Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; SP1: 119-122

Ravi Shanker Khande
Department of Agronomy, College of Agriculture, I.G.K.V., Raipur, (C.G.), India

HL Sonboir
Department of Agronomy, College of Agriculture, I.G.K.V., Raipur, (C.G.), India

Chetna Sinha
Department of Agronomy, College of Agriculture, I.G.K.V., Raipur, (C.G.), India

Correspondence
Ravi Shanker Khande
Department of Agronomy, College of Agriculture, I.G.K.V., Raipur, (C.G.), India

Effect of Nitrogen Levels and Splitting on Nutrient Uptake and Soil Fertility Status in Pre-Monsoon Established Rice (*Oryza sativa* L.)

Ravi Shanker Khande, HL Sonboir and Chetna Sinha

Abstract
The field experiment was conducted at the Research cum Instructional Farm, IGKV, Raipur (C.G.) during *kharif* season of 2015. The experiment was laid out in split-plot design with three replications. The treatment composed of three nitrogen levels N_1 (100 kg N ha^{-1}), N_2 (125 kg N ha^{-1}) and N_3 (150 kg N ha^{-1}) assigned to main plot and six nitrogen splitting S_1–3 Splits (20:50:30 at 0, 30, 60 DAS), S_2–3 Splits (20:50:30 at 10-12, 30, 60 DAS), S_3–4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS), S_4–4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS), S_5–5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL) and S_6–5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) were allotted to sub-plot. The crop was fertilized with 60 kg P_2O_5 and 40 kg K_2O ha^{-1}. Among nitrogen levels and splitting, N_3 (150 kg N ha^{-1}) with S_6–5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL), recorded the maximum nitrogen, phosphorus, potassium uptake kg ha^{-1} and soil available nitrogen but lower in soil available phosphorus and potassium.

Keywords: Nitrogen, phosphorus, potash, splitting, rice

Introduction
Rice (*Oryza sativa* L.) is the most important crop of the World. Rice is belong to graminae family and is relished as staple food by majority of world's population. Rice is the most important cereal crop in Asia and it occupies 85% of the total rice area. Rice is the second most important crop next to wheat in terms of area in the world and about 40% of the World's population consumes rice as a major source of calorie (Banik 1999) [2]. India is the second largest producer and consumer of rice in the world. Area under rice crop in India is about 43.95 million hectare with production 103.61 million tonnes and productivity of 2492 kg per hectare during 2015-16 (GOI, 2015) [1].
Sowing of rice before onset of monsoon was an age old practice in Chhattisgarh. Direct-seeding of rice has several advantages over transplanting reduces labour needs, input requirements, investment and save time by timely sowing of rice and shorten crop duration by 7–10 days than transplanted rice (Gill *et al*., 2014) [5].
Nitrogen is the kingpin in fertilizer management programme for rice as it is the key to realise the yield potential of high yielding rice varieties. Insufficient and inappropriate fertilizer nitrogen management may account for one half to two thirds of the gap between actual and potential yields. For maximization of rice yield agronomic management is highly important. Among the management practices, soil fertilization, particularly nitrogen management is the most important. High yielding varieties are generally more adaptive to nitrogen application and they show increased yield with increasing nitrogen level up to a certain limit (Sarker and Ghatak 1988 and Park 1987). Pre-monsoon direct sowing of rice under irrigated condition has unique environment where losses of nitrogen is very high due to its aerobic environment. An aerobic condition leads to fast conversion of ammonium to nitrate and is consequents leached down. As the nitrogen use efficiency in rice is between the ranges of 40 to 60 percent, application of appropriate quantity of nitrogen at right time is perhaps the simplest agronomic solution for improving the use efficiency of nitrogen (Devi *et al*., 2012) [3].

