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SOIL AVAILABLE NUTRIENT STATUS AS INFLUENCED BY ORGANIC SOURCES AND FERTILIZER LEVELS IN HYBRID RICE

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ABSTRACT
A two year field study was conducted at College Farm, College of Agriculture, Rajendranagar, Hyderabad to study the effect of organic sources and fertilizer levels on soil available nutrient status at different stages of crop growth in hybrid rice during *kharif* 2009 and 2010.The experiment was laid out in split plot design with three replications. The treatments included organic manures (control – no organic manuring, subabul incorporation @ 5 t ha^{-1}, rice straw incorporation @ 2.5 t ha^{-1}) as main plot treatments and fertilizer levels comprising of N:K_2O kg ha^{-1} (150:75, 175:50, 175:25, 200:50, 200:25, 225:0) as sub plot treatments. The results revealed that among the organic sources, incorporation of subabul @ 5 t ha^{-1} recorded the highest available N P K status. Available N status was the highest with application of 225:0 N: K_2O kg ha^{-1} while 150:75 N: K_2O kg ha^{-1} recorded the highest available P and K status. Interaction effect was found significant on available nitrogen status. The highest available N status was recorded with incorporation of subabul @ 5 t ha^{-1} + 225:0 N: K_2O kg ha^{-1}.

KEY WORDS: Subabul, rice straw, fertilizer levels, soil available nutrient status.

INTRODUCTION

Rice is the most important food crop for more than half of the world's population. In India it is grown in an area of 44.8 million ha with a production of 99.37 million tons and productivity of 2.2 t ha^{-1} (CMIE, 2010) contributing to 62% of the food granary of the nation. India has to produce around 140 million tons of rice by 2020 to meet the food grain requirement of burgeoning population (Kavitha *et al*., 2008).The increasing demand for rice grain production has to be achieved by using limited available resources in a sustainable manner. In India about 40 % of total plant nutrients are consumed by rice crop alone (Porpavai *et al*., 2006). Though the use of fertilizers per unit area of rice is higher, the fertilizer use efficiency is low. Addition of organic sources could increase yield through increased soil productivity and higher fertilizer use efficiency. Soil fertility maintenance is necessary for sustainable rice production and could be enhanced by judicious combination of green manures and inorganic fertilizers. Keeping this in view, present experiment was undertaken to study the effect of organic sources and fertilizer levels on available soil nutrient status in rice.

MATERIALS & METHODS

A two year field study was conducted at College Farm, College of Agriculture, Rajendranagar, Hyderabad, during 2009 and 2010. The farm is geographically situated at an altitude of 542.6 m above the mean sea level on 17º 19' N latitude and 78º 23' E longitudes. The soil of the experimental site was sandy clay loam in texture, alkaline in reaction (pH-7.9), low in organic carbon (0.26%), and low in available nitrogen (242 kg ha^{-1}), medium in available phosphorus (39.4 kg ha^{-1}) and high in available potassium (368 kg ha^{-1}). The experiment was laid out in split plot design replicated thrice with organic manures (M_1- No organic manuring (control), M_2 - Subabul incorporation @ 5 t ha^{-1}, M_3 - Rice straw incorporation @ 2.5 t ha^{-1}) assigned to main plots and six N:K_2O kg ha^{-1} fertilizer levels (F_1-150:75; F_2-175:50; F_3-175:25; F_4-200:50; F_5-200:25; F_6-225:0) to sub plots. Measured quantities of subabul twigs and rice straw were incorporated twelve days before transplanting. The nutrient content (%) of N:P_2O_5:K_2O in subabul twigs was 3.90:0.39:2.2 and 3.84:0.40:2.30 in 2009 and 2010 respectively while in rice straw N:P_2O_5:K_2O was 0.54:0.16:1.6 and 0.51:0.14:1.5 in 2009 and 2010 respectively. The hybrid used was KRH-2. Twenty five and twenty one days seedlings @ one seedling hill^{-1} were transplanted during 2009 and 2010 respectively. Standard cultural practices were carried out from transplanting to maturity. The entire dose of P_2O_5 and half dose of K_2O were applied basally while N was applied in three equal splits *i.e.* at transplanting, maximum tillering and at panicle initiation stage. The remaining K_2O was applied at flowering stage of the crop. Soil samples were collected at tillering, panicle initiation and after harvest of the crop from 0 -30 cm depth from each treatment for analysis. The samples were stored in plastic bags and taken to the laboratory, it was air dried and grounded to pass through 2 mm sieve. The soil samples were analyzed for available nitrogen, phosphorus and potassium. Available nitrogen was estimated by alkaline potassium permanganate method (Subbiah and Asija, 1956) available phosphorus by Olsen's method (Olsen *et al*., 1954) and available potassium by flame photometer method (Muhr *et al*., 1963). The experimental data recorded on different parameters were analyzed statistically by applying the technique of analysis of variance for split plot design and significance was tested by F-test (Snedecor and Cochran, 1967).

