Research Paper Agriculture

Nitrogen Nutrition to Rice – A Review

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ABSTRACT

Nitrogen is pivotal in yield realization of rice. In India about 67 per cent of rice soils are estimated to be in shortage of adequate nitrogen and consequently rice crop has become a major consumer of nitrogen fertilizer. The use efficiency of applied fertilizer nitrogen by rice crop is very low, nitrogen use efficiency (NUE) usually ranges from 30 to 40 per cent. The influence of 'time of N application' on crop growth and grain yield is reported by many authors and attempts have been made to quantitatively describe the effect. Supplying N as and when the crop required is of paramount importance in increasing the use efficiency. With this background, the literatures related to introduction of SRI, seedling age on growth and yield attributes effect of crop water management on root characters and different N management approaches in relation to nutrient uptake and yield parameters are presented in this chapter.

KEYWORDS Rice, Nitrogen nutrition, efficiency

Nitrogen nutrition to rice

The response of rice genotypes to nitrogen application has been undoubtedly established. Supply of N is, probably the most important factor for increased rice production.

i. It imparts dark green colour to plans
ii. It promotes rapid root growth, increase height and tiller, the later being particularly important to increase grain yield.
iii. It increases the size of the leaves and grains, and
iv. It increases the protein content in the grains

The modern dwarf rice varieties are much more N responsive and lodging resistant than conventional varieties.

Critical growth stages of rice crop and N supply

Fertilizer N should be applied at times that are compatible with the stage of development of the crops that permits higher recovery which will ensure adequate sink (panicles and spikelets) and source (leaves and stems). Inadequate N supply at any critical or physiological stages may retard the growth and yield of rice. N should be applied in suitable fractions to synchronize with the stages of vigorous absorption and efficient N assimilation by the plant for grain production.

Split application needed to be phased at transplanting, maximum tillering and panicle initiation to correspond to the need of rice. Application of 80 kg N ha^{-1} in five splits i.e. 20 percent each at basal, 15 DAT, tillering initiation, maximum tillering, and panicle initiation stages proved that the best in terms of productivity and net returns of scented rice (Shekhar *et al*., 2004).

N Supply during vegetative period

The postponing the first dose of N application until PI had no significant effect on grain yield. This was also indicated by the capacity of the soil to maintain the time course of sufficient leaf N concentration proposed by Thiyagarajan *et al*. (1994). They showed that the first N application could be delayed to the time up to which native soil N supply could maintain the leaf N concentration. Studies in Japan indicated that a controlled amount of basal N followed by a large amount of top dressed N gave better results than traditional method and N application focused on the latter half of growing period had resulted in an average yield of more than 4.5 t ha^{-1}.

N supply at Panicle initiation

Application of 100 kg N ha^{-1} at PI increased the grain yield of variety CR 1009 which received different amount at 10 DAT and the crop N uptake was very low at PI (Thiyagarajan *et al*., 1994). Application of 80 kg N/ha in five splits i.e. 20 percent each at basal, 15DAT, tillering initiation, maximum tillering, and panicle initiation stages proved that the best in terms of productivity and net returns of scented rice (Shekhar *et al*., 2004).

Prasad and De Datta (1979) reported that conventional N fertilizer should be applied in two or three splits, with one dose applied at panicle initiation. The dry matter produced and the grain yield were found to be strongly correlated with the average crop N status from PI to flowering and the number of spikelets per unit area was strongly related to the increase in total crop weight during this period which indicated the importance of N application at PI stage

N supply after PI

Pandey et al. (1997) suggested that controlling the supply of N during initial growth stages and following with the application of large amount of N as top dressing in the reproductive phases bring higher yield than the recommended split application. Miah et al. (1997) concluded that N application during ripening period was more beneficial for yield and the effects fluctuated from variety to variety.

Effect of split application of N on growth characters

Taller plants and increased number of tillers were noticed when N was applied in four equal splits at basal, AT, maximum tillering and PI stages. Upadhyaya *et al*. (1985) reported that split application of N significantly increased the plant height and number of tillers. Split application of N maintained higher leaf area and leaf duration thus contributing to the growth and development of the plants improved by increased photosynthetic activity.

