To Study the Influence of Planting Geometry and Nitrogen Level on Yield Attribute and Yield of Rice (*Oryza sativa* L.) under Upper Gangetic Plains Region of India

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A B S T R A C T

A field experiment was conducted for two years during kharif season of 2017 and 2018 at Agronomy research Farm, N.D. University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) on sandy loam soil with a pH of 8.1 to study the Influence of planting geometry and nitrogen levels on rice (*Oryza sativa* L.)". The experiment was laid out in split plot design (SPD) with three replications Sixteen treatment combinations; comprised of four planting geometry, viz. (S_1) 15x10 cm, 15x15 (S_2),20x10 (S_3) and 20x15 (S_4) were kept in main plot and four nitrogen level, viz. 0kg/ha (N_0), 60 kg/ha (N_1), 120 kg/ha (N_2) and 180 kg/ha (N_3) were kept in sub plot. Under different treatments (planting geometry and nitrogen level) higher number of panicles with the value of 289.7 and 295.4 were recorded in planting geometry of 20x10cm which was at par with 15×15cm spacing while significant over rest both of the treatments while under nitrogen level higher number of panicles by 299.0 and 304.9 were recorded during 2017 and 2018 year of investigation respectively which was at par with 120 kg N/ ha while significant over control and 60 kg N/ha. Whereas highest grain yield of 39.5 q/ha and 46.5 q/ha was recorded during 2017 and 2018 year respectively with planting geometry of 20×10cm spacing which was at par with 15×15cm spacing while significant over rest both of the treatments.

Introduction

Rice (*Oryza sativa* L.) is the foremost staple food for more than 60% of the world's population providing major source of the food energy. It is grown in 114 countries across the world on an area about 160 million hectares with annual production of 494.3 million tonnes, and total supply of 711.5 million tonnes (Anonymous, 2015-16). Globally, total rice consumption was recorded 491.5 million metric tonnes in 2014-15 (Anonymous, 2015-16). It is the important crop in the country's food security accounting about 44% of the total food grain production and holds about 20% share in national agricultural GDP and provides 43% calorie requirement for more than 70% of Indians.

Plant spacing is also an important factor that needs to be considered during transplanting of rice. Rice plants compete among themselves for space, nutrients, water, sunlight, air. Proper spacing may help to increase maximum leaf Area Index (LAI), light interceptions etc. which are required for better photosynthesis as well as yield of rice.

Nitrogen plays a key role in rice production and it is required in large amount. It is one of the most important limiting nutrient in rice production and has heavy system losses when applied as inorganic sources in puddled field. Nitrogen has a positive influence on the production of effective tillers per plant, yield and yield attributes. It is necessary to find out the suitable dose of nitrogen for efficient management and better yield of rice. A suitable planting geometry and dose of nitrogen is necessary for better yield.

Materials and Methods

The field experiment was conducted during *Kharif* 2017 and *Kharif* 2018 at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). Geographically the experimental site is situated at $26^0.47'$ North latitude and $81^0.12'$ East longitude with is an altitude of 113 m. from mean sea level in the Indo Gangatic Plain Zone of Eastern Uttar Pradesh. The climate in this region is sub humid. The soil is sandy loam with a pH of 8.1. Sixteen treatment combinations; comprised of four planting geometry, viz. (S_1) 15x10 cm, 15x15 (S_2), 20x10 (S_3) and 20x15 (S_4) were kept in main plot and four nitrogen level, viz. 0kg/ha (N_0), 60 kg/ha (N_1), 120 kg/ha (N_2) and 180 kg/ha (N_3) were kept in sub plot. The experiment was conducted in split plot design (SPD) and replicated three times.

Results and Discussion

Number of panicle/m^2, panicle length and number of grains/panicle were significantly influenced by planting geometry Table-1. Higher values of yield attributes were recorded under spacing of 20 ×10cm which was at par with 15×15 spacing. While significant over rest of the treatments yield attributing characters are the function of growth and development that develop during vegetative phase of the plant. Due to better partitioning of photosynthesis from source to sink as a result of which better growth owing to favorable growing conditions might have resulted for better development and higher value of yield attributes (Srinivasan, 1990, Verma *et al.,* 2002 and Chopra and Chopra, 2004).

