International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 2420-2423

Received: 14-07-2018
Accepted: 18-08-2018

**Ashiana Javeed**
M.Sc. Scholar, Department of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Meenakshi Gupta**
Associate Professor, Department of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Kartikeya Choudhary**
Ph.D. Scholar, Department of Agronomy, Banaras Hindu University, Varanasi, Uttar Pradesh, India

**Kapilashiv Bazgalia**
Ph.D. Scholar, Department of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

**Correspondence**
**Ashiana Javeed**
M.Sc. Scholar, Department of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu and Kashmir, India

# Effect of graded levels of N, P & K on yield and nutrient uptake of fine rice (*Oryza sativa*) under sub-tropical conditions

**Ashiana Javeed, Meenakshi Gupta, Kartikeya Choudhary and Kapilashiv Bazgalia**

**Abstract**
An experiment was conducted during *kharif* 2015 at Agronomy Research Farm, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (J&K), India to study the effect of graded levels of N, P & K on yield and nutrient uptake of fine rice (*Oryza sativa*) under sub-tropical conditions. Results revealed that, graded levels of P and K, highest grain (4091 kg $ha^{-1}$) and straw yield (7242 kg $ha^{-1}$) was recorded with $P_3K_1$ (35:15 kg $ha^{-1}$ of $P_2O_5$ and $K_2O$) though the difference was non-significant. Whereas, with N application highest grain (4214 kg $ha^{-1}$) and straw yield (7475 kg $ha^{-1}$) was recorded with 60 kg N $ha^{-1}$ which was statistically at par with 50 kg $ha^{-1}$. Graded levels of P and K not influence the nitrogen, phosphorus and potassium uptake but levels of N significantly improve NPK uptake by crop. Highest uptake of total NPK by grains as well as straw was recorded with application of 60 kg N $ha^{-1}$ which was at par with 50 kg N $ha^{-1}$.

**Keywords:** graded levels, transplanting, nutrient concentration, uptake

## Introduction

Rice is the main source of food for more than half the world's population and its cultivation secures a livelihood for more than two billion people. Rice in India has attained great significance in terms of area, production and productivity so as to feed the large masses. In fact, rice cultivation is in crisis the world over and India is no exception, with a shrinking area, fluctuating annual production, stagnating yields and escalating input costs in general and fertilizer in particular. Application of inadequate and unbalanced fertilization to crops not only results in low crop yields but also deteriorate the soil health. The existing fertilizer recommendations for major nutrients in rice are proving to be sub-optimal for attaining higher productivity levels and need a fresh look to revise them to optimum and more balanced levels. Since the fertilizer is an expensive input, determination of its economical and appropriate dose to enhance crop productivity is imperative to fetch the maximum profit for the growers. At present, the world is facing the shortage of major fertilizers especially nitrogenous and phosphatic fertilizers. Proper fertilization of aromatic rice is an important factor in obtaining higher grain yield and better quality. The traditional varieties of scented rice are tall and prone to lodging particularly when a higher dose of nitrogen is applied. Nitrogen fertilization plays a great role in increasing rice production (Kumar *et al.*, 2017) [7]. Nitrogen is one of the most mobile plant nutrients in the soil. As phosphorus is necessary for many of the bio-chemical reactions concerning the metabolism of carbohydrates, proteins, fats, transfer of energy within the organization of cell and transformation of hereditary characteristics. So the requirement of plants for phosphorus & potassium is only next to nitrogen.

Basmati rice cultivation is profitable system in Jammu district of J&K and decreasing nutrient availability for crop production directly affects its productivity. Pusa-1121 is the newly developed short to medium duration cultivar could be helpful in higher crop productivity. Also, there comparative analysis of productivity in Jammu district is still not be done. Keeping these facts in view, the present investigation was undertaken as effect of graded level of N, P and K on yield and nutrient uptake by fine rice.

**Materials and Methods**

An experiment was conducted during *Kharif* 2015, at Agronomy Research farm, Sher-e-kashmir University of Agricultural Sciences and Technology of Jammu (J&K), India (situated at 32º40' N latitude and 74º58' E longitude with an altitude of 332 m above mean sea level). The soil was sandy loam in texture having a *p*H of 8.03, EC 0.22 ($dSm^{-1}$) organic Carbon 0.45%, total N 248.02 kg $ha^{-1}$, available phosphorus 13.26 kg $ha^{-1}$ and available potassium 145.10 kg $ha^{-1}$. The experiment was conducted in split plot design with replicate thrice consisted of three fertility levels of P (25, 30 and 35 kg $P_2O_5$ $ha^{-1}$) and two fertility levels of K (15 and 20 kg $K_2O$ $ha^{-1}$) in main plots and four fertility levels of N (30, 40, 50 and 60 kg N $ha^{-1}$) in sub plots involving Pusa-1121 variety.