Vaiyapuri *et al*. (1998) reported that addition of 100kg N ha^{-1} in three splits resulted an increased in dry matter accumulation with 200 kg N ha^{-1} in hybrid rice. Kavitha (2001) observed that the plant height, number of tillers, LAI, DMP were higher in three equal splits at AT stage, but during later stages the four equal split application of N and K at AT, PI, post panicle initiation and flowering recorded higher growth attributes.

Effect of split application on yield components and yield

Application of 200 kg N ha^{-1} in four splits at basal, AT, PI and panicle emergence recorded higher grain yield in CORH-1 which was comparable with the application of 150 kg N in three splits at basal, AT and PI (Selvaraju *et al*., 1999). Dheebakaran and Ramasamy (1999) reported that for medium duration rice variety, N may be applied into five split doses at 40

kg basal, 20 kg AT, 20 kg seven days after AT, 20 kg PI and 20 kg heading stages was significantly increase the productive tiller, panicle efficiency, 1000 grain weight, HI and grain yield (6486 kg ha^{-1}) in clay loam soil.

Among various yield attributes, panicle length and grains per panicle increased significantly with four equal splits at basal, tiller initiation, panicle initiation and reduction division stages, respectively (Sharief Ahamed Dar et al., 2000).

Anandhakrishnaveni *et al*. (2001) reported that the recommended N + K in four splits i.e. 16.7% at 7DAT, 33.3% at 21 DAT, 33.3% at 55 DAT, 16.7% at 65 DAT registered the higher grain yield of 4.5 percent over the existing practice of three splits. Applying 16.7% of recommended N levels as basal followed by 33.3% N at 10 DAT, 25% N at 20 DAT and 25% N at 40DAT was found to be significantly superior than all the other treatments tried and recorded higher grain yields and N use efficiency.

Kavitha (2001) reported that four equal split application of N and K at AT, PI, booting and flowering recorded superior yield parameters which inturn registered higher grain yield of hybrid rice. Jayakumar (2001) observed that the application of N in four equal splits as 16.7% at 10 DAT, 33.3% at AT, 33.3% at PI and 16.7% at heading registered higher values of number of panicles per hill, panicle length and panicle weight, 1000grain weight, grain and straw yield of CORH-2. Nirmalakumari *et al*. (2002) recommended that application of 50% N and K and complete dose of P a day before transplanting and 25% at booting and 10 to 20% at heading stage gave higher yield.

Nitrogen Fertilizer Use Efficiency

Use of the LCC for N management as compared with farmers practice often increased and never decreased agronomic efficiency of N (AE_N) and recovery efficiency of N (RE_N). Use of LCC for N management combined with improved P and K fertilizer management often significantly increases yield and N use efficiency as compared with farmers' fertilizer practice in Asian rice fields (Gines *et al*., 2004). LCC in intensive, irrigated rice production systems of Asia have been reported savings in N fertilizer use, which can result in increased N fertilizer use efficiency (Bijay-Singh *et al*., 2002).

Economics

Integrating organic sources with inorganic nitrogen minimized the fertilizer N cost by 50% with green manure and 42% with FYM. Chavan *et al*. (1996) pointed out that basal application of 7.5 t ha^{-1} of green manure with 25 kg urea N ha^{-1} was on par with 100 kg N ha^{-1} in terms of yield. Cost of cultivation, gross return, net return, benefit cost ratio of the integrated nutrient management treatment were comparable with those of the recommended dose and there was a saving of 75 kg urea N ha^{-1}. Considering the maximum grain and straw yields and the highest benefit cost ratio, 50% N through organic and 50% N through inorganic is the best treatment (Balasubramanian and Veerabadran, 1997).

