AU
DOI: 10.15740/HAS/AU/11.1/75-78
Agriculture Update
Volume **11** | Issue 1 | February, 2016 | 75-78
Visit us : *www.researchjournal.co.in*
e ISSN-0976-6847

RESEARCH ARTICLE :

Effect of split application of NPK fertility on nutrient uptake by hybrid rice (*Oryza sativa* L.) and soil health

N.K. TIWARI, S.F.A. ZAIDI, CHANDAN KUMAR SINGH AND RAHUL KUMAR SINGH

ARTICLE CHRONICLE :
Received : *01.01.2016;*
Revised : *13.01.2016;*
Accepted : *24.01.2016*

SUMMARY : The experiment was conducted during *Kharif* season of 2011-12 and 2012-13 to study the effect of split application of NPK on fertilizer use efficiency, nutrient availability and yield of hybrid rice in partially reclaimed salt affected soil 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 as 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), T_5 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_8 NPK (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 used for the experiment. The split application of NPK (100% RDF) N 1/3(7DAT+MT+ PI) P and K 1/3 (B + MT+PI) produced highest growth parameters, yield attributing parameters grain (7.35 t ha^{-1}), straw (9.70 t ha^{-1}) yield and uptake of NPK (172.78, 39.04 and 153.68 kg ha^{-1}) was significantly superior over the rest of all treatments. Significantly at par , yield attributes gain yield, nutrient and protein content and nutrient uptake were recorded by T_{10} (75% NPK- RDF with split application) and T_2 (100% NPK- RDF applied as recommended practices). This way 25% NPK could be saved by spliting NPK without loosing yield.

KEY WORDS :
Spliting, NPK uptake, availability of NPK, Soil health

How to cite this article : Tiwari, N.K., Zaidi, S.F.A., Singh, Chandan Kumar and Singh, Rahul Kumar (2016). Effect of split application of NPK fertility on nutrient uptake by hybrid rice (*Oryza sativa* L.) and soil health. *Agric. Update*, **11**(1): 75-78.

Author for correspondence :
N.K. TIWARI
Department of Extension Education, N.D. University of Agriculture and Technology, Narendra Nagar, Kumarganj, FAIZABAD (U.P.) INDIA
Email: nktiwarissnd@gmail.com
See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is an important cereal crop that provides 43 per cent of calorie requirement for more than 70 per cent of Indian as well as world's population. It is an excellent source of carbohydrates, proteins, and mineral matter hence it is primarily used as staple food crop and source of livelihood for 120-150 million rural households. Therefore rice is the backbone of Indian agriculture. The requirement of rice production in the country is to be estimated around 145 million tonnes by the year 2020.To achieve this target in coming few years without affecting the soil fertility and environmental condition would be a challenge.

India is the second largest producer and consumer of rice in the world. Rice production in India crossed the mark of 100 million tonnes in 2012-13 accounting for 22.81 per cent of global production in that year. In India, rice is cultivated over an area about 39.47 million hectares with an annual production of about 92.76 million tonnes. In U.P. rice is grown on an area of about 5.59 m ha with a production of 11.7 million tonnes and productivity of about 2.06 tonnes ha^{-1} (Anonymous, 2013).

Crop utilization of N by rice is generally less than 40 per cent of the applied N. This is attributed to rapid loss of applied N through ammonia volatilization, denitrification and leaching. However, management practices such as split and timing of NPK application.The recommended practice is to apply full P and K and 50 per cent 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. More potassium is required by hybrid rice 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).

RESOURCES AND METHODS

The field experiment was conducted at the Research Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during two *Kharif* seasons of 2012-13 and 2013-14. The treatments were laid out in Randomized Block Design with three replications. 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), T_5 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 used for the experiment. The experimental soil was silt loam with pH (1:2.5) 8.41 and 8.40, EC 0.37 and 0.36 dSm^{-1}, during season 2012-13 and 2013-14.