The crop was transplanted in the $2^{nd}$ week of July in main field. Full dose of P, K and half dose of N was applied at the time of transplanting and rest half dose in two splits. Rice from each net plot in each replication was harvested and dried. The grains after threshing were weighed and recorded as grain yield per net plot. Further, this net plot grain yield was converted to grain yield per hectare.

**Chemical analysis of plant sample**

The plant samples were taken from each plot at the time of harvesting for estimation of N, P and K concentration. The samples were oven dried, then finely grounded with electric grinder and analyzed for nitrogen, phosphorus and potassium concentration. N, P and K uptake in grain and straw samples were calculated by multiplying per cent nutrient content with their respective dry matter accumulation as per the formula given below:

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x dry matter accumulation (kg ha}^{-1})}{100}$$

Nitrogen content of grain and straw were estimated by modified micro-kjeldhal's method as outlined by Jackson (1967) [5] and expressed in per cent. The phosphorus content of grain and straw were determined by Vanadomolybdo phosphoric acid method and absorbance of the solution was recorded at 430 nm using spectrophotometer (Jackson, 1967) [5] and potassium content in plant sample (grain and straw separately) was determined by flame photometer method (Jackson, 1967) [5].

**Chemical analysis of soil**

Representative soil samples from the experimental plot were drawn from the top 15 cm depth before sowing of the crop. Similarly, the surface soil samples from 0 to 15 cm depth were also collected from each experimental plot at harvest. Soil samples thus collected were air dried under shade, powdered with wooden mallet and passed through 2 mm sieve and analyzed for nitrogen, phosphorus and potassium content. Available nitrogen was determined by alkaline permanganate method as outlined by Subbiah and Asija (1956) [13]. Available phosphorus was determined by Olsen *et al*., 1954 [9] and available potassium was determined by ammonium acetate extractable K method using flame photometer as outlined by Jackson (1973) [6].

**Statistical analysis and interpretation of data**

Data recorded on various parameters of the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984) [4]. The levels of significance used in 'F' and 't' test was $p$= 0.05. Critical difference values were calculated where F test was found significant.

**Results and Discussion**

**Grain and straw yield**

The outcomes of the study showed that different graded levels of N significantly influence the grain and straw yield but among P and K treatment combination though the results were non-significant is presented in Table 1. Data indicated that among P and K treatment combination, highest grain (4091 kg $ha^{-1}$) and straw yield (7242 kg $ha^{-1}$) was recorded with $P_3K_1$ (35:15 kg $ha^{-1}$ of $P_2O_5$ and $K_2O$) followed by $P_3K_2$ (35:20 kg $ha^{-1}$ of $P_2O_5$ and $K_2O$) though the difference was non-significant. Whereas, with N application highest grain (4214 kg $ha^{-1}$) and straw yield (7475 kg $ha^{-1}$) was recorded with 60 kg $ha^{-1}$ of N which was statistically at par with 50 kg $ha^{-1}$ of N but superior to 40 and 30 kg $ha^{-1}$ of N. The increase in yield may be due to increased NPK uptake and utilization by crop resulting in enhanced growth and yield attributes which may be due to increased photosynthetic efficiency of crop leading to greater dry matter production and translocation to sink. Positive correlation was reported among yield and nitrogen levels (Mahajan *et al.,* 2012 and Devi *et al.,* 2012) [8, 3], phosphorus levels (Yuanqiu-He *et al.,* 2007 and Ya-jie *et al.,* 2012) [16, 15], potassium levels (Uddin *et al.,* 2013 and Arif *et al.,* 2010) [14, 1] and NPK levels (Choudhary and Suri, 2014) [2].

