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Effect on yield, nutrient uptake by rice (*Oriza sativa*) and soil properties by rice genotypes and fertility levels in Vertisol of Chhattisgarh

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Abstract
The present investigation was carried out at the Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *kharif* season of 2010. The experiment was conducted in soil locally known as *kanhar* belongs to order *Vertisols*. Higher grain and straw yield (38.79 and55.25 q ha-1) and total NPK uptake by rice (58.94,10.83and 103.78 kg ha-1 respectively) with the rice genotype MTU-1010 (V3) and higher fertility level as compared to the grain and straw yield of 33.71and 47.76 q ha-1 total NPK uptake 58.16, 10.76 and 103 kg ha-1 respectively with the medium fertility level and rice genotype R-RF-69 (V1).The yield and nutrient uptake by rice were lower with the lower fertility level and IR 84899- B183. On the other hand, the available status of NPK, micro nutrients and PH, EC and OC in soil at crop harvest were not influenced by rice genotypes and fertility levels. Soil test based major available nutrients were found to be higher with higher rate of application of N, P and K fertilizers, whereas micronutrients availability showed the reverse trend.

Keywords: Rice, yield, genotype, uptake, grain and straw

Introduction

Chhattisgarh popularly known as “Rice Bowl of India” occupies an area around 3.61 million hectares with the production of 5.22 mt and productivity of 1517 kg per hectare (Anonymous, 2011c) [1]. The prime causes of low productivity of rice in Chhattisgarh are drought limited irrigation (28.0%), lack of improved varieties suitable to different ecosystems. The interaction effects of drought and low fertility also effects on grain yield and also work on cultivar requirements. Low soil fertility resulted from inadequate level of many essential nutrients, but especially of nitrogen and phosphorus. In multi-location trials involving a large number of genotypes, the variance component for grain yield was often greater for genotype by environment interaction than for genotype alone. While the genotype by fertilizer interaction was often significant, its contribution to the genotype by environment interaction was rather small. The limited information from research conducted with irrigation and under rainfed lowland conditions suggest that both uptake of N and P and their utilization efficiency (grain yield/unit nutrient uptake) to produce grain yield are important for adoption to low soil fertility environments. Genotypic variation in utilization efficiency appears to be consistent across environments, and the efficiency can be improved by the development of cultivars that require a low nutrient concentration in the plant and a higher nutrient allocation to the grain.

Materials and Methods

A field experiment was conducted at the Instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, Chhattisgarh. The present study was carried out during Kharif season of the year, 2010- 2011. The experiment was laid out in strip plot design with three replications, the main plots were seven rice genotypes namely R-RF-69**,** IR-64**,** MTU-1010**,** IR83614-349-B**,** IR84887- B183-CRA-19-1**,** IR-80013-B-141-4-1 and R-RF-65 and subplots were three fertility levels namely Low fertility level i.e.00:00:00 kg ha-1 N:P:K**,** Medium fertility level i.e. 45:30:20 kgha-1N:P:K and High fertility level 90:60:40 kg ha-1 N:P:K. The collected soil samples were air dried and passed through 2mm sieves for different laboratory analysis. Physiochemical analysis of soil available nutrients like (N.P&K).The available N in the soil sample was determined by alkaline potassium permanganate method (Subbiah and Asija 1956), P by Olsen method and available K by neutral normal ammonium acetate method (Jackson 1973) [4]. Grain and straw yields were recorded after harvest of safflower. the grain and straws samples were digested in H2SO4 for determination of nitrogen and in tri acid mixture (HNO3: H2SO4, HCLO4, 9;2:1) for phosphorus and potassium estimation (page *et al*. 1982) Plant uptake of nitrogen, phosphorus and potassium were computed by multiplying the yield with the respective nutrient content.

