RESPONSE OF HYBRID RICE (*ORYZA SATIVA* L.) TO INTEGRATED NUTRIENT MANAGEMENT (INM) IN PARTIALLY RECLAIMED SODIC SOIL

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Abstract : The field experiment was carried out at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during *Kharif* season of 2010 and 2011 to study the response of hybrid rice to Integrated Nutrient Management on grain yield, nutrient uptake and economics of various treatments and their effect on physico-chemical properties of soil after harvest of the crop. The experiment was carried out on silt loam soil having pH 8.9, EC 0.4 dSm^{-1} organic carbon 3.6mg kg^{-1}, Available N 194.00, P_2O_5 14.46and K_2O 246.80 kg $ha^{-1.}$ The Seven treatments of integrated nutrient management practices (T_1 -100% NPK, T_2 -75% NPK T_3 .50% NPK, T_4 -75%NPK +25%FYM-N, T_5 -50%NPK +50%FYM-N T_6 -25%NPK+75%FYM-N and T_7 -100%FYM-N) were tested in randomized block design, replicated thrice. The maximum grain yield (69.26 qha^{-1}), straw yield (83.22qha^{-1}), nutrient uptake of N (155.32 kg ha^{-1}), P (44.15 $kgha^{-1}$), K (158.23$kgha^{-1}$) were recorded with the application of 75%NPK +25%FYM-N (T_4) which were significantly superior over 75%NPK and 50% NPK + 50 % FYM-N, minimum was recorded with 100 % N through FYM. The maximum gross income Rs. 70489.0 ha^{-1} was recorded with 75%NPK +25%FYM-N (T_4) followed by 100%NPK (T_1).

Keywords : INM, hybrid rice, sodic soil

INTRODUCTION

Rice (*Oryza sativa* L.) being one of the richest starch food is consumed by about half of the world's population. India ranks second position in production of rice among the food grain, and half of the world population subsist on rice by receiving the highest (26.2%) calories intake from it (FAO 2009). Uttar Pradesh is the largest rice growing state after West Bengal in the country, where rice grown over an area of 5.69 m ha with production and productivity of 11.80 mt and 2060 kg ha^{-1}, respectively. Area under hybrid rice in India is about 2.5 m ha which is very low as compared to other growing countries, viz China and Japan. Hybrid rice gave about 20-25% more yield than promising high yielding commercial rice varieties. Salt-affected soils are those soils, which have an excess of soluble salts or an excess of exchangeable sodium (Na^+) or both in root zone to an extent, which can adversely affect crop growth or completely inhibit production of most of the crops. Excessive amount of salts in the root zone besides inducing toxicity, create physiological imbalance in growing plants. The Use of adequate dose of organic source coupled with chemical fertilizers is expected to ensure optimum growth conditions under intensive agriculture using rice hybrid. It is well established that the applied organic resources not only increase soil fertility but also improve soil physical conditions which help for proper growth of plants. Majumdar, *et. al.* (2007) reported that Integrated use of FYM and inorganic fertilizers significantly improve the yield as well as N, P and K uptake by paddy. They also reported that the integrated use of inorganic and organic fertilizers also improve the water holding capacity, aeration, permeability, soil aggregation, nutrient availability and decreasing bulk density. Keeping in view, the present investigation was aimed to study the effect of integrated nutrient management on hybrid rice in partially reclaimed sodic soil.

MATERIAL AND METHOD

The field experiment was conducted on Silt loam (sodic soil) at Instructional Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) situated at 26.47^0 latitude and 81.12^0 longitude with an elevation of about 113m from mean sea level in the Gangetic eastern Uttar Pradesh for two consecutive years (2010 and 11) to study the effect of Integrated Nutrient Management (INM) on hybrid rice (*Oryza sativa* L.) in partially reclaimed sodic soil. The mean annual rainfall is 1200 mm. The soil of experimental site (0-15 cm) had pH (1:2.5) 8.9, EC 0.40 m dSm^{-1} at 25^0C, organic carbon 3.6 mg kg^{-1}, available N 194.0, P_2O_5 14.46 and K_2O 246.80 $kgha^{-1}$. Seven treatment combinations consisted (T_1) 100% NPK, (T_2) 75% NPK, (T_3) 50% NPK, (T_4) 75% NPK+25% FYM-N, (T_5) 50% NPK+50%FYM-N (T_6) 25% NPK+75% FYM-N and (T_7) 100% N through FYM. The experiment was laid out in a randomized block design replicated thrice. Hybrid rice variety ARIZE-6444 was taken as test crop. The total N, P and K contents in grain and straw were analyzed as per standard procedures described by *Jackson* (1973). The uptake of N, P and K were computed by multiplying with total nutrient concentration in grain and straw with corresponding yields of the crop. The soil samples were analyzed for pH, organic carbon, available N, P and K by standard methods described by Jackson, 1973.

