RESEARCH ARTICLE

INFLUENCE OF SPACING AND NUTRIENT LEVEL ON NUTRIENT UPTAKE AND ENERGETIC OF HIGH ZINC LINE OF RICE (*ORYZA SATIVA* L.)

Mahesh Kumar*, H.L. Sonboir and Bhujendra Kumar

Department of Agronomy, College of Agriculture, IGKV, Raipur-492006 Chhattisgarh ,India
Email: maheshkumarmargiya12@gmail.com

Received-14.01.2017, Revised-02.02.2017

Abstract: An field experiment was carried out to at Research cum Instructional farm, I.G.K.V., Raipur, during *kharif* season of 2013. The experiment comprised three spacing *viz.,*10cm x 10cm, 15cm x 10cm and 20cm x 10cm and three levels of nutrient *viz.,* 50%, 100% and 150% RDF. The experiment was laid out in factorial randomized block design with four replications to evaluate the effect of planting geometry and nutrient levels on nutrient uptake and energetic of high zinc line of rice. Result indicated that the highest nitrogen, phosphorus and potassium uptake, energy input, energy output, net energy output and energy output: input ratio was obtained under 20cm x 10cm spacing. As regards different nutrient levels, application of 150 per cent RDF recorded higher values of nitrogen, phosphorus and potassium uptake, total energy output and net energy output. Whereas, the highest energy input and energy output: input ratio was observed under 50 per cent RDF.

Keywords : Spacing , Nutrient levels, Nutrient uptake, Energetic high zinc rice

INTRODUCTION

Rice has supported a greater number of people for a longer period of time and provides more calories per hectare than any other crop. At present, rice is one of the most important staple foods for more than half of the world's population (IRRI, 2006) and influences the livelihoods and economies of several billion people. In Asian countries, rice provides 50–80 per cent of the energy intake of the poor but it does not provide enough essential micronutrients to eliminate "hidden hunger," in particular iron deficiency anaemia and zinc deficiency. Micronutrient malnutrition, and particularly Fe and Zn deficiency affect over three billion people worldwide, mostly in developing countries (Sperotto *et al.,* 2010, Welch *et al.,* 2010). In India, almost 31per cent of calories of diet are supplied through rice.

Nutrient uptake influences due to different planting geometry and nutrient levels. Wider spaced crop absorb more nutrient and produce higher dry matter. Dense spaced plant decrease the nutrient uptake because of the more competition between plants for available nutrient. Availability of nutrients in soil and its translocation to the plant is very important to obtain maximum yield. The higher dose of nutrient supply to the plant enhance its uptake and translocation during development phase of growth stage which facilitate more photosynthesis process and resulted in higher dry matter accumulation.

Nutrient deficiency in soil is the key factor for poor productivity of rice. Rice yield largely depend upon the soil conditions and also on the supply of available nutrients like nitrogen phosphorus and potassium. Optimum level of nutrient ensures proper plant growth and grain formation as a result of higher yield (Wang, 2005). Nutrient uptake increases with increasing level of nutrient and spacing up to certain extent and thereafter there is no further increase. Balanced use of nutrients in adequate quantities are necessary to increase yield and to sustain soil health and productivity level.

MATERIAL AND METHOD

The present field experiment was conducted during kharif season of 2013. at Research cum Instructional farm, I.G.K.V., Raipur, and lies at 21^0 4' North latitude and 81^0 35' East longitude with an altitude of 290.2 meters above the mean sea level. The climate of this region is sub-humid with an average annual rain fall of about 1200-1400 mm of which 80 per cent is received from July to September, mainly from South-West monsoon. The crop received 1413.6 mm of the total rainfall during its crop growth. The weekly average maximum and minimum temperature varied in between 27.9^0C to 33^0C and 16.6^0C to 25.3^0C, respectively. The experimental soil was *Vertisols*, neutral in reaction, low in available nitrogen and medium in available phosphorus and potassium content. The experiment was laid out in factorial randomized block design with four replications. The treatments consisted of three spacing viz., S1(10cm x 10cm), S2(15cm x 10cm) and S3(20cm x 10cm) and three levels of nutrient viz., F1(50%RDF), F2(100%RDF) and F3(150%RDF). Recommended level of nutrient was 80:50:30 kg NPK/ha. The nursery was raised in wet nursery beds, as per recommended package of practices. Twenty three days old seedling were transplanted in to the main field at the rate of two to three seedling per hill at the spacing of 10cm x 10cm, 15cm x 10cm and 20cm x 10cm spacing, respectively

