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Nitrogen management for short duration T. Aman rice with aged seedlings

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ABSTRACT

Intensive crop cultivation become popular in many parts of Bangladesh and the cropping pattern in Bangladesh is T. Aman rice based. To allow intensive crop cultivation short duration rice varieties should be selected. But due to adverse situation sometimes farmers have to delay transplanting with aged seedlings. So this experiment was taken to find out appropriate nitrogen management for short duration T. Aman rice with aged seedlings. The experiment was conducted in Aman 2017 at Bangladesh Rice Research Institute (BRRI) farm, Gazipur. The soil of BRRI farm was clay loam under Madhupur tract (AEZ 28).The experiment was laid out in split-split plot design with three replications. The experiment was laid out in split-split plot design with three replications. The main plot treatment was fertilizer management options: M_1 = N: 70 kg ha^{-1} and $1/3^{rd}$ as basal + $1/3^{rd}$ at 10 DAT + $1/3^{rd}$ at 25 DAT and M_2= N: 120 kg ha^{-1} and $2/3^{rd}$ as basal + $1/3^{rd}$ at 25 DAT. The sub plot treatment was variety: V_1 = BRRI dhan56, V_2 = BRRI dhan62, V_3 = BRRI dhan71 and V_4 = BRRI dhan75. Sub-sub plot treatment was seedling age: A_1 = 20 days, A_2 = 25 days, A_3 = 30 days, A_4 = 35 days and A_5 = 40 days. M_1 gave higher yield for all aged seedlings. Comparatively higher yield was found in younger seedlings but with M_1 the yield reduction of aged seedlings of short duration rice varieties can be minimized.

INTRODUCTION

Bangladesh Rice Research Institute (BRRI) already released several (BRRI dhan33, BRRI dhan39, BRRI dhan56, BRRI dhan57, BRRI dhan62, BRRI dhan66, BRRI dhan71, BRRI dhan75 and BRRI hybrid dhan4) short duration (growth duration <125 days) high yielding T. Aman rice varieties (BRRI, 2017). Shen et al. (2006) stated that transplanting at the appropriate seedling age followed by the application of fertilizer is the most important crop management that enhances rice performance. Age of seedling is a key factor which influences the tiller production, grain formation and other yield contributing parameters (Faruket al., 2009). Younger seedlings produced more grain yield as compared to older seedlings (Ali et al., 2013; Rahimpour et al., 2013). Due to lack of actual knowledge or adverse environment like drought at transplanting, no rainfall in time; farmers of Bangladesh are bound to delay transplanting with older seedling. Farmers normally applied N (nitrogen) two times for short duration rice variety. But nitrogen supply must be available according to the needs of the plant for optimal yield (Azarpour et al., 2011). N application significantly improved rice yield but there are very little information regarding effect of applied N on growth and performance of over-aged rice seedlings. Appropriate time of N supply to rice is a key factor for increasing rice yield but farmers are still now not aware about optimum dose and timely application of N fertilizer and excess amount of fertilizers are applied by them. Although N is the major input for rice production, heavy fertilization does not always result in higher yield; moreover, it may decreases nitrogen use efficiency (Kamruzzaman et al., 2013). Selection of the appropriate level of N fertilizer is a major concern for achieving economic benefit of the crop by decreasing the quantity and increasing nitrogen use efficiency (NUE) while maintaining a sound environment. Indeed, excessive N causes vigorous vegetative growth resulting in lodging of plants, increased susceptibility to insects, pests and diseases that ultimately reduces yield (Kamruzzamanet al., 2013). Two splits of N are commonly practiced at the farmer's level for transplanted Aman rice production in Bangladesh. However, the application of N into three splits at planting, tillering, and panicle initiation stages is most beneficial for achieving higher grain yield of modern rice varieties at medium to high land elevation (Kaushal et al., 2010).

According to Appel (1994), application time is important for good synchrony between rice demand of N and its supply throughout the cropping season. Timely and split application of N allows for more efficient use of N by rice throughout the growing season as this practice provides specific amounts of nutrient to the crop during peak periods of growth and reduces N losses (Kamruzzaman et al.,2013). Therefore, this experiment was conducted to find out suitable nitrogen management practice for short duration T. Aman rice varieties with aged seedlings.

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MATERIALS AND METHODS

Experimental site and design

The experiment was conducted in Aman season (December-January), 2017 at Bangladesh Rice Research Institute (BRRI) farm, Gazipur. The soil of BRRI farm was clay loam under Madhupur tract (AEZ 28). The experiment was laid out in split-split plot design with three replications.

