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Arun Pratap Singh
Krishi Vigyan Kendra, Sargatia, Kushinagar, Uttar Pradesh, India

VP Singh
Dr. Rajendra Prasad Central Agriculture University, Pusa, Bihar, India

Corresponding Author:
Arun Pratap Singh
Krishi Vigyan Kendra, Sargatia, Kushinagar, Uttar Pradesh, India

Response of low land rice to different levels of NPK

Arun Pratap Singh and VP Singh

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Abstract
Fertilizer affects the plant growth and development and is necessary for obtaining maximum crop productivity. However, attainment of maximum nutrient use efficiency is dependent on application of major crop nutrient at proper dose further which varies with variation in genotype. A field experiment was carried out at Rajendra agricultural university farm, Bihar, Pusa to assess influence of various NPK levels (40:20:10, 80:40:20 and 120:60:40 $kgha^{-1}$) on growth, development and yield of four low land Rice varieties (RAU 720-45-42, RAU 83-500, RAU716-420-31 and Radha). The results revealed that the growth, development and yield attributing characters increased significantly with increase in levels of NPK. Best result observed for NPK level 120:60:40 kg/ha which was found significantly superior. So for good growth and yield the use of appropriate doses of fertilizer will significantly improve the field of low land rice.

Keywords: Rice, low land, fertilizer, development

Introduction

Rice (*Oryza sativa* L.) is an important cereal in the world and can be grown different condition as low land, irrigated and upland. In India rice commands the largest area but the yield level is very low in comparison to other rice growing countries. The productivity of rice in India is about 19.2q/ha. The productivity of rice in Bihar is still lower (14.75 q/ha) in comparison to the national average yield of the crop. The low yield of rice in Bihar is mainly due to poor water and fertilizer management under the low land situation, water with varying depth, sometimes stagnates for about 3-4 months continuously. The rice crop suffers due to moisture stress in the event of failure of rain. It becomes difficult to fertilize the crop at the appropriate time due to either excess water level in the field or drought after failure of rain. Amongst the various agricultural production fertilizers have already become an integral part of agricultural production strategies. According to one estimate, about 50% increase in crop productivity in recent years can be contributed to the fertilizer use. Among all essential factors for growth and development of rice plant, the imbalanced use of fertilizer is one of the most key factors [17]. Amongst all essential plant nutrients, N, P and K play the major role in the growth and development of plants.

Nitrogen is one of the most important elements required for the growth and development of rice plant. It is the main constituent of chlorophyll, so it is actively involved in photosynthesis process. It is also the main constituent of enzymes, proteins and vitamins, so it assist production of carbohydrates and also required for the energy reaction taken place within the plants [18]. So it is most important to know the optimum level of nitrogen fertilizer and to determine the potential variety having higher nitrogen use efficiency to produce the better production of rice [7].

Phosphorus play a vital role in the root proliferation and uniform grain filling. It is the main constituent of ADP and ATP energy rich bond. It plays a major role in cell division, photosynthesis, respiration, tissue growth and development so it is vital macronutrient for sustaining the plant life cycle [2].

Higher dose of potassium is required in rice crop. It is involved in maintenance, cellular processes, translocation, development, and transpiration and respiration process of the rice plant. It also prevent the crop by adverse conditions and improves the grain quality also.

The selection of varieties is of prime importance as its genetic character limits the expression of yield. Rice strains differ in their potentials to respond to high fertility conditions. Further, the NPK requirement of the crop is known to differ according to duration of the variety.

Since the response of nutrient may vary from variety to variety owing to above mentioned reason, it become essential to investigate the differential response of newly pre-released varieties to nutrient levels so that, suitable varieties could be identify and its optimum dose of NPK can be worked out.

Material and Method

This trial was undertaken at brick field 2 B of Rajendra Agriculture university, Pusa, Bihar to evaluate the response of different levels of NPK fertilizer viz. 40:20:10, 80:40:20 and 120:60:30 kg ha^{-1} on four low land rice varieties viz. RAU 720-45-42, RAU 83-500, RAU 716-422-31 and Radha. The experiment was laid out in split plot design with three levels of NPK in main plot and four rice varieties in subplot with three replications.

Clean seeds of all the varieties with germination percentage about 90% were sown in the well prepared nursery bed and covered with thin layer of soil. Sowing of nursery was done by wet bed method in the last week of the June and transplanting was carried out 21 days after sowing of nursery in last week of July. The seedling was transplanted with spacing 20cm x 15cm. The experimental plot size was 8.32 sq. m. Standard agronomic practices were followed for crop cultivation. At the time of paddling one fourth nitrogen of whole amount and total amount of P_20_5 as well as K_2O was applied as basal in all the plots. The remaining N was applied in to splits i. e. one fourth at 20 DAT and rest one fourth at 40 DAT. after transplanting three irrigation were given in later part of crop growth due to lack of rainfall in the month of September and October. Two hand weeding were done and proper plant protection measures were followed to keep the insect pest below economic threshold level. The crop was harvested 108 days after nursery transplanting.

