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Effect of pressmud and inorganic fertilizers on yield and nutrient uptake by rice and its residual effect on succeeding wheat and soil fertility in rainfed lowlands

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ABSTRACT
Field experiment conducted during 2000 -2002 on rice-wheat system revealed that the values of all yield attributes were improved significantly due to integrated use of pressmud alongwith recommended does of fertilizer (RDF) over RDF alone. Rice received 10 t PM ha^{-1} alongwith RDF produced significantly higher grain yield over RDF alone, RDF + 25 Kg $ZnSO_4$ ha^{-1} and farmer's practice. Addition of 25 Kg $ZnSO_4$ ha^{-1} alongwith RDF gave significantly higher grain and straw yield as compared to RDF alone, and farmer's practice . Application of 20 t PM ha^{-1} alongwith RDF to preceding rice and 100% RDF to succeeding wheat gave significantly highest yield of 32.6 q/ha^{-1} over rest of the treatment except 15 t PM ha^{-1} alongwith RDF applied to preceding rice. The highest rice equivalent yield (37.62 q/ha^{-1}) was recorded with 20 t PM ha^{-1} to preceding rice alongwith 100% RDF to both rice and wheat followed by 15 t PM ha^{-1} (36.70 q/ha^{-1}) to preceding rice, and 100% RDF to both rice and wheat. The uptake of nutrients by rice was highest with 20 t PM ha^{-1} + RDF, however, significant response was recorded only up to 15 t PM ha^{-1} + RDF. The value of pH and bulk density of soil was reduced but content of organic carbon, available N_1, P_2O_5 and K_2O was improved with all integrated nutrient management practices as compared to its initial values.

Key words : Wheat, Rice, $ZnSo_4$.

INTRODUCTION

The productivity of rice-wheat system is declining day by day owing to continuous use of inorganic fertilizers resulting in deterioting the soil physical, chemical and biological properties besides, application of inorganic fertilizer in large quantities over a long period create imbalance in soil supply of nutrients . On the other hand, escalation of price of inorganic fertilizers is beyond to the reach of the farmers. Application of organic manures like pressmud / FYM alongwith inorganic fertilizer is beneficial for improving the productivity of rice-wheat system as well as soil properties (Dwivedi and Thakur , 2000) . Hence an attempt was made to study the effect of pressmud and inorganic fertilizers on yield and nutrient uptake by rice and its residual effect on succeeding wheat and soil fertility in rainfied lowlands

MATERIALS AND METHODS

Field experiment was conducted at the Crop Research Station Ghagraghat during 2000- 2002 to find out the effect of integrated use of pressmud in different doses alongwith inorganic fertilizers with and without zinc sulphate on productivity of rice – wheat system and soil fertility in rainfed lowland. The experimental soil was sandy loam in texture with pH 8.1, organic carbon 4.0g Kg^{-1} , available N, 218 , P, 20.10 and K, 174 kg ha^{-1} .Seven treatments consisted of farmer's practice (T1) , RDF alone (T2), 5 t PM ha^{-1} + RDF (T3) , 10 t PM ha^{-1} + RDF (T4) , 15 t PM ha^{-1} + RDF (T5) , 20 t PM ha^{-1} + RDF (T6) , and 25 Kg $ZnSO_4$ ha^{-1} + RDF (T7) were tested in randomized block design with four replications . Rice variety "Jalpriya" was transplanted on 17th July with 20 x 10 cm hill spacing in all years . The recommended dose of fertilizer was 100 Kg N + 50 Kg P_2O_5 +40 Kg, K_2O ha^{-1}. A dose of 40 Kg N + 20Kg P_2O_5 ha^{-1} alongwith FYM (5 t ha^{-1}) was used in farmer's practice, The entire quantity of P_2O_5, K_2O and half of the nitrogen was applied as basal and remaining N was applied in two splits i.e. at tillering, and panicle intiation stage (PIS) of crop. Sulphitation pressmud used in the experiment had pH 7.5, organic matter 260 g Kg^{-1}, N 1.07, P_2O_5 2.63, K_2O 1.75% . Pressmud was applied 20 days before transplanting of rice crop., The soil samples collected before and after harvest of rice and grain samples at threshing were analyzed adopting standard laboratory methods. Wheat variety "HUW 234" was sown at 22.5 cm rows apart on December, 15 during both year . The wheat was fertilized with 120Kg N + 60Kg P_2O_5 + 40 Kg K_2O ha^{-1} and received four irrigations. All improved packages of practices were adopted for both crops. The rainfall received during the Kharif 2000 and 2001 was 980 mm and 1075 mm respectively and Rabi 2000-2001 was 41.3 mm and 52.5 mm respectively.

