Effect of NPK Application at Two Levels on Yield and Yield Component of Rainfed Shallow Lowland Rice

Abstract

Field experiment was carried out at Crop Research Station, (ANDUAT), Ghaghraghat, Bahraich to evaluate the effect of two levels of fertilizers (F1: 60-30-20 & F2: 120-60-40 NPK kg/ha) on grain yield of Seven Advance Varietal Trial-2 rice cultures (IET 29026, IET 27538, IET 29031, IET 29032, IET 26744, IET 28281 and IET 27547) under rainfed shallow land in split plot design with three replications. Soil of the experimental field was sandy loam with pH 7.2, organic carbon 0.40%, Nitrogen 200 kg/ha, P2O5 24 kg/ha and K2O 234 kg/ha. Results revealed that application of higher level of fertilizers significantly increased the grain yield of rice cultures. IET 26744 recorded maximum grain yield (5.25 t/ha) followed by IET 29032 (5.20 t/ha) at higher dose of fertilizers and per cent increase over lower dose were 55.78 and 67.20, respectively. At 50% recommended dose of fertilizers variety Swarna-Sub 1 yielded maximum grain (3.54 t/ha) followed by IET 26744 (3.37 t/ha). All cultivars yielded higher at 100 per cent recommended dose of fertilizers.

Keywords: Growth, Productivity, Fertilizer Recommendation, Yield, Rice

Introduction

A large proportion of world's population utilizes rice (Oryza sativa L.) as staple food (Islam et al., 2010; Atera et al., 2011). "On global scale the cultivation of rice is carried out on about 148 million hectares with production of 710 million tons" (FAO, 2011). Out of this almost 90% rice production and consumption takes place in Asian countries (Islam et al., 2010). In Asia, the largest rice producing countries include China, India, Indonesia, Bangladesh and Pakistan (FAO, 2011). A share of 41.39% in total food grain produced and 55% of cereals produced in the country, contributing 20-25 % to Agricultural GDP (Anonymous, 2016). In India, rice is grown on nearly 43.49 m ha with total production of 104.4 m t and productivity of 2400 kg/ha (Anonymous, 2016). "Cultivated area in India is 143 million ha, out of which 85 million ha (60%) is completely depends on rainfall received throughout the year. Rice (*Oryza sativa L.*) is the world's most important food crop belongs to Poaceae. It serves as the staple food for more than half of the globe's population" (khan et al, 2013). "Rice is the second most important crop which brings economic prosperity of the growers as well as earns billions of rupees through its export for country. Rice is the third highest produced cereal after wheat and maize" (FAOSTAT, 2012).

"NPK is the key element in the production of rice and gives by far the largest response. It is the most essential element in determining the yield potential of rice and nitrogenous fertilizer is one of the major inputs to rice production" (Mae T, 1997). However, "recovery of applied nitrogen in rice is very low owing to various losses. Optimization of applied nitrogen at critical growth stages, coinciding with the period of efficient utilization is essential to meet the nitrogen requirement of crop throughout the growing season" (Pandey S *et,al* 2002). Almost every farmer has the tendency to apply costly N fertilizer excess to get a desirable yield of Aman rice (Saleque MA et, al. 2004), but the imbalance use of N fertilizer causes harm to the crop and decreases grain yield. It is also a fact that improper use of nitrogenous fertilizer, instead of giving yield advantage, may reduce the same. "Nitrogen management is an important aspect for obtaining good yield of rice. Optimum dose and schedule of fertilizer application is necessary to achieve higher yields, minimize lodging and damage from insect pests" (DRR, 2013). Sangeetha and Balakrishnan (2013) reported that "lower grain yield of rice obtained with absolute control which did not receive organic manures and recommended NPK addition". "Nitrogen fertilization and proper time of its application is the major agronomic practice that affects the yield and quality of rice crop" (Lampayan RM et,al.2010).

