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Effect of different Nutrient Management Practices on Phonological Characters, Yield and Economics of Hybrid Rice

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A B S T R A C T

A field experiment was conducted during *kharif* season of 2018 in *Alfisols* to study grain yield of hybrid rice varieties as influenced by different nutrient management practices. Results revealed that the variety IRH-103 (V1) was recorded significantly higher grain yield qha^{-1}, straw yield qha^{-1}, harvest index (%), gross income, net income and B: C ratio than the variety IRH-111 (V2). However, in case of different nutrient management practices treatment 150% RDF through inorganic (N5) recorded significantly highest grain yield q ha^{-1}, straw yield q ha^{-1}, gross income, net income and B: C ratio among all treatments.

Introduction

Rice (*Oryza sativa* L.) is one of the vital cereal crop of the world as it is most likely food grain of over half of the globe population and more than 70% people obtained energy from rice (Bamangaonkar *et al.*, 2009). Rice has the distribution of being the most extensively cultivated crop in the world and important staple food of more than 60% of the world Rice supplies 20% and 31% of the total energy required by world and Indian population, respectively (Singh *et al., 2018*). World's 90% rice is grown and consumed in Asia region in the world (Dekhane *et al.*, 2014). In India, rice occupies an area of 43.39 m ha with production and productivity of 104.32 mt and 2.4 t ha^{-1}, respectively and In Chhattisgarh, rice occupies an area of 3.84 m ha with production and productivity of 6.09 mt and 1.5 t/ha, respectively (Ministry of agriculture & farmers welfare, 2016). To achieve food security, hybrid rice can be one of the most possible options to increase 15% to 20% of food production (Peng *et al.*, 1999, Siddiq, 1996). Rice yield and biomass increased

rapidly due to increased use of chemical fertilizers. Imbalanced nutrient management under intensive cropping system and it reduces soil organic carbon is the key factors responsible for decline in soil quality (Kang *et al.,* 2005).

Under such situation organic nutrient management has significant role in improving productivity of crop and soil fertility (Tiwari *et al., 2017*).

Materials and Methods

The experiment was conducted in Instructional cum Research Farm of SG College of Agriculture and Research Station, Jagdalpur, Chhattisgarh. The experiment was laid out in Split plot design with 2 main plot *viz* V1- IRH 103, and V2- IRH 111 and subplot treatment was in 5 level *i.e.* 100% RDF through inorganic (N1), 75% RDF through inorganic + organic (N2), 100% RDF through inorganic + organic (N3), 150% RDF through inorganic + organic (N4) and 150% RDF through inorganic (N5) which was replicated in thrice three. Treatment N2, N3 and N4 and 2 q ha^{-1} Vermicompost + 25 kg ha^{-1} DAP were applied at 25-30 DAT. The recommended dose of fertilizer was 120:60:40 kg N: P: K ha^{-1} applied as per treatment. The soil of the experimental site was characterized as silty loam (*Alfisols*) which is locally known as *Mal.* It comes under midland situation of landscape of Bastar and soil was slightly acidic in reaction with high to medium in fertility level. A total 1085 mm rainfall was received during the cropping season. During the experimentation maximum and minimum temperature was recorded ranges between 26.8 and 37.2 ^{0}C and 8.7 to 24.3 ^{0}C.

Results and Discursion

The variety V_1 produce significantly taller plant than V_2 at 60, 90 DAT and at harvest. However, in case of different nutrient management practices, treatment N_5 recorded significantly taller plant among all the treatment but it was found at par with treatment N_1 at 60, 90 DAT and at harvest. The smaller plant height recorded with treatment N_2 at all growth stages of observation. The plant height was more it may be due to 150% RDF through inorganic produce more nutrient to the plant and had vigorous plant root and taller plant and uptake more nutrients. Similar result had recorded by Maiti, *et al.,* (2006) he observed the taller plant when the crop received 125% recommended doses of fertilizer along with 5 tonnes of FYM ha^{-1}. Hossaen *et al., (*2011*)* also observed the taller plant was found with 70% NPKS +2.4 t poultry manure ha^{-1} at all growth stages of observation and the lowest was observed from control treatment.

