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Studies on residual effect of different organic sources of nutrients in paddy-groundnut cropping sequence under acidic soil of coastal Karnataka.

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Abstract

A field experiment was carried out during kharif, 2014 at Zonal Agricultural & Horticultural Research Station, Brahmavar, Udupi, Karnataka, India, to study the residual effect of different organic sources of nutrients in paddy-groundnut cropping sequence. The experiment was laid out in RCBD with 10 treatments and replicated thrice. Significantly higher grain and straw yield (5859 and 7203 kg/ha, respectively), obtained with application of FYM 5 t/ha + cow urine equivalent to 90 kg N/ha in four splits. Maximum uptake and availability of nitrogen, phosphorus and potassium (132.25, 34.41 and 96.36 kg/ha, respectively) and (173.34, 29.54 and 95.76 kg/ha, respectively), similarly higher net returns (Rs. 78,200) and B: C ratio (3.23) also obtained in the same treatment. Significantly higher groundnut pod and haulm yield (1752 and 4168 kg ha-1, respectively) and also highest nutrient uptake and availability (142.38, 12.63, 58.24 and 210, 130, 78 kg ha-1 NPK and N, P2O5 and K2O) was recorded in residual effect of Poultry manure (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits.

Keywords: yield, fym, paddy, groundnut, poultry manure, cow urine

INTRODUCTION

High productivity through crop intensification is the primary goal of agronomic research. But to sustain high productivity over a longer period, soil fertility has to be maintained at fairly high level. Hence, nutrient management strategies should be aimed at achieving these goals with minimum cost. The negligence shown to the conservation and use of inorganic sources of nutrients has not only caused the exhaustion of soil nutrient reserves but also resulted in an imbalance among the available nutrients leading to soil problems. Among problematic soils, acid soils less availability of nutrients (N, P, Ca, S, and B) besides inadequate organic matter. Paddy being exhaustive crop, removes large amount of macro and micro nutrients from soil. Organic and biological sources of nutrients are the most efficient way to supply plant nutrients for sustained crop productivity and improved of soil fertility.

However, practice of following a cereal-cereal cropping system on the same piece of land over years has led to soil fertility deterioration, and questions are being raised on its sustainability (Duxbury and Gupta, 2000). Efforts were, therefore, made to find out alternate cropping systems. Sharma and Prasad (1999) recommended that growing a short-duration legumes after rice made rice-legume cropping system more productive, remunerative, and soil recuperative than traditional rice-rice cropping system.

Groundnut (*Arachis hypogaea* L.), is an important conventional oilseed crop in India. It is grown principally for its protein-rich edible seeds. An important feature of the groundnut crop is its ability to establish a symbiotic partnership with specific bacteria, setting up the biological N_2 fixation in root nodules that supplies required nitrogen to the plant (Mandal et al., 2009).

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Though many nutrient management studies have been carried out in paddy and groundnut, the location specific study on organic nutrient management in paddy-groundnut cropping sequence for the farmers of coastal region of Karnataka is lacking. The present investigation was therefore undertaken to assess the residual influence of different organic sources of nutrients in paddy-groundnut cropping sequence.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2014 at Zonal Agricultural and Horticultural Research Station, Brahmavar, Udupi district, Karnataka. The experimental site is situated between 740 45' to 740 46' East longitude and 130 24' 45'' to 130 25' 30'' North latitude and an altitude of 10 meters above mean sea level. Soil type is sandy loam in texture and pH was acidic (5.04). The soil was medium in available nitrogen (325 kg ha-1), high in available phosphorus (62.01 kg ha-1) and medium in available potassium (157.63 kg ha-1). The organic carbon content was high (1.23 %) in range. MO-4 (Red rice) a popular medium duration variety was transplanted in June with a spacing of 20 cm X 10 cm and GPBD-4 (Groundnut) variety was sown in January 2014 with a spacing of 30 x 10 cm under residual nutrient conditions in paddy fallows . Experiment included ten treatments were laid out in Randomized Complete Block Design (RCBD) with three replications. All organics were applied 25 days before sowing of paddy, cow urine and BDL applied at 20 days intervals during crop growing period. Yield (biological and economical) was recorded from individual plots at harvest and converted to kg/ha. Composite soil sample were used to assess soil nutrient status. Standard statistical methods were used for comparing the treatment means.