RESULTS AND DISCUSIONS

Yield Attributes:

Addition of 25 Kg ha^{-1} $ZnSO_4$ alongwith recommended does of fertilizer (RDF) resulted significantly higher values of all yield attributes like panicle m^{-2} panicle weight and 1000 grain weight over RDF alone (Table-1) . This is because of synergestic effect of Zn with other nutrients improved the availability of nutrients for crop resulted in higher values of yield attributes. Similar results were also reported by Chappale and Badole (1999). Application of RDF alongwith pressmud @ 5, 10,15 and 20 t ha^{-1} improved all the yield attributes significantly over rest of the treatments . The improvement in all yield attributes with

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Table 1 : Yield attributes , yield , nutrient uptake, and economics as affected by different treatments

Treatment	Rice					Nutrient uptake (Kg/ha)			Wheat grain Yield (q/ha)	Rice equiva-lent (q/ ha)	Benefit Cost Ratio
	Panicles /m^2	Panicle weight (g)	1000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	N	P	K			
Farmer's Practice	136	1.42	18.2	17.05	22.35	26.85	6.27	44.75	17.9	20.66	1.46
RDF alone	205	1.80	22.32	28.01	46.80	38.92	8.96	64.00	25.6	29.54	2.10
RDF + PM@5t/ha	235	1.95	23.10	29.95	51.10	41.55	9.70	69.25	27.7	31.97	2.14
RDF + PM@10t/ha	238	2.02	23.20	32.25	53.20	45.90	10.71	76.50	30.6	35.31	2.27
RDF + PM@15t/ha	241	2.08	23.60	32.45	54.80	47.70	11.13	79.50	31.8	36.70	2.27
RDF + PM@20t/ha	245	2.18	23.81	32.70	55.70	48.90	11.41	81.50	32.6	37.62	2.25
RDF + $ZnSO_4$@25Kg/ha	218	1.88	22.90	29.81	49.53	39.90	9.31	66.50	26.6	30.70	2.12
CD(0.05)	07	0.06	0. 21	1.54	3.55	3.71	0.87	5.77	2.5	2.4.	

RDF (100 Kg N+50 Kg P_2O_5 +40 Kg, K_2O ha^{-1})

integrated use of RDF + pressmud was owing to slow and prolong supply of nutrients to rice crop. The lowest value of all yield attributes were recorded with farmer's practice (Table-1) due to use of sub-optimum fertilizers.

Yield of Rice:

Application of RDF + 20 t PM ha^{-1} being at par with RDF + 10 t PM ha^{-1} and RDF + 15 t PM ha^{-1} but produced significant higher yield (32.70 q/ha^{-1}) of rice over rest of the treatments . This could be attributed to improvement in supply of both macro and micro nutrient to rice crop resulted in improvement in all yield attributes and yields. Application of RDF + 25 Kg $ZnSO_4$/ha^{-1} gave significantly higher yield of 29.81 q/ha^{-1} as compared to RDF alone (28.01q/ha^{-1}). Farmer's practice gave the lowest grain yield (17.05 q/ha^{-1}) and straw yield (22.35 q/ha^{-1}) owing to use of sub-optimum fertilizer.

Yield of Wheat:

Application of 20 t PM ha^{-1} to preceding rice crop and RDF to both rice and wheat crop gave significantly highest grain yield of wheat 32.6 q/ha^{-1} over rest of the treatments, however being at par with application of RDF to both crops alongwith pressmud @ 15 t/ha^{-1} and @ 10 t/ha^{-1} to preceding rice. Application of RDF + 25Kg $ZnSO_4$ ha^{-1} to preceding rice and 100% RDF to wheat crop resulted higher yield (26.6 q/ha^{-1})as compared to RDF alone applied to both crop . Farmer's practice in both crop gave the lowest yield of wheat (17.9 q/ha^{-1}). Higher yield of wheat with pressmud applied to preceding rice crop alongwith RDF to both crop could be attributed to improved availability of plant nutriensts to wheat crop as compared to RDF alone to both crops.