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content grain (\%) x Grain yield (kg/ha)}}{100} + \frac{\text{Nutrient content in straw (\%) x Straw yield (kg/ha)}}{100}$$

OBSERVATIONS AND ANALYSIS

The grain and straw yield of rice were influenced significantly due to spliting of NPK fertilizers. The maximum grain and straw yields were recorded in the treatment T_6 (7.25, 7.45 and 9.45, 9.95 t ha^{-1}) followed by T_5 (7.05, 7.21 and 9.55 and 9.55 t ha^{-1}) and T_3 (6.40, 6.44 and 8.40, 8.75 t ha^{-1}). Obviously significantly minimum grain and straw yields were recorded in control treatment T_1 (3.30, 3.40 and 5.15, 5.25 t ha^{-1}) during the both years (Table 1). The splitting of nitrogenous fertilizer resulted better response followed by potassium and phosphate fertilizers. The availability of urea is very quick and before utilizing by plants the element N could be lost by leaching volatilization and denitrification. The availability of potassic and phosphatic fertilizers reduced due to fixation of these elements. The splitting of these fertilizers reduces losses and improved the availability of these elements to root zone (Zaidi *et al.*, 2007). These findings could be corroborated with the findings of Wei (2011) and Dey *et al.* (2014).

The nutrient (NPK) uptake is directly related to the grain and straw yield of rice crop. The generally split application of NPK fertilizers improved the uptake of these elements in rice crop. The maximum N uptake was recorded by the treatments T_6 (170.11 and 175.44 kg ha^{-1}) followed by T_5 (158.54 and 161.92 kg ha^{-1}) and

Table 1 : Effect of split application of NPK fertilizers on nutrient uptake (kg ha^{-1}) of hybrid rice

Treatments		Nitrogen		Phosphorus		Potassium		Grain yield	
		2012	2013	2012	2013	2012	2013	2012	2013
T_1	Control	75.08	77.37	12.74	13.94	74.84	77.16	3.30	3.40
T_2	NPK (100% RDF) as Recommended practices (RP)	129.87	131.16	26.97	28.45	119.33	120.47	6.15	6.18
T_3	NPK (100% RDF) as N1/3(7DAT+MT+PI) P and K basal	147.60	150.26	32.44	34.61	132.44	137.56	6.40	6.44
T_4	NPK (100% RDF) N and K recommended P 1/3 (B+ MT+ PI)	140.73	141.74	28.85	30.57	128.43	131.09	6.25	6.27
T_5	NPK (100% RDF) N and P as RP and K 1/3 (B+MT+ PI)	158.54	161.92	33.59	36.03	142.88	149.28	7.05	7.21
T_6	NPK (100% RDF) N 1/3(7DAT+MT+PI) P and K 1/3(B+MT+PI)	170.11	175.44	38.32	39.76	150.22	157.14	7.25	7.45
T_7	NPK (75% RDF) N 1/3(7DAT+MT+PI) P and K basal	117.98	122.82	23.47	25.69	110.39	118.03	5.25	5.30
T_8	NPK (75% RDF) N and K as RP and P 1/3 (B+MT+ PI)	108.05	114.81	18.85	21.13	103.22	112.56	5.00	5.15
T_9	NPK (75% RDF) N and P as RP and K 1/3 (B+ MT+ PI)	111.96	117.52	20.63	22.71	107.48	112.91	5.15	5.25
T_{10}	NPK (75% RDF) N1/3 (7DAT+ MT+PI) P and K 1/3 (B+MT+PI)	118.11	119.37	23.50	24.68	112.82	114.12	5.35	5.37
S.E.±		4.2	3.86	1.03	1.49	3.91	5.29	0.29	0.24
C.D. (P=0.05)		12.47	11.47	3.06	4.43	3.75	15.72	0.89	0.70

Table 2 : Effect of split application of NPK fertilizers on pH, EC and OC of hybrid rice

