Asian J. Exp. Sci., Vol. 23, No. 1, 2009; 303-306 **Short Communication**

Effect of Split Application of Nitrogen on Growth and Yield of Aerobic Rice

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Abstract : Aerobic rice is a new system of cultivation gaining importance under water constraint situations and research on optimum dose and time of nitrogen application is timely warranted. Field experiment was carried out at Wetland Farm of Tamil Nadu Agricultural University, Coimbatore during *kharif*, 2006 to study the effect of different split doses of nitrogen, Leaf Colour Chart (LCC) and Soil Test Crop Response (STCR) based nitrogen management on growth and yield of aerobic rice. The results showed that nitrogen management at LCC value of 4 (150 kg N ha^{-1}) produced significantly higher tillers (369.3 m^{-2}) at maximum tillering stage, plant height (81.7 cm) at maturity, dry matter at flowering (5.71 t ha^{-1}) and grain yield (2915 kg ha^{-1}) than LCC value of 3 that produced grain yield of 2211 kg ha^{-1}. Soil test crop response based nitrogen application produced markedly lower grain yield (2475 kg ha^{-1}) than the LCC value 4 of nitrogen management. Among the different split doses of nitrogen, application of 150 kg N ha^{-1} in four splits – 1/6 at 15 DAS, 1/3 at tillering, 1/3 at PI, 1/6 at flowering recorded higher tillers (361 m^{-2}), plant height (77.0 cm), dry matter at flowering (5.20 t ha^{-1}) and grain yield (2827 kg ha^{-1}) over four equal splits where the grain yield was 2673 kg ha^{-1}. Four splits (1/5 at 15 DAS, 1/5 at tillering, 2/5 at PI, 1/5 at flowering) of 150 N ha^{-1} also recorded comparable yield of 2783 kg ha^{-1} than other split doses. Thus, nitrogen application with LCC value of 4 or application of 150 kg N ha^{-1} in four splits – 1/6 at 15 DAS, 1/3 at tillering, 1/3 at PI, 1/6 at flowering is considered a suitable nitrogen management technique in aerobic rice cultivation at Coimbatore.

Key words : Aerobic rice, nitrogen, split application, grain yield.

Introduction

The traditional rice cultivation has being threatening by increased scarcity of fresh water under wet land ecosystem that warrants new water saving rice cultivation. Aerobic rice cultivation offers an opportunity to produce rice with less water. In aerobic rice system, fields remain non-flooded throughout the season like an upland crop, such as wheat. This way of growing rice saves water by eliminating continuous seepage and percolation, land preparation and reducing evaporation (Bouman *et al.*, 2002). Nitrogen fertilization is the major agronomic practice that affects the yield and quality of rice crop, which requires as much as possible at early and mid tillering stages to maximize panicle number and during reproductive stage to produce optimum spikelets per panicle and percentage filled spikelets (Murty *et al.*, 1992). Aerobic rice is a new method of rice cultivation and the form and availability of nitrogen is entirely differing from traditional paddy field. Nitrogen application should coincide with crop growth and its requirement. The leaf color chart (LCC) is an easy-to-use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant N status (Alam et al. 2005). The LCC can be used to guide the application of fertilizer N to maintain

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an optimal leaf N content for achieving high rice yield with effective N management. In addition, altering the split doses according to the crop requirement is also need to be analysed under aerobic rice cultivation. So, optimization of nitrogen level as well as split doses to different crop growth stages is more important to produce higher grain yield. Considering the above facts, field experiment was conducted at Wetland Farm of Tamil Nadu Agricultural University, Coimbatore to find out the optimum nitrogen level and better split application for aerobic rice cultivation.

Materials and Methods

The field experiment was conducted during *kharif*, 2006 in randomized block design with three replications. The field was clay loam in texture, taxonomically known as *Typic Haplustalf* and neutral in pH (7.1) and the EC was 0.9 dSm^{-1}. The soil was low (203 kg ha^{-1}) in available N, medium (19.6 kg ha^{-1}) in available P and high (524 kg ha^{-1}) in available K. Treatments were consisted of application of 150 kg ha^{-1} in different split doses (Four equal splits – 15 DAS, tillering, PI and flowering, Four splits – 1/6 at 15 DAS, 1/3 at Tillering, 1/3 at PI, 1/6 at flowering and Four splits – 1/5 at 15 DAS, 1/5 at Tillering, 2/5 at PI, 1/5 at flowering), Leaf Colour Chart (LCC) based nitrogen application (LCC values of 3 and 4) and Soil Test Crop Response (STCR) based nitrogen management.

