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Comparative study of farmers' method with improved methods of nitrogen application in rice

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ABSTRACT

Farmers' knowledge, attitude and belief towards fertilizer N management in rice was assessed through survey schedule and it was observed that there exists a large extension gap between fertilizer recommendations of the government extension services and actual fertilizer pattern being followed by the farmers. About 60% of the farmers used 195 kg N ha^{-1} in 3-4 splits but over fertilized condition of farmers' practice (45 kg more N) did not show any significant yield advantage over existing recommended and soil test based nitrogen management practices under field conditions. However, field study showed LCC based N scheduling a better perspective for higher N-use efficiency of rice along with basal N application. Among rice cultivars, HKR 126, PR 106 and PR 114 were statistically at par providing significantly higher yield than in IR 64.

Key words: *Rice yield, farmers' fertilizer use pattern, N management, genotypes*

Different methods of nitrogen management have shown that the recovery of fertilizer N applied was not more than 50% (Singh *et al*., 2001) because rice is grown in an environment that is conducive to N losses due to nitrification-denitrification, ammonia volatilization, run-off and leaching (Stalin *et al*., 1999). Therefore, efficient nitrogen management is one of the most important strategies for increasing rice production as well as N-use efficiency (Lafitte, 1998). Farmers apply nitrogen in excess of the crop requirements for apparent increase in yield without considering its ill effects on underground water, disease infestation and other environmental pollution problems. However, flexibility of farmers in adjusting the timing and amount of fertilizer applied offers great potential to synchronize N application with the crop requirement in real time to maintain soil health as well as to get desirable yield, but it varies considerably even within small recommendation domains. In order to evaluate its impact assessment, field experiments were conducted at different locations for studying farmers' fertilizer use pattern *vis-a-vis* other improved practices of N fertilization. Leaf colour chart (LCC) based N management (Yang *et al*., 2003), soil test based N application (Riazuddin Ahmed *et al*., 1999) and State agriculture university (SAU) recommended method were taken as other nitrogen treatments. The main objective of this study was (a) to assess the existing farmers' fertilizer use pattern and further its impact assessment at farmers' fields in comparison with other improved practices of N fertilization and (b) to suggest the right scheduling of nitrogen application based on crop requirement so as to economize its dose and reduce losses.

Field experiments were conducted during wet season 2002 at three different sites, *viz*., village Teek, District Kaithal, Krishi Vigyan Kendra, Kaithal and village Rampur Thery, District Sirsa in predominantly rice growing areas of Haryana. The soil of the experimental fields were sandy clay loam in texture, slightly alkaline (pH 8.0-8.6), low in available nitrogen (148-175 kg N ha^{-1}), medium in available phosphorus (24-29 kg P_2O_5 ha^{-1}) and high in available potassium (380-500 kg K_2O ha^{-1}). Prior to the experiment, a benchmark survey was conducted to investigate farmers' knowledge, attitude and beliefs towards

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fertilizer N management (amount and time) in rice in these villages. Accordingly, sixteen treatment combinations comprising of four nitrogen management practices (Recommended, Soil test based, Farmers' practice and Leaf colour chart based) and four varieties (IR 64, HKR 126, PR 114 and PR 106) were laid out in a randomized block design with three replications. For recommended and soil test based fertilizer application, N: P_2O_5: K_2O in the ratio of 150: 60: 60 and 150: 40: 0 kg ha^{-1}, respectively was applied (Table 1). In LCC based fertilizer application, LCC readings were taken once every 10 days starting from 14 days after transplanting (DAT) to 54 DAT and a critical value of 4.0 was adjudged as the signal for fertilizer application. For this, 10 youngest fully expanded leaves were chosen for leaf colour measurement. If the mean of all the readings remains <4.0, then N as urea @ 23 kg ha^{-1} was applied on that day, otherwise the N dose was skipped off. In this practice, 60 kg P_2O_5 as single super phosphate and 60 kg K_2O as murate of potash per hectare were applied as basal dose before transplanting. At 44 DAT, LCC value of >4.0 was recorded in HKR 126 and PR 106 at all the sites. Therefore, a fertilizer dose of 23 kg N ha^{-1} was omitted in these two varieties. Full dose of P and K was applied at the time of puddling in all the practices, however, nitrogen application was done as per the treatments under study (Table 1).

Generally, medium to large farmers showed greater response towards these management aspects. Only 13.75% of the total farmers were aware of these fertilizer recommendations and they reported that N should be applied in split doses (36.36%) within 40-50 days after transplanting (59.09%). Majority of the farmers applied 375 and 125 kg of urea and di-ammonium phosphate (DAP) per hectare, respectively. Most of the farmers applied first, second, third and fourth dose of N within 0-5 (80.00%), 10-20 (66.25%), 30-40 (46.25%) and 40-50 (45.63%) days after

Table 1. Time and dose of fertilizer application

Nitrogen scheduling practices	Fertilizer dose (kg ha^{-1})			No. of splits	Time of N application
	N	P_2O_5	K_2O		
Recommendation	150	60	60	4	Basal, 20 and 40 DAT
Soil test	150	40	-	4	Basal, 20 and 40 DAT
Farmers' practice	195	57.5	-	4	Basal, 15, 30 and 45 DAT
Leaf colour chart	92*/115**	60	60	5	14, 24, 34, 44 and 55 DAT