Results and Discussions

Paddy and straw yields: Higher paddy and straw yield obtain from rice genotype MTU-1010 (V3) produced (34.40 and 48.99 q ha-1) which was at par with R-RF -69 (V1), IR-64 (V2) and the IR 83614-349-B (V4).The lowest yields 28.63 and 46.67 q ha-1 were given by IR 84899-B183-respectively. Fertility levels also increased paddy and straw yield significantly. The highest paddy and straw yield (38.79 and55.23q ha-1) was recorded with high soil fertility level (F2) followed by 33.71 and 47.76 q ha-1 in medium soil fertility level (F1) and the lowest 23.74 and 33.5 q ha-1 in low soil fertility level (F0)**.** Interaction between rice genotypes and fertility levels found significant effect on the growth and yield attributes and among them, MTU-1010 (V3) recorded Kaushik *et al.*, Effect of Rice Genotypes and Fertility Levels on Yield, Nutrient Uptake by Rice (*Oriza sativa*) and Soil Properties the better growth and yield attributes i.e. total tiller, effective tiller higher root and shoot growth, leaf area index, and efficient translocation of metabolites towards grain formation and their combined effect resulted the maximum paddy and straw yield. The findings of increased paddy and straw yields by the different fertility levels are also in consonance with the results of Azad *et al*. (1995), Haq *et al.* (2002) [3] Chaudhary *et al.* (2007) [2] and Ndaeyo *et al*. (2008), who reported increase in paddy yield of rice as the rates of NPK increased.

Table 1: Effect of rice genotypes and fertility levels on Yield and total nutrient uptake of rice

Treatments	**Paddy yield (q ha-1)**	**Straw yield (q ha-1)**	**Total N uptake (kg ha-1)**	**Total P uptake (kg ha-1)**	**Total K Uptake (kg ha-1)**
Genotypes (V)					
R-RF -69 (V1)	34.26	48.56	58.16	10.76	103.78
IR-64 (V2)	33.49	45.50	56.30	10.52	96.96
MTU-1010 (V3)	34.40	48.99	58.94	10.83	102.88
IR 83614-349-B (V4)	32.61	46.67	56.81	10.39	93.92
IR 84899-B183-CRA-19-1 (V5)	28.63	43.24	49.88	9.14	87.53
IR 80013-B-141-4-1 (V6)	31.74	45.14	55.45	9.93	102.32
R-RF -65 (V7)	29.44	40.44	49.93	9.23	78.68
SEm±	0.67	1.27	1.15	0.24	2.71
CD at 5%	2.06	3.90	3.53	0.73	8.37
Fertility levels (F)					
Low (F0)	23.74	33.51	42.04	7.43	74.17
Medium (F1)	33.71	47.76	57.71	10.61	96.80
High (F2)	38.79	55.25	65.46	12.31	114.48
SEm±	0.31	0.76	0.71	0.07	0.34
CD at 5%	1.23	2.98	2.79	0.28	1.33
Interaction VxF					
V1xF	34.26	48.56	58.16	10.76	103.78
V2xF	33.49	45.50	56.30	10.52	96.96
V3xF	34.40	48.99	58.94	10.83	102.88
V4xF	32.61	46.67	56.81	10.39	93.92
V5xF	28.63	43.24	49.88	9.14	87.53
V6xF	31.74	45.14	55.45	9.93	102.32
V7xF	29.44	40.44	49.93	9.23	78.68
SEm±	0.81	1.44	1.17	0.28	0.20
CD at 5%	2.35	4.19	3.39	NS	0.59

Table 2: Effect of rice genotypes and fertility levels on Physico-chemical property of soil after rice harvest.

Treatments	**pH (1:2.5)**	**EC (dSm-1)**	**OC (%)**	**Available N (kg ha-1)**	**Available P (kg ha-1)**	**Available K (kg ha-1)**
Genotypes (V) R-RF -69 (V1)	7.59	0.23	0.68	196.16	13.74	457.02
IR-64 (V2)	7.64	0.21	0.69	213.24	13.11	460.10
MTU-1010 (V3)	7.74	0.22	0.69	208.67	13.52	460.29
IR 83614-349-B (V4)	7.72	0.22	0.68	191.99	13.10	464.70
IR 84899-B183-CRA-19-1 (V5)	7.65	0.22	0.70	202.44	12.62	460.52
IR 80013-B-141-4-1 (V6)	7.60	0.22	0.69	205.93	12.33	478.73
R-RF -65 (V7)	7.54	0.22	0.69	202.09	13.10	463.57
SEm±	0.05	0.01	0.01	6.25	0.54	22.36
CD at 5%	NS	NS	NS	NS	NS	NS
Fertility levels (F)						
Low (F0)	7.61	0.22	0.70	197.99	11.64	476.62
Medium (F1)	7.66	0.22	0.69	204.28	13.51	458.30
High (F2)	7.65	0.22	0.68	206.52	14.07	455.77
SEm±	0.04	0.01	0.01	9.13	1.09	19.49
CD at 5%	NS	NS	NS	NS	NS	NS
Interaction VxF						
SEm±	0.11	0.01	0.01	12.10	0.86	28.29
CD at 5%	NS	NS	NS	NS	NS	NS

