Environment & Ecology 29 (1) : 32—33, 2011
 ISSN 0970-0420

Impact of Integrated Nutrient Management on Productivity in Rice-Horsegram Cropping Sequence in Rainfed Upland Soil

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Abstract

A field experiment was conducted in rainfed upland red and laterite soils for maximising the yield of rice-horsegram cropping sequence through use of organic and inorganic source of nutrient alone or their combination on sustainable basis. Rice yield (15.6 q/ha) was achieved with the treatment receiving 50% N through chemical fertilizer and 50% N through organic manures (FYM). The other organic manures like *Glyricidia* and *Cassia* leaves along with 50% RD (recommended Dose) of fertilizers were better than chemical fertilizer. The horsegram was grown on residual fertility and moisture. Use of FYM gave the yield (2.36 q/ha) of horsegram than other treatments. The rice equivalent yield (17.28 q/ha) was highest in the integrated treatment of 50% N as chemical fertilizer and 50% N through organic source like FYM.

Key words : Rice, Upland soil, Integrated nutrient management, REY.

Nearly 62% of the cultivable land in the state of Orissa is rainfed and depends on monsoon. The farmers in the state grow paddy widely in all situations despite the stress of moisture and low yield. In Eastern India, Kandhamal is a poor tribal district of Orissa, situated under North-Eastern Ghat agro-climatic zone with hot and moist sub-humid climate and red and laterite (Alfisols) soil having low waterholding capacity and severe nutrient deficiency. Under such situation, upland early variety of paddy with short duration (90 days) has a reasonable chance of success. Organic manure is the backbone for the sustainability of soil fertility and productivity. Therefore, use of chemical fertilizers alone may not keep pace with time in maintenance of soil health for sustaining the productivity. Keeping these in mind, a field experiment was conducted to study the effect of chemical fertilizers and organic manures such as FYM, *Gliricidia/ Cassia* leaves on the sustainable production of rice-horsegram cropping sequence.

Methods

A field experiment on rice-horsegram cropping sequence was started from 1994 in Dryland Agricultural Research Station (OUAT), Phulbani. The soil of the experimental site was red and laterite (Alfisols). The soil was sandy loam with clay content 14.4%, bulk density 1.63 g cm^3, field capacity 13.1%, wilting point 9.5%, pH 5.2, E.C (dsm^1) 0.032, organic C (g/kg) 3.2, available N (kg/ha) 165, available P_2O_5 (kg/ha) 20 and available K_2O 220 kg/ha. The experiment comprised nine-treatment combinations.

Main Plot Treatments (T) were as follows :

T_1—Control, T_2—Recommended dose (RD) of fertilizers (60-40-40 kg. N-P_2O_5-K_2O/ha), T_3—50% RD, T_4—*Glyricidia* leaf to supply 30 kg. N/ha + 20-20 Kg P_2O_5-K_2O/ha, T_5—*Cassia* leaf to supply 30 kg. N/ha + 20-20 kg P_2O_5-K_2O/ha, T_6—FYM to supply 30 kg. N/ha + 20-20 kg P_2O_5-K_2O/ha, T_7—$T_3 + T_4$, T_8—$T_3 + T_5$, and T_9—$T_3 + T_6$.

Green leaves were applied one week before sowing and mixed thoroughly with soil. The treatments were tried in randomized block design with three replications. All the treatments were imposed before sowing of rice crop (var ZHU 11—26) while horsegram (Local) was grown 10—15 days before harvest of rice on residual moisture and fertility.

Results and Discussion

The results revealed that all the nutrient supply systems recorded higher grain yield of rice cv ZHU 11-26 than control. (Table 1). The grain yield ranged from 3.75 to 15.60 q/ha. The maximum mean grain yield of rice (15.60 q/ha) was obtained in the treatment which received 30 kg N (50% RD) through chemical fertilizer and 30 kg N through FYM along with P and K fertili-

Table 1. Effect of fertilizer and organic manures on the yield (q/ha) of rice-horsegram relay cropping during 2004-2005. Price of rice : Rs 530/-per quintal, Horsegram Rs. 700/-per quintal.

Treatments	Rice grain yield (q/ha)	Horsegram grain yield (q/ha)	REY (Rice equivalent yield)	Biomass addition after harvest of horsegram (q/ha)	WUE (kg grain/ ha mm water)	Agronomic efficiency (kg/kg N)
T_1	3.75	0.24	4.08	6.32	0.62	-
T_2	10.1	0.35	11.16	8.24	1.67	10.6
T_3	8.41	0.32	8.83	7.06	1.39	15.5
T_4	7.19	0.62	8.01	7.98	1.19	11.5
T_5	6.19	0.44	6.77	7.46	1.02	8.1
T_6	12.38	2.31	15.43	21.63	2.05	28.8
T_7	12.06	0.63	12.89	9.30	1.99	13.8
T_8	10.89	0.40	11.42	7.77	1.80	11.9
T_9	15.06	1.27	17.28	20.57	2.58	19.7
CD (0.05)	1.43	0.27	-	-	-	-

zation. Only 30 kg FYM along with P and K fertilization recorded the yield of rice (12.38 q/ha). The yield in both the treatments were significantly higher than the rice grain yield (10.1 q/ha) achieved with full dose of recommended fertilizer. This may be due to release and availability of nutrients and in turn may have favored crop for obtaining higher yield of rice (1, 2). The water use efficiency (WUE) of 2.58 kg grain/ha-mm water was obtained in 30 kg N as chemical fertilizer + 30 kg N as FYM along with 40-40 kg P_2O_5-K_2O/ ha (T_9) followed by 2.05 kg grain/ha-mm water in the treatment of 30 kg N as FYM along with 20-20 kg P_2O_5-K_2O/ha. The agronomic efficiency (AE) of 28.80 kg grain/kg N was obtained in FYM supplying 30 kg N with half (20- 20 kg/ha) P_2O_5-K_2O (T_6) followed by 19.75 kg grain/kg N in the treatment of 30 kg N as chemical fertilizer + 30 kg N as FYM along with 40-40 kg P_2O_5-K_2O/ha (T_9)

Horsegram was grown with the residual moisture and fertility as a relay crop in rabi were presented in Table 1. All nutrient supply system gave higher grain yield of horsegram. It was observed that 30 kg FYM along with 20 kg each of P and K fertilization gave the maximum grain yield (2.31 q/ha) of horsegram followed by 1.27 q/ha in the treatment receiving 50% chemical fertilizer and 50% organic manure (FYM). The increase in yield due to organic manure may be due better soil health in turn of soil fertility enhanced the yield of horsegram.

System Performance

Rice-horsegram is the predominant sequence cropping system for rainfed upland of Orissa. The success of the system depends on the quantity and distribution of rainfall during crop growth period. Since the receipt of rainfall is low during November and December coinciding with flowering and pod formation stage of horsegram, the crop succeed if it is dibbed in between rows of standing crop of rice 10—15 days before harvest as a relay crop. The treatment receiving 30 kg. N (50%) from chemical fertilizer and 30 kg. N (50%) from FYM along with P- and K- fertilization gave maximum rice equivalent yield of 17.28 q/ha. Maximum yield of both rice and horsegram was achieved. By supplying 30 kg. N (50%) from chemical fertilizer and 30 kg. N (50%) from FYM along with P- and K- fertilization. Maximum biomass of 21.63 q/ha was added through the treatment receiving 30 kg. N from FYM followed by 20.57 q/ha through 30 kg N from chemical fertilizer + 30 kg. N from FYM which in turn develop the fertility status of soil and may favor the crop growth to obtain the higher yield.

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