**Table 1:** Effect of different fertility levels on grain and straw yield of rice

| Treatments | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) |
|---|---|---|
| **Main plots** | | |
| $P_1K_1$ - 25:15 | 3796 | 5098 |
| $P_1K_2$ - 25:20 | 3897 | 5154 |
| $P_2K_1$ - 30:15 | 4020 | 5278 |
| $P_2K_2$ - 30:20 | 4014 | 5406 |
| $P_3K_1$ - 35:15 | 4091 | 5781 |
| $P_3K_2$ - 35:20 | 4067 | 5414 |
| SEm± | 107 | 293 |
| LSD (p=0.05) | NS | NS |
| **Sub plots** | | |
| $N_1$ - 30 | 3642 | 4756 |
| $N_2$ - 40 | 3925 | 5206 |
| $N_3$ - 50 | 4135 | 5665 |
| $N_4$ - 60 | 4221 | 5794 |
| SEm± | 088 | 153 |
| LSD (p=0.05) | 252 | 438 |

**Nutrient concentration**

The nitrogen, phosphorus and potassium content in grain and straw as influenced by irrigation schedules and varieties (Table 2). Highest N, P and K concentration grain and straw was recorded with application of $P_3K_1$ (35:15 kg $ha^{-1}$ of $P_2O_5$ &$K_2O$) followed by $P_3K_2$ (35:20 kg $ha^{-1}$ of $P_2O_5$ &$K_2O$) with non- significant difference. In terms of N levels, significantly highest N, P and K concentration was observed with application of 60 kg N $ha^{-1}$ which was at par with 50 kg N $ha^{-1}$.

**Table 2:** Effect of different fertility levels on nutrient concentration of rice

| Treatments | Nitrogen (%) | | Phosphorus (%) | | Potash (%) | |
|---|---|---|---|---|---|---|
| | Grain | Straw | Grain | Straw | Grain | Straw |
| **Main plots** | | | | | | |
| $P_1K_1$ - 25:15 | 0.88 | 0.49 | 0.17 | 0.14 | 0.44 | 0.81 |
| $P_1K_2$ - 25:20 | 0.89 | 0.50 | 0.20 | 0.13 | 0.44 | 0.84 |
| $P_2K_1$ - 30:15 | 0.87 | 0.51 | 0.21 | 0.13 | 0.44 | 0.84 |
| $P_2K_2$ - 30:20 | 0.89 | 0.51 | 0.20 | 0.16 | 0.45 | 0.87 |
| $P_3K_1$ - 35:15 | 0.90 | 0.54 | 0.22 | 0.16 | 0.48 | 0.88 |
| $P_3K_2$ - 35:20 | 0.90 | 0.52 | 0.19 | 0.14 | 0.47 | 0.87 |
| SEm± | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| LSD (p=0.05) | NS | NS | NS | NS | NS | NS |
| **Sub plots** | | | | | | |
| $N_1$ - 30 | 0.86 | 0.48 | 0.18 | 0.13 | 0.42 | 0.82 |
| $N_2$ - 40 | 0.88 | 0.50 | 0.20 | 0.14 | 0.45 | 0.85 |
| $N_3$ - 50 | 0.90 | 0.53 | 0.20 | 0.15 | 0.47 | 0.86 |
| $N_4$ - 60 | 0.91 | 0.54 | 0.21 | 0.16 | 0.48 | 0.88 |
| SEm± | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| LSD (p=0.05) | 0.03 | 0.04 | 0.02 | 0.02 | 0.04 | 0.04 |

## Nutrient uptake

Graded levels of P and K not influence the nitrogen, phosphorus and potassium uptake (Table 3) by rice but highest NP and K uptake (68.0, 18.2 and 70.6 kg $ha^{-1}$, respectively) recorded with application of $P_3K_1$ (35:15 kg $ha^{-1}$ of $P_2O_5$ &$K_2O$) followed by $P_3K_2$ (35:20 kg $ha^{-1}$ of $P_2O_5$ &$K_2O$) with non- significant difference. However, NPK content of grain and straw showed that increasing levels of N significantly improve NPK uptake by crop. Highest uptake of total nitrogen, phosphorous and potash by grains as well as straw was recorded with application of 60 kg N $ha^{-1}$ which was at par with 50 kg N $ha^{-1}$. This may be due to the higher concentration of N, P and K in both grain & straw and dry matter accumulation that led to higher N, P and K uptake at higher level of fertilizers application. Improvement in N, P and K uptake by crop was reported with increased N levels (Sandhu and Mahal, 2014 and Devi *et al.*, 2012) [10, 3], P levels (Sanusan *et al.*, 2009) [12], K levels (Arif *et al.*, 2010) [1] and NPK levels (Sandhyakanthi *et al.*, 2014) [11].