*Corresponding Author

as per treatment. The test variety was R-RHZ-1 which was short duration. Crop was transplanted on 27.07.2013 and harvested on 20.10.2013. Fertilizer application in the field was done as per treatment *i.e.*the entire amount of Phosphorus and Potash and half dose of Nitrogen were applied as basal and remaining half dose of Nitrogen was applied in two equal splits viz. 25 per cent at active tillering and 25 per cent at panicle initiation stage. The Nitrogen, Phosphorus and Potash were applied in the form of urea, single super phosphate and muriate of potash, respectively. Intercultural operations and plant protection measures were adopted as per the recommended package of practices whenever needed right from nursery sowing up to the harvest of the crop. The crop was irrigated as and when necessary to keep a water level of about 3- 5 cm from transplanting to grain filling. Frequent irrigation was given to keep the field wet. The crop was harvested and threshed manually in each plot and observations were recorded from individual plots. Nitrogen, phosphorus and potassium uptake, energy input, energy output, net energy output and energy output : input ratio were calculated and analyzed statistically. The significance of treatment effects was judged with the help of 'F' (Variance ratio) test and critical difference (CD) was worked out at 5 per cent level of significance.

RESULTS AND DISCUSSION

Nutrient uptake

Nutrient uptake increased with increasing the spacing and nutrient levels. The nitrogen uptake by grain was significantly affected by nutrient levels while it was not influenced due to spacing. Among the three spacing, the highest uptake of nitrogen by straw and total was noticed with the spacing of 20cm x 10cm which was found to be statistically at par with 15cm x 10cm spacing .The highest phosphorus, potassium and zinc uptake by grain, straw and total was also observed with the spacing of 20cm x 10cm. while, the lowest uptake was recorded with the spacing of 10cm x 10cm. The higher uptake of nutrients in widely spaced crop is ascribed to higher root growth and greater volume of soil available to individual hill to absorb water and nutrients under wider spacing. Higher nutrient uptakes under wider spacing have also been reported by Jacob and Syriac (2005) and Throat *et al.* (2007). Regarding nutrient levels, the highest nitrogen, phosphorus, potassium and zinc uptake was observed with the application of 150 per cent RDF. The application of higher nutrient application leads to increased availability of nutrient in soil and which enhances absorption in plants. The lowest uptake was recorded with application of 50per cent RDF. This result supports the finding of Pandey *et al.* (2009) and Yaduvanshi *et al.* (2010).

Energetics

Energy input, energy output, net energy output, energy output : input ratio and energy production was significantly affected by spacing and nutrient levels However, the interaction effect between spacing and fertility level was found non-significant. The maximum energy input, energy output, net energy output, energy output : input ratio and energy production was obtained under 20cm x 10cm spacing while the highest energy output : input ratio obtained under 15cm x 10cm spacing. Among nutrient levels, the highest total energy output and net energy output, were obtained with the application of 150 per cent RDF while the highest energy input were obtained under 50 per cent RDF. Output : input ratio and energy production were obtained highest with the application of 50 per cent RDF. The lowest total energy output and net energy output was recorded with application of 50 per cent RDF.

Table 1. Nitrogen uptake (kg/ha) by high zinc rice as influenced by spacing and nutrient levels

Treatment	Nitrogen uptake (kg/ha)		
	Grain	**Straw**	**Total**
Spacing			
S_1 (10cm x 10cm)	48.5	24.5	73.1
S2 (15cm x 10cm)	50.2	26.6	76.8
S3 (20cm x 10cm)	52.1	27.5	79.7
SEm±	**1.3**	**0.4**	**1.4**

CD (P=0.05)			
	NS	**1.3**	**4.1**
Nutrient levels			
N1 (50% RDF)	38.0	20.4	58.4
N2 (100% RDF)	48.0	25.9	74.0
N3 (150% RDF)	64.8	32.2	97.1
SEm±	**1.3**	**0.4**	**1.4**
CD (P=0.05)	**3.8**	**1.3**	**4.1**

Table 2. Phosphorus uptake kg/ha of high zinc rice as influenced by spacing and nutrient levels.

Treatment	**Phosphorus uptake (kg/ha)**		
	Grain	**Straw**	**Total**
Spacing			
S_1 (10cm x 10cm)	11.2	3.9	15.1
S_2 (15cm x 10cm)	11.7	4.1	15.8
S_3 (20cm x 10cm)	12.3	4.2	16.6
SEm±	**0.3**	**0.05**	**0.2**
CD (P=0.05)	**0.8**	**0.15**	**0.7**
Nutrient levels			
N_1 (50% RDF)	7.81	2.8	10.7
N_2 (100% RDF)	11.53	4.2	15.7
N_3 (150% RDF)	15.89	5.2	21.0
SEm±	**0.26**	**0.05**	**0.2**
CD (P=0.05)	**0.76**	**0.15**	**0.7**

Table 3. Potassium uptake kg/ha of high zinc rice as influenced by spacing and nutrient levels.