Materials and Methods

An experiment was carried out to assess the effect of two levels of fertilizers (F1: 60-30-20 & F2: 120-60-40 kg/ha) on grain yield of five new rice cultures namely IET 26767, IET 26803, IET 26477, IET 24914, IET 25713 and one national check Swarna Sub-1 one local check Sambha Mahsuri in split plot design with three replications under field condition at Crop Research Station, (ANDUAT), Ghaghraghat, Bahraich which is situated at 27.10^{0}N (latitude), 81.49 ^{0}E (longitude) and at 111 m (altitude). Soil of the experimental field is sandy loam with pH 7.2, organic carbon 0.40%, Nitrogen 200 kg/ha, P2O5 24 kg/ha and K2O 234 kg/ha. Crop nursery was grown in raised beds and twenty one days old seedlings were transplanted in the 2nd

week of July, seedlings were planted in each plot with spacing of 20x10 cm. Cultural practices such as weeding, irrigation, pest control etc. were done when necessary. Fertilizers namely urea, single super phosphate (SSP) and muriate of Plotash (MOP) were used as source of nitrogen, phosphorus and Potassium, respectively. Urea fertilizer was applied as split application, 50% dose at field preparation and rest amount during vegetative and heading phase.

Parameters measured for rice were: (i) grain yield t/ha, (ii) panicle no per sqm, (iii) panicle weight per panicle (g), (iv) test weight (g) and (vii) days to 50% flowering. Harvesting were carried out when 90% of the grains had turned hard, clear and free from greenish tint (Panda, 2010). The data on grain yield of each plot were recorded separately by threshing the harvested rice cultures on tarpaulin followed by proper sun drying and winnowing. Data collected were statistically analysed using two-ways analysis of variance (ANOVA), and Duncan's new multiple range test (DMRT) was employed to determine the mean differences between the treatments using the statistical package.

Grain Yield Efficiency Index values (GYEI): Grain yield is the best measure for evaluation of given genotype in the screening experiments for its efficiency. Further, field screening results can be interpreted using the grain yield efficiency index (GYEI) for identifying efficient, stable, suitable and promising cultures at various levels of nutrient application. Grain yield efficiency Index (GYEI) was computed for genotype evaluation using the following formula in the present Nitrogen variety evaluation trial.

$$GYEI = \frac{\text{(Yield at low nutrient level) (Yield at high nutrient level)}}{\text{(Experimental mean yield at low nutrient level) X (Experimental mean yield at high nutrient level)}}$$

Tolerant genotypes have a (GYEI) of 1 or higher and the susceptible ones have a GYEI in the range of 0 to 0.50 and the genotypes between these two limits (0.50 to 1.00) are considered intermediate types. The results of these trials, if utilized meticulously not only aid to develop promising cultivars but also to reduce the cost of cultivation in rice production.

Results and Discussion

Yield and Yield Component: Plant growth, yield attributes and grain yield of rice genotypes were affected significantly due to fertility level. All yield attributing characters (number of panicle/m2 and panicle weight) were remained differed with different varieties. The data presented in table-2 and figure 1 clearly revealed that the higher level of NPK increase grain yield significantly. At 100% recommended dose of fertilizer (120:60:40 NPK) IET 26744 recorded maximum grain yield (5.25 t/ha) followed by IET 29032 (5.20 t/ha) and per cent increase over F1 were 55.78 and 67.20, respectively. At 50% recommended dose of fertilizer (60:30:20 NPK) check variety Swarna-Sub 1 recorded maximum grain yield (3.54 t/ha) followed by IET 26744 (3.37 t/ha). All cultivar yielded higher at 100% recommended dose of fertilizer.

Among the genotypes, IET 29032 produced maximum number of panicles m-2 (209 & 290), maximum panicle weight was recorded with Swarna-sub 1 (2.25 & 3.21 g) and finally IET 28281 recorded highest test weight (24.8 & 25.6 g).