The variety V_1 produced significantly highest number of effective tillers than V_2 at harvest. However, in different nutrient management practices, treatment N_5 noticed significantly highest number of effective tillers among all treatment but it was at par with treatment N_1 at 30,90 DAT and at harvest and the lowest number of effective tillers was recorded with treatment N_2 at all growth period of observation. Similarly observation was recorded by Singh *et al.,* (2016) revealed that the maximum effective tillers was recorded when nitrogen applied @ 120 kg ha^{-1} through urea + P and K: 60:60 kg ha^{-1}. Manzoor *et al., (*2006) also reported similar result and reveals that the rice plants produced more number of productive tillers $hill^{-1}$ when 225 kg nitrogen ha^{-1} was applied which remained statistically at par with that obtained by nitrogen application levels between 125 to 200 kg ha^{-1}. Similarly Bezbaruha *et al.,* (2011) observed that in nutrient management practices, recommended dose 140:60:60 kg NPK ha^{-1} through inorganic sources was recorded 46% higher productive tillers.

The variety V_2 produced significantly highest dry matter hill^{-1} than V_1 at 60 DAT. However, in case of different nutrient management practices treatment N_5 observed significantly highest dry matter hill^{-1} among all treatment but it was significantly at par with treatment N_1 at 60, 90 DAT and at harvest, while the lowest dry matter hill^{-1} was recorded with treatment N_2 at all the growth stages. Variety IRH- 111 and 150% RDF through inorganic produced higher dry matter accumulation, more number of tillers and leaves because more assimilation due to 150% RDF through inorganic. Similar result was found by Naseer and Bali (2007) he reported that significant increased dry matter accumulation with application of N up to 90 kg ha^{-1}. Maiti, *et al.,* (2006) also observed the maximum dry matter accumulation and LAI when the crop received 125% recommended doses of fertilizer along with 5 tons of FYM ha^{-1}.

The crop growth rate increased from 30-60 to 60-90 and thereafter, it declined at 90 to at harvest. The significantly highest crop growth rate was observed in V2 treatment than V1 at 60 DAT. However, in case of different nutrient management practices all treatments shows no significant effect on crop growth rate but numerically highest crop growth rate was observed in treatment N5 and the lowest was recorded with treatment N2 at all growth stages of observation. The treatment 150% RDF through inorganic observed highest crop growth rate, it may be due to highest dry matter accumulation and more assimilation in 150% RDF through inorganic.

The relative growth rate declined with advancement of crop age. The treatment V_1 and V_2 shows no significant effect on relative growth rate but numerically highest relative growth rate was observed in treatment V_2 than V_1 at 30-60 and 60-90 DAT. However, in case of different nutrient management practices, all the treatments were observed no significant effect on relative growth rate but numerically highest relative growth rate was noticed in N_2 treatment at 30-60 and 60-90 DAT.

The net assimilation rate declined with advancement of crop age. The treatment V_1 and V_2 shows no significant effect on net assimilation rate but numerically highest net assimilation rate was observed in treatment V_2 than V_1 at 30-60 DAT and 90-at harvest. However, in case of different nutrient management practices all treatments recorded no significant effect on net assimilation rate but numerically highest net assimilation rate was noticed in treatment N2 at 30-60 and 60-90 DAT.

The Leaf area index increased with advancement of crop age. The data reveals that the treatment V_1 and V_2 shows no significant effect on leaf area index but numerically highest LAI was observed in treatment V_2 than V_1 at 30 and 60 DAT but at 90 DAT and at harvest highest LAI was noticed in treatment V_1 than V_2. However, in different nutrient management practices, it was found no significant effect on leaf area index among all treatment but numerically highest LAI was noticed in treatment N_5 among all treatments, while the lowest LAI was recorded with treatment N_2 at all growth. The treatment 150% RDF through inorganic produced higher leaf area index, it may be due to more number of tillers and leaves because more assimilation in 150% RDF through inorganic.