Treatment	**Potassium uptake (kg/ha)**		
	Grain	**Straw**	**Total**
Spacing			
S_1 (10cm x 10cm)	27.6	161.6	189.2
S_2 (15cm x 10cm)	29.4	170.5	199.9
S_3 (20cm x 10cm)	30.3	176.2	206.5
SEm±	**0.7**	**1.5**	**1.5**
CD (P=0.05)	**2.1**	**4.4**	**4.5**
Nutrient levels			

N_1 (50% RDF)	24.1	146.4	170.6
N_2 (100% RDF)	28.3	163.0	191.3
N_3 (150% RDF)	34.9	198.9	233.8
SEm±	**0.7**	**1.50**	**1.5**
CD (P=0.05)	**2.1**	**4.4**	**4.5**

Table 4. Zinc uptake kg/ha of high zinc rice as influenced by spacing and nutrient levels.

Treatment	**Zinc uptake (kg/ha)**		
	Grain	**Straw**	**Total**
Spacing			
S_1 (10cm x 10cm)	0.091	0.40	0.49
S_2 (15cm x 10cm)	0.096	0.41	0.50
S_3 (20cm x 10cm)	0.098	0.41	0.51
SEm±	**0.003**	**0.01**	**0.01**
CD (P=0.05)	**NS**	**NS**	**NS**
Nutrient levels			
N_1 (50% RDF)	0.091	0.36	0.45
N_2 (100% RDF)	0.095	0.41	0.50
N_3 (150% RDF)	0.100	0.45	0.55
SEm±	**0.003**	**0.01**	**0.01**
CD (P=0.05)	**NS**	**0.03**	**0.03**

Table 5. Energy calculation of high zinc rice as influenced by spacing and nutrient level.

Treatment	**Energy input (MJ x 10^3/ha)**	**Total energy output (MJ x 10^3/ha)**	**Net energy output (MJ x 10^3/ha)**	**Energy output: input ratio**
Spacing				
S_1(10cm x 10cm)	7.20	132.32	121.84	13.11
S_2 (15cm x 10cm)	9.96	134.85	125.14	14.51
S_3 (20cm x 10cm)	12.71	136.90	127.47	15.24
SEm±	-	**1.07**	**1.07**	**0.11**
CD (P=0.05)	-	**3.14**	**3.14**	**0.33**
Nutrient level				
N_1 (50% RDF)	10.55	126.20	119.08	17.82
N_2 (100% RDF)	9.74	134.87	124.99	13.69
N_3 (150% RDF)	9.58	143.01	130.38	11.34
SEm±	-	**1.07**	**1.07**	**0.11**
CD (P=0.05)	-	**3.14**	**3.14**	**0.33**

REFERENCES

IRRI (International Rice Research Institute). (2006). Bringing hope, improving lives: Strategic Plan 2007–2015, Los Banos, Philippines. p. 61.

Jacob, D. and Syriac, E. K. (2005). Performance of transplanted scented rice (Oryza sativa L.) under different spacing and water management regimes in southern Kerala. *Indian Journal of Agronomy*. 51(2):56-58

Pandey, A.K. Kumar V. and Kumar, R. (2009). Effect of long-term organic and inorganic nutrients on transplanted rice under rice-wheat cropping system. *Oryza*. 46(3) : 209- 212.

Sperotto, R.A., T. Boffa, G.L. Duartea, L.S. Santosb, M.A. Grusakc and J.P. Fett (2010). Identification of putative target genes to manipulate Fe and Zn concentrations in rice grains. *Jouurnal of Plant Physiology* 167:1500–1506.

Thorat, S.T., Sonawane, S.V., Chavan, S.A. and Bore, S.C. (2007). Effect of plant density and weed control measures on the nitrogen uptake and yield of rice planted by SRI technique. In: Proc. SRI India 2007 Syrn. Tripura, pp. 70-7 1. Tropical Agriculture 43(1-2): 71–73

Wang GX. (2005). Efficient amount of nitrogen application for grain filling at full panicle stage in mid-season hybrid rice. Beijing, China Science Press. *Acta Agron. Sin*. 33(3): 449-454.

Welch, R.M. and R.D. Graham. (2004). Breeding for micronutrients in staple food crops from a human nutrition perspective. *J Exp Bot* 55:353–64.

Yaduvanshi, N.P.S., and Sharma, D.R. (2010). Effect of organic sources with and without chemical fertilizing on productivity of rice (Oryza sativa) and wheat (Triticum eastivum) sequence and plant nutrient balance in reclaimed sodic soil. *Indian journal of agricultural sciences.* 80(6): 482-486.