RESULT AND DISCUSSION

Yield and yield attributes

The pooled data presented in table-1 revealed that the grain and straw yield of rice increased with the

application of NPK along with Farmyard manure. The maximum grain (69.26 qha^{-1}) and straw (83.22 qha^{-1}) were recorded with the application of 75% NPK + 25% FYM which was significantly superior to 75% NPK (54.20 qha^{-1}**),** and 50% NPK+ 50% FYM (58.48 qha^{-1}) treatment and statistically at par with the application recommended NPK (100%NPK) treatments. This may be due to fact that slowly released nutrients through FYM and applied inorganic fertilizer helped to produce higher yield of rice. The per cent increase in grain yield of rice was higher under 75% NPK+ 25% FYM- N over 100% NPK, 75% NPK, 50% NPK + 50% FYM-N 3.58 21.60 and 15.56% respectively. The yield of rice was lowest under 100% N through FYM-N. On the basis of pooled mean data of two years, the superiority of the treatment may be arranged as: $T_4 > T_1 > T_5 > T_2 > T_6 > T_3$ and T_7 in case of grain yield of rice. These results are also corroborated by majority of workers Singh *et. al.* (2004) and Sowmpya *et. al.* (2011).

Nutrient Uptake

The N, P and K uptake were improved with the application of 75% NPK+ 25% FYM-N followed by 100% NPK applied through chemical fertilizer by hybrid rice during both the year of investigation (Table 2). Minimum uptake values of the N, P and K were recorded with 100 % N through FYM. Majumdar *et al.* (2007) also reported that N, P and K uptake by paddy and various forms of N in soil increased significantly by application of fertilizer N alone with Farmyard manure.

Soil properties and Nutrients Contents in Soil

Application of 75% NPK with chemical fertilizer along with 25% N through farmyard manure slightly decreased the soil pH over 100% NPK through chemical fertilizer but the difference among these was not significant (Table 3). However, the EC value was decreased with increasing the application farmyard manure. The minimum EC (0.24 dSm^{-1}) value was observed with the application of 100 % N through farmyard manure followed by 25% NPK + 75%FYM-N. Incorporation in increasing amount of FYM with decreasing value of NPK through inorganic fertilizer slightly improved the organic carbon. The increase in soil organic carbon with the use of FYM has also been reported by Yadvinder–Singh *et al.* (2004), Balwinder–Kuamr *et al.* (2008). Available N, P and K status of soil after harvest of the crop increased considerably with the application 75% NPK through chemical fertilizer + 25% N through farmyard manure (Table 2). The maximum build up of available N,P and K (175.10, 16.75 and 251.12 kg ha^{-1} respectively) were obtained with conjunctive use of 75% NPK+ 25% FYM-N which was significantly superior over 75% NPK applied through chemical fertilizer and at par 100% NPK applied through chemical fertilizer. Dixit and Gupta (2000) reported similar increase in N, P and K contents of soil under conjoint application of FYM and inorganic fertilizers as compared to inorganic fertilizers alone. An organic material like FYM from a protective cover on sesquioxide and this facilitates reduction in the phosphate fixation capacity of soil. The beneficial effect of FYM on available potassium may be described to the reduction in potassium fixation, solubilization and release of potassium due to organic matter with clay**.**

Economics

The cost of cultivation increased when farmyard manure applied to supplement the recommended nitrogen (Table 3). The highest net return (Rs. 42024.67) and cost benefit (1.47) ratio were workout with the application of 75% NPK+ 25% FYM-N followed by 100% NPK applied through chemical fertilizer (Rs. 43242.61).The minimum net return (Rs.37528.18) and cost benefit ratio (0.12) computed with the application of 100 % N through Farmyard manure.

CONCLUSION

Incorporation of farmyard manure in combination with chemical fertilizers could maintain sustainable hybrid rice yield as well as fertility in the partially reclaimed sodic soils. Application of farmyard manure increased the availability of nutrient content of the soil as compared to the chemical fertilizer. For obtaining the higher grain yield of hybrid rice the crop may be fertilized with 75% NPK + 25 % FYM.