Materials and Methods
The field experiment was conducted at the Research Cum Instructional Farm of IGKV, Raipur (C.G.) during *kharif* season, 2015. The soil was inceptisol, and neutral in pH (7.2) and the EC was 0.33dSm^{-1}. The soil was medium in available N (241.24 kg ha^{-1}), available P_2O_5 (18.13 kg ha^{-1}) and available K_2O (285.66 kg ha^{-1}). Treatments were consisted of application of nitrogen @ 100 kg ha^{-1}, 125 kg ha^{-1} and 150 kg ha^{-1} in main plot and different split doses S_1-3 Splits (20:50:30 at 0, 30, 60 DAS),

S_2-3 Splits (20:50:30 at 10-12, 30, 60 DAS), S_3-4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS), S_4-4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS), S_5-5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & flowering) and S_6–5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering) in sub plot in split-plot design with three replications. The field was thoroughly prepared by using mould bord plough, plankar and leveler. Rice variety "Rajeshwari (IGKV-R1)" was grown as a test crop. Sowing was done on June 14, 2015 and harvesting was done on October 19, 2015. Entire dose of Phosphorus and potassium were applied basally as per the recommended dose of 60 kg ha^{-1} of P_2O_5 and 40 kg K_2O ha^{-1} through SSP and MOP, respectively. Irrigation was given to crop to maintain soil saturation only instead of flooding. All other crop management practices were followed as per the recommendations of aerobic rice culture.

Nitrogen content in samples was determined by using Kjeldhal's distillation method. The phosphorus content in plant at harvest was determined by digested with triacid mixture consisting of HNO3: HClO4:H2SO4 (9:4:1) using Vanado-Molybdo-Phosphoric Yellow Colourmethod (Jackson 1967) [7]. Intensity of developed colour was measured by Spectronic-20 Colorimeter at wavelength of 660 nm using blue filter. The potassium content was estimated using Lange's Flame Photometer (Jackson 1967) [7]. The nitrogen, phosphorus and potassium uptake in plant was calculated by multiplying the respective per cent contents with total plant biomass (grain and straw yield). The soil sample was taken from 15-20 cm depth for soil analysis. Available nitrogen content in soil after harvest of rice crop was determined by alkaline permanganate method as described by Subbiah and Asija (1956) [11]. Available phosphorus content in soil after harvest of rice crop was analyzed by the method as suggested by Olsen (1954) [9] using 0.5 N $NaHCO_3$. Available potassium content in soil after harvest of rice crop was analysed by the flame photometer after 5 minute shaking with 25 ml of 1 N ammonium acetate (Jackson 1967) [7]. The significance of treatment effects was tested with variance ratio (f-value). Appropriate standard errors and critical difference at 5% probability level to test the statistical significance of the results (Gomez and Gomez, 1984) [6].

Results and Discussion
Nutrient uptake
Nitrogen uptake

Increasing levels of nitrogen increased the nitrogen uptake by rice. Data presented in Table 1 indicated that application of 150 kg N ha^{-1} found higher nitrogen uptake at all the stages except 30 DAS. Significantly the lowest nitrogen uptake was recorded under 100 kg N ha^{-1}. Application of nitrogen at 10 DAS recorded higher nitrogen uptake as compared to basal application of nitrogen. At 30 DAS, basal application of nitrogen was found higher nitrogen uptake kg ha^{-1} at respective level of splitting. The comparison of nitrogen splitting recorded that nitrogen applied in five splits S_6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering) found higher nitrogen uptake as compared to all other split applications of nitrogen at all the stages except 30 DAS. At 30 DAS four splits (S_3-20:25:25:30 at 0, 20, 40, 60 DAS) found higher nitrogen uptake. The lowest nitrogen uptake was recorded under three splitting of nitrogen S_1 (20:50:30 at 0, 30, 60 DAS). At 30 DAS three splitting of nitrogen (S_2-20:50:30 at 10-12, 30, 60 DAS) was found lowest nitrogen uptake which was at par with (S_1-20:50:30 at 0, 30, 60 DAS). Application of nitrogen in splits according to crop requirement might have reduced the loss of nitrogen and increased the nitrogen absorption consequently better utilization of applied nitrogen leads to higher dry matter accumulation and finally resulted in higher nitrogen uptake. Similar result was also found by Zaidi *et al.* (2007) [12] and Fatehjeet Singh *et al.* (2015) [4].

Phosphorus and Potassium uptake

Data presented in table 2 shows that increasing levels of nitrogen increased the phosphorus and potassium uptake of rice. Application of 150 kg N ha^{-1} reported significantly higher phosphorus and potassium uptake. Significantly the lowest phosphorus and potassium uptake was found under 100 kg N ha^{-1}. Application of nitrogen at 10 DAS reported higher phosphorus and potassium uptake as compared to basal application of nitrogen.