Grain Yield Efficiency Index values (GYEI): At 100% recommended dose of fertilizer IET 27538 recorded maximum GYEI (1.30) followed by IET 27547 (1.10)

From the present study, it may be concluded that among the rainfed shallow land varieties, IET 26744 proved most impressive by recording the highest grain yield and IET 29032 exerted second promising early rice genotype under rainfed shallow land situation of Eastern Uttar Pradesh. IET 26744 has potential to be an alternative/replacement as rainfed shallow land at recommended dose of fertilizers.

Table. 1: Identification of cultures based on the GYEI values of cultivars at Nutrient Level F2.

Varieties	**GYEI**
IET-29026	0.85
IET 27538	1.30
IET 29031	0.39
IET 29032	0.88
IET 26744	0.92
IET 28281	1.00
IET 27547	1.10
Swarna-Sub 1	1.01
Sambha Mahsuri	0.75

Table 2: Grain yield and ancillary characters of RSL rice at different levels of NPK fertilizer doses.

	Grain yield t/ha	**% increase over F1**	**Panicle No./m2**	**% increase over F1**	**Panicle weight (g)**	**% increase over F1**	**Test weight (g)**	**% increase over F1**	**days to 50% flowering**	**Nutri. res. (kg grain/kg Nutri.) (Base level 100%**

															RDF)
Cultivar	**F1**	**F2**		**F1**	**F2**		**F1**	**F2**		**F1**	**F2**		**F1**	**F2**	
IET-29026	3.29	4.24	28.87	205	242	18.05	2.24	2.45	9.38	23.7	24.9	5.06	113	117	8.64
IET 27538	3.22	4.66	44.72	210	284	35.23	2.22	3.18	43.24	24.7	25.5	3.23	116	119	13.09
IET 29031	3.24	4.13	27.47	204	248	21.57	2.01	2.24	11.44	22.2	23.2	4.50	114	120	8.09
IET 29032	3.11	5.20	67.20	209	299	43.06	2.11	2.84	34.59	23.6	24.2	2.54	118	122	19.00
IET 26744	3.37	5.25	55.78	209	237	13.39	2.12	2.55	20.28	23.3	24.7	6.00	116	122	17.09
IET 28281	3.13	4.65	48.56	196	244	24.48	1.97	2.21	12.18	24.8	25.6	3.22	115	119	13.82
IET 27547	2.92	4.29	46.91	190	255	34.21	2.04	3.09	51.47	24.4	24.9	2.04	119	120	12.45
Swarna-Sub 1	3.54	4.46	25.99	234	272	16.23	2.25	3.21	42.67	20.0	20.9	4.50	120	124	8.36
Sambha Mahsuri	2.79	4.07	45.87	214	263	22.89	1.94	2.27	17.01	15.0	16.0	6.67	112	117	11.64
Interation F at same V	0.25			16.48			0.18			NS			NS		
V at same F	0.24			17.76			0.17			NS			NS		
F1	3.18			208.00			2.10			22.41			116.00		
F2	4.55			261.00			2.67			23.32			120.00		
C.D.(0.05)	0.05			11.02			0.05			0.07			2.68		
C.V.(%)	1.16			4.02			1.73			0.27			1.94		

