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RESEARCH ARTICLE

EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON HYBRID RICE

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ABSTRACT

The experiment was carried out during *kharif* 2002 and 2003 at research farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh India. Experiment was comprised of different levels of inorganic fertilizer and its conjunction with different organic fertilizers. In all 12 treatments, comprising of different N, P and K levels and its conjunction with organic fertilizers were laid out in randomized complete block design replicated thrice. Yield and yield attributing characters was significantly increased with increasing fertilizer levels from 50:30:20 kg, NPK ha^{-1} to 150:80:60 kg, NPK ha^{-1} during both the year of experiment. Seed yield and yield attributes were significant among different treatments. Application of 100:60:40 kg NPK ha^{-1} + blending of N with cow-dung urine (T_9) or poultry manure (T_{10}) resulted higher effective tillers, panicle length, and test weight which is statistically at par to that of inorganic level 150:80:60 kg NPK ha^{-1} (T1). Almost similar trend was noticed when said organic fertilizer was combined with lower level of inorganic fertilizer (50:30:20 kg NPK ha^{-1}), which tended to produced above yield components comparable to that of inorganic fertilizer level of 100:60:40 kg NPK ha^{-1}. Nutrient uptake by seed was higher if inorganic fertilizer were used with combination with organic fertilizer. Uptake of NPK kg/ha was maximum under in-organic level of 150:80:60 kg NPK/ha and was followed by inorganic level of 100:60:40 kg, NPK/ha along with organic sources i.e. blending of N with cow dung uren (T9), poultry manure (T10) or slow release nitrogen (T12).Thus it was concluded that use of inorganic fertilizer with different organic fertilizers sources are better for sustaining growth, yield and nutrient uptake by hybrid rice.

INTRODUCTION

Rice (*Oryza sativa L.*) is the second most important cereal crop in the world and in India. It's providing 43 per cent of calorie requirement for more than 70 per cent of Indian population. Rice productivity of high yielding varieties in the world is 3.68 ton/ha, whereas in India is only 1.9 ton/ha and in Chhattisgarh is around 1.3 ton/ha, which is extremely low as compared to the national productivity. Among the technological options, hybrid rice as the commercially viable technology with 15-20 per cent yield advantage over the best inbred (Virmani, 1996). The amount of nutrients absorbed by hybrid rice to yield 7.5 t ha^{-1} were 208 kg N ha^{-1}, 24 kg P ha^{-1} and 190 kg K ha^{-1} (Chengxiu and Shangxian, 1989). To meet the requirement of these nutrients, chemical fertilizers are the one option; but the use of chemicals in agriculture as input deteriorates the soil health. Use of organic matter as source of plant nutrients increases the soil health, fertilizers use efficiency and makes soil living. This also increases microbial population of the soil system, which might help in nutrient transformation in rice field. In Chhattisgarh as a whole, availability of cow-dung is throughout the year, but there is mis-utilization of cow-dung for fuel. The blended materials at later stage when applied in rice may be beneficial to succeeding crops.

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MATERIAL AND METHODS

The field experiments was carried out for two consecutive years during *Kharif* 2002 and 2003 on hybrid rice (*Oryza sativa* L.) under irrigated condition at Research farm, Indira Gandhi Krishi Vishwavidyalaya,, Raipur, Chhattisgarh. Experiment was comprised of different levels of inorganic fertilizer and its conjunction with different organic fertilizers. In all 12 treatments, comprising of different N, P and K levels and its conjunction with organic fertilizers were laid out in randomized block design with 3 replications). The soil of experiments was clay-loam in texture (*Vertisols*), neutral in reaction (pH7.4), medium in organic carbon (0.52%) low in available N (216 kg/ha), medium in available P (18.35 kg/ha) and high in available K (325 kg/ha). Rice hybrid cultivar *'Sahayadri'* was used as the test crops. The treatments were 150:80:60 kg NPK ha^{-1} (T1); 100:60:40 kg NPK ha^{-1} (T2);

50:30:20 kg NPK ha^{-1} (T3); T3 + FYM 10 t ha^{-1} (T4); T3 + BL of N with CDU (T5); T3 + PM 3t ha^{-1} (T6); T3 + SRN (NC treated N) (T7); T2 + FYM 3t ha^{-1} (T8); T2 + BL of N with CDU (T9); T2 + PM 3t ha^{-1} (T10); T2 + SRN (NC treated N) (T11); and No N, P and K (T12) The total rainfall of 208.66 mm was received during *kharif* 2002 and 349.73 mm during 2003.It was laid out in randomized block design (RBD) with three replications. One seedling $hill^{-1}$ was planted with the spacing of 20 cm x 15 cm. Cow-dung urine mixture was prepared by taking cow-dung and urine in ratio of 9 : 7. The decomposition of cow-dung was made following a simulated technique of biogas slurry preparation. The data collected from field observations and recorded in laboratory were subjected to statistical analysis by standard analysis of variance technique as described in "Statistical procedures for Agricultural Research" by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth and yield attributes