Table 1: Effect of nitrogen levels and splitting on nitrogen uptake (kg ha^{-1}) by rice at different growth stages of pre-monsoon established rice

Treatments	Nitrogen uptake (kg ha^{-1})					
	30 DAS	60 DAS	90 DAS	Grains	Straw	Total
Nitrogen levels (kg ha^{-1})						
N1-100	1.02	7.75	35.71	30.57	7.46	38.03
N2-125	1.40	10.37	47.66	37.57	11.50	49.07
N3-150	1.82	11.70	53.97	44.63	14.52	59.15
SEm±	0.02	0.18	0.93	0.68	0.24	0.90
CD (P=0.05)	0.10	0.72	3.65	2.67	0.94	3.55
Nitrogen splitting						
S1 – 3 Splits (20:50:30 at 0, 30, 60 DAS)	1.09	8.42	38.58	32.75	8.55	41.30
S2 – 3 Splits (20:50:30 at 10-12, 30, 60 DAS)	0.97	8.76	40.93	34.21	8.93	43.15
S3 – 4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS)	1.88	9.79	45.58	36.17	10.85	47.01
S4 – 4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS)	1.67	10.26	47.41	38.64	11.68	50.33
S5 – 5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL)	1.53	10.90	50.01	40.63	12.89	53.52
S6 – 5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL)	1.34	11.50	52.16	43.14	14.07	57.21
SEm±	0.05	0.30	2.52	1.07	0.40	1.44
CD (P = 0.05)	0.16	0.87	7.30	3.01	1.18	4.18

DAS= Days after sowing: FL= Flowering

Table 2: Effect of nitrogen levels and splitting on phosphorus and potassium uptake (kg ha^{-1}) of pre-monsoon established rice.

Treatments	Nutrient uptake (kg ha^{-1})					
	Phosphorus Potassium					
	Grain	Straw	Total	Grain	Straw	Total
Nitrogen levels (kg ha^{-1})						
N1-100	13.77	7.58	21.35	21.81	59.98	81.79
N2-125	15.55	8.37	23.92	23.13	69.85	92.99
N3-150	17.89	9.60	27.49	24.55	91.74	116.29
SEm±	0.35	0.23	0.48	0.14	0.91	0.98
CD (P=0.05)	1.38	0.92	1.91	0.58	3.58	3.86
Nitrogen splitting						
S1 – 3 Splits (20:50:30 at 0, 30, 60 DAS)	13.38	7.68	21.07	20.76	61.37	82.13
S2 – 3 Splits (20:50:30 at 10-12, 30, 60 DAS)	14.47	8.08	22.55	22.10	68.27	90.37
S3 – 4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS)	15.33	8.12	23.45	21.98	71.18	93.16
S4 – 4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS)	16.40	8.65	25.04	22.97	75.03	98.00
S5 – 5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL)	16.73	8.94	25.66	24.16	80.75	104.91
S6 – 5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL)	18.11	9.65	27.75	27.03	86.55	113.57
SEm±	0.50	0.28	0.57	0.52	2.41	2.70
CD (P = 0.05)	1.44	0.83	1.67	1.53	6.98	7.80

DAS= Days after sowing: FL= Flowering

Table 3: Effect of nitrogen levels and splitting on soil available nitrogen, phosphorus and potassium of pre-monsoon established rice.

Treatments	Soil available nutrients (kg ha^{-1})		
	Nitrogen	**Phosphorus**	**Potassium**
Nitrogen levels (kg ha^{-1})			
N1-100	253.83	20.28	281.72
N2-125	267.24	19.64	270.63
N3-150	273.73	18.30	263.07
SEm±	1.77	0.31	0.85
CD (P=0.05)	6.97	1.23	3.38
Nitrogen splitting			
S1 – 3 Splits (20:50:30 at 0, 30, 60 DAS)	254.05	20.84	282.65
S2 – 3 Splits (20:50:30 at 10-12, 30, 60 DAS)	257.67	20.07	278.06
S3 – 4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS)	262.46	19.76	274.06
S4 – 4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS)	266.72	19.27	269.99
S5 – 5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL)	271.47	18.63	265.79
S6 – 5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL)	277.23	17.87	260.30
SEm±	5.23	0.38	4.94
CD (P = 0.05)	15.12	1.11	14.29

DAS= Days after sowing: FL= Flowering

The comparison of nitrogen splitting exhibited that nitrogen applied in five splits S6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) reported significantly higher phosphorus and potassium uptake. The lowest phosphorus and potassium uptake was recorded under three splitting of nitrogen (S1-20:50:30 at 0, 30, 60 DAS) which was at par with (S2-20:50:30 at 10-12, 30, 60 DAS.

