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Effect of time of Nitrogen Application on the Performance of Rice Varieties in Lowlying area.

D. C. GHOSH[1] and B. N. CHATTERJEE[2]

Field experiments were conducted at Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani in the lowlying area where submergence was as high as 50 cm. by August, during Kharif seasons of 1973 and 1974 to compare the single basal application of nitrogen with its split applications to the rice varieties suitable for such areas. Results showed that application of nitrogen in two splits half at planting and the other half at tillering favourably influenced leaf area index, leaf area duration, number of panicles per unit area, number of grains per panicle and percentage of filled grains and so also th e grain yield of rice, but it did not affect the plant height, tillering and test weight of grains. It also increased the protein content in grain. Inadequate fertiliser application at any of the above-mentioned stages gave reduced yield. Delayed application at booting stage uuder lewland situation, to avoid nitrogen application panicle initiation when water stagnation was maximum, did not show any advantage. Pankaj, a semidwarf variety was found to be the best under such condition as compared to IR-442-2-58or other tall *indica* varieties - Nc 1281 and Jalakamini.

The timing of nitrogen application is an important aspect of overall nitragen management in rice crop from the view point of its efficient utilization. Proper time of nitrogen application reduces the loss of nitrogen in rice fields (Evatt, 1965), which depends on the rice varieties (Hall, 1960) and also environmental conditions under which the crop is grown. Application of nitrogen in three splits–at planting, tillering and panicle initiation stages of rice was found most beneficial for increasing grain yield of high yielding rice varieties under medium to high land situations (Singh *et al*, 1972; Modgal *et al*, 1974 and Chatterjee and Maiti, 1977). Informations collected with regard to nitrogen management in rice crop under lowlying areas are scanty. In wet season large area under lowland situation, where water stagnates upto 50 cm. or even more, is used for rice growing. At the time of panicle initiation of rice, in August and September, the water stands so high in the field that it is difficult to apply nitrogenous fertilizer at that time.

Considering the importance of the problem, an attempt has been made to analyse the effect of single basal application of nitrogen and different split applications on the growth and yield of rice varieties under lowland situation.

Deparment of Agronomy, Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani-741235, West Bengal.

1. Lecturer in Agronomy, Palli Siksha Sadana, Sriniketan-731236, West Bengal.

2. Dean, Faculty of Agriculture, Bidhan Chandra Krishi Viswa Vidyalaya. Kalyani, Nadia.

MATERIAL AND METHODS

The field experiment was conducted in lowlying area of Agricultural Research Farm, Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani, during the Kharif seasons of 1973 and 1974. The soil of the experimental field was alluvial clay leam (34% sand, 33% silt and 30% clay) containing 0.71 per cent organic carbon, 315 kg/ha available N, 15.6 kg/ha available P and 186 kg/ha available K with a pH of 7.2. The experiment was laid out in randomised block design with four fertilizer treatments - (i) control (no nitrogen), (ii) 60 kg N/ha at plantiing, (iii) 30 kg N/ha each at planting and tillering (30 days after planting) and (iv) 30 kg N/ha each at tillering and booting (80 days after planting) stages of rice crop. Nitrogen was applied in the form of ammonium sulphate. All plots received a general dose of 60 kg P_2O_5/ha and 40 kg K_2O/ha at planting in the form of single super phosphate and muriate of Potash respectively. Twenty days old seedlings were transplanted at 20 cm x 15 cm. spacing by middle of June. Usually in lowlying areas early planting is reported to escape ill effects of deep submergence. The experimental field at the beginning remained submerged upto 10-15 cm. water which gradually raised upto 50cm. by the middle of August when panicle initiation of the crop was observed. Later on the water level gradually reduced to about 5 cm. by early November when the crop was harvested. The crop received 1156 and 1166 cm. rainfall during the crop seasons of 1973 and 1974 respectively. The crop was adequately protected against weeds diseases and insectpests. Ten hills and ten panicles were randomly selected for recording biometrical observations from one-third area of each plots ear-marked for this purpose and the other portion was used for yield estimation. Observations were recorded on tillering at maximum tillering stage (40 days after planting), height of plant, number of panicles per unit area, number of grains per penicle, percentage of filled grains and weight of 1000 grains (test weight) at maturity. The dry weights of green leaves of rice plants per unit area recorded at flowering, 15 days after flowering and at maturity were used for calculating leaf area index and leaf area duration The ratio of area/weight of the measured cut pieces of green leaves was used to determine the leaf area index (Kemp, 1960). Leaf area duration was measured following the method suggested by Watson (1952).