RESULTS & DISCUSSION

Soil available nutrient status

Nitrogen

The data presented in Table 1 revealed that available soil nitrogen status was significantly influenced by organic sources and fertilizer levels. Subabul incorporation @ 5 t ha^{-1} significantly improved the available nitrogen status compared to rice straw incorporation @ 2.5 t ha^{-1} and control in both the years. Highest values of available soil N status with incorporation of subabul might be due to considerable addition of N through green matter and incorporation of green leaf manure might have scavenged the soil mineral N thus avoiding losses by leaching. The results are in line with the reported findings of Neelima (2005) and Porpovai *et al*., 2006. Among the fertilizer levels, 225:0 N:K$_2$O kg ha^{-1} recorded the highest available soil nitrogen status. This might be due to higher level of nitrogen application in this treatment. Debarati Patra (2006) and Santhosh Kumar (2009) also reported higher available nitrogen status with the application of higher level of nitrogen. Perusal of the data indicated that interaction effect between organic sources and fertilizer levels on available soil N status was significant at tillering, panicle initiation and after harvest (Tables 2, 3 and 4). Subabul incorporation @ 5 t ha^{-1} improved the soil N status at all fertilizer levels as compared under rice straw incorporation @ 2.5 t ha^{-1} and control throughout the crop growth period. The highest available nitrogen status was recorded in M$_2$F$_6$ (subabul incorporation @ 5 t ha^{-1} coupled with 225:0 N:K$_2$O kg ha^{-1}) at all stages of crop growth in both the years. Green leaf manuring coupled with higher level of nitrogen might have helped in improving the available nitrogen status in soil. The results are in line with the findings of Neelima (2005).

TABLE 1. Available soil nitrogen (kg ha^{-1}) at different stages of crop growth as influenced by organic sources and fertilizer levels

Treatment	Tillering		Panicle initiation		Post harvest	
Organic sources	2009	2010	2009	2010	2009	2010
M$_1$ - No organic manuring (control)	273.5	258.8	214.6	197.1	168.4	144.4
M$_2$ - Subabul incorporation @ 5 t ha^{-1}	379.8	415.4	308.8	340.8	219.7	230.2
M$_3$ - Rice straw incorporation @ 2.5 t ha^{-1}	283.0	264.6	219.4	199.7	168.2	141.8
S.Em±	4.3	6.5	3.9	6.0	3.4	5.5
CD (P=0.05)	11.9	18.0	10.8	16.7	9.5	15.3
Fertilizer levels (N:K$_2$O kg ha^{-1})						
F$_1$ - 150:75	286.3	274.5	228.1	212.8	173.3	148.9
F$_2$ - 175:50	303.3	298.1	240.1	232.2	179.7	161.5
F$_3$ - 175:25	306.0	305.4	244.2	242.1	186.5	171.2
F$_4$ - 200:50	318.3	316.6	248.7	244.2	181.9	168.5
F$_5$ - 200:25	320.3	323.0	252.0	252.7	188.0	177.4
F$_6$ - 225:0	338.3	360.3	272.4	291.3	203.3	205.5
S.Em±	0.8	1.2	3.9	1.1	1.9	2.1
CD (P=0.05)	1.5	2.5	10.8	2.3	3.9	4.3
M x F						
S.Em±	4.5	6.8	4.0	6.3	4.6	9.3
CD (P=0.05)	12.2	18.4	10.9	17.0	11.3	16.6

TABLE 2. Effect of interaction between organic sources and fertilizer levels on available soil nitrogen status (kg ha^{-1}) at tillering stage