Treatments		pH (1:2.5)		EC dSm^{-1}(1:2.5)		OC (g kg^{-1})	
		2012	2013	2012	2013	2012	2013
T_1	Control	8.40	8.32	0.34	0.32	3.50	3.54
T_2	NPK (100% RDF) Recommended practices (RP)	8.24	8.16	0.32	0.32	3.80	3.84
T_3	NPK (100% RDF) as N 1/3(7DAT+MT+ PI) P and K basal	8.10	8.02	0.30	0.29	3.95	3.96
T_4	NPK (100% RDF) N and K recommended P (3/4 B+1/3 PI)	8.20	8.12	0.32	0.31	3.80	3.84
T_5	NPK (100% RDF) N 1/3(7DAT+MT+ PI) K (3/4 B+1/3 PI) and P RP	8.17	8.09	0.32	0.30	3.90	3.94
T_6	NPK (100% RDF) N 1/3(7DAT+MT+ PI) P and K 1/3 (B+MT+PI)	8.00	7.92	0.29	0.28	3.96	3.98
T_7	NPK (75 % RDF) N 1/3(7DAT+MT+ PI) P and K basal	8.25	8.17	0.33	0.30	3.70	3.74
T_8	NPK (75% RDF) N and K RP and P 1/3 (B+MT+PI)	8.39	8.31	0.33	0.32	3.50	3.54
T_9	NPK (75% RDF) N and P RP and K 1/3 (B+MT+PI)	8.30	8.22	0.31	0.33	3.61	3.64
T_{10}	NPK (75% RDF) N1/3 (7DAT+MT+PI) P and K 1/3 (B+MT+PI)	8.11	8.03	0.31	0.30	3.80	3.84
S.E.±		-	-	-	-	-	-
C.D. (P=0.05)		NS	NS	NS	NS	NS	NS

NS=Non-significant

Table 3 : Effect of split application of NPK fertilizers on CEC and ESP of hybrid rice

Treatments		CEC (C mol p+) kg^{-1}		ESP	
		2012	2013	2012	2013
T_1	Control	13.50	13.54	26.05	26.31
T_2	NPK (100% RDF) as Recommended practices (RP)	13.80	13.82	24.00	24.24
T_3	NPK (100% RDF) as N1/3(7DAT+MT+PI) P and K basal	13.90	13.94	23.95	24.09
T_4	NPK (100% RDF) N and K recommended P 1/3 (B+ MT+ PI)	13.80	13.84	24.55	24.80
T_5	NPK (100% RDF) N and P as RP and K 1/3 (B+MT+ PI)	14.00	14.04	22.65	22.88
T_6	NPK (100% RDF) N 1/3(7DAT+MT+PI) P and K 1/3(B+MT+PI)	14.10	14.14	22.20	22.42
T_7	NPK (75% RDF) N 1/3(7DAT+MT+PI) P and K basal	13.70	13.74	24.40	24.64
T_8	NPK (75% RDF) N and K as RP and P 1/3 (B+MT+ PI)	13.50	13.54	25.25	25.50
T_9	NPK (75% RDF) N and P as RP and K 1/3 (B+ MT+ PI)	13.60	13.64	24.95	25.20
T_{10}	NPK (75% RDF) N1/3 (7DAT+ MT+PI) P and K 1/3 (B+ MT+ PI)	13.80	13.84	23.15	23.30
S.E.±		0.40	0.50	0.90	1.01
C.D. (P=0.05)		1.30	1.70	2.14	3.00

T_3 (147.60 and 150.26 kg ha^{-1}) where N was given as 1/3 as 7 DAT + 1/3 at MT and 1/3 at PI stage of crop growth. The maximum P uptake were recorded by the treatment T_6 (38.32 and 39.76 kg ha^{-1}) followed by T_5 (33.59 and 36.03 kg ha^{-1}) and T_3 (32.44 and 34.61 kg ha^{-1}) where P was given in three split and maximum K was recorded in the treatment T_6 (150.22 and 157.14 kg ha^{-1}) followed by T_5 (142.88 and 149.28 kg ha^{-1}) where potassium was given in three splits as 1/3 basal + 1/3 MT and 1/3 PI stage of plant growth. Fortunately NPK uptake were recorded at par in T_{10} there 75% RDF-NPK were applied splits as compare to 100% RDF-NPK given as recommended practices (Table 1). The split application of these nutrients improved the availability of these nutrients is root zone when required urgently. The split application also increased the quantum of available nitrogen, phosphorus and potassium in the soil which ultimately favoured the increased NPK uptake by crop. Similar result, were also reported by Zaidi *et al.* (2007), Shah *et al*. (2006).

Effect split application of NPK fertilizers on pH, EC and OC was found non-significant (Table 2).

