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Effect of Level and Splitting of Nitrogen and Potassium Fertilizers on Summer Rice *(Oryza sativa)*

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Abstract

The experiment was conducted on the different fertilizer dose and split application of nitrogen and potassium at the Agricultural experimental farm of Calcutta University at baruipur 24-Pargana situated in the Gangetic alluvial region of West Bengal during crop season 2004-2005. The results suggest that different levels of N and K_2O at different split application had profound influence on physiological growth parameters. Application of nitrogen at 120 kg/ha and potassium at 60 kg/ha was found to be most effective increasing growth parameters, like LAI, CGR, RGR and component like tiller number, number of grain/ panicle, grain yields of summer rice. Futher, splitting of nitrogen and potassium thrice from 1/3 N K_2O as tillering stage and 1/3 N and K_2O as panicle initiation stage gave best results.

Key words : Splitting of fertilizer, Rice, Nitrogen, Potassium.

Split application of N and K_2O fertilizer was generally effective in increasing grain yield. A favorable effect of split application of K_2O fertilizer on rice was also observed by Shen and Yuen (1) and Hongh and Kuo (2). However, split application of phosphorus fertilizer did not show any significant increase in grain yield of rice. Chang and Yang (3, 4) also concluded that sufficient amount of phosphoric fertilizer applied as a basal dressing would be enough to cover the need for a maximum yield production. The efficiency of fertilizer utilization by the rice plant can be improved if the timing of fertilizer application concurs with the periods of maximum plant uptake. Combinations of split application of fertilization should, therefore, be tried to evaluate their relative efficiency in relation to increase in grain yield. Nitrogen losses are high due to elevated temperature and rainfall condition the split N application based on crop growth stage and nutrient need could reduce N losses to teaching. Best yield are obtained by applying 20% of total N at planting time 20% at till and the remaining 60% at flowering filed research has also demonstrated that equal or higher yields are possible with four split N application but the additional cost with four split N application but the additional cost of application increases total production expenses. Potassium fertilizer requirements are related to soil K availability. The K demand and yield received substantial amount of K accumulated in rice straw and are lost when straw is removed from the field Incorporating crop.

Methods

The present experimental was carried out at longitude of $28^0 06'$ E and latitude of $22^0 22'$ N. The topography of the side was low land with more or less uniform drainage condition. The soil quality of the area was slightly acidic in reaction having 0.729% organic carbon and 0.78% nitrogen. The estimated phosphorus and potassium contents of the plot were 30 and 260 kg/ha respectively. The plot was 2.5×2 cm^2 and soiling was done during first week of January in broadcasting method. Seedling were transplanted in treatment with a spacing of 20×15 cm at 3-4 cm depth. Nitrogen and potash were applied based on the treatment. Frequent irrigation was given to maintain submergence of 25 cm. First and second weeding was done at 30 and 60 days, respectively after transplanting.

The experiment was laid out in randomized block design with three replication "Satabdi" rice (*Oryza sativa* L.) consisted of 16 treatments. (F = Fertilizer dose and M = Split application) : F_0M_0 (T_1)—control (without fertilizer and no need for splitting), F_1 M_O (T_1)—control (without fertilizer and no need for splitting) F_1 M_1 (T_2—60 kg N/ha + 30 kg K_2O/ha and ½ N

Table 1. Vegetative growth parameter of summer rice for different dose of N and K_2O and also different splitting.