Fertilizer levels (N:K$_2$O kg ha^{-1})							
Organic sources	F$_1$ 150:75	F$_2$ 175:50	F$_3$ 175:25	F$_4$ 200:50	F$_5$ 200:25	F$_6$ 225:0	
M$_1$- No organic manuring (control)				2009			
	245.0	264.0	267.0	281.0	283.0	301.0	273.5
M$_2$- Subabul incorporation @ 5 t ha^{-1}	356.0	372.0	374.1	385.0	387.1	405.0	379.8
M$_3$- Rice straw incorporation @ 2.5 t ha^{-1}	258.0	274.0	277.0	289.0	291.2	309.3	283.0
Mean	286.3	303.3	306.0	318.3	320.3	338.3	
	S.Em±		CD (P=0.05)				
F at same level of M	1.3		3.5				
M at same or different level of F	4.5		12.2				
2010							
M$_1$- No organic manuring (control)	214.9	239.1	253.8	264.3	272.8	307.9	258.8
M$_2$- Subabul incorporation @ 5 t ha^{-1}	383.9	404.4	407.5	415.7	420.8	460.3	415.4
M$_3$- Rice straw incorporation @ 2.5 t ha^{-1}	224.7	250.7	254.7	269.8	275.4	312.7	264.6
Mean	274.5	298.1	305.4	316.6	323.0	360.3	
	S.Em±		CD (P=0.05)				
F at same level of M	2.1		5.7				
M at same or different level of F	6.8		18.4				

Phosphorus

The available soil phosphorus status was the highest with incorporation of subabul @ 5 t ha^{-1} (M$_2$) at all stages of crop growth during both the years of study (Table 5). Insoluble P in the soil would be solubilized to some extent by organic acids produced on decomposition of green manures which might have increased its availability. The beneficial role of green manures in increasing the available soil P status was also highlighted by Yashpal *et al*. (1995), Hemalatha *et al*. (2000) and Porpovai *et al*. (2006). Among the fertilizer levels, 150:75 N:K_2O kg ha^{-1} recorded the highest available P status at all stages of crop growth (tillering, panicle initiation and after harvest) during both the years. Interaction effect between organic sources and fertilizer levels was found non-significant at all stages of crop growth.

TABLE 3. Effect of interaction between organic sources and fertilizer levels on available soil nitrogen status (kg ha^{-1}) at

Fertilizer levels (N:K_2O kg ha^{-1})							
Organic sources	F_1 150:75	F_2 175:50	F_3 175:25	F_4 200:50	F_5 200:25	F_6 225:0	
2009							
M_1- No organic manuring (control)	192.0	203.8	213.5	216.4	221.5	240.2	214.6
M_2- Subabul incorporation @ 5 t ha^{-1}	292.9	303.7	304.2	308.6	310.7	332.5	308.8
M_3- Rice straw incorporation @ 2.5 t ha^{-1}	199.4	212.9	214.9	221.1	223.7	244.4	219.4
Mean	228.1	240.1	244.2	248.7	252.0	272.4	
	S.Em$\pm$		CD (P=0.05)				
F at same level of M	1.3		3.5				
M at same or different level of F	4.5		12.2				
2010							
M_1- No organic manuring (control)	197.1	176.5	197.5	197.9	209.6	244.8	197.1
M_2- Subabul incorporation @ 5 t ha^{-1}	317.2	332.6	336.0	334.9	341.4	383.1	340.8
M_3- Rice straw incorporation @ 2.5 t ha^{-1}	164.8	187.6	192.8	199.9	207.2	246.0	199.7
Mean	212.8	232.2	242.1	244.2	252.7	291.3	
	S.Em$\pm$		CD (P=0.05)				
F at same level of M	1.9		5.3				
M at same or different level of F	6.3		17.0				

panicle initiation stage

TABLE 4. Effect of interaction between organic sources and fertilizer levels on available soil nitrogen status (kg ha^{-1}) after

Fertilizer levels (N:K_2O kg ha^{-1})							
Organic sources	F_1 150:75	F_2 175:50	F_3 175:25	F_4 200:50	F_5 200:25	F_6 225:0	
2009							
M_1- No organic manuring (control)	150.8	158.0	170.9	165.9	173.8	190.7	168.4
M_2- Subabul incorporation @ 5 t ha^{-1}	215.4	218.8	222.3	213.8	219.0	229.2	219.7
M_3- Rice straw incorporation @ 2.5 t ha^{-1}	153.7	162.4	166.5	165.9	171.2	190.0	168.2
Mean	173.3	179.7	186.5	181.9	188.0	203.3	
	S.Em$\pm$		CD (P=0.05)				
F at same level of M	3.4		8.2				
M at same or different level of F	4.6		11.3				
2010							
M_1- No organic manuring (control)	113.9	128.3	145.3	142.9	154.1	181.8	144.4
M_2- Subabul incorporation @ 5 t ha^{-1}	217.2	224.7	230.7	222.3	229.7	256.4	230.2
M_3- Rice straw incorporation @ 2.5 t ha^{-1}	115.5	131.4	137.5	140.1	148.4	178.1	141.8
Mean	148.9	161.5	171.2	168.5	177.4	205.5	
	S.Em$\pm$		CD (P=0.05)				
F at same level of M	3.6		9.3				
M at same or different level of F	6.4		16.6				

