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SOIL TEST CROP RESPONSE BASED GRADIENT EXPERIMENT ON RICE (*Oryza sativa L.*) TO NPK FERTILIZERS IN THE ALLUVIAL SOIL

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Abstract: *Soil test crop response correlation studies conducted with rice on a loamy soil at Banaras Hindu University agriculture farm during Kharif 2014. Experiment conducted in 3 strips Ist, IInd and IIIrd in which fertilizer level $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$ applied respectively. Source of nutrients N, P and K were urea, single super phosphate and muriate of potash fertilizers, respectively. Gradient crop taken for this experiment is rice cv. Sarjoo-52. After harvest, plant samples were collected and analyzed for NPK content and uptake calculated nutrients. Grain and straw yields of rice were also recorded. There is reflection of application of graded levels of NPK fertilizers in the result and there is significant effect on NPK uptake, grain and straw yields of rice crop.*
Keywords*: Rice, STCR, nutrient uptake, grain yield and straw yield etc.*

Introduction: Among important crops rice is the major crop in Uttar Pradesh and is grown in about 5.90 million hectare. Which comprises of 13.5% of total rice in India. Rice provides 21% of global human per capita energy and 15% of per capita protein. Uttar Pradesh is the leading producer of rice and rank 3rd in the country with annual rice production around 12 metric tonnes. Rice is cultivated mainly in Kharif season (wet season) in around 5.90 million hectare followed by zaid (summer season) 35000-40000 hectare only. Farmers are using imbalanced and overdose of fertilizer to achieve higher yield but the decision on fertilizer use requires knowledge of the expected crop yield and response to nutrient application. It is a function of crop nutrient needs, supply of nutrients from indigenous sources and the short- and long-term fate of the applied fertilizer nutrients [1]. Field specific balanced amounts of primary nutrients (N.P and K) were prescribed based on crop based estimates of the supply of N, P and K and by modelling the expected yield response as a function of nutrient interaction [2]. These equations are developed after establishing significant relationship between soil test values and the added fertilizer. Keeping the above facts in view and non availability of STCR data for rice in eastern Uttar Pradesh this study was conducted. The objective of this study was to obtain the sound basis of fertilizer dose recommendation for rice crop in alluvial soil (Inceptisols order) at different soil fertility levels under the conditions of fertilizer scarcity and to ensure maximum fertilizer use efficiency [3]**.** By using STCR model the study also intended to find the relationship between the nutrients supplied by the soil and other sources, their uptake to develop a guideline for optimum application of fertilizer for desired yield target of rice [4].

Material and Methods

To establish significant relationship between soil test values, uptake for NPK and yield, a gradient rice crop experiment was carried out in the agriculture research farm, Banaras Hindu University during Kharif 2014. Soil samples (0-20 cm in depth) were collected from each experimental unit, dried and passed through 2 mm sieve and analyzed for physicochemical properties by the following methods:

1. Available nitrogen	Alkaline permanganate method [5]
2. Available phosphorus	Olsen *et al*. (1954)[6]
3. Available potassium	Ammonium acetate method [7] described [8]

The soil with clay loam texture p^H = 7.9 (slightly alkaline), EC (dSm^{-1}) = 0.24 and O.M. =1.16%. The available nitrogen, phosphorus and potassium status were 230.45, 35.65 and 260.25 kg ha^{-1} respectively. The field was divided into three equal strips like Ist, IInd, and IIIrd. Fertilizers level $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$ were given to strip Ist, IInd, and IIIrd, different fertilizer doses, low- 0, 0, 0, medium- 120, 60, 60 and high- 240, 120, 120 kg ha^{-1} N,P_2O_5,K_2O, respectively. Source of nutrients N, P and K were urea, single super phosphate and muriate of potash fertilizers, respectively. Rice crop (rice cv. Sarjoo-52) was grown as a test crop in this fertility gradient crop experiment by following proper cultural practices. At maturity, rice crop was harvested and grain yield, straw from each strip were recorded and Plant samples were also collected from each strip and analyzed for the content of nitrogen, phosphorus, potassium and calculated total nutrients uptake.