RESULTS AND DISCUSSION

Yield attributes and yield: The economic yield is a fraction of the total biological yield of the crop. Total dry matter production mostly reflects on the economic yield in view of the fact that, vegetative part of the plant serves as the source and the grains as sink. Accumulation of dry matter (resultant of leaf area duration and crop growth rate during the crop cycle) and its distribution to yield attributes during reproductive stage (translocation from source to sink) determines the yield of a crop. Present investigation showed that, significantly higher grain yield and straw yield (5859 and 7203 kg/ ha, respectively) were produced by the application of T_4- FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits and it was on par with T_{10} PM (1.0 t/ha) + CU equivalent to 90 kg N/ha in 4 splits (5345 and 6314 kg/ ha, respectively). These could have resulted in significantly higher yield components *viz*., number of tillers per hill (45.0), panicle length (31.56 cm) and number of filled grains per panicle (154.0) than other treatments (Table 1). The yield parameters and yield of rice showed higher stability due to combined use of FYM and Cow urine. Stability in yield under integrated use of organic sources of nutrients may be ascribed to balance use of essential nutrients besides improvement in soil health. Positive effects of use of organic manures have been reported by Singh and Mandal (2000) and Das et al. (2001).

Table 1. Effect of different organic sources of nutrients on yield parameters and yield of paddy

Treatments	Leaf area/ plant (cm^2)	TDM (g/plant)	No. of tillers	Panicle length (cm)	Filled grains	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1- FYM 5 t/ha + 60:30:45 (RDF)	375.63	118.55	35.23	126.63	142.63	4414	7371
T_2- FYM 5t/ha + CU equivalent to 60 kg N/ha in 4 splits	381.57	120.99	37.43	127.57	147.50	5019	6945
T_3- FYM 5t/ha + CU equivalent to 75 kg N/ha in 4 splits	375.28	112.24	34.20	127.07	141.47	3969	6664
T_4- FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits	386.63	121.46	45.00	131.54	154.00	5859	7203
T_5- 50% N through BDL + CU equivalent to 60 kg N/ha in 4 splits	381.53	114.92	36.43	128.57	146.37	4805	6533

T_6- 50% N through BDL + CU equivalent to 75 kg N/ha in 4 splits	376.45	115.79	35.93	126.33	142.77	4667	6552
T_7- 50% N through BDL + CU equivalent to 90 kg N/ha in 4 splits	384.52	115.99	38.63	129.57	148.57	5631	6943
T_8- PM (1.0 t/ha) + CU equivalent to 60 kg N/ha in 4 splits	378.49	119.14	36.97	127.53	144.50	4726	7047
T_9- PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits	382.62	118.44	39.07	129.60	148.43	5345	6314
T_{10} - PM (1.0 t/ha) + CU equivalent to 90 kg N/ha in 4 splits	384.57	119.85	42.37	131.13	150.43	5788	7816
SEm±	9.50	7.40	5.03	2.86	6.34	346	499
CD (0.05)	28.49	22.19	15.08	8.57	18.99	1025	1497.0

Groundnut: Residual effect of PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits recorded significantly higher pod yield (1752 kg/ha) and haulm yield (4168 kg/ha) represented in Table 2. The higher pod yield could be attributed to residual effect of different organic source of nutrients were greater influence on succeeding groundnut as this could ascertain continuous supply of nutrients throughout the crop growth period and also yield attributing parameters and yield indirectly depend on growth parameters *viz.,* leaf area index and dry matter production. Residual effect of organics was also noticed by Reddy and Reddy (2005) wherein the plant height, number of leaves, leaf area, yield attributes, and root yield in radish were significantly affected due to the residual effect of vermicompost in onion-radish cropping system.