**Table 3:** Effect of different fertility levels on N, P and K uptake of rice

| Treatments | Nitrogen (kg $ha^{-1}$) | | | Phosphorus (kg $ha^{-1}$) | | | Potassium (kg $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain | Straw | Total | Grain | Straw | Total | Grain | Straw | Total |
| **Main plots** | | | | | | | | | |
| $P_1K_1$ - 25:15 | 33.34 | 25.12 | 58.46 | 6.52 | 7.30 | 13.82 | 16.80 | 41.18 | 57.98 |
| $P_1K_2$ - 25:20 | 34.56 | 25.66 | 60.22 | 7.71 | 6.83 | 14.54 | 17.15 | 43.41 | 60.56 |
| $P_2K_1$ - 30:15 | 34.85 | 26.93 | 61.77 | 8.38 | 7.10 | 15.48 | 17.89 | 44.58 | 62.48 |
| $P_2K_2$ - 30:20 | 35.86 | 27.62 | 63.48 | 8.15 | 8.39 | 16.54 | 18.05 | 47.34 | 65.39 |
| $P_3K_1$ - 35:15 | 36.95 | 31.12 | 68.07 | 8.90 | 9.30 | 18.21 | 19.69 | 50.93 | 70.61 |
| $P_3K_2$ - 35:20 | 36.44 | 28.29 | 64.73 | 7.78 | 7.58 | 15.36 | 19.30 | 47.14 | 66.44 |
| SEm± | 0.87 | 1.59 | 1.97 | 0.51 | 0.60 | 0.88 | 0.67 | 3.13 | 3.37 |
| LSD (p=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Sub plots** | | | | | | | | | |
| $N_1$ - 30 | 31.27 | 22.81 | 54.08 | 6.49 | 6.25 | 12.74 | 15.53 | 39.03 | 54.56 |
| $N_2$ - 40 | 34.73 | 26.11 | 60.84 | 7.65 | 7.15 | 14.80 | 17.50 | 44.21 | 61.71 |
| $N_3$ - 50 | 37.11 | 29.83 | 66.93 | 8.46 | 8.53 | 16.99 | 19.23 | 48.98 | 68.21 |
| $N_4$ - 60 | 38.22 | 31.08 | 69.30 | 9.03 | 9.07 | 18.11 | 20.33 | 50.84 | 71.17 |
| SEm± | 0.92 | 1.10 | 1.73 | 0.34 | 0.43 | 0.58 | 0.72 | 1.50 | 1.81 |
| LSD (p=0.05) | 2.64 | 3.16 | 4.97 | 0.96 | 1.23 | 1.68 | 2.06 | 4.31 | 5.18 |

## Available nutrients in soil after harvest of crop

In soil, after harvest of crop, the available nutrients *viz.*, nitrogen, phosphorus and potassium were significantly not influenced by different graded levels of N, P and K (Table 4). Results revealed that, $P_3K_2$ (35:20 kg $ha^{-1}$ of $P_2O_5$ & $K_2O$) recorded higher available nitrogen, phosphorus and potassium in soil after harvest of crop (244.0, 17.0 and 141.9 kg $ha^{-1}$, respectively) followed by $P_3K_1$ (35:15 kg$ha^{-1}$ of $P_2O_5$ & $K_2O$). In the different graded levels of N recorded significantly higher available nitrogen, phosphorus and potassium in soil after harvest of crop (244.2, 16.2 and 142.7 kg $ha^{-1}$, respectively) followed by 50 kg $ha^{-1}$. This might be due to the fact that increased application of fertilizers leave some residual nutrient in soil besides nutrient uptake be crop. Similar results were also observed by Choudhary and Suri (2014) [2] and Yuanqiu He *et al.* (2007) [16]. Further, it was also observed that increased root growth with increased application of fertilizers added nutrients in soil after decaying (Devi *et al.*, 2012) [3].

