



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

Mahendra Singh <sup>a\*</sup>, S. K. S. Rajpoot <sup>a</sup>, N. Parkash <sup>a</sup>,  
R. A. Singh <sup>b</sup> and A. L. Upadhyay <sup>a</sup>

<sup>a</sup> Crop Research Station (A.N.D.U.A.T.), Ghaghraghat, Bahraich, India.

<sup>b</sup> Crop Research Station (A.N.D.U.A.T.), Bahraich, India.

## Authors' contributions

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## Article Information

DOI: 10.9734/IJPSS/2022/v34i242662

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/93299>

**Original Research Article**

**Received: 18/10/2022**

**Accepted: 26/12/2022**

**Published: 29/12/2022**

## ABSTRACT

A 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, P<sub>2</sub>O<sub>5</sub> 24 kg/ha and K<sub>2</sub>O 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.

\*Corresponding author: E-mail: singhm7@yahoo.com;

**Keywords:** Growth; productivity; fertilizer recommendation; yield; rice.

## 1. INTRODUCTION

“A large proportion of world’s population utilizes rice (*Oryza sativa* L.) as staple food” (Islam et al., 2010); [1]. “On global scale the cultivation of rice is carried out on about 148 million hectares with production of 710 million tons” [2]. “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” [2]. “A share of 41.39% in total food grain produced and 55% of cereals produced in the country, contributing 20-25 % to Agricultural GDP” [3]. “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” [3]. “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” [4]. “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” [5].

“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” [6]. 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” [7]. “Almost every farmer has the tendency to apply costly N fertilizer excess to get a desirable yield of Aman rice, 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” [8,9]. “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 [10] 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” [11].

## 2. 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°N (latitude), 81.49°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, P<sub>2</sub>O<sub>5</sub> 24 kg/ha and K<sub>2</sub>O 234 kg/ha. Crop nursery was grown in raised beds and twenty one days old seedlings were transplanted in the 2<sup>nd</sup> 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 Potash (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” [11].

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.

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

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.

### 3. 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/m<sup>2</sup> and

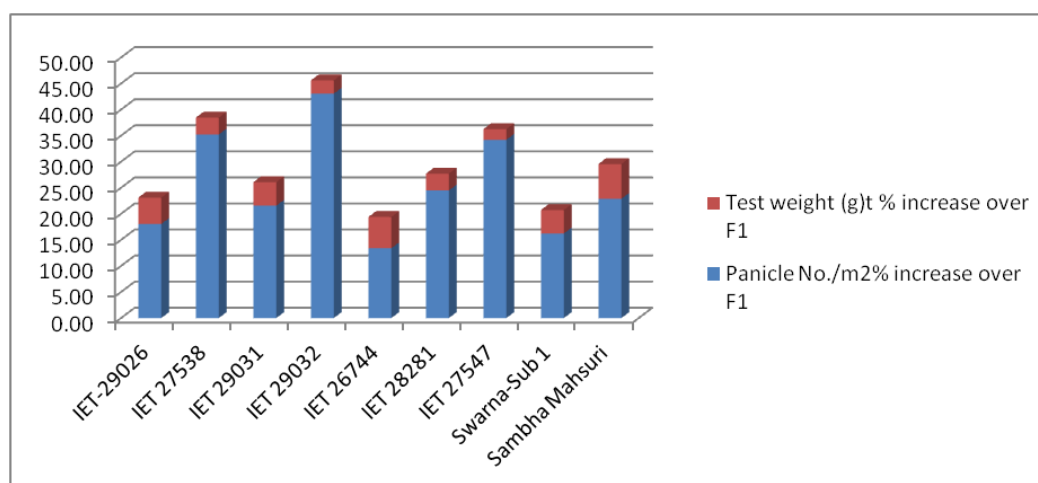
panicle weight) were remained differed with different varieties. The data presented in Table 2 and Fig. 1 clearly revealed that the higher level of NPK increase grain yield significantly. At 100% recommended dose of fertilizer (120:60:40 NPK) IET 26744 recorded maximum grain yield (5.25 t/ha) followed 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<sup>-2</sup> (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).

