.12	32.01	37.80	219.52	241.80
75% RDFN through inorganic fertilizers +25% RDFN through FYM	122.83	124.59	52.86	49.21	246.96	244.03
75% RDFN through inorganic fertilizers +25% RDFN throughVC	126.11	129.14	58.83	49.50	249.94	245.06
75% RDFN through inorganic fertilizers +25% RDFN through PM	124.68	126.31	58.65	49.30	248.23	244.11
Initial values	119.82		48.06		242.20	

recorded at 60DAS. The highest number (70 pods/ plant) was recorded in T7 treatment at 60DAS (Table 1). Increased no. of pods/plant were noticed with the application of vermicompost @ 4.76q/ha to supply 25% RDFN. This might when contributed for higher crop dry matter production and nutrient uptake by crop. These findings are in line with the findings of Nayak et al., (2000).

Thousand seed weight:

Seed weight is an important attribute, which has a direct influence on the yield. The highest thousand seed weight was registered in T7 treatment (Table 1). Increased nutrient uptake and assimilation by crop plants at the reproductive stage enhanced the thousand seed weight. The results are in conformity with the findings of Pannerselvam (1997) and Sammuria and Nepalia (1998).

Seed yield:

The soybean seed yield was recorded in all the plants after harvest. The seed yield for different treatments ranged between 8.22 to 12.9 q/ha. Among the treatments T7 registered the highest seed yield of 12.9 q/ha. It was 56.93 % increase over the control. The next best treatment was T8, which recorded a seed yield of 9.68 q/ ha.the lowest yield of 8.22 q/ha was recorded in control (Table1**).** Parameters such as plant height, DMP, accompanied by an increase in nutrient uptake in various treatments resulted in better yield attribute and increased seed yield. The higher seed yield recorded in T7 treatment might be due to better crop growth, yield parameters and consequently the seed yield. The results are in line agreement with the reports of Jat and Gaur (2000).

Available N (kg N ha^{-1}):

Among all the treatments tested, the available nitrogen after harvest of soybean crop in soil was highest in T7 treatment during 2002-03 (126.11) and 2003-04 (129.14) respectively. This was followed by T8 treatment. Control recorded the lowest available nitrogen in soil during 2002-03 (120.11) and 2003-04 (120.41) respectively. The increase in available nitrogen due to the application of 25% RDFN through VC over control during 2002-03 is 4.75 and during 2003-04 is 6.76 percent respectively and over RDF during 2002-03 is 4.11 and during 2003-04 is 4.60 percent respectively (Table 2). In General, the available nitrogen in soil increased compared to initial values (119.82) in all treatments that received manure application in combination with fertilizers in all types of manures tested. The highest available N was recorded with the treatment where in inorganic nitrogen was supplied trough vermicompost followed by poultry manure.

Available P (kg P_2O_5 ha^{-1}):

Among all the treatments tested, the available phosphorous after harvest of soybean crop in soil was highest in T7 treatment during 2002-03 (58.83) and 2003-04 (49.50) respectively. This was followed by T8 treatment. Control recorded the lowest available phosphorous in soil during 2002-03 (18.83) and 2003-04 (20.26) respectively. The increase in available phosphorous due to the application of 25% RDFN through VC over control during 2002-03 is 67.99 and during 2003-04 is 4.97 percent respectively and over RDF during 2002-03 is 33.46 and during 2003-04 is 10.54 percent respectively (Table 2). In General, the available phosphorous in soil decreased compared to initial values (48.06) in all treatments that received 50% RDFN through manure application in combination with fertilizers in all types of manures tested. Available phosphorous in soil increased compared to initial values in T6, T7, and T8 treatments that received 25% RDFN through manure application in combination with fertilizers in all types of manures tested. The highest available phosphorous was recorded with the treatment where in inorganic nitrogen was supplied trough vermicompost followed by poultry manure.

Available K (kg K_2O ha^{-1}):

Among all the treatments tested, the available potassium after harvest of soybean crop in soil was highest in T7 treatment during 2002-03 (249.94) and 2003-04 (245.06). This was followed by T8 treatment. Control recorded the lowest available potassium in soil during 2002-03 (195.51) and 2003-04 (241.31). The increase in available potassium due to the application of 25% RDFN through VC over control during 2002-03 is 21.77 and during 2003-04 is 1.93 percent respectively and over RDF during 2002-03 is 5.30 and during 2003-

Table 3. Effect of treatments on availability of micronutrients in soil after harvest of soybean in soybean-maize cropping system.

Treatments	Fe*		Cu*		Mn*		Zn*	
	1year	2year	1year	2year	1year	2year	1year	2year
Control (0:0:0)	3.72	3.64	0.04	0.04	11.03	11.21	2.19	1.98
RDF (40:50:40) Kg/ha	3.70	3.72	0.05	0.05	11.61	11.80	2.42	2.31
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	3.84	3.76	0.05	0.05	13.01	12.00	3.18	3.08
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	3.83	3.75	0.05	0.05	13.02	12.01	3.16	3.11
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	3.86	3.78	0.05	0.05	13.04	12.09	3.19	3.12
75% RDFN through inorganic fertilizers + 25% RDFN through FYM	3.91	3.83	0.05	0.05	13.04	13.01	3.18	3.11
75% RDFN through inorganic fertilizers + 25% RDFN throughVC	3.91	3.83	0.05	0.05	13.04	13.01	3.19	3.10
75% RDFN through inorganic fertilizers + 25% RDFN through PM	3.80	3.72	0.05	0.05	12.98	12.55	3.09	3.00
Initial values	3.98		0.06		13.07		3.20	

* Mean of two years

Table 4. Effect of treatments on N uptake ($kgha^{-1}$) by soybean in soybean-maize cropping system.