Table 2. To study the residual effect of different organic nutrients on yield parameters and yield of groundnut

Treatment details	LAI	TDM (g/plant)	Pods/plant	100 seed weight (g)	Pod yield (kg/ha)	Haulm yield (kg/ha)	Shelling per cent
T_1- FYM 5 t/ha + 60:30:45 (RDF)	2.01	36.5	19.03	28.7	1419	3464	69.20
T_2- FYM 5t/ha + CU equivalent to 60 kg N/ha in 4 splits	2.21	38.7	20.13	29.8	1578	3936	70.80
T_3- FYM 5t/ha + CU equivalent to 75 kg N/ha in 4 splits	2.23	40.8	20.43	30.8	1608	4024	70.80
T_4- FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits	2.82	46.4	23.43	32.8	1743	4114	72.90
T_5- 50% N through BDL + CU equivalent to 60 kg N/ha in 4 splits	2.18	37.8	19.73	29.2	1567	3872	69.50
T_6- 50% N through BDL + CU equivalent to 75 kg N/ha in 4 splits	2.26	43.3	21.70	30.5	1648	4047	71.40
T_7- 50% N through BDL + CU equivalent to 90 kg N/ha in 4 splits	2.48	43.7	22.46	30.6	1723	4031	71.60
T_8- PM (1.0 t/ha) + CU equivalent to 60 kg N/ha in 4 splits	2.78	44.1	23.36	31.8	1738	4095	71.60
T_9- PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits	3.38	51.1	28.20	35.8	**1752**	**4168**	73.50
T_{10} - PM (1.0 t/ha) + CU equivalent to 90 kg N/ha in 4 splits	3.02	49.4	26.86	33.6	1748	4154	72.30
SEm±	0.24	1.58	1.19	1.2	183.23	198.48	1.6
CD (0.05)	0.69	4.69	3.51	3.57	546.02	579.56	4.72

Availability and Uptake of nutrients:

Paddy: High yield was accompanied by high uptake of nutrients which could be attributed to better availability matching the rhythm of crop growth and high nutrient use efficiency. Improved microbial population in soil under organic condition would have promoted nutrient availability (173, 29.54 and 95.76 kg N, P_2O_5 and K_20/ ha, respectively) in soil and uptake

(132.28, 34.41 and 96.37 kg N, P & K /ha, respectively) by the crop (Table 3). Similar observations were resulted by Rawat and Pareek (2003).

Table 3. Effect of different organic sources of nutrients on Availability (kg/ha), uptake of nutrients (kg/ha) and economics of paddy

Treatments	Available N	Available P_2O_5	Available K_2O	N uptake	P uptake	K uptake	Net returns (Rs.)	B:C ratio
T_1- FYM 5 t/ha + 60:30:45 (RDF)	160	22.67	85.76	125.68	22.79	84.80	50,888	1.18
T_2- FYM 5t/ha + CU equivalent to 60 kg N/ha in 4 splits	159	27.53	90.56	128.58	28.76	84.73	61,228	2.25
T_3- FYM 5t/ha + CU equivalent to 75 kg N/ha in 4 splits	188	22.82	85.20	125.55	22.34	98.34	47,488	0.8
T_4- FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits	173	29.54	95.76	132.28	34.41	96.37	78,200	3.23
T_5- 50% N through BDL + CU equivalent to 60 kg N/ha in 4 splits	139	26.45	89.87	126.53	26.70	89.86	58,836	1.87
T_6- 50% N through BDL + CU equivalent to 75 kg N/ha in 4 splits	136	22.92	87.55	128.41	24.80	87.21	45,648	1.10
T_7- 50% N through BDL + CU equivalent to 90 kg N/ha in 4 splits	150	27.88	92.85	118.17	30.54	93.70	62,454	2.49
T_8- PM (1.0 t/ha) + CU equivalent to 60 kg N/ha in 4 splits	145	28.35	89.39	124.99	24.50	87.77	54,916	1.29
T_9- PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits	164	23.69	92.69	128.18	30.83	93.40	65,300	2.44
T_{10} - PM (1.0 t/ha) + CU equivalent to 90 kg N/ha in 4 splits	160	28.75	93.89	130.24	32.73	94.83	66,084	2.86
SEm±	13.4	1.90	6.32	6.28	2.44	9.597		
CD (0.05)	40.23	5.71	18.97	18.83	7.33	28.77		