**Table 1. Identification of cultures based on the GYEI values of cultivars at nutrient level F2**

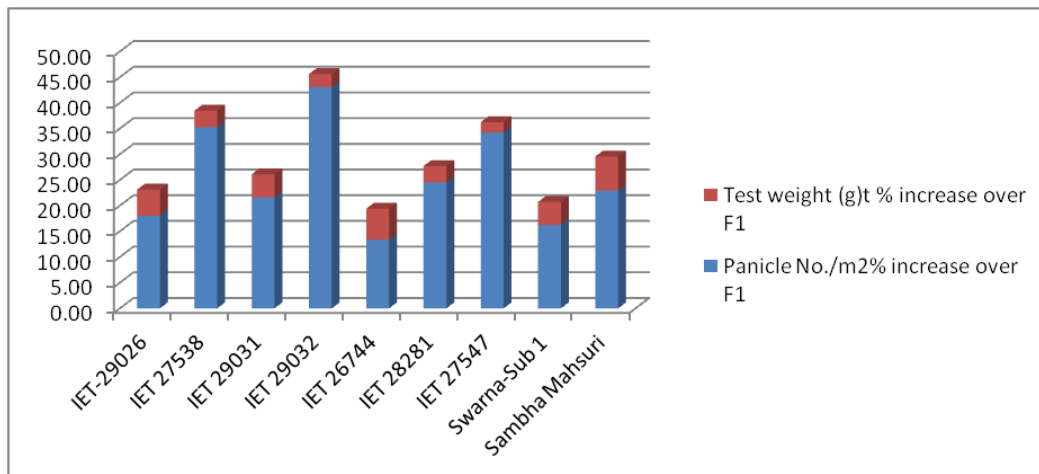
Varieties	GYEI
IET-29026	0.85
IET 27538	1.30
IET 29031	0.39
IET 29032	0.88
IET 26744	0.92
IET 28281	1.00
IET 27547	1.10
Swarna-Sub 1	1.01
Sambha Mahsuri	0.75



**Fig. 1. Grain yield and panicle weight increase % over F1**

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

Cultivar	Grain yield t/ha		% increase over F1	Panicle No./m <sup>2</sup>		% 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)
	F1	F2		F1	F2		F1	F2		F1	F2		F1	F2	
<b>IET-29026</b>	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
<b>IET 27538</b>	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
<b>IET 29031</b>	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
<b>IET 29032</b>	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
<b>IET 26744</b>	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
<b>IET 28281</b>	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
<b>IET 27547</b>	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
<b>Swarna-Sub 1</b>	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
<b>Sambha Mahsuri</b>	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
<b>Interaction F at same V</b>	0.25			16.48			0.18			NS			NS		
<b>V at same F</b>	0.24			17.76			0.17			NS			NS		
<b>F1</b>	3.18			208.00			2.10			22.41			116.00		
<b>F2</b>	4.55			261.00			2.67			23.32			120.00		
<b>C.D.(0.05)</b>	0.05			11.02			0.05			0.07			2.68		
<b>C.V.(%)</b>	1.16			4.02			1.73			0.27			1.94		



**Fig. 2. Panicle no/m2 and test weight (g) increase % over F1**

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.

#### 4. CONCLUSION

Depending on their agronomic characteristics, different varieties may respond differently to N-fertilizer. Nowadays, the recognition and release of high yielding very early rice varieties necessitates a comparative evaluation of growth studies and their influence on grain yield under various nutrient combinations.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Atera EA, Onyango JC, Azumal T, Asanuma S, Itoh K. Field evaluation of selected NERICA rice cultivars in Western Kenya. *Afr J Agric Res.* 2011; 6:60-66.
2. FAO. Trends of rice paddy production: monitoring the market; 2011. Available:[http://www.fao.org/esc/fr/15/70/hihighlight\\_71html](http://www.fao.org/esc/fr/15/70/hihighlight_71html)
3. Anonymous. Indiastat base; 2016.

Available:<https://www.india.stat.com>  
Anonymous (2017)

4. Khan AS, M Imran, M Ashfaq. Estimation of Genetic Variability and Correlation for Grain Yield Components in Rice (*Oryza sativa* L.). *American-European J Agric Environ Sci.* 2013;6:585–590.
5. FAOSTAT. Food and Agricultural Organization of the United Nations, Rome Italy, Statistical Data Base; 2012. Available:<http://faostat.fao.org> (Accessed 2017 January 12)
6. Mae T. Physiological nitrogen efficiency in rice: Nitrogen utilization, photosynthesis and yield Potential. *Plant Soil.* 1997;196(2):201- 210.
7. Pandey S, Mortimer M, Wade L, Tung TP, Lopez K, et al. Direct seeding: Research strategies and opportunities. IRRI, Los Banos, Philippines. 2002;383.
8. Saleque MA, Naher UA, Islan A, Patahn ABMU, Hossain ATMS, et al. Inorganic and organic phosphorous fertilizer effects on the phosphorus fractionation in wetland rice soils. *Soil Sci Soc Am J.* 2004;68: 1635-1644.
9. Verma DK, Giri SP, Verma S, Singh RP, Rajpoot SK, Singh PK, Singh S, Parksh N. Effect of nitrogen, phosphorus and potassium (NPK) application at various doses on yield of early transplanted rice. *International Journal of Chemical Studies.* 2020;SP-9(1):81-84.
10. Sangeetha SP, Balakrishnan A. Effect of organically supplemented N on yield of rice (*Oryza sativa* L.). *Journal of Crop and Weed.* 2011;7(1):86- 88.

11. Lampayan RM, Bouman BAM, Dios JLD, Espirity AJ, Soriano JB, et al. Yield of aerobic rice in rainfed lowlands of the Philippines as affected by nitrogen management and row spacing. *Field Crop Res.* 2010;116(1-2):165-174.

© 2022 Singh et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*

*The peer review history for this paper can be accessed here:*

<https://www.sdiarticle5.com/review-history/93299>