Treatments		25DAS*	50DAS*	75DAS*
Control (0:0:0)	T1	4.13	15.6	28.0
RDF (40:50:40) Kg/ha	T2	4.22	16.5	27.2
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	T3	4.38	16.9	29.2
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	T4	4.77	18.4	38.3
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	T5	4.67	17.2	37.4
75% RDFN through inorganic fertilizers + 25% RDFN through FYM	T6	4.75	18.8	41.2
75% RDFN through inorganic fertilizers + 25% RDFN throughVC	T7	4.99	22.2	51.5
75% RDFN through inorganic fertilizers + 25% RDFN through PM	T8	4.89	21.7	44.8
SE (d)		0.03	0.17	0.90
CD (p=0.05)		0.06	0.34	1.89

RDFN=Recommended Dose of Fertilizer Nitrogen.

* Mean of two years

Table 5. Effect of treatments on P uptake ($kgha^{-1}$) by soybean in soybean-maize cropping system.

Treatments		25DAS*	50DAS*	75DAS*
Control (0:0:0)	T1	0.50	3.30	5.96
RDF (40:50:40) Kg/ha	T2	0.51	3.12	6.20
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	T3	0.52	5.26	8.06
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	T4	0.55	5.31	10.60
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	T5	0.55	5.30	8.18
75% RDFN through inorganic fertilizers + 25% RDFN through FYM	T6	0.57	5.50	11.20
75% RDFN through inorganic fertilizers + 25% RDFN throughVC	T7	0.91	9.60	16.30
75% RDFN through inorganic fertilizers + 25% RDFN through PM	T8	0.90	7.73	11.70
SE (d)		0.006	0.05	0.11
CD (p=0.05)		0.01	0.11	0.23

- Mean of two years

Table 6. Effect of treatments on K uptake ($kgha^{-1}$) by soybean in soybean-maize cropping System.

Treatments		25DAS*	50DAS*	75DAS*
Control (0:0:0)	T1	2.02	15.0	23.7
RDF (40:50:40) Kg/ha	T2	2.11	15.3	24.8
50% RDFN through inorganic fertilizers+ 50% RDFN through FYM	T3	2.24	16.9	25.9
50% RDFN through inorganic fertilizers+ 50% RDFN through VC	T4	2.74	17.7	33.6
50% RDFN through inorganic fertilizers+ 50% RDFN through PM	T5	2.52	17.5	26.5
75% RDFN through inorganic fertilizers + 25% RDFN through FYM	T6	3.04	18.7	35.5
75% RDFN through inorganic fertilizers + 25% RDFN throughVC	T7	3.65	21.3	45.6
75% RDFN through inorganic fertilizers + 25% RDFN through PM	T8	3.21	21.0	45.2
SE (d)		0.03	0.29	0.44
CD (p=0.05)		0.05	0.61	0.90

- Mean of two years

04 is 1.37 percent respectively (Table 2). In General, the available potassium in soil decreased compared to initial values (242.20) in all treatments that received 50% RDFN through manure application in combination with fertilizers in all types of manures tested. Available potassium in soil increased from to initial values in T6, T7, and T8 treatments that received 25% RDFN through manure application in combination with fertilizers in all types of manures tested. The highest available potassium was recorded with the treatment where in inorganic nitrogen was supplied trough vermicompost followed by poultry manure.

Available micronutrients (ppm):

The available micro nutrients (Fe, Cu, Mn and Zn) in soil after harvest of soybean crops were decreased during two years (2002-03 and 2003-04) compared to initial status. But the percent of decrease was less in treatments that received organic manures in conjunction with inorganic fertilizers over control and RDF (Table 3). Available iron ranged from 3.64 to 3.91 against initial status of 3.98 ppm, available copper ranged from 0.04 to 0.05 against initial status of 0.06 ppm, available manganese was ranged from 11.03 to 13.04 against initial status of 13.07 ppm and available zinc was ranged from 1.98 to 3.19 against initial status of 3.20 ppm.

N uptake: Nitrogen uptake of crop was significantly influenced by different treatments. Uptake of crop increased with crop growth and was highest at 75 DAS. The highest N uptake (4.99 kg/ha) was recorded in T7 treatment and was followed by T8 treatment at 25DAS. The control recorded lowest uptake of N. The highest N uptake (22.2 kg/ha) was recorded in T7 treatment and was followed by T8 treatment at 50 DAS. The highest N uptake (51.5 kg/ha) was recorded in T7 treatment and was followed by (44.8 kg/ha) T8 treatment at 75 DAS (Table 4). The plant height, crop dry matter production might have resulted in highest uptake of nitrogen. Similar results were reported by Suryaprabha et al., (2007).

P uptake: The highest P uptake (0.91 kg/ha) was recorded in T7 treatment followed by (0.90 kg/ha) T8 treatment at 25DAS. The highest P uptake (9.60 kg/ha) was recorded in treatment T7 at 50DAS. Highest P uptake (16.30 kg/ha) recorded in T7 treatment followed by T8 treatment (11.70 kg/ha) at 75 DAS. The control recorded lowest at all stages (Table 5). Better crop growth conditions favored the uptake of P. These results are in line with the findings of Sammuria and Nepalia (1998).

K uptake: The K uptake was estimated at 25DAS, 50DAS and 75DAS.The highest K uptake (3.65 kg/ha) recorded in T7 treatment at 25DAS. The highest K uptake of 21.3 kg/ha and 45.6 kg/ha was recorded in T7 treatment at 50DAS and 75 DAS, respectively. The control recorded the lowest uptake of K at all the stages (Table 6). Increased uptake of potassium might be due to crop dry matter production and crop growth. Similar findings were reported by Singh and Bhan (2002).

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