Results and Discussion

Yields: The grain yield of gradient crop of rice cv. Sarjoo-52in strip Ist, IInd and IIIrd were 2519.5, 4614.25 and 5398.75 kg ha^{-1} respectively. The straw yield registered in strip Ist, IInd and IIIrd were 2715.75, 5922.75 and 6416.25 kg ha^{-1}, respectively. This might be due to better nutrient uptake by the Crop which favorably influenced the growth and yield of rice as reported [9]. From the STCR gradient crop experiment, it is concluded that an application of graded levels of NPK fertilizers significantly influenced NPK uptake, grain and straw yield of rice crop [10].

Nutrient Uptakes: The results of NPK uptake, grain and straw yield in rice crop are show in table I. Nutrient uptake the mean nitrogen uptake of strip, Ist, IInd and IIIrd were 39.47, 85.07 and 114.18 kg ha^{-1}, respectively. The mean phosphorus uptake of strip Ist, IInd and IIIrd were 9.37, 21.07 and 30.11 kg ha^{-1}, respectively. While the mean potassium uptake of strip, Ist, IInd and IIIrd were 34.91, 91.11and 129.79 kg $ha^{-1,}$ respectively. A progressive increase in N, P and K uptake was found from strip Ist to strip IIIrd. The uptake of nitrogen increased from strip Ist (39.47 kg ha^{-1}) to strip IIIrd (114.18 kg ha^{-1}). This may be due to adequate quantity of nitrogen available to crop, which would have created favorable for N uptake resulting in vigorous growth [11]. The significant increase in P uptake from 9.37 to 30.11 kg ha^{-1} was due to higher levels of phosphorus application which would have led to higher root proliferation of the crop. The increase in K uptake from 34.91 to 129.79 kg ha^{-1}can be attributed to higher application fertilizer potassium [12].

Table1: Effect of graded levels of N, P_2O_5 and K_2O fertilizer application on grain and straw yield and nutrient uptake of gradient crop of rice cultivar.

Strips	Fertilizer dose application (kg ha^{-1})			Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Nutrient uptake (kg ha^{-1})		
	N	P_2O_5	K_2O			N	P_2O_5	K_2O
I	0	0	0	2519.50	2715.75	39.47	9.37	34.91
II	120	60	60	4614.25	5922.75	85.07	21.07	91.11
III	240	120	120	5398.75	6416.25	114.18	30.11	129.79
SEm+				21.38	21.92	0.85	0.24	0.49
CD(0.05)				53.34	54.68	2.13	0.61	1.22

Soil Characteristics: The soil test values after crop harvest give significant effect of fertilizer treatment on soil properties. The pH, EC and organic matter content increases. The pH of strip Ist, IInd and IIIrd were7.52, 7.85 and 8.16, respectively. EC of strip, Ist, IInd and IIIrd were 0.225, 0.263 and 0.285(dSm^{-1}), respectively. While Organic matter of strip, Ist, IInd and IIIrd were 1.158, 1.272 and 1.405 kg ha^{-1}, respectively. Fertilizer treatment significantly increased the nutrient availability. The amount of mean available nitrogen of strip Ist, IInd and IIIrd were 232.01, 256.14 and 286.7 kg ha^{-1}, respectively. The amount of mean available phosphorus of strip, Ist, IInd and IIIrd were 35.62, 38.0 and 41.86 kg ha^{-1}, respectively. While the amount of mean available potassium of strip, Ist, IInd and IIIrd were263.5, 295.96 and 332.29 kg ha^{-1}, respectively. This may be due to the adequate application of the fertilizer in the crop [13].

Table2: Physiochemical properties and fertility status of soil

Strips	Fertilizer dose application (kg ha^{-1})			EC (dSm^{-1})	pH	O.M.%	Nutrients (kg ha^{-1})		
	N	P_2O_5	K_2O				N	P_2O_5	K_2O
I	0	0	0	0.225	7.50	1.158	232.01	35.62	263.50
II	120	60	60	0.263	7.80	1.272	256.14	38.00	295.96
III	240	120	120	0.285	8.20	1.405	286.70	41.86	332.29
SEm±				0.007	0.028	0.026	0.296	0.323	1.127
CD(0.05)				0.01	0.04	0.037	0.418	0.457	1.594

Conclusion: From the STCR gradient crop experiment, it is concluded that an application of graded levels of NPK fertilizers significantly influenced NPK uptake, grain and straw yield of rice crop and also influenced the quality and nutrient status of soil. Fertilizer recommendations based on the concept of STCR are more quantitative, precise and meaningful because combined use of soil and plant analysis is involved in it.

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