Treatments (on days)	Tiller height 30	60	90	Tiller/hill 30	60	90	Dry matter/hill 30	60	90
Level of N, K_2O Fertilizer									
F_0	30.79	50.66	62.02	7.5	14.33	7.75	5.92	25.15	45.34
F_1	34.7	54.09	67.12	11.25	22.5	11.25	6.71	31.04	52.09
F_2	39.37	57.12	68.64	12.33	22.25	11.58	8.44	33.38	56.03
F_3	43.34	59.14	69.91	14.08	24.5	13.75	9.02	35.4	58.28
SE (±)	0.041	0.210	0.278	0.196	0.212	0.269	0.004	0.003	0.004
CD (0.5)	0.119	0.608	0.803	0.566	0.612	0.777	0.012	0.009	0.011
Spliting of Application									
M_0	33.47	53.26	65.86	10.08	10.25	10.25	7.02	30.03	50.07
M_1	36.44	53.28	65.88	11.25	10.92	10.92	7.65	30.68	51.97
M_2	39.07	57.22	68.59	11.25	11.42	11.42	7.69	31.72	54.25
M_3	39.21	57.26	67.35	12.58	11.75	11.75	7.74	32.54	55.45
SE (±)	0.041	0.210	0.278	0.196	0.212	0.269	0.004	0.003	0.004
CD (0.05)	0.239	1.215	1.605	0.566	0.612	0.777	0.012	0.009	0.011
SE (±) for F × M	0.083	0.421	0.556	0.392	0.424	0.538	0.008	0.006	0.008
CD (0.05) for F	0.239	1.215	1.605	NS	1.224	NS	0.023	0.019	0.022

Table 1. Continued.

Treatments (on days)	Leaf area index 30	60	90	Crop growth rate 30 to 60	60 to 90	Relative growth rate 30 to 60	60 to 90
Level of N, K_2O Fertilizer							
F_0	2.87	3.86	0.73	0.64	0.67	0.048	0.0196
F_1	3.04	4.04	0.84	0.81	0.7	0.051	0.0173
F_2	4.14	4.14	0.95	0.83	0.75	0.046	0.0173
F_3	4.47	4.47	1.09	0.88	0.76	0.045	0.0166
SE (±)	0.041	0.056	0.003	0.00017	0.00016	0.00002	0.000004
CD (0.5)	0.119	0.161	0.008	0.0005	0.0004	0.00006	0.00001
Spliting of Application							
M_0	2.92	3.92	0.82	0.77	0.67	0.048	0.67
M_1	3.09	4.1	0.85	0.77	0.71	0.046	0.71
M_2	3.24	4.16	0.95	0.8	0.75	0.047	0.75
M_3	3.24	4.34	0.99	0.83	0.76	0.048	0.46
SE (±)	0.041	0.056	0.003	0.00017	0.00016	0.00002	0.000004
CD (0.05)	0.239	0.321	0.015	0.001	0.0009	0.00006	0.00001
SE (±) for F × M	0.083	0.111	0.005	0.00035	0.00032	0.00004	0.00001
CD (0.05) for F × M	0.239	0.321	0.015	0.001	0.00091	0.00002	0.00002

+ K_2O as basal, ½ N at panicle initiation stage. F_2M_2 (T_3)—80 kg N/ha + 40 kg K_2O/ha and ½ N + ½ K_2O as basal, ½ N + ½ K_2O as tillering stage, F_3M_3 (T_4)—120 kg N/ha + 60 kg K_2O as tillering stage, $^1/_3$ N + $^1/_3$ K_2O as panicle initiation stage, F_0M_1 (T_5)—No fertilizer F_1M_0 (T_6)—60 kg N/ha and 30 kg K_2O/ha as basal, F_2M_3 (T_7)—80 kg N/ha + 40 kg K_2O/ha and $^1/_3$ N + $^1/_3$ N + $^1/_3$ K_2O as basal, $^1/_3$ N + $^1/_3$ K_2O as tillering stage, $^1/_3$ N + $^1/_3$ K_2O as panicle initiation stage, F_3M_1 120 kg N/ha + 60 kg K_2O/ha and ½ N + K_2O as basal, ½ Nat at

Table 2. Yield attribution characters and yield parameter of summer rice for different dose of N and K_2O and also different splitting.