The field was thoroughly prepared by using disc plough, cultivator and rotavator. Rice variety PMK(R) 3 was used as test crop. The seeds were treated with carbendazim at 2 g kg^{-1} of seeds and soaked in water for 12 hours. The soaked seeds were inoculated with Azospyrillum at 20 g kg^{-1} of seeds and incubated for 10 hours. The pre germinated seeds were sown in rows 20 cm apart and 10 cm within rows by using TNAU aerobic rice drum seeder. A common fertilizer dose of 50: 50 kg P and K ha^{-1} was adopted. The entire dose of P in the form of single super phosphate was applied as basal dose. Nitrogen as urea was applied as per the treatment schedule and potassium as muriate of potash was applied in four equal splits along with nitrogen. Nitrogen management through LCC value of 3 and 4 were done with 90 and 150 kg N ha^{-1} respectively. STCR based nitrogen management used 106 kg N ha^{-1} according to the initial soil status. A total of 763 mm of water was used for this crop which includes irrigation water plus effective rainfall. Observations on plant height at maturity, tillers at maximum tillering stage, dry matter production at flowering and yield parameters and grain yield during maturity stage were done.

Results and Discussion

Growth parameters

Growth parameters like plant height, tillers and dry matter production of aerobic rice were positively influenced by different nitrogen management practices. Significantly higher plant height (81.7 cm) was obtained with nitrogen application based on LCC value of 4 as compared to LCC value 3 and it was on par with STCR based nitrogen application and application of nitrogen in four splits – 1/6 at 15 DAS, 1/3 at Tillering, 1/3 at PI, 1/6 at flowering and four splits – 1/5 at 15 DAS, 1/5 at Tillering, 2/5 at PI, 1/5 at flowering (Table 1). Tiller population (370.1 m^{-2}) was significantly higher under LCC value 4 over LCC value 3. Application of 150 kg N ha^{-1} in four splits – 1/5 at 15 DAS, 1/5 at Tillering, 2/5 at PI, 1/5 at flowering registered higher dry matter production (5.82 t ha^{-1}), closely followed by application of nitrogen four splits – 1/6 at 15 DAS, 1/3 at Tillering, 1/3 at PI, 1/6 at flowering (4.80 t ha^{-1}) and LCC value 4. Application of nitrogen in splits according to the crop needs was the reason for better rice growth parameters. Soil test crop response based nitrogen management recorded the lowest dry matter of 4.20 t ha^{-1}. The usefulness of

Table 1 : Effect of nitrogen management on growth and yield characters of aerobic rice

Treatments	plant height (cm)	Tillers m^{-2} at maximum tillering	DMP (t/ha) at flowering	Panicles/m^2	Filled grains/ panicle	Test weight
N_{1}- 1/4+1/4+1/4+1/4 Splits*	73.2	345.3	5.45	301	88.1	20.9
N_{2}- 1/6+1/3+1/3+1/6 Splits*	77	361.3	5.8	322	94	21.4
N_{3}- 1/5+1/5+2/5+1/5 Splits*	77.7	350.7	5.82	316	92.1	20.4
N_4 - LCC 3	71.2	316.7	4.72	267	75.5	21.2
N_5- LCC 4	81.7	369.3	5.71	327	95.4	21.5
N_6 – STCR 5 t/ha	76.3	353.7	5.2	297	85	20.8
CD (P=0.05)	5.2	23.6	0.36	28.63	8.3	1.4

increased N application on tiller production was also observed by Singh *et al.* (2006).