Nutrient Uptake:

The uptake of nutrients (NPK) by rice crop was highest with RDF +20 t PM ha^{-1} (48.90 N + 11.41, P +81.50 K, Kg/ha^{-1}) because of to higher yield with this treatment owing to higher availability of nutrients. (Kumar *et al*. 2001). However, the differences between RDF + 10 t PM ha^{-1}, and RDF + 15 t PM ha^{-1} and 20 t PM ha^{-1} for nitrogen uptake and RDF +15 t PM ha^{-1}, and

RDF +10 t PM ha^{1} for phosphorous and potassium uptake were non significant. Addition of zinc sulphate with

Table 2 : Soil properties as affected by different treatments

Treatments	pH	O.C. (%)	B.D. (g/cm^3)	Available Nutrients (Kg/ha)		
				N	P	K
Farmer's Practice	8.2	0.40	1.51	220	20.1	175
RDF alone	8.3	0.41	1.52	220	20.1	190
RDF + PM@5t/ha	8.1	0.43	1.50	237	21.8	191
RDF + PM@10t/ha	8.0	0.44	1.50	238	22.0	194
RDF + PM@15t/ha	8.0	0.46	1.49	240	22.5	196
RDF + PM@20t/ha	8.0	0.47	1.48	242	22.7	197
RDF + $ZnSO_4$@25Kg/ha	8.3	0.42	1.52	221	20.2	191
Initial Values	8.1	0.40	1.50	218	20.1	174

RDF - (100 Kg N + 50 Kg P_2O_5 + 40 Kg K_2O / ha)

RDF resulted higher uptake of NPK (39.90, 9.31 and 66.50 kg/ha^{-1}) as compared to RDF alone (38.92, 8.96 and 64.00 kg/ha^{-1}). This might be due to its function as catalyst stimulant in most of the physiological and metabolic processes. Similar results was also reported by Sakal *et al*. (2000).

Rice Equivalent & Economics:

The highest rice equivalent yield (37.62 q/ha^{-1}) was recorded with application of RDF to both rice and wheat crop alongwith 20 t PM ha^{-1} followed (36.70 q/ha^{-1}) by RDF to both crop alongwith 15 t PM ha^{-1} to preceding rice crop. This is because of higher yield of wheat with above treatments Farmers practice resulted the lowest rice equivalent yield (20.66 q/ha^{-1}) . The lowest benefit:cost ratio (1.46) was accrued from farmer's practice. The addition of ZnSO4 alongwith recommended dose of fertilizer (RDF) gave the higher benefit : cost ratio (2.12) as compared to recommended dose of fertilizer (RDF) alone (2.10) . Amongst, integrated nutrient management practice, the highest benefit : cost ratio of 2.27 was recorded with application of pressmud @ 10 t/ ha^{-1} to preceding rice and 100% RDF to both rice and wheat crop.

Soil Fertility:

The values of pH and bulk density of soil were reduced, in all treatments as compared to its initial values (Table 1) . Reduction in pH was because of the fact that pressmud produced certain organic acids which are helpful in reducing the pH of soil. However, addition of organic carbon due to application of pressmud was mainly resposible for reduction in bulk density of soil . The content of Organic carbon and available NPK was found highest as improvement with the application of 20 t/ha^{-1} + RDF (0.47 %, 242, 22.7 & 197 Kg/ha^{-1}) respectively over RDF alone. (0.41%, 220, 20.1 & 175 Kg/ha^{-1}) respectively, after harvest of rice-wheat system. Balance NPK fertilization alongwith organics manure which may increase soil organic carbon. Kumaraswami *et.al* (1998).

CONCLUSION

It is concluded from the above results that rice should be fertilized with 100% RDF alongwith 10 t PM ha^{-1} , and wheat with 100% RDF in rice-wheat system under rainfied lowlands.

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