RESULTS AND DISCUSSION

Growth attributes :

Results presented in Table 1 clearly showed that nitrogen fertilization at various growth stages favourably influenced the tillering of rice but it did not affect the height of the plants. Maximum number of tillers per unit area were produced by the crop receiving 30 kg N/ha each at planting and tillering (30 days after planting) stage. Jalakamini produced tallest plants while dwarfmost plants were observed in IR 442-2-58. Pankaj recorded highest number of tillers per unit area during both the years. Application of nitrogen half at planting and other half at tillering also increased the leaf area index recorded at flowering and 15 days after flowering and so also the leaf area duration from flowering to maturity of this crop, significantly over other treatments where nitrogen application was missing at any of the above stages. Late application of nitrogen at booting stage did not have any effect on the growth of rice plants under lowland situation. Pankaj recorded maximum values of leaf area index during both the stages and leaf area duration from flowering to maturity. Very high rainfall (386 mm rainfall in June) received after transplanting the crop during 1974 resulted in poor stand of the crop particularly in semidwarf varieties (Pankaj and IR 442-58) which ultimately decreased the height of the plant of all varieties and tiller production. LAI and LAD of semidwarf varieties during 1974 while in 1973, well distributed rainfall resulted in good growth of this crop.

Yield components:

Maximum number of panicles per unit area and grains per panicle were observed in plots receiving 30 kg N/ha each at planting and tillering (Table-2). Similarly, the percentage of filled grains and test weight of grains also increased significantly with this treatment over single basal application. Application of nitrogen at booting stage was not beneficial for the improvement of yield components of rice under lowland condition. Pankaj produced maximum number of panicles per unit area while Jalakamini recorded large number of grains in its panicles during both the years. Higher percentage of filled grains were observed in tall *indica* varieties in 1974. Pankaj and Jalakamini recorded significantly higher test weight of grains than that obtained in NC 1281 and IR 442-2-58. Poor tiller production of semi-dwarf varieties as a result of receiving very high rainfall at the beginning of crop growth during 1974 decreased the number of panicles per unit area of these varieties during this seas_n as compared to those of 1973.

Grain yield and protein content:

Data presented in Table 3 clearly showed that application of 30 kg N/ha each at planting and tillering stage gave significantly higher grain yield of rice than single basal application. The per cent increase over control treatment were 25, 39, and 24 for 60 kg N/ha at planting, 30 kg N/ha each at planting and tillering and 30 Kg N/ha each at tillering and booting stages respectively The highest yields were recorded in Pankaj (40 q/ha) and was closely followed by IR 442-2-58 (37 q/ha) which matured 20 days earlier than others and caused inconvenience in harvesting in the submerged field. The local improved varieties yielded 27 to 30 q/ha with good management, particularly when fertilized in two splits at early growth stages. Nitrogen application in two splits at carly stages of crop growth also increased the protein content in grain. Maximum protein content in grain was observed in Pankaj.

Application of nitrogenous fertilizer in the form of pellets or mudballs has been recommended to be helpful in lowland situation (De Datta et al, 1974) But to apply nitrogenous fertilizer in the form of mudballs, when the water stagnated upto 50 cm. or more, appeared to be very laborious and cumbersome. The experimental results reported in this paper, confirmed that in such areas, where possibilities of losses of ammonium nitrogen due to denitrification and leaching are low. early applications of nitrogen in two splits can safely be conserved into the soil and utilised by the plants. Yields of high yielding varieties to the tune of 40 q/ha and local improved varieties to the tune of 27 to 30 q/ha are fairly good under such situation.