The yield attributes were primarily by the amount of nutrient. The carbohydrate production has positive correlation with levels of nitrogen. Hence, under present study increase in the value of yield attributes might be due to better translocation of carbohydrates from source to sink.

Higher number of panicles/m^2, length of panicle, number of grains/panicle, were recorded with 180 kg N/hawhich was at par with 120 kg N/ha while significantly superiority over rest of the treatments. The lowest value of yield attributing characters were obtained under control and 60kg nitrogen level because plants were subjected to utilize the least amount of available nitrogen which resulted into reduced translocation of photosynthates from source to sink and thus led to poor yield attributing characters. The results of present investigation in respect of these yield attributes are in agreement with the findings of Banerjee *et al.,* 2011 and Prakash *et al.,* 2011 who reported the response of rice crop to nitrogen in attributing the yield attributes.

Grain yields of rice influenced significantly by planting geometry of crop. The plant geometry under 20x10 cm resulted in higher grain yield which was at par with 15x15 cm spacing while significant over rest both of the treatments and lowest grain yield under 15x10

cm planting geometry was obtained. Yield is functions of complex inter relationship of growth in vegetative phase and yield attributes, this may due to better translocation of assimilation. Rajesh and Thanuthan (2003), Powar and Deshpande (2001) and Shinde *et al.,* (2005) also reported similar results.

The yield was recorded higher under 180 kg N/ha which was at par with 120 kg N/ha and significant as compared to other treatments. This might be due to adequate nitrogen availability which contributed to increased dry matter accumulation. Productivity of a crop is collectively determined by vigour of the vegetative growth, development as well as yield attributes which is the result of better translocation of photosynthates from source of leaves and stem to the grains. Better vegetative growth coupled with high yield attributes resulted into higher grain yield in said treatments Prakash *et al.,* (2014) and Nayak *et al.,* (2014) also reported similar results.

Table.1 Influence of planting geometry and nitrogen levels on yield attributes of transplanted rice

Treatments	No. of panicles/ m2		No. of grain/ panicle		Length of Panicle (cm)		Test Weight(g)	
	2017	2018	2017	2018	2017	2018	2017	2018
Planting Geometry								
15cmx10cm	238.5	243.2	149.8	151.4	23.7	23.9	22.8	22.8
15cmx15cm	283.2	289.8	164.8	161.4	25.7	27.2	23.3	23.3
20cmx10cm	289.7	295.4	197.7	166.4	26.7	27.5	23.4	23.4
20cmx15cm	278.5	283.4	159.7	159.4	25.5	27.0	23.2	23.2
SEm+	6.81	6.95	4.10	4.02	0.64	0.64	0.11	0.13
CD (P=0.05)	23.57	24.05	14.21	13.91	2.21	2.23	NS	NS
Nitrogen levels (Kg/ha)								
0	206.0	210.2	139.4	140.9	23.4	23.6	22.2	22.2
60	276.0	291.7	147.2	148.8	25.9	25.1	22.9	22.9
120	292.0	300.9	160.0	163.6	26.4	26.7	23.6	23.6
180	299.0	304.9	163.5	165.1	26.9	27.2	23.8	23.9
SEm+	5.62	5.73	2.12	2.23	0.51	0.52	0.10	0.12
CD (P=0.05)	16.41	16.74	6.13	6.51	1.51	1.53	NS	NS

Table.2 Influence of planting geometry and nitrogen levels on Grain(q/ha), Straw yield (q/ha) and Harvest index of transplanted rice