*applied to HKR 126 and PR 106, **applied to PR 114 and IR 64, DAT- days after transplanting

Table 2. Effect of different nitrogen management practices on promising rice genotypes in Haryana

Treatments	Panicles m^{-2}	Grains $Panicle^{-1}$	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	NUE (kg grain kg N^{-1})
Nitrogen management practices						
Recommendation basis	302.4	95.5	25.57	6.92	8.52	46.1
Soil test basis	300.0	96.25	25.51	6.83	8.51	45.6
Farmer's practice	311.7	96.08	26.14	7.11	8.75	36.4
Leaf colour chart basis	274.2	91.47	24.02	5.86	7.60	56.8
SEm±	5.34	1.16	0.40	0.12	0.23	-
C.D. (P=0.05)	15.42	3.36	1.15	0.34	0.67	-
Genotypes						
IR 64	273.9	99.32	24.46	5.79	7.86	38.7
HKR 126	297.7	97.63	25.94	7.17	8.38	47.9
PR 114	305.5	92.22	25.26	6.86	8.73	45.9
PR 106	311.4	90.14	25.60	6.90	8.39	46.1
SEm±	5.34	1.16	0.40	0.12	0.23	-
CD (P=0.05)	15.42	3.36	1.15	0.34	0.67	-

transplanting.

Nitrogen management as per farmers' practice resulted in highest mean grain and straw yield and was statistically at par with nitrogen application based on soil test basis and also on SAUs recommendation (Table 2). However, all these practices proved significantly superior to LCC based N application (92-115 kg N ha^{-1}). The per cent increase in grain yield due to farmers' practice, recommended and soil test based fertilizer application was 17.6, 15.3 and 1.3%, respectively over LCC based nitrogen management practice. The panicle number, grains $panicle^{-1}$ and 1000-grain weight also recorded similar trend as that of grain yield. Similar results on cumulative effect of favourable growth and yield attributes have also been reported by Surekha *et al*. (1999). The study further revealed that in farmers' practice, mean response of fertilizer N applied was only 36.4 kg grain kg N^{-1} while the corresponding response for the soil test based and recommended N application was 45.6 and 46.1 kg grain kg N^{-1}, respectively. However, the N applied on the basis of LCC gave mean response of 56.8 kg grain kg N^{-1} indicating the most efficient N management under this practice. This was due to the fact that in case of LCC based N application, whole N was applied in 4-5 splits (depending on variety requirement) upto 54 DAT, which resulted in its enhanced availability and consequently higher NUE (Surekha *et al.,* 1999). Higher losses at higher N levels in farmers' practice might have led to lower utilization of applied N (Velu and Ramanathan, 1988). However, the lower growth and yield of LCC based N application might be due to the omission of basal dose and must be applied to achieve the acceptable yield to compare it with other practices. Similar results were reported by Maity and Mishra (2001).

HKR 126, PR 106 and PR 114 were statistically at par with each other and gave 19.3, 16.1 and 15.7% higher mean yield over IR 64, respectively. The data further indicate that the mean response regarding grain yield per unit N applied was 47.9, 46.1 and 45.9 kg grain kg N^{-1} for HKR 126, PR 106 and PR 114, respectively. However, it was only 37.9 kg grain kg N^{-1} applied in case of IR 64. Genotypic variation in the efficiency of N utilization has also been reported by Lee *et al.* (2004).

On the basis of theses results, it can be concluded that over fertilized condition of farmers' practice could not bring out any significant yield advantage as compared to other improved practices of N management. LCC based N scheduling seems to be a better prospective for higher NUE in rice provided basal N is applied.

REFERENCES

Bijay Singh, Bronson KF, Yadvinder Singh, Khera TS and Pasuquin E 2001. Nitrogen balance as affected by rice straw management in north-west India. Nutrient Cycling in Agro-ecosystem. 59: 227-237

Lafitte HR 1998. Research opportunities to improve nutrient use efficiency in rice cropping systems. Field Crops Res 56: 223-236

Lee Ho Jin, Lee Seung-Hun and Chung Ji Hoon 2004. Variation of nitrogen use efficiency and its relationships with growth characteristics in Kor rice cultivars. New directions for a diverse planet: Proceedings of the 4th International Crop Science Congress, Brisbane, Australia, 26 September 26 – 1 October, 2004

Maity SK and Mishra BN 2001. Effect of levels and time of nitrogen application on productivity of hybrid rice. Ann Agric Res 22(1): 160-161

Riazuddin Ahmed S, Chandrasekhar Reddy K and Shan Mohammad 1999. Soil test -yield goal approach as an aid to balanced fertilization to rice in intensive cropping systems. Oryza 36(3): 223-227

Stalin P, Thiyagarajan TM and Rangarajan R 1999. Nitrogen application strategy and use efficiency in rice. Oryza 36(4): 322-326

Surekha K, Narayana Reddy M and Mahender Kumar R. 1999. Yield attributes and yield of rice hybrids as influenced by nitrogen sources and its split application. Indian J Agron 44(1): 80-88

Velu V and Ramanathan KM 1988. Leaching losses of nitrogen in clay loam soils of Cauvery delta. Oryza 25: 374-379

Yang W, Peng S, Huang J, Sanico AL, Buresh RJ and Witt C 2003. Using leaf colour charts to estimate leaf nitrogen status of rice. Agron J 95: 212-217