Growth studies measurement

For the plant height five hills were randomly selected. The observations were recorded at regular interval of 30 days starting from 30 days after transplanting (DAT). The average height of these plants was computed and the mean values were recorded.

The number of tiller were recorded on the hills selected for the plant height of the interval of 30 days starting from 30 DAT. Final tiller which represented the number of effective tillers per sq. meter were recorded before harvesting.

For dry matter four hills from each second row were selected randomly and culms were dried in an over 60 ^{0}C till constant weight was attend. Finally the dry matter yield was converted into g/m^2. Observations were recorded at 30, 60 and 90 DAT and at harvest. The leaf area was computed for those plants from which dry matter studies were made. Ten leaves from all the out plant for studies were separated from the sheath. Fifteen leaves were selected randomly from the bulk and the print of those leaves was taken on a plain paper. The area of those leaves was measured by planimeter. The area of total leaves of studied plant were calculated. Then leaf area index was calculated by dividing the leaf area with the leaf area occupied.

Yield studies

Ten panicles were randomly selected from the marked hills and the length was measured in cm and finally the average length of panicle was recorded. The total number of spikelet of ten panicles selected from marked hills was counted and then average number of spikelet per panicle was marked out. The number of ripened grains in the above mentioned ten panicles was calculated by subtracting the number of unfertile spikelet from total number of spikelets. The fertility percentage of spikelet was calculated as per following formula:

$$\text{Fertility percentage} = \frac{\text{No.of fertile spikelet}}{\text{Total no.of spikelet}} \text{ X } 100$$

Grain samples were drawn from the yield of rice selected hills and dried under the sun. The weight of 1000 grains was recorded in gram to obtain test weight. Grain yield was recorded after threshing. Winnowing and cleaning the produce was adjusted at 14 per cent moisture. The grain yield was obtained from the net plot was finally converted into quintal per hectare. The straw from each plot was air dried and weighed. The straw yield this converted into q/ha.

Result

Plant height at 30, 60, 90 DAT and harvest was found maximum with NPK level 120:60:30 kg/ha and was found significantly higher that NPK level 40:20:10 kg. The plant height due to 80:40:20 kg/ha and 40:20:10 kg/ha NPK level also differed significantly among themselves. The effect of NPK level on number of tillers was significant at all the stage of growth. NPK level 120:60:30 kg/ha produced maximum number of tillers differed significantly from rest two NPK level. The leaf area index increased correspondingly with increase of NPK level of rice plant at all stages of growth. The effect of NPK level on dry matter of shoot was significant at all the stages of growth. The maximum dry matter (1156.70 g m^2) was recorded under 120:60:30 kg/ha level of NPK.

Effective number of tillers/m^2 was influenced significantly up to NPK level 120:60:30 kg/ha. Maximum effective number of tillers/m^2 (251) was recorded under NPK level 120:60:30 kg/ha. Panicle length was increased significantly with NPK increase in the level of NPK Maximum panicle length (23.42 cm) was recorded with NPK level 120:60:30 kg/ha. With an increase in nutrient level there was a corresponding increase in the total number of spikelets/panicle. NPK level 120:60:30 kg/ha recorded maximum number of spikelets per panicle (92.50) which was significantly superior to rest of the NPK level. Fertile spikelets/panicle was increased correspondingly with increase in the NPK level. Maximum 83 was recorded under NPK level 120:60:30 kg ha^{-1}. With an increase in NPK level there was a corresponding increase the test weight. Maximum test weight (24.5g) was recorded. Effective numbers of tillers/m^2 was influenced significantly up to NPK level 120:60:30 kg/ha. Maximum effective numbers of tiller/m^2 (251) was recorded under NPK level 120:60:30 kg/ha. Panicle length was increased significantly with increase in the level of NPK. Maximum panicle length (23.42 cm) was recorded with NPK level 120:60:30 kg/ha.

Table 1: Plant height, Number of tillers/m^2, Leaf area index and Dry matter of shoot (g/m^2) at different stages of growth as affected by different treatments.