harvest

Potassium

The data pertaining to available soil K status at different stages of crop growth revealed that both organic sources and fertilizer levels significantly influenced the available K status at all stages of crop growth. Available soil potassium was the highest with incorporation of subabul @ 5 t ha^{-1} in both the years (Table 5). Rice straw incorporation @ 2.5 t ha^{-1} was the next best treatment. Higher values of available K due to green leaf manuring might be due to additional K applied through it and the solubility action of certain organic acids produced during decomposition, dislodging of exchangeable K into soil solution and its greater capacity to hold in available form. The results corroborate with the findings of Porpavai *et al.* (2006) and Sri Ranjitha (2011). Among the fertilizer levels, F_1 (150:75 N:K_2O kg ha^{-1}) recorded the highest available soil K status throughout the crop growth period (tillering, panicle initiation and after harvest) in both the years. The application of higher levels of potassium could be the reason for higher available K status in F_1. Lack of potassium application might be the reason for the lowest available potassium status in F_6 (225:0 N:K_2O kg ha^{-1}). Interaction effect between organic sources and fertilizer levels on available soil K status was found non-significant at all stages of crop growth.

TABLE 5. Available soil phosphorus and potassium (kg ha^{-1}) at different stages of crop growth as influenced by organic sources and fertilizer levels

Treatment	Available phosphorus						Available potassium					
	Tillering		Panicle initiation		Post harvest		Tillering		Panicle initiation		Post harvest	
Organic sources	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
M_1 - No organic manuring (control)	57.39	54.80	34.97	31.78	17.27	13.44	387.8	374.8	375.8	358.3	354.8	341.0
M_2 - Subabul incorporation @ 5 t ha^{-1}	50.42	59.03	36.10	34.03	19.49	18.66	442.1	436.2	428.1	417.2	400.7	391.2
M_3 - Rice straw incorporation @ 2.5 t ha^{-1}	57.27	53.72	34.16	29.96	16.74	12.72	414.2	399.7	401.4	382.4	378.1	361.5
S.Em$\pm$	0.52	0.57	0.43	0.47	0.33	0.35	3.0	3.3	2.9	3.2	2.7	2.6
CD (P=0.05)	1.43	1.58	1.18	1.29	0.92	0.97	8.2	9.1	7.9	8.7	7.5	7.3
Fertilizer levels (N:K_2O kg ha^{-1})												
F_1 - 150:75	60.52	58.86	39.06	36.26	18.26	15.88	440.1	450.3	428.1	434.0	407.5	417.0
F_2 - 175:50	56.82	56.15	35.69	32.41	17.04	14.55	423.1	418.4	410.4	401.0	387.1	379.2
F_3 - 175:25	58.61	57.59	38.20	35.53	17.96	15.51	406.7	393.8	394.6	377.3	373.3	357.5
F_4 - 200:50	55.25	52.01	30.80	30.83	16.33	13.44	422.5	411.3	408.5	392.2	380.5	365.5
F_5 - 200:25	55.54	53.77	32.60	31.14	16.62	13.88	406.1	386.3	392.6	367.8	366.4	342.9
F_6 - 225:0	56.01	55.73	34.64	32.07	15.10	14.32	389.7	361.3	376.6	343.6	352.4	325.2
S.Em+	0.47	0.49	0.43	0.45	0.23	0.23	3.3	3.9	3.2	3.8	3.1	3.1
CD (P=0.05)	0.96	0.99	0.89	0.93	0.47	0.48	6.7	7.9	6.6	7.8	6.4	6.3
M x F												
S.Em$\pm$	0.99	1.01	0.91	0.90	0.49	0.51	6.0	7.0	5.8	6.8	5.7	5.5
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

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