***Groundnut*:** There is no significant difference in nutrient uptake and availability, numerically higher uptake and availability (142.38, 12.63, 58.24 and 210, 130, 78 kg ha^{-1} NPK and N, P_2O_5 and K_2O) was recorded in residual effect of Poultry manure (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits (Table 4). Mahanta and Borah (1998) observed that poultry manure was the most effective in increasing the yield of blackgram. The treatments with 33% RDF showing higher values of organic carbon, available P_2O_5 and K_2O may be due to the reduced volatilization and leaching losses. Similar trend was maintained by the interactive effect of these factors, thereby proving the principle of synergy active in the rhizosphere.

Economics: The higher B: C ratio may be due to lower cost of cultivation and higher net returns. From the economic analysis, it is imperative that application of 5t/ha + CU equivalent to 90 kg N/ha in 4 splits for Paddy would be advantageous in terms of cost effectiveness and higher return per rupee investment (Table 4). The results are also close conformity with that of Kumar, (2008). In case of groundnut residual effect of PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits recorded higher net returns and benefit cost ratio (52,821Rs./ha and 1.87, respectively) compared to other treatments. Naeem et al. (2006) reported the maximum net benefit of mung bean obtained from the treatment, where poultry manure was applied.

Conclusion: FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits were produced higher grain and straw yield, availability and uptake of nutrients, where residual effect of PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits recorded significantly higher pod and haulm yeld and also higher economic returns.

Table 4. Residual effect of different organic sources of nutrients on Availability (kg/ha), uptake of nutrients (kg/ha) and economics of groundnut

Treatment details	Available N	Available P_2O_5	Available K_2O	N uptake	P uptake	K uptake	Net returns (Rs.)	B:C ratio
T_1- FYM 5 t/ha + 60:30:45 (RDF)	172.9	97.0	71.0	97.60	6.9	40.2	31,643	1.06
T_2- FYM 5t/ha + CU equivalent to 60 kg N/ha in 4 splits	178.7	102.4	64.3	118.0	9.9	44.8	34,707	1.19
T_3- FYM 5t/ha + CU equivalent to 75 kg N/ha in 4 splits	182.4	109.0	65.0	112.7	10.2	46.2	35,408	1.30
T_4- FYM 5t/ha + CU equivalent to 90 kg N/ha in 4 splits	202.8	121.0	75.1	136.2	11.3	55.0	41,518	1.20
T_5- 50% N through BDL + CU equivalent to 60 kg N/ha in 4 splits	175.8	99.0	62.7	119.9	9.4	43.0	33,735	1.12
T_6- 50% N through BDL + CU equivalent to 75 kg N/ha in 4 splits	187.7	114.0	69.2	125.0	10.1	48.7	35,504	1.04
T_7- 50% N through BDL + CU equivalent to 90 kg N/ha in 4 splits	192.0	118.0	70.4	130.9	10.7	50.1	37,641	1.41
T_8- PM (1.0 t/ha) + CU equivalent to 60 kg N/ha in 4 splits	198.1	121.0	73.1	128.4	10.8	53.6	40,348	1.51
T_9- PM (1.0 t/ha) + CU equivalent to 75 kg N/ha in 4 splits	210.0	130.0	78.0	142.4	12.6	58.5	52,821	1.87
T_{10} - PM (1.0 t/ha) + CU equivalent to 90 kg N/ha in 4 splits	207.3	128.7	76.9	138.9	11.9	56.2	41,891	1.54
SEm±	0.65	0.50	0.38	0.49	0.05	0.20		
CD (0.05)	1.91	1.47	1.12	1.45	0.148	0.58		

Note:
PM: Poultry manure
CU: Cow urine
BDL: Bio-digester liquid
FYM: Farm yard manure
RDF: Recommended dose of fertilizer

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