Treatments	Grain Yield(q/ha)		Straw Yield(q/ha)		Harvest Index (%)	
	2017	2018	2017	2018	2017	2018
Planting Geometry						
15cmx10cm	35.4	36.4	53.6	57.1	41.2	39.8
15cmx15cm	37.3	45.5	65.6	68.4	41.7	41.5
20cmx10cm	39. 5	46.5	67.0	69.6	41.9	41.8
20cmx15cm	37.0	39.5	55.2	66.5	41.7	41.0
SEm+	1.2	1.2	1.7	1.7	0.1	0.1
CD (P=0.05)	4.2	4.4	5.9	6.1	0.4	0.4
Nitrogen levels kg/ha						
0	30.9	32.2	47.4	49.1	39.4	39.5
60	40.8	41.5	57.9	60.2	41.9	40.9
120	44.3	44.7	62.7	65.7	42.5	42.6
180	45.0	45.5	63.4	66.5	42.6	42.7
SEm+	1.09	1.1	1.47	1.52	0.1	0.20
CD (P=0.05)	3.1	3.3	4.29	4.4	0.3	0.58

Table.3 Interaction effect of planting geometry and nitrogen levels on grain yield (q/ha)

Nitrogen levels (kg/ha)	2017			
	Planting Geometry			
	15cmx10cm	15cmx15cm	20cmx10cm	20cmx15cm
0	28.3	31.6	33.0	31.0
60	40.0	41.2	46.2	40.3
120	44.2	46.4	50.5	46.2
180	45.6	50.0	53.2	48.9
	SEm+		CD (P=0.05)	
N at S	2.17		6.36	
S at N	2.25		6.94	

Nitrogen levels (kg/ha)	2018			
	Planting Geometry			
	15cmx10cm	15cmx15cm	20cmx10cm	20cmx15cm
0	29.5	33.9	34.3	33.1
60	40.3	45.8	49.0	42.0
120	46.0	49.0	51.1	46.2
180	48.2	51.5	52.0	49.7
	SEm+		CD (P=0.05)	
N at S	2.26		6.61	
S at N	2.34		7.22	

Table.3 Interaction effect of planting geometry and nitrogen levels on straw yield (q/ha)

Nitrogen levels (kg /ha)	2017			
	Planting Geometry			
	15cmx10cm	15cmx15cm	20cmx10cm	20cmx15cm
0	43.0	48.7	50.8	48.0
60	54.0	57.4	64.6	55.8
120	70.5	74.4	82.1	72.7
180	73.8	81.7	84.8	80.1
	SEm$\pm$		CD (P=0.05)	
N at S	2.94		8.5	
S at N	3.07		9.50	
Nitrogen levels (kg /ha)	2018			
	Planting Geometry			
	S_1	S_2	S_3	S_4
N_0	44.7	50.8	52.6	48.3
N_1	56.3	59.9	66.9	57.5
N_2	69.3	72.1	75.7	70.3
N_3	69.1	74.0	78.3	69.2
	SEm$\pm$		CD (P=0.05)	
N at S	3.05		8.92	
S at N	3.19		9.86	

Straw yield of rice were highest when rice crop was planted by 20x10 cm spacing which was at par with 15×15cm planting geometry . Higher number of tillers/m^2 with plant height and better growth. Ultimately led the increased biomass in 20x10 cm of rice spacing. The lowest yield was recorded under 15x10 cm spacing due to lesser number of tillers/m^2 for available growth resources on account of more competition (Shinde *et al.,* 2005; Jalil, 2008)

Harvest index was significantly affected due to planting geometry during both the years of investigation. Higher harvest index was found significantly with 20x10cm planting geometry mainly due to proportionately higher grain yield relative to biomass.

Increase in N availability increase the harvest index of transplanted rice during both the years of investigation. Higher harvest index were recorded under 180 kg N/ha which was at par with 120 kg N/ha due to higher grain yield (economic yield) relative to biomass (Prakash *et al.,* 2014).

In conclusion, the data collected were subjected to statistical analysis to draw valid conclusion. Planting geometry of 20cm×10cm was found suitable for higher yield attributes and yield of rice.

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