Table 1: Effect of various treatments on yield and f economics of various treatments of hybrid rice crop (mean of two years).

Treatments	Yield (qha^{-1})		Cost of cultivation (Rs.)	Gross return (Rs.)	Net return (Rs.)	B:C ratio
	Grain	Straw				
T_1 100% NPK	66.64	81.15	25723.60	68025.4	42301.8	1.64
T_2 75% NPK	54.20	66.52	24695.38	54424.3	29728.9	1.20
$T_3$50% NPK	43.26	54.35	23666.75	43503.0	19836.25	0.84
(T_4) 75% NPK+25% FYM-N	69.26	83.22	28465.76	70611.2	42145.44	1.48
(T_5) 50% NPK+50%FYM-N	58.48	78.25	31687.88	60567.0	28879.22	0.91
(T_6) 25% NPK+75% FYM-N	48.15	57.25	34507.13	48909.3	14402.17	0.42
(T_7) 100% N through FYM	42.40	51.15	37528.20	43256.0	5727.8	0.15
CD *(P=0.05)*	5.38	6.69				

Table 2: Effect of various treatments on uptake of nutrients by rice crop (mean of 2010& 2011).

Treatment	Nutrient uptake ($kgha^{-1}$)		
	N	P	K
T_1 100% NPK	144.83	36.44	154.01
T_2 75% NPK	104.15	26.86	113.99
$T_3$50% NPK	75.77	20.64	85.05
(T_4) 75% NPK+25% FYM-N	155.32	44.15	158.23
(T_5) 50% NPK+50%FYM-N	130.54	31.01	135.87
(T_6) 25% NPK+75% FYM-N	92.92	24.31	97.60
(T_7) 100% N through FYM	74.42	20.42	85.17

Table 3: Effect of various treatments on the soil fertility after harvest of hybrid rice (mean of 2010 & 2011).

Treatments	pH (1:2.5)	EC (dSm^{-1})	Organic carbon ($mg\ kg^{-1}$)	Available N ($kg\ ha^{-1}$)	Available P_2O_5 ($kg\ ha^{-1}$)	Available K_2O ($kg\ ha^{-1}$)
T_1 100% NPK	8.83	0.38	2.6	173.10	15.00	248.20
T_2 75% NPK	8.87	0.39	2.5	153.50	14.60	223.00
$T_3$50% NPK	8.89	0.39	2.6	136.20	13.38	206.10
(T_4) 75% NPK+25% FYM-N	8.77	0.35	3.3	175.10	16.75	251.12
(T_5) 50% NPK+50%FYM-N	8.71	0.28	3.5	156.75	16.01	239.40
(T_6) 25% NPK+75% FYM-N	8.65	0.27	3.6	141.30	15.22	234.10
(T_7) 100% N through FYM	8.60	0.24	3.8	138.00	14.02	231.85
CD (P=0.05)	0.67	0.04	0.2	1.64	2.01	2.78

REFERENCES

Balvinder Kumar, Gupta, R.K. and Bhandari, A.L. (2008). Soil fertility changes after long- term application of organic manure and crop residues under rice-wheat system. *Journal of the Indian Society of soil science* ***56****, 80-85.*

Dixit, K.G. and Gupta, B.R. (2000). Effect of farmyard manure, chemical and biofertilizer on yield and quality of rice. *Journal of the Indian Society of Soil Science* **48,** 773-780.

Jackson, M. L. (1973). *Soil Chemical Analysis*. Prentice Hall of India, Pvt. Ltd. New Delhi.

Majumdar, B.: Venkateshi, M.S. and Saha, R. (2007). Effect of nitrogen FYM and non-symbiotic nitrogen fixing bacteria on yield, nutrient uptake and soil fertility in upland rice (*Oryza sativaL.)* . Indian J. Agri. Sci., **77** (6): 335-339.

Singh Yadvinder, Singh Vijay, Khind, C. S., Gupta, R.K., Meelu, O.P, Pasq Uvin E. (2004). Long term effect of organic input on yield and soil fertilizer in rice- wheat rotation. *Soil Science Society of America Journal,* **68** (3): 845-853.

Sowmya, C., Ramana, M.V., Mahender Kumar (2011). Effect of systems of rice cultivation and nutrient management options on yield, nutrient uptake and economics of rice. Crop Research (*Hissar*), **42:** 1/2/3, 6-9.