NPK level (kg/ha)	Plant height (cm)				No. of Tillers/m^2				Leaf Area				Dry matters of shoot			
	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest
40:20:10	53.97	71.06	89.46	90.21	231.75	263.00	221.25	216.75	1.50	2.24	2.98	2.52	101.11	387.52	661.57	869.40
80:40:20	61.03	76.80	96.69	97.22	267.25	310.25	260.00	254.75	1.81	2.86	3.54	2.95	139.11	469.41	683.25	1026.10
120:60:30	63.34	81.26	100.82	101.16	291.50	347.25	290.50	286.50	1.83	2.95	3.64	3.34	153.58	525.48	807.76	1156.70
S. Em±	1.19	1.32	1.4	1.03	2.302	2.69	2.09	2.25	0.036	0.024	0.04	0.03	0.86	1.82	2.08	2.01
CD (P= 0.05)	4.68	4.14	5.5	4.06	9.039	10.5	8.23	8.85	0.14	0.09	0.17	0.12	3.36	7.13	8.15	7.89

Table 2: Yield attributing character as influenced by different treatments.

NPK level (kg/ha)	Effective number of tillers/m^2	Panicle length(cm)	Total spikelets per panicle	Fertile spikelet/panicle	Test weight(gm)	Grain yield(q/ha)	Straw yield (q/ha)
40:20:10	197.25	21.13	70.00	63.00	22.43	22.19	64.56
80:40:20	228.25	22.89	84.50	76.75	23.64	33.15	69.31
120:60:30	251.00	23.42	92.50	83.00	24.50	40.16	75.07
S. Em±	2.1	0.33	1.67	0.82	0.21	0.317	0.896
CD (P= 0.05)	8.23	1.30	4.59	3.23	0.81	1.243	3.521

With an increase in nutrient level there was a corresponding increase in the total number of spikelet panicle. NPK level 120:60:30 kg/ha recorded maximum numbers of spikelets per panicle (92.50) which was significantly superior to rest of the NPK levels. Fertile spikelet/panicle was increased correspondingly with increase in the NPK level. Maximum (83) was recorded under NPK level 120:60:30 kg/ha. With an increase in NPK level there was a corresponding increase in the test weight. Maximum test weight (24.5g) was recorded under NPK level 120:60:30 kg/ha which was found significant over rest of two NPK level. Grain yield was recorded correspondingly with increase in NPK level. Maximum grain yield (40.16 q/ha) was recorded with NPK level 120:60:30 kg/ha which was found significant over rest of two NPK level. There was a corresponding increase in the straw yield of rice with rise in the NPK level. The maximum straw yield (75.07 q/ha) was recorded under NPK level 120:60:30 kg/ha.

Discussion

Growth conditions modify the yield contributory character and finally the grain yield. In the present study, the plant growth was studied with respect to height (cm) number of tillers/m^2, Leaf area index, and dry matter of shoot (g/m^2) at different intervals (table-1). At all the stages growth plant height was increased with increasing level of NPK fertilizers. Study indicates that standardization for the determination of an optimum level of NPK is necessary for better growth and development of plant [8]. With Increasing level of NPK there was corresponding increase in plant height. It might be due to higher uptake of nutrients by increasing levels of NPK [11, 22]. In the present study it was observed that number of tillers increased with increasing NPK level in all the stage. This might be due to higher production of meristems with increasing levels of NPK. Similar results were reported by various researchers [13, 14, 20, 21]. Khalil *et al* (2003) [6] perceived that application of NPK at various levels significantly affected the plant height and tillers per hill [6].

Shoot dry matter is also increased with increasing level of NPK, this is due to increasing level of NPK may be attributed to the direct as indirect effect of nitrogen uptake and efficiency of chlorophyll, resulting in an increase in plant height umber of tillers and number of panicles which contribute to dry matter yield [9, 22]. LAI increased up to 90 DAT i.e., up to flowering stage irrespective of treatments of thereafter a declining trend was observed. This may be due to shrinking and drying of tissues. L.A.I at flowering is closely related to grain production because it affects the amount of photosynthesis. [3]It has been reported that LAI at ear emergence and dough stage were related to yield [5, 15]. In the Present investigation panicle length increase in the significantly due to increase in the level of NPK. The increase in the length of panicle at the higher level of NPK might be due to better nutrition of panicle premordia [12, 16, 21]. Increase in number of fertile spikelets/panicle with increased level of NPK may be better nutrition of panicle premosdia which resulted in higher of filled spikelets [4, 19]. Test weight increased significantly with increasing level of NPK. It may be due to better nutrition of spikelets [9, 15]. Grain yield increased significantly with increasing level of NPK. Higher yield with increasing level of NPK might be due to better uptake of NPK leading to better dry matter production [1, 18, 23]. Significant increase in grain yield up to NPK level 120:60:30 kg/ha was also being reported by large number of workers [19, 14, 24]. Straw yield increased significantly with increasing level of NPK. This increase was perhaps due to increased production of growth and some of yield attributer [10, 11].

Conclusion

Under the north Bihar condition with respect to available NPK fertilizes, it could be applied @ 120:60:30 kg/ha in long duration rice varieties under HYV group. The lower of NPK application resulted either leaching or partly converted into non exchangeable from. Therefore lower level of NPK are not economically sound.

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