There was significant increase in plant height, dry matter production, effective tillers m^2, panicle length cm. and test weight, g with increasing level of inorganic fertilizer from 50:30:20 kg NPK ha^{-1} to 150:80:60 kg NPK ha^{-1} during both the years. As regard to conjunctive use of organic and inorganic fertilizers, application of inorganic level of 100:60:40 kg NPK ha^{-1} along with organic fertilizer as blending of N with cow –dung uren (T_9) or poultry manure3t/ha. (T_{10}) were found to be statistically at par to that of inorganic level 150:80:60 kg NPK ha^{-1} for above growth and yield components. Almost similar trend was noticed when said organic fertilizer was combined with lower level of inorganic fertilizer (50:30:20 kg NPK ha^{-1}), which tended to produced above yield components comparable to that of inorganic fertilizer level of 100:60:40 kg NPK ha^{-1}, this may be indicated that source to sink supply was at potential level under said treatments and increased effective tillers, panicle length, and test weight. The lower nutrient level unable to maintain available N, P and K in soil according to crop need and crop was suffered and failed to produce crop parameters similar to that obtained at higher nutrient level. The findings are in agreement with the results of Baig *et al.* (1999).

Yield and harvest index

The application of different levels of inorganic fertilizer and conjunctive use of organic fertilizers significantly affect the grain & straw yield and harvest index. Among inorganic fertilizer levels, grain & straw yield and harvest index was significantly increased with increasing levels from 50:30:20 kg NPK ha^{-1} to 150:80:60 kg NPK ha^{-1} but 100:60:40 kg NPK/ha with blending of N with cow –dung uren (T_9) or poultry manure3t/ha (T_{10}) produced grain and straw yields statistically at par to that inorganic level of 150:80:60 kg NPK ha^{-1} both the years. Rao *et al.* (1985) and Yan (1988), observed a significant and positive heteriosis with a yield advantage of 11-23% and this was due to more biomass production, panicle numbers per hill, spikelet's per panicle and higher test weight.

Table 1. Effect of conjunctive use of organic and inorganic fertilizer on growth and yield attributes of hybrid rice

Treatments	Plant height(cm.)		Dry matter (g/hill)		Effective tillers (m-2)		Panicle length(cm.)		Test weight (g)	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
150:80:60 kg NPK ha^{-1}	120.70	122.81	63.22	62.53	327.90	335.41	29.10	30.18	24.23	24.53
100:60:40 kg NPK ha^{-1}	113.80	115.35	54.70	54.50	238.50	245.70	27.52	27.54	22.52	23.66
50:30:20 kg NPK ha^{-1}	109.42	106.68	47.04	49.62	156.00	167.61	24.58	25.43	21.23	22.16
T_3 + FYM 10 t/ha^{-1}	113.65	114.74	53.74	53.44	186.37	199.29	27.33	27.90	22.49	23.37
T_3 + BL of N with CDU	109.35	112.53	50.24	52.07	174.25	187.66	25.57	27.38	22.03	22.79
T_3 + PM 3 t/ha^{-1}	109.62	112.68	51.43	52.72	179.40	191.31	26.35	28.04	22.23	23.36
T_3 + SRN (NC treated N)	108.77	107.68	48.67	50.97	167.11	178.50	25.34	27.93	21.42	22.33
T_2 + FYM 3 t/ha^{-1}	118.91	120.55	58.96	56.20	259.80	271.38	27.26	28.35	23.13	24.01
T_2 + BL of N with CDU	118.89	120.70	58.55	57.35	316.87	325.46	28.37	29.84	23.58	24.69
T_2 + PM 3 t/ha^{-1}	120.63	121.76	60.47	57.41	317.19	329.45	28.41	29.97	23.64	24.83
T_2 + SRN (NC treated N)	114.71	117.83	55.70	55.20	244.83	255.57	27.25	28.40	23.02	23.47
Control (No NPK)	102.62	103.81	37.64	42.74	135.75	148.33	23.77	25.03	20.87	22.03
CD (p=0.05)	4.21	4.65	4.99	7.02	11.20	9.97	1.02	2.13	1.09	1.01

Table 2. Effect of conjunctive use of organic and inorganic fertilizer on growth and yield attributes of *hybrid rice*