Figure 1: Grain yield and panicle weight increase % over F1

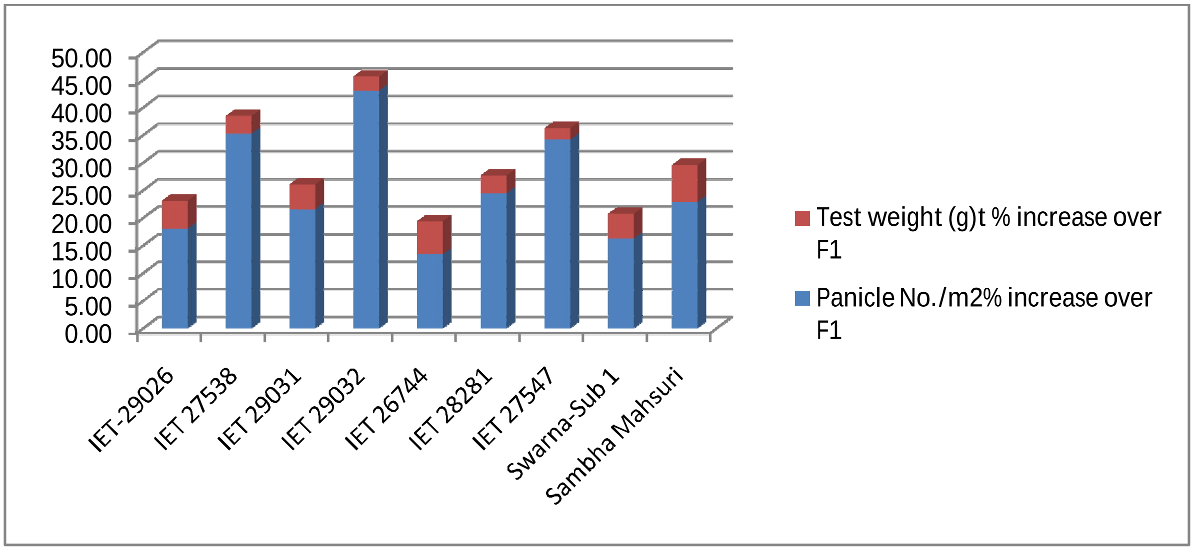
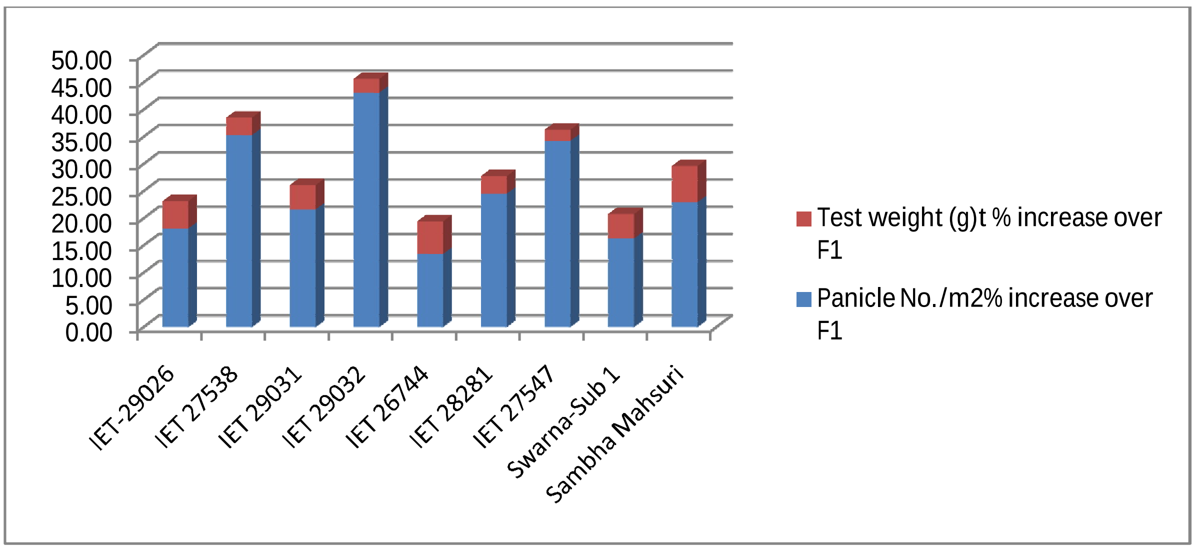


Figure 2: Panicle no/m2 and test weight (g) increase % over F1



Conclusion

Different varieties may have varying responses to N-fertilizer depending on their agronomic traits. Now a days the identification and release of high yielding very early rice varieties, it becomes imperative to make a comparative assessment of the growth studies and their influence on grain yield under different nutrient combination.

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