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TABLE I. Growth attributes of rice varieties as influenced by time of nitrogen application

Treatments	'Plant height (cm.)'		No. of Tillers/m²		'LAI** at flowering		'LAI at 15 DAF'		LAD from flowering to maturity	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1984
Time of nitrogen application (Kg/ha)										
p* T B										
No nitrogen	178	136	201	204	3.16	2.71	1.73	1.32	54.2	45.1
60 0 0	189	139	247	242	3.91	3.25	2.25	1.59	70.3	50.5
30 30 0	188	142	258	247	4.59	3.60	2.78	1.91	84.4	60.6
0 30 30	183	142	226	230	3.71	3.27	2.54	1,55	74.5	52.8
Vatieties										
Pankaj	155	111	285	247	6.19	4.55	4.77	2.12	132.7	74.6
IR 442-2-58	126	107	248	236	4.64	2.90	2.56	1.95	79.6	61.3
Nc 1281	203	160	191	214	2.42	2.57	1.09	1.05	38 7	35,2
Jalakamini	255	182	209	225	2.13	2.81	0.89	1·24	32.3	37.9
S. Em.(±)	3.8	2.6	10.0	7.2	0,17	0.11	0.11	0.10	4.3	2.7
C.D. at 5%	11.5	7.8	30.0	22.0	0.51	0.33	0.34	0 31	12.9	8.5
C. V.	5.8	5.1	12.1	8 8	12.5	9.6	13.6	18.2	17.2	14.9

*P=Planting, T=Tillering, B=Booting,

**LAI=Leaf area index, DAF=Days after flowering: LAD=Leaf area duration

TABLE 2 Yield components of rice varieties as influenced by time of nitrogen application

Treatments	No. of Panicles/m²		No. of grains/Panicle,		% of filled grains		1000-grain weight (g)	
	1973	1974	1973	1974	1973	1974	1973	1974
Time of nitrogen application (Kg/ha)								
P* T B								
No nitrogen	161	172	80	77	74	70	24.9	24.5
60 0 0	185	183	90	88	76	73	24.5	25.2
30 30 0	200	202	102	99	83	82	26.0	25.5
0 30 30	180	186	92	87	80	77	25.7	24.9
Varieties								
Pankaj	241	225	81	89	75	75	26.8	26.4
IR 442-2-58	218	204	76	71	76	76	23.7	22.9
NC 1281	131	153	100	99	80	75	25.2	24.3
Jalakamini	136	160	106	92	80	76	26.4	26.4
S. Ex.(±)	4.7	4.8	2.7	2.8	1.8	1.8	0.32	0.31
C. D. at 5%	14.3	14.5	8.2	8.4	5.4	5.5	0.95	0.92
C. V.	7.4	7.2	8.3	8.9	6,4	7.0	3.4	3.6

P=Planting, T=Tiilering, B=Booting

TABLE 3 Grain yield and protein content in grain of rice varieties influenced by time of nitrogen application

Treatments			Grain yield (q/ha) 1973	1974	Pooled	Protein percentage in grains (1974)
Nitrogen applicatoin						
P	T	B*				
No nitrogen			28.3	26.9	27.6	6.47
60	–	–	34.3	34.0	34.2	6.74
30	30	–	40.0	37.4	38.7	7.50
–	30	30	35.9	32.6	34.2	7.36
Varieties						
Pankaj			41.4	38.6	40.0	7.69
IR 442·2-58			38.3	35.8	37.0	7.49
NC 1281			28.7	26.7	27.7	6.18
Jalakamini			30.1	29 8	30.0	6.81
S Em (±)			1.1	1.0	0.8	
C D at 5%			3.3	2.9	2.4	
C V			9.0	8.0		

*P=Planting, T=Tillering, B=Booting