Available soil nutrient

Available nitrogen

The data on Table 3 shows that increasing levels of nitrogen increased the soil available nitrogen. Application of 150 kg N ha^{-1} found higher soil available nitrogen (273.73 kg ha^{-1}). The lowest soil available nitrogen (253.83 kg ha^{-1}) was recorded under 100 kg N ha^{-1}. Higher nitrogen content in soil after harvest might be due to application of nitrogen to the soil. This result is in agreement with findings of Mujumdar *et al.* (2005) [8] and Zaidi *et al.* (2007) [12]. The comparison of nitrogen splitting recorded that nitrogen applied in five splits (S_6-20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) found higher soil available nitrogen (277.23 kg ha^{-1}). The lowest soil available nitrogen (254.05 kg ha^{-1}) was observed under three splitting of nitrogen (S_1-20:50:30 at 0, 30, 60 DAS).

Available phosphorus and potash

Data presented in table 3 shows that increasing levels of nitrogen decreased the soil available phosphorus and potash. Application of 100 kg N ha^{-1} found higher soil available phosphorus and potash. Significantly the lowest soil available phosphorus and potash was recorded under 150 kg N ha^{-1}. The comparison of nitrogen splitting revealed that nitrogen applied in three splits (S1-20:50:30 at 0, 30, 60 DAS) reported higher soil available phosphorus and potash, however which was at par with S2 (20:50:30 at 10-12, 30, 60 DAS) and S3 (20:25:25:30 at 0, 20, 40, 60 DAS). The lowest soil available phosphorus and potash was found under six splitting of nitrogen S6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) which was at par with S5 (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL).

Conclusion

Application of 150 kg N ha^{-1} in five splits S_6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) was found higher nitrogen, phosphorus and potassium uptake kg ha^{-1} than that of other levels of nitrogen. Application of 150 kg N ha^{-1} in five splits S_6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL) recorded higher soil available nitrogen at harvest, however application of 100 kg N ha^{-1} in three splits (S_1-20:50:30 at 0, 30, 60 DAS) found higher soil available phosphorus and potassium. Interaction effect of levels and splitting of nitrogen was found non-significant.

References

1. Anonymous. GOI. Second estimate, 2015-16, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture, GOI, 2015-16.
2. Banik P. Cold Injury Problems in Boro Rice. In Proc. of the Workshop on Modern Rice Cultivation in Bangladesh. Bangladesh Rice Res. Inst. Joydebpur, Gazipur, Bangladesh. 1999, 37.
3. Devi. Influence of levels and time of nitrogen application on yield, nutrient uptake and post-harvest nitrogen status of soil in aerobic rice. Current Biotica. 2012; 6(1):98-102, 2012.
4. Fatehjeet Singh, Kang JS, Avtar Singh, Thakar Singh. Nutrient uptake, nutrient availability and quality parameters of mechanically transplanted rice (*Oryza sativa* L.) under split doses of nitrogen. Agric. Sci. Digest., 2015; 35(2):95-100.
5. Gill JS, Walia SS, Gill RS. Direct seeded rice: An alternative rice establishment technique in north-west India – A review. International Journal of Advanced Research. 2014; 2(3):375-386.
6. Gomez AK, Gomez AA. Statistical Procedures for Agriculture Res. A wiley-Inter Sci. Publication. Johan Wiley and Sons, New York, 1984.
7. Jackson ML. Soil chemical analysis, pentice hall of India Pvt. Ltd., New Delhi, 1967.
8. Mujumdar B, Venkatesh MS, Kumar K, Patiram. Nitrogen requirement of lowland rice in valley lands of Meghalaya. Indian Journals of Agricultural Science. 2005; 75(8):504-506.
9. Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bi-carbonate. USDA. Circ. 1954; 939:1-19.
10. Sarker RK, Ghatak S. Growth analysis and agronomic appraisal of Indian rape under nitrogen application. Ind. J. Agron. 1988; 32(i):63-69.
11. Subbiah BV, Asija GC. A rapid method for the estimation of nitrogen in soil. Current Science. 1956; 26:259-288.
12. Zaidi SFA, Tripathi HP, Singh B. Effect of N application timings on nitrogen use efficiency of rice. Crop production *Oryza.* 2007; 44(3):243-246.