The variety V_1 produced significantly highest grain yield than V_2. However, in case of different nutrient management practices, treatment N_5 recorded significantly highest grain yield among all the treatments and lowest grain yield was recorded in treatment N_3. It was due to increased number of grain panicle^{-1}, number of effective tiller hill^{-1} and test weight (Table 1–7).

Table.1 Effect of different nutrient management practices on Plant height of hybrid rice

Treatment	Plant Height (cm)			
	30 DAT	60 DAT	90 DAT	At harvest
Varieties				
V1	51.09	86.76	104.11	106.88
V2	49.80	75.95	93.77	97.74
SEm±	0.77	1.41	2.18	1.69
CD at 5%	NS	9.22	6.40	4.57
CV %	5.93	6.70	8.55	6.43
Nutrient management practices				
N1	51.30	82.77	100.40	103.42
N2	47.45	76.97	95.47	98.82
N3	48.93	79.47	96.60	100.79
N4	50.68	81.33	98.47	101.73
N5	53.87	86.23	103.77	106.79
SEm±	1.45	1.95	1.85	2.18
CD at 5%	NS	5.90	5.60	4.84
CV %	7.02	5.88	4.58	5.23

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.2 Effect of different nutrient management practices on no. of effective tillers plant^{-1} of hybrid rice

Treatment	Number of Tillers Plant^{-1}			
	30 DAT	60 DAT	90 DAT	At harvest
Varieties				
V1	7.72	10.68	7.60	9.16
V2	8.92	13.49	6.49	8.18
SEm±	0.26	0.54	0.28	0.12
CD at 5%	NS	NS	NS	0.79
CV %	12.16	17.35	15.53	5.37
Nutrient management practices				
N1	9.13	11.13	7.59	9.4
N2	6.87	10.17	6.08	7.33
N3	7.40	11.67	6.42	7.78
N4	8.17	12.83	6.87	8.53
N5	10.03	14.63	8.26	10.3
SEm±	0.54	0.48	0.45	0.61
CD at 5%	1.64	1.45	1.36	1.85
CV %	15.9	9.68	15.60	17.3

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.3 Effect of different nutrient management practices on dry matter accumulation of hybrid rice

Treatment	Dry Matter Accumulation hill^{-1} (g)			
	30 DAT	60 DAT	90 DAT	At harvest
Varieties				
V1	3.00	26.27	51.09	56.33
V2	3.47	28.67	48.88	56.41
SEm±	0.11	0.15	2.00	0.90
CD at 5%	NS	0.98	NS	NS
CV %	12.88	6.65	15.53	6.18
Nutrient management practices				
N1	3.57	28.71	51.17	57.78
N2	2.43	24.28	47.0	52.01
N3	2.64	25.93	48.72	55.23
N4	3.23	27.2	49.42	57.03
N5	4.34	31.2	53.3	59.78
SEm±	0.23	1.24	1.03	1.20
CD at 5%	0.70	3.76	3.10	3.62
CV %	17.54	11.07	5.02	5.21

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.4 Effect of different nutrient management practices on CGR of different growth stages of hybrid rice

Treatment	Crop Growth Rate (g hill^{-1}d^{-1})		
	30-60 DAT	60-90 DAT	90- At harvest
Varieties			
V1	0.78	0.83	0.18
V2	0.84	0.67	0.25
SEm±	0.008	0.07	0.04
CD at 5%	0.06	NS	NS
CV %	12.38	8.32	20.49
Nutrient management practices			
N1	0.84	0.75	0.22
N2	0.73	0.76	0.17
N3	0.78	0.76	0.22
N4	0.80	0.74	0.24
N5	0.90	0.71	0.22
SEm±	0.05	0.06	0.02
CD at 5%	NS	NS	NS
CV %	14.12	19.3	6.65

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.5 Effect of different nutrient management practices on RGR of different growth stages of hybrid rice

Treatment	Relative Growth Rate (g $^{-g}$ hill^{-1}d^{-1})		
	30-60 DAT	60-90 DAT	90- At harvest
Varieties			
V1	0.032	0.010	0.001
V2	0.031	0.008	0.002
SEm±	0.001	0.01	0.001
CD at 5%	NS	NS	NS
CV %	10.04	11.44	18.12
Nutrient management practices			
N1	0.030	0.008	0.002
N2	0.034	0.010	0.001
N3	0.033	0.009	0.002
N4	0.031	0.009	0.002
N5	0.029	0.008	0.002
SEm±	0.001	0.01	0.001
CD at 5%	NS	NS	NS
CV %	10.04	11.44	18.12