Yield attributes

Various nitrogen management practices showed significant difference on yield attributes of aerobic rice. Among the nitrogen management practices, LCC value 4 produced higher number of panicles m^{-2} (327), number of filed grains per panicle (93) and test weight (21.5). Nitrogen management at LCC value 3 registered significantly lower number of panicles (267), filled grains and test weight over LCC 4. Soil test crop response based nitrogen management also recorded poor yield attributes over LCC value 4 as well as different split doses of N management treatments. Application of 150 kg N ha^{-1} in four splits – 1/6 at 15 DAS, 1/3 at Tillering, 1/3 at PI, 1/6 at flowering registered higher number of panicles m^{-2} (322), number of filed grains per panicle (94) and test weight (21.4), followed by application of 150 kg N ha^{-1} in four splits – 1/5 at 15 DAS, 1/5 at Tillering, 2/5 at PI, 1/5 at flowering (Table 1). Application of nitrogen in four equal splits recorded lower yield attributes than that of other split doses. This could be due to the fact that increasing dose of nitrogen at tillering stage produced higher leaf area, biomass coupled with more number of tillers. Further, increasing the dose at panicle initiation stage might have improved the yield attributes like more number of panicles, grains per panicle and test weight through the mechanism of improved grain filling process. This was in accordance with the findings of Dhyani and Mishra (1994) who stressed the importance of split application of nitrogen at tillering and panicle initiation stages.

Productivity

Grain and straw yields of aerobic rice were significantly influenced by nitrogen management treatments. Significantly higher grain and straw yields (2915 and 4956kg ha^{-1} respectively) were obtained with nitrogen application based on LCC value of 4 compared to LCC value 3 (2211 and 3958kg ha^{-1}). Leaf nitrogen status of rice is closely related to photosynthetic rate and biomass production, and

Table 2 : Effect of nitrogen management on grain and straw yields and water productivity of aerobic rice

Treatments	Grain yield (kg ha-1)	Straw yield (kg ha-1)	Harvest Index (%)	Water productivity (kg rice ha mm-1)
N_{1-} 1/4+1/4+1/4+1/4 Splits*	2673	4731	0.36	3.5
N_{2-} 1/6+1/3+1/3+1/6 Splits*	2827	4919	0.36	3.7
N_{3-} 1/5+1/5+2/5+1/5 Splits*	2783	4842	0.36	3.6
N_4 - LCC 3	2211	3958	0.36	2.9
N_5- LCC 4	2915	4956	0.37	3.8
N_6 _ STCR 5 t/ha	2475	4381	0.36	3.2
CD (P=0.05)	351	613	-	-

** N at 150 kg ha^{-1}*

it is a sensitive indicator of changes in crop nitrogen demand within a growing season. Application of fertilizer nitrogen based on leaf colour chart was found effective to maintain optimal leaf nitrogen which resulted in better crop growth and high rice grain yield. STCR based nitrogen application recorded lower grain yield of 2475 kg ha^{-1} than LCC value 3. Among the split doses of nitrogen, application of 1/6 at 15 DAS, 1/3 at Tillering, 1/3 at PI, 1/6 at flowering registered higher grain and straw yields (2827 and 4919 kg ha^{-1} respectively) over four equal split doses and four splits – 1/5 at 15 DAS, 1/5 at Tillering, 2/5 at PI, 1/5 at flowering (Table 2). Availability of adequate quantity of nitrogen during critical stages of plant growth might have resulted in better growth characters and yield components at various phenological stages and finally on the yield of aerobic rice. These results are in accordance with the findings of Bouman *et al* (2002) who reported that higher level of nitrogen at 150 kg N ha^{-1} recorded higher grain yield of rice. Higher values of harvest index were noticed under LCC value 4 as compared of other treatments. Higher water productivity (3.8 kg ha-mm^{-1}) was noticed under LCC value 4 nitrogen management followed by application of 150 kg N ha^{-1} in four splits – 1/6 at 15 DAS, 1/3 at tillering, 1/3 at PI, 1/6 at flowering.

Thus, nitrogen application with LCC value of 4 or application of 150 kg N ha^{-1} in four splits – 1/6 at 15 DAS, 1/3 at tillering, 1/3 at PI, 1/6 at flowering is considered a suitable nitrogen management technique in aerobic rice cultivation at Coimbatore.

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