The split application of NPK to increase the inorganic sources improved the cation exchange capacity of soil. The maximum CEC increase in soil was noted treatment T_6 (14.10 and 14.14 C mol (p+) kg^{-1}) followed by T_5 (14.00 and 14.04 C mol (p+) kg^{-1}) and T_3 (13.90 and 13.94 C mol (p+) kg^{-1}) treatments, while minimum in treatment T_1 (13.50 and 13.54 C mol (p+) kg^{-1}) control plot. The increase of soil CEC may be due to available higher amount of NPK in soil solution and root zone. Sharma and Gupta (2002) also observed similar findings. The exchangeable sodium percentage of soil after harvesting of hybrid rice reduced significantly in split application treatment recording minimum by T_6 (22.20 and 22.42 %) followed by T_5 (22.65 and 22.88%) and T_3 (23.95 and 24.09%), while maximum ESP was recorded in treatment T_1 (26.05 and 26.31%). It is may be due to availability of higher amount of NPK nutrient and hence neutralization of alkali present in the soil. These results corroborates with the finding of More (1994) and Kavita *et al.* (2008).

Authors' affiliations :

S.F.A. ZAIDI, Department of Extension Education, N.D. University of Agriculture and Technology, Narendra Nagar, Kumarganj, FAIZABAD (U.P.) INDIA

CHANDAN KUMAR SINGH, Department of Soil Science, N.D. University of Agriculture and Technology, Narendra Nagar, Kumarganj, FAIZABAD (U.P.) INDIA

RAHUL KUMAR SINGH, Department of Plant Pathology, N.D. University of Agriculture and Technology, Narendra Nagar, Kumarganj, FAIZABAD (U.P.) INDIA

REFERENCES

Anonymous (2013). Annual Progress Report AICRP, Vol. 3, Directorate of Research, Hyderabad (A.P.) INDIA.

Celik, H., Ashik, B.B., Gurel, S. and Katkat, A.V. (2010). Potassium as on intensifying factor for iron chlorosis. *Internat. J. Agric. Biol.*, **12** : 359-364.

Dey, B.R. Rahman, M.M. and Hoque, M.A. (2014). Enhancement of the growth and yield of rice bf spilt application Nitrogen phosphorous, potassium and sulphur fertilizer. *J. Soil Nature,* **7**(1):7-12.

DRR (1998). Annual report, 1997-98. Dirctorate of Rice Research, Rajendranagar, Hyderabad (A.P.) INDIA.

Kavita, M.P., Balasubramanian, R., Babu, R. and Pandi, V.K. (2008). Effect of nitrogen and potassium management on yield attributes, yield and quality parameters of hybrid rice. *Crop Res.*, **35** (3) : 172-175.

More, S.D. (1994). Effect of split application of NPK on soil peroperties, nutrient availability and yield of rice – wheat cropping grown on sodic vertisaol. *J. Indian Soc. Soil. Sci*., **42** (2) : 253-256.

Sharma, M.P., Bali, S.V. and Gupta, D.K. (2002). Crop yield and properties of inception as influenced by residue management under rice-wheat cropping sequence. *J. Indian Sco. Soil. Sci.,* **48** (3) : 506-509.

Shah, Syed Khursheed Hussain, Aslam, Muhammad, Khan, Parvez, Memon, Muhammad Yousuf, Muhammad Imita, Siddiqui, Saleem –ul –Haq and Nizamuddin (2006). Effect of different method and rates of phosphorous application in mungbeen. *Soil & Environ.*, **25** (1): 55-58.

Wei, Ni, Lu, Jian, Wei, He, Yu, Qing, Li, Xiao and Kun, Li Hui (2011). Effects of N, P, K fertilizer application on grain yield, quality, nutrient uptake and utilization of rice. *Chinese J. Rice Sci.,* **25**(6) : 645-653.

Zaidi, S.F.A., Tripathi, H.P. and Singh, B. (2007). Effect of N application timing on nitrogen use efficiency of rice. *Oryza*, **44** (3): 243-243.

Zhang, E.R., Haro, X.Y., Wang, R., Xu, Y. and Kong, X.B. (2004). Changes in soil properties in southern Beijing municipality following long reform. *Soil Til. Res.*, **75** : 143-150.