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.6 Effect of different nutrient management practices on NAR of different growth stages of hybrid rice

Treatment	Net assimilation rate (g hill^{-1}d^{-1})		
	30-60 DAT	60-90 DAT	90- At harvest
Varieties			
V1	0.014	0.009	0.001
V2	0.015	0.007	0.002
SEm±	0.001	0.001	0.001
CD at 5%	NS	NS	NS
CV %	6.76	4.0	6.17
Nutrient management practices			
N1	0.015	0.008	0.002
N2	0.015	0.009	0.001
N3	0.015	0.008	0.002
N4	0.015	0.008	0.002
N5	0.014	0.007	0.001
SEm±	0.001	0.001	0.001
CD at 5%	NS	NS	NS
CV %	6.76	4.0	6.17

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Table.7 Effect of different nutrient management practices on LAI of hybrid rice

Treatment	Leaf Area Index			
	30 DAT	60 DAT	90 DAT	At harvest
Varieties				
V1	0.90	2.463	2.71	2.97
V2	0.97	2.511	2.56	2.66
SEm±	0.12	0.22	0.08	0.16
CD at 5%	NS	NS	NS	NS
CV %	15.17	34.84	11.23	22.54
Nutrient management practices				
N1	1.06	2.43	2.65	3.00
N2	0.73	2.14	2.44	2.37
N3	0.80	2.41	2.48	2.53
N4	0.99	2.50	2.71	2.71
N5	1.10	2.95	2.89	3.45
SEm±	0.11	0.22	0.20	0.28
CD at 5%	NS	NS	NS	NS
CV %	9.11	21.27	18.34	24.49

V1-IRH 103, V2- IRH 111, N1- 100% RDF (Inorganic), N2-75% RDF (Organic + inorganic), N3-100% RDF (Organic + inorganic), N4- 150% RDF (Organic + inorganic), N5- 150% RDF (Inorganic)

Similarly, Dixit and Gupta (2000) stated that the grain yield and straw yields of rice increased significantly with increasing levels of NPK fertilizers. Singh *et al.*, (2004) also observed the highest grain and straw yield with the highest level of N nutrition (180 kg ha^{-1}), through the differences between successive N levels were only significant up to 120 kg N ha^{-1}. Similarly Manzoor *et al.*, *(*2006) reported that the application of fertilizer where 175 kg nitrogen ha^{-1} was applied produced a maximum (4.24 t ha^{-1}) of paddy yield which was statistically similar with that obtained in 150, 200, and 225 kg ha^{-1} nitrogen application.

The variety V_1 recorded significantly highest straw yield than V_2. Where, in case of different nutrient management practices, treatment N_5 recorded significantly highest straw yield among all the treatments and lowest straw yield was recorded in treatment N_2. Increased number of tillers $hill^{-1}$, number of leaves and plant height inward straw yield in V_1 and N_5 during experimentation.

The treatment V_1 recorded significantly higher gross and net return than V_2. While, in case of different nutrient management practices, treatment N_5 was noticed significantly highest gross return and net return and lowest economic return was observed in treatment N_3 among all treatment.

The variety V_1 recorded significantly higher B: C ratio than V_2. However, in case of different nutrient management practices, treatment N_5 was noticed significantly highest B: C ratio but it was at par with N_2 and N_4 treatment and lowest was observed in N_3 treatment among all treatment. Similar result found by Usman *et al.*, (2003) reveals that highest value of benefit cost ratio was observed in case of combined application of organic manure in form of poultry manure @ 20 t ha^{-1} followed by application of FYM @ 20 t ha^{-1} along with same amount of mineral fertilizers. Tiwari *et al.*, (2017) also recorded the maximum gross and net returns and the lowest cost of cultivation under 50% recommended NPK through fertilizer + 50% N (FYM) than other treatments.

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