Treatments	Panicle length (cm)	No of filled grain/ panical	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index
Level of N, K_2O Fertilizer							
F_0	24.14	114.74	19.88	3.20	3.86	7.06	0.453
F_1	24.21	120.56	20.26	3.65	3.99	7.64	0.477
F_2	24.64	125.97	20.85	4.12	4.14	8.26	0.498
F_3	24.99	128.42	21.50	4.17	4.23	8.4	0.496
SE (±)	0.021	0.119	0.033	0.003	0.003	0.006	
CD (0.05)	0.06	0.345	0.096	0.009	0.007	0.016	
Splitting of Application							
M_0	24.18	116.75	20.12	3.69	3.93	7.62	0.484
M_1	24.38	120.11	20.36	3.83	4.03	7.86	0.487
M_2	24.61	125.51	20.96	3.90	4.12	8.02	0.486
M_3	24.80	127.32	21.04	3.73	4.12	9.87	0.377
SE (±)	0.021	0.119	0.033	0.003	0.003	0.006	
CD (0.05)	0.06	0.345	0.096	0.009	0.007	0.016	
SE (±) for F × M	0.041	0.239	0.067	0.006	0.005	0.0011	
CD (0.05) for F × M	0.199	0.69	0.19	0.017	0.015	0.032	

panicle initiation stage, F_0M_2 (T_9) — without fertilizer, F_2M_0 (T_{10})—80 kg N/ha + 40 kg K_2O/ha as basal, F_1M_2 (T_{11})—60 kg N/ha + 30 kg K_2O/ha and ½ N + ½ N + ½ K_2O as basal, ½ N + ½ K_2O as tillering stage, F_3M_0 (T_{12})—120 kg N/ha and 60 kg K_2O/ha as basal, F_0M_3—without fertilizer, F_2M_1—80 kg N/ha + 40 K_2O /ha and ½ N + K_2O as basal, ½ N at panicle initiation stage. F_3M_2 (T_{15})—120 kg N/ha + 60 kg K_2O/ha and ½ N + ½ K_2O as basal, ½ N + ½ K_2O as tillering stage. F_1M_3 (T_{16})—60 kg N/ha + 30 kg K_2O/ha and $^1/_3$ N + $^1/_3$ K_2O as basal, $^1/_3$ N + $^1/_3$ K_2O as tillering stage, $^1/_3$ N + $^1/_3$ K_2O as panicle initiation stage.

Results and Discussion

The rice crop exhibited a typical linear pattern in respect of plant height under respective treatments. Rice plants showed a faster rate of growth in respect of plant height during 40—55 days after transplanting (Table 1). After 55 days of transplanting the rate of increase in plant height followed diminishing rate of increase. The maximum plant height was observed with 120 and 60 kg/ha with three splitting of N and K_2O application recorded the highest plant height. Dry matter accumulation in plant growth under the different treatment has manifested a more or less quadratic from with increase in age. Dry matter accumulation increased progressively upto 60 DAS. The maximum dry matter was recorded with application of fertilizer at N 120, K_2O 60 kg/ha and split tillering stage, $^1/_3$ N + $^1/_3$ K_2O as basal dose, $^1/_3$ N + $^1/_3$ K_2O at tillering stage, $^1/_3$ N +, $^1/_3$ K_2O as panicle initiation stage resulted in higher dry matter production of plant and different days after sowing. The results on yield attributing characters of rice reveal that different fertilizer doses and split applications significantly influenced the important yield components like number of effective tillers per hill, length of panicle, number of filled grain per panicle and test weight of grains (Table 2). Among the different fertilizer dose and split application F_3M_3 showed better manifestation of most of the yield attributes except test weight probably due to high dose of fertilizer. Yield attribution of rice varied significantly due to combined use of nitrogen and potassium. Among the treatment application of fertilizer dose N-0, 40, 80, 120 and K_2O 0, 30, 40, 60 recommended dose in combination with splitting application improved the yield attribution characters like number of effective tiller/hill, panicle length, number of filled grain per panicle and test weight of rice grain. The beneficial effect of combined use of fertilizer and splitting at F_3M_3 treatment was found to be beneficial

which increased the yield attribution of rice (5).

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