Nutrient Uptake: Rice genotypes and high fertility levels recorded significantly higher total (grain+straw) uptake of N, P and K over rice genotype IR 84899-B183-CRA-19-1 (V5) and lower fertilizer application. The highest total uptake of N,P and K (58.94,10.83,103.88 kg ha-1 respectively)was recorded with rice genotype MTU-1010 (V3) and (65.46,12.31 and 114.4 kg ha-1 respectively) was recorded with higher fertilizer application followed by genotype R-RF -69 (V1) and medium fertilizer application (58.16,10.76 and 10378 kg ha-1 respectively) use of higher fertilizer dose and better genotype significantly enhanced the total uptake of N,P and K. The increase in nutrient uptake with the increase in fertility level could be attributed to higher application of fertilizer and thereby the better availability of nutrients in soil and their transport to the plant from the soil, as the nutrient application leads to its enhanced uptake by plant. Interaction between rice genotypes and fertility levels found as significant. Similar result was also reported by Rani *et al.* (1997), Sudhakar *et al.* (2006) and Singh *et al.* (2010) [6]. The absorption by grain with the increase of notrient level was also reported by Sheng *et al*., 2004

Soil properties: The results pertaining to physico-chemical properties of soil such as pH, electrical conductivity and organic carbon content presented in Table 2Either rice genotypes or fertility levels did not have any significant effect on the pH, EC and OC of the soil. Interaction between rice genotypes and fertility levels were found non significant. Similar results on soil properties as influenced by rice varieties and soil fertility status were also found by Sinkander *et al.* (2008) [5] and Singh *et al*. (2008).

Available soil nitrogen status: Both rice genotypes and fertility levels did not show any variation in available nitrogen content of soil at harvest of rice crop. However, higher soil available nitrogen (213.24 kg ha-1) was observed where IR-64 (V2) was grown followed by MTU-1010 (V3) (208.67 kg ha-1), IR 80013-B-141-4-1 (V6) (205.93 kg ha-1), and IR 83614-349-B (V4) (191.99 kg ha-1).Increased fertility levels also tended to increase soil available nitrogen content at harvest which ranged from 197.99 kg ha-1 to 206.52 kg ha- 1 in low and high fertility levels, respectively. Similar N availability in different treatment tested may be due to its higher mobility and leaching losses did not favor the buildup of available soil N status. Interaction between rice genotypes and fertility levels found non significant. Similar results were also found by Pandey *et al.* (1992) and Sikdar *et al*. (2008) [5].

Available soil phosphorus status: Available phosphorus status of soil was not influenced by treatments i.e. rice KAUSHIK *et al.*, Effect of Rice Genotypes and Fertility Levels on Yield, Nutrient Uptake by Rice (Oriza sativa) and Soil Properties genotypes at harvesting of rice crop. Increase fertilizer application showed slightly higher available phosphorus status in soil and varied from 11.64 to 14.07 kg ha-1 in low and high fertility levels respectively. The variation soil available P can be due to variation in application of P fertilizer in different fertility treatments. The interaction between rice genotypes and fertility levels were also non significant on nutrient status of post harvest soil. Similar findings are also reported by Singh *et al.* (2006) [6] and Sikdar *et al.* (2008) [5].

Available soil potassium content: Values for soil available potassium after harvesting of rice as influenced by rice genotypes and fertility levels are non significant, however higher soil available potassium was observed in treatment (V6) IR 80013-B-141-4-1 (478.73 kg ha-1), followed by (V4) IR 83614-349-B (464.70 kg ha-1), (V7) R-RF -65 (463.57 kg ha-1), and lowest in (V1) R-RF -69 (457.02 kg ha-1).With increase in fertility level, soil available potassium was slightly decreased may be due to higher uptake of K from the soil by the crop Interaction between rice genotypes and fertility levels also found non significant. Similar results were also noticed by Suresh *et al.* (2002) and Reddy *et al.* (2007).

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