Treatments	Grain yield (q/ha)		Straw yield (q/ha)		Harvest Index		Nutrient uptake by grain (kg/ha)					
							N		P		K	
	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
150:80:60 kg NPK ha^{-1}	72.71	73.43	99.78	99.13	42.15	42.55	114.15	118.22	24.72	27.17	31.27	33.04
100:60:40 kg NPK ha^{-1}	63.15	64.49	92.98	95.20	40.45	40.38	90.30	93.51	17.05	18.70	23.37	24.51
50:30:20 kg NPK ha^{-1}	47.79	46.25	67.33	63.85	41.51	42.01	61.65	60.59	10.04	10.18	11.95	12.49
T_3 + FYM 10 t/ha^{-1}	64.53	65.39	89.77	93.69	41.82	41.11	89.05	90.89	15.49	16.35	21.29	23.54
T_3 + BL of N with CDU	59.79	62.23	84.65	88.63	41.39	41.25	80.72	84.63	13.15	14.94	17.94	19.91
T_3 + PM 3 t/ha^{-1}	65.40	66.65	91.56	92.68	41.67	41.83	88.94	91.98	16.35	17.99	20.27	21.33
T_3 + SRN (NC treated N)	53.19	56.48	74.28	77.94	41.73	42.02	73.40	78.50	11.70	12.99	15.43	17.51
T_2 + FYM 3 t/ha^{-1}	68.06	69.35	95.64	97.39	41.58	41.59	100.05	104.72	19.74	21.49	25.86	27.05
T_2 + BL of N with CDU	69.70	71.18	96.85	98.48	41.85	41.95	105.25	109.62	21.61	24.20	27.18	29.89
T_2 + PM 3 t/ha^{-1}	71.67	72.91	98.90	98.61	42.02	42.51	109.66	113.01	23.65	25.52	29.38	31.35
T_2 + SRN (NC treated N)	66.95	68.25	95.15	96.24	41.30	41.49	101.76	104.42	22.09	23.21	24.77	27.30
Control (No NPK)	24.47	25.64	41.20	45.04	37.26	36.28	30.59	32.31	4.89	5.38	5.38	5.89
CD (p=0.05)	3.96	3.75	3.74	3.89	0.31	0.24	8.92	11.03	3.37	5.71	6.61	7.91

Similarly conjunction of inorganic fertilizer level of 50:30:20 kg NPK ha^{-1} with Farm yard manure 10t/ha (T4) or poultry manure 3t/ha (T6) produced grain and straw yield comparable to that of inorganic fertilizer level of 100:60:40 kg NPK ha^{-1} under study. Not only this, the addition of organic fertilizers of poultry manure or blending of N with cow –dung uren along with inorganic fertilizes level of 50:30:20 or 100:60:40 kg NPK ha^{-1} produced significantly higher grain yields than that of respective levels during both the years. Higher grain yield of hybrid rice due to higher nutrient level have also reported by Luo and Yang (1993) and Yang and Sun (1991). This may be due to the fact that cow -dung uren added 7.50 kg N, 3.54 kg P and 14.82 kg K ha^{-1} and gave a saving of 50 kg N, 20 kg P and 20 kg ha^{-1}. Whereas, PM added 40.49 kg N, 43.13 kg P and 19.37 kg K ha^{-1} and saved said amount of inorganic fertilizer.

Nutrient uptake

The addition of organic fertilizer either farm yard manure (T8), blending of N with cow –dung uren (T9) or poultry manure (T10) along with inorganic fertilizer 100:60:40 kg NPK/ha (T2) gave the comparable N uptake to that of 150:80:60 kg NPK/ha. Phosphorus uptake by grain was maximum under inorganic level 150:80:60 kg, NPK/ha and was followed by inorganic level of 100:60:40 kg, NPK/ha along with organic sources i.e., blending of N with cow –dung uren (T9), poultry manure (T10) or slow release nitrogen (T12). Almost similar trend was observed for potassium uptake by grain at harvest.

Conclusion

The grain quality was significantly influenced due to application of different inorganic fertilizer levels and conjunctive use of inorganic and organic fertilizer. Among the inorganic fertilizer levels increasing level of nutrients from 50:30:20 kg NPK ha^{-1} to 100:60:40 kg NPK ha^{-1} significantly increased the hulling and milling percentage and length and breadth of kernel during both the years.

Further increase in inorganic level of fertilizer to 150:80:60 kg NPK ha^{-1} did not increased the above grain quality parameters over inorganic fertilizer level of 100:60:40 kg NPK ha^{-1}. The increasing level of inorganic fertilizer from 50:30:20 kg NPK ha^{-1} to 150:80:60 kg NPK ha^{-1} significantly increased effective tillers, panicle length, fertile grain $panicle^{-1}$ and sterility percentage during both the years. As regard to conjunctive use of organic and inorganic fertilizers, application of inorganic level of 100:60:40 kg NPK ha^{-1} along with organic fertilizer of BL of N with CDU or PM were found to be statistically at par to that of inorganic level 150:80:60 kg NPK ha^{-1} for above yield attributing characters during both the years.

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