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Effect of differential nutrient doses and scheduling on growth, yield attributes, yield and nutrient efficiency in hybrid rice (*Oryza sativa* L.)

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ABSTRACT

An experiment was conducted during Kharif seasons of 2011-12 and 2012-13 to study the effect of split application of NPK fertilizer growth yield parameters and yield of hybrid rice at Student Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad U.P. The experiment was laid out in RBD comprising of ten treatments with three replication with ten practices. The split timing with doses of NPK fertilizer (100% RDF) N 1/3(7DAT+MT+PI) P and K 1/3 (B + MT+PI) growth, yield (7.25-7.45 t ha^{-1}) and availability of N (174.10- 175.55), P (17.75-17.93) and K (246.15- 248.61) kg ha^{-1} was significantly superior over the rest treatments. Significantly at par, yield attributes growth and yield parameters recorded by T_{10} NPK (75% RDF) N1/3 (7DAT+ MT+PI) P and K 1/3 (B+ MT+ PI) and T_2 NPK (100% RDF) as Recommended practices (RP). This way 25% NPK could be saved by splitting NPK without losing yield.

Key word: *Nitrogen, Phosphorus, Potassium, Basal, Days after transplanting, Recommended Practices, Maximum tellering, Panicle inanition, and recommended dose of fertilizer.*

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INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal crop that provides 43 per cent of calorie requirement for more than 75 per cent of Indian as well as world's population. It is an excellent source of carbohydrates, proteins, and mineral matter. The requirement of rice production in our country is to be estimated around 145 million tonnes by the year 2020. To achieve this goal in coming years without affecting the soil fertility and environmental condition would be a challenge.

Nitrogen use efficiency rice is generally less than 40% of the total applied N, rapid loss of applied N through ammonia volatilization, de-nitrification and leaching. However, management practices such as split and scheduling of NPK application improves availability and efficiency through at growing season. The recommended practice of further application of P and K full dose and 50% N at the time of transplanting and the remaining N in two equal splits at active tillering and panicle initiation, mid-heading and first flowering resulted in higher uptake and grain yield in rice observed due to split application of P (DRR, 1998). Further, the post panicle initiation nutrient management studies also revealed that application of N and K at flowering improved the grain yield and yield parameters in hybrid rice.

Potassium being major nutrient for most of the physiological function of the plant viz., photosynthesis, water and salt transport, and osmotic potential, protection of cell and tissue etc. potassium required by hybrid rice is high than inbred varieties at grain filling stage as the hybrid rice has more sink size than conventional rice. Potassium is a macro element known to be very dynamic and a major contributor to the organic structure and metabolic functions of the plant. Adequate K supply is also desirable for the efficient use of Fe, while higher K application result into competition with Fe (Celik *et al.,* 2010). There is a considerable decrease in available K due to increased cropping intensity and lower K application rates (Zhang *et al.,* 2004).

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during two kharif seasons of 2012-13 and 2013-14. The experiment was laid out in randomized block design with three replications and ten treatments *viz.,* T_1 control, T_2 NPK (100% RDF) Recommended practices (RP), T_3 NPK (100% RDF) as N 1/3(7DAT+MT+ PI) P and K basal, T_4 NPK (100% RDF) N and K recommended P (3/4 B+1/3 PI), NPK (100% RDF) N 1/3(7DAT+MT+ PI) K (3/4 B+1/3 PI) and P RP, T_6 NPK (100% RDF) N 1/3(7DAT+MT+ PI) P and K 1/3 (B+MT+PI), T_7 NPK (75 % RDF) N 1/3(7DAT+MT+ PI) P and K basal, T_8NPK (75% RDF) N and K RP and P 1/3 (B+MT+PI), T_9 NPK (75% RDF) N and P RP and K 1/3 (B+MT+PI) and T_{10} NPK (75% RDF) N1/3 (7DAT+MT+PI) P and K 1/3 (B+MT+PI) the hybrid rice variety Arize-6444 was conducted the experimental soil was silt loam with pH 8.41 and 8.40, EC 0.37 and 0.36 dSm^{-1}, during season 2012-13 and 2013-14.

RESULTS AND DISCUSSION

The data in Table-1 regarding grain indicated that yield of rice was spliting of NPK fertilizers on plant height of hybrid rice was showed that spliting doses of NPK fertilizers. The maximum plant height at 30 DAT increase in hybrid rice was noted treatment T_6 (61.20 and 63.04 plant height (cm)) followed by T_5 (59.45 and 61.23 plant height (cm)) and T_3 (59.00 and 60.77 plant height (cm)), while the maximum plant height at 60 DAT increase in treatment T_6 (90.00 and 92.70 plant height (cm)) followed by T_5 (88.55and 91.21 plant height (cm)) and T_3 (86.90 and 89.51 plant height (cm)) and significantly increase plant height at harvest stage in treatment T_6 (127.30 and 131.12 plant height (cm)) followed by T_5 (124.75 and 128.49 plant height (cm)) and T_3 (120.45 and 124.06 plant height (cm)) Sharma and Gupta (2002) also observed almost similar findings in plant height by the application of NPK fertilizers. The data in Table-2 the split doses of NPK fertilizers improved the availability of these nutrients in rice crop. The maximum Nitrogen availability was recorded at the treatments T_6 (174.10 &175.84 kg ha^{-1}) followed by T_5 (172.45 & 174.17 kg ha^{-1}) and T_3 (168.95 & 170.64 kg ha^{-1}). The maximum Phosphorus availability was recorded at the treatment T_6 (17.75 & 17.93 kg ha^{-1}) followed by T_5 (16.70 & 16.86 kg ha^{-1}) and T_3 (15.65 &15.81 kg ha^{-1}) similar trend was potassium availability was recorded as treatment T_6 (246.15 and 248.61 kg ha^{-1}) followed by T_5 (237.45 and 239.82 kg ha^{-1}) NPK availability was recorded at par in T_{10} there (75% RDF-NPK) were applied splits as compare to T_2 100% RDF-NPK given as recommended practices. The split doses of nutrients improved the availability of these nutrients root zone materials different with the growth stages of plant similar result, were also reported by Zaidi *et al.* (2007), and Shah *et al.* (2006). The maximum grain yields were recorded in the treatment T_6 (7.25 and 7.45 t has^{-1}) followed by T_5 (7.05, 7.21 t ha^{-1}) and T_3 (6.40 and 6.44 t ha^{-1}). In year 2012 and 2013 respectively, grain yields were recorded in control treatment T_1 (3.30 and 3.40 t ha^{-1}) during the both years similar result found (Zaidi, 2007). These findings could be corroborated with the findings of Wei (2011) and Dey *et al.* (2014).