REFERENCES

Anandhakrishnaveni, S., R. Balasubramanian and P. Badmaja. 2001. Efficient nutrient management for late rabi rice. Madras Agric. J., 88(7-9): 469-472. | Balasubramanian, R. and V. Veerabadran. 1997.Substitution of inorganic nitrogen through local green leaf amnure and azospirillum in rice. Indian J. Agron., 42(2): 285-287. | Bijay-Singh, Yadvinder singh, J.K. Ladha, K.F. Bronson, V. Balasubramanian, J. Singh and C.S. Khind. 2002. Chlorophyll meter- and leaf color chart-based nitrogen management for rice and wheat in northeastern India. Agron. J., 94: 821-829. | Chavan, L.S., B.P. Patil and T.S. Ingole. 1996. Integrate nitrogen management with Glyricidida maculata and Sesbania aculeata for transplanted rice. IRRN, | 21(2-3): 70. | Dheebakaran, G. and S. Ramasamy. 1999. Source and time of splits of nitrogen on N uptake and its efficiency on irrigated lowland rice. Madras Agric. J., 86(7-9): 429-431. | Gines, H.C., G.O. Redondo, A.P. Estogoy, and A. Dobermann. 2004. Site-specific nutrient management for irrigated rice systems of central Luzon, Philippines. P.145-170. Jeyakumar, M. 2001. Irrigation and nitrogen management for medium duration hybrid rice. M.Sc., Thesis. Tamil Nadu Agricultural University, Coimbatore. | Kavitha, M. P. 2001. Studies on nitrogen and potassium management in maximizing the productivity. M.Sc., Thesis. Tamil Nadu Agricultural University, Coimbatore. | Miah, M.N.H., T. Yoshida and Y. Yamamoto. 1997. Effect of nitrogen application during ripening period on photosynthesis and dry matter production and its impact on yield and yield components of semi dwarf indica rice varieties under water culture conditions. Soil Sci. Plant. Nutr., 43(1): 205-217. | Nirmalakumari, A., K. Natarajamoorthy and P. Gnanamurthy. 2002. The short duration rice hybrid-ADTRH 1 a boon to boost up the yield in first season. KISAN WORLD, p. 43-44. | Pandey, P.C. and P. Lal. 1997. Increased yield of low land rice with late application in the reproductive phases at high nitrogen rates. Int. Rice Res. Notes, 22(1): 38-39. | Prasad, R. and S.K. De Datta. 1979. Increasing fertilizer nitrogen efficiency in wetland. In: nitrogen and rice. Int.Rice.Res.Inst., Los Banas. Philippines. pp.465-484. | Selvaraju, R., S. Mahendran and T. N. Balasubramanian. 1999. Split application of nitrogen to hybrid rice. Vistas of Rice Research. pp. 340-342. | Sharief Ahmed Dar, Amarjit, S. Bali and M.H. Shah. 2000. Effect of different levels and time of nitrogen application on wet-seeded rice in Kashmir valley. Oryza, 37(3): 244-246. | Shekhar, C., S.N. Khajanji and G.K. Shrivastava. 2004. Effect of seedling age and split application of nitrogen on production of scented rice (Oryza sativa L). J. Agril. Issues. 9(1&2): 105-107. | Thiyagarajan, T.M., R. Sivasamy, H.F.M. TenBerge. 1994. Time course of leaf N concentration required to attain target yields in transplanted rice. In: | H.F.M. TenBerge, M.C.S. Woperies and J.C. Shin (Editors), N econmy in irrigated rice: Field and simulation studies, SARP Res. Proc. A.B/ DLO, Wageningen, The Netherlands. | Upadhyaya, S.P., R.S. Sharma and S.C. Choubey. 1985. Studies on improvement of nitrogen efficiency for transplanted rice (Oryza sativa L.). Indian J. Agron., 30: 163-166. | Vaiyapuri, V., M. Ravichandran and M.V. Srirama Chandra Sekharan. 1998. Effect of graded levels of sesbania speciosa with time of N application on growth and yield in rice-rice sequence. Ann. Agric. Res., 19(1): 1-3. |