**Table 4:** Effect of different fertility levels on available nutrients in soil after harvest of rice

| Treatments | Available nutrients (kg $ha^{-1}$) | | |
|---|---|---|---|
| | Nitrogen | Phosphorus | Potassium |
| **Main plots** | | | |
| $P_1K_1$ - 25:15 | 231.77 | 11.83 | 127.92 |
| $P_1K_2$ - 25:20 | 232.44 | 12.06 | 132.61 |
| $P_2K_1$ - 30:15 | 238.77 | 14.25 | 135.42 |
| $P_2K_2$ - 30:20 | 238.51 | 14.71 | 139.33 |
| $P_3K_1$ - 35:15 | 243.07 | 16.72 | 139.66 |
| $P_3K_2$ - 35:20 | 244.04 | 17.07 | 141.91 |
| SEm± | 4.73 | 1.33 | 3.65 |
| LSD (p=0.05) | NS | NS | NS |
| **Sub plots** | | | |
| $N_1$ - 30 | 230.01 | 11.46 | 127.89 |
| $N_2$ - 40 | 234.96 | 12.79 | 131.51 |
| $N_3$ - 50 | 242.13 | 15.31 | 142.37 |
| $N_4$ - 60 | 244.28 | 16.20 | 142.79 |
| SEm± | 2.30 | 0.77 | 3.15 |
| LSD (p=0.05) | 6.60 | 2.21 | 9.02 |

## Conclusion

From data presented it might reasonably be argued that the highest yield and nutrient uptake of rice was recorded with treatment $P_3K_1$ (35:15 kg ha$^{-1}$ of $P_2O_5$ and $K_2O$) with non-significant difference. Among the graded levels of N higher values were recorded with the application of 60 kg N ha$^{-1}$ which was at par with 50 kg N ha$^{-1}$.

## References

1. Arif M, Arshad M, Asghar NH, Shahzad MAB. Response of rice (*Oryza sativa*) genotypes varying in K use efficiency to various levels of Potassium. International Journal of Agriculture & Biology. 2010; 12(6):926-930.
2. Choudhary AK, Suri VK. Integrated nutrient management technology for direct seeded upland rice (*Oryza sativa* L.) in Northwestern Himalayas. Communication in Soil Science and Plant Analysis. 2014; 45:777-784.
3. Devi Ganga M, Reddy TS, Sumati V, Pratima T, John K. Nitrogen management to improve the nutrient uptake, yield and quality parameters of scented rice under aerobic culture. International Journal of Applied Biology and Pharmaceutical Technology. 2012; 3(1).
4. Gomez AK, Gomez AA. Statistical Procedures for Agriculture Res. Awiley-Inter Sci. Publication. Johan Wiley and Sons, New York, 1984, 680p.
5. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1967, 38-226.
6. Jackson ML. Soil chemical analysis. Asia publication house, Bombay, 1973, 165-167.
7. Kumar S, Kaur S, Gupta M, Kachroo D, Singh H. Influence of rice varieties and fertility levels on performance of rice and soil nutrient status under aerobic conditions. Journal of Applied and Natural Sciences. 2017; 9(2):1164-1169.
8. Mahajan G, Timsina J, Jhanji S, Sekhon NK, Singh K. Cultivar response, dry matter portioning and nitrogen use efficiency in direct seeded rice in northwest India. Journal of Crop Improvement. 2012; 26:767-790.
9. Olsen SR, Cole CV, Watanable FS, Dean LA. Estimation of available phosphorus in soils by extracting with sodium bicarbonate. United State Department of Agriculture Circulation, 1954, 939p.
10. Sandhu SS, Mahal SS. Performance of rice under different planting methods, nitrogen levels and irrigation schedules. Indian Journal of Agronomy. 2014; 59(3):392-397.
11. Sandhyakanthi M, Raman AV, Ramanmurthy KV. Effect of different crop establishment techniques and nutrient doses on nutrient uptake and yield of rice. Karnataka J Agric. Sci. 2014; 27(3):293-295.
12. Sanusan S, Polthanee A, Seripong S, Audebert A, Mouret J. Rates and timing of phosphorus fertilizer on growth and yield of direct seeded rice in rainfed conditions. Acta Agriculturae Scandinavica Section B- Soil and Plant Science. 2009; 59:491-499.
13. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil. Current Science. 1956; 25:259-260.
14. Uddin S, Sarkar MAR, Rahman MM. Effect of nitrogen and potassium on yield of dry direct seeded rice cv. NERICA 1 in aus season. International Journal of Agronomy and Plant Production. 2013; 40(1):69-75.
15. Ya-jie Z, Jing-jing H, Ya-chao L, Ying-ying C, Jian-chang Y. Effect of phosphorus on grain quality of upland and paddy rice under different cultivation. Rice Science. 2012; 19(2):135-142.
16. Yuanqiu He, Shen Q, Kong H, Xiong Y, Wang X. Effect of soil moisture content and phosphorus application on phosphorus nutrition of rice cultivated in different water regime systems. Journal of Plant Nutrition. 2007; 27(12):2259-2272.