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Table 1: Effect of Split application of NPK fertilizers on plant height (cm) in hybrid rice

Treatments		30 DAT		60 DAT		Harvest stage	
		2012	2013	2012	2013	2012	2013
T_1	Control	43.40	44.70	60.50	62.32	104.65	107.79
T_2	NPK (100% RDF) as Recommended practices (RP)	53.00	54.59	76.45	78.74	115.80	119.27
T_3	NPK (100% RDF) as N1/3(7DAT+MT+PI) P and K basal	59.00	60.77	86.90	89.51	120.45	124.06
T_4	NPK (100% RDF) N and K recommended P 1/3 (B+ MT+ PI)	51.15	52.68	76.50	78.80	117.90	121.44
T_5	NPK (100% RDF) N and P as RP and K 1/3 (B+MT+ PI)	59.45	61.23	88.55	91.21	124.75	128.49
T_6	NPK (100% RDF) N 1/3(7DAT+MT+PI) P and K 1/3(B+MT+PI)	61.20	63.04	90.00	92.70	127.30	131.12
T_7	NPK (75% RDF) N 1/3(7DAT+MT+PI) P and K basal	49.80	51.29	73.60	75.81	112.85	116.24
T_8	NPK (75% RDF) N and K as RP and P 1/3 (B+MT+ PI)	49.00	50.47	74.59	76.83	109.75	113.04
T_9	NPK (75% RDF) N and P as RP and K 1/3 (B+ MT+ PI)	48.67	50.13	74.00	76.22	111.15	114.48
T_{10}	NPK (75% RDF) N1/3 (7DAT+ MT+PI) P and K 1/3 (B+ MT+ PI)	52.60	54.18	75.50	77.77	114.95	118.40
SEm±		**2.61**	**2.68**	**3.10**	**3.35**	**4.27**	**4.27**
CD (P=0.05)		**7.90**	**8.05**	**9.42**	**9.94**	**12.82**	**12.82**

NPK-Nitrogen, Phosphorus, Potassium ; RDF- Recommended dose of fertilizer
DAT- Days of transplanting; MT- Maximum tillering ; PI- panicle initiation; B -Basal

Table 2: Effect of split application of NPK fertilizers on nutrients available (kg ha^{-1}) and Grain yield (ton ha^{-1}) of hybrid rice

Treatments		Nutrients available (kg ha^{-1})						Grain yield (ton ha^{-1})	
		Nitrogen		Phosphorous		Potassium			
		2012	2013	2012	2013	2012	2013	2012	2013
T_1	Control	144.56	146.01	12.25	12.37	205.15	207.20	3.30	3.40
T_2	NPK (100% RDF) as Recommended practices (RP)	163.44	164.07	14.85	15.00	218.45	220.63	6.15	6.18
T_3	NPK (100% RDF) as N1/3(7DAT+MT+PI) P and K basal	168.95	170.64	15.65	15.81	235.60	237.95	6.40	6.44
T_4	NPK (100% RDF) N and K recommended P 1/3 (B+ MT+ PI)	163.95	164.59	16.55	16.71	216.80	218.97	6.25	6.27
T_5	NPK (100% RDF) N and P as RP and K 1/3 (B+MT+ PI)	172.45	174.17	16.70	16.86	237.45	239.82	7.05	7.21
T_6	NPK (100% RDF) N 1/3(7DAT+MT+PI) P and K 1/3(B+MT+PI)	174.10	175.84	17.75	17.93	246.15	248.61	7.25	7.45
T_7	NPK (75% RDF) N 1/3(7DAT+MT+PI) P and K basal	158.92	160.51	13.85	13.99	214.35	216.49	5.25	5.30
T_8	NPK (75% RDF) N and K as RP and P 1/3 (B+MT+ PI)	153.97	155.51	14.50	15.00	212.49	214.61	5.00	5.15
T_9	NPK (75% RDF) N and P as RP and K 1/3 (B+ MT+ PI)	156.45	158.01	13.70	13.84	213.60	215.74	5.15	5.25
T_{10}	NPK (75% RDF) N1/3 (7DAT+ MT+PI) P and K 1/3 (B+ MT+ PI)	160.80	162.41	14.70	14.85	220.90	223.11	5.35	5.37
SEm±		**3.61**	**3.95**	**0.52**	**0.57**	**3.40**	**4.04**	**4.04**	**0.29**
CD (P=0.05)		**10.01**	**11.50**	**1.50**	**1.68**	**10.01**	**12.22**	**12.22**	**0.89**

NPK- Nitrogen, Phosphorus, Potassium ; RDF- Recommended dose of fertilizer; DAT- Days of transplanting; MT- Maximum tillering; PI- panicle initiation; B -Basal

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