Treatments

The main plot treatment was fertilizer management options: M_1 = N: 70 kg ha^{-1} and 1/3rd as basal + 1/3rd at 10 DAT + 1/3rd at 25 DAT and M_2= N: 120 kg ha^{-1} and 2/3rd as basal + 1/3rd at 25 DAT. The sub plot treatment was variety: V_1 = BRRI dhan56, V_2 = BRRI dhan62, V_3 = BRRI dhan71 and V_4 = BRRI dhan75. Sub-sub plot treatment was seedling age: A_1 = 20 days, A_2 = 25 days,A_3 = 30 days, A_4 = 35 days and A_5 = 40 days.

Planting method and application of fertilizers

Seedlings were transplanted on 31 July, 2017at a spacing of 20 × 20 cmusing one seedling per hill. The full dose of P-K-S (11-41-11 kg ha^{-1}) was applied during final land preparation.

Data collection procedure

Leaf area index (LAI) was taken at heading stage from one representative hill (selected from average of twelve hills). Plant height was measured from the base of the plant to tip of the panicle. At maturity, 5 m^2 area was harvested for grain yield and adjusted to 14% moisture content.

Statistical analysis

The data were statistically analyzed using Statistix-10analytical software. The least significant difference (LSD) at 5% probability was used to compare means of the treatments.

RESULTS AND DISCUSSION

Leaf area Index (LAI)

In two nitrogen management practices M_1 gave higher Leaf area Index (LAI) compare to M_2. Twenty-day-old seedling gave highest LAI for BRRI dhan62 and BRRI dhan75 but in BRRI dhan56 and BRRI dhan71 Twenty-five-day-old seedling gave highest LAI (Figure 1). For all variety LAI reduced gradually from 25 day to 40 day old seedling due to nitrogen uptake decreased with seedling age. This result confirms the finding of Rasool et al. (2016).

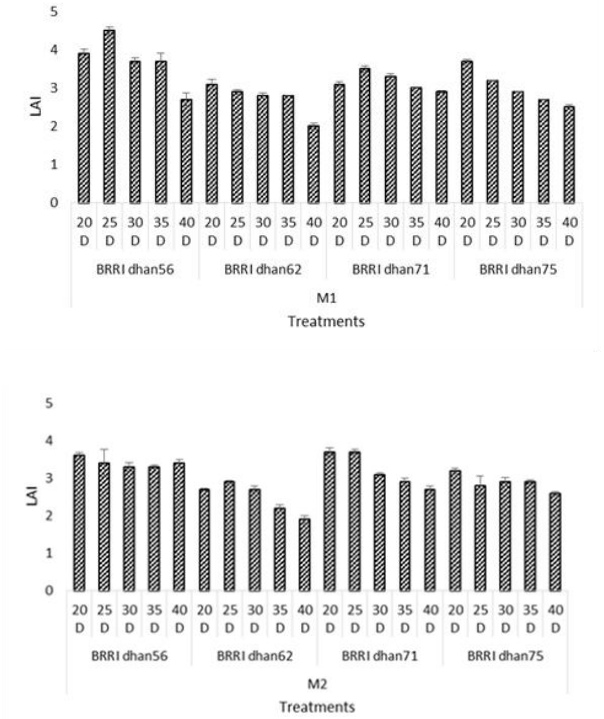
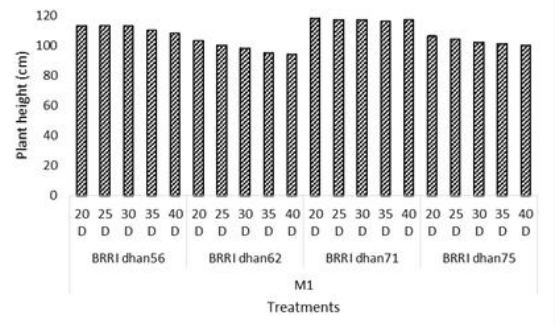


Figure 1: Effect of nitrogen management on LAI of short duration T. Aman rice varieties with aged seedlings

Plant height

Plant height did not vary for different nitrogen management practices.In BRRI dhan71, for different seedling age plant height was similar but in BRRI dhan56, BRRI dhan62 and BRRI dhan75 plant height gradually reduced from young to old age seedling (Figure 2). Asbur (2013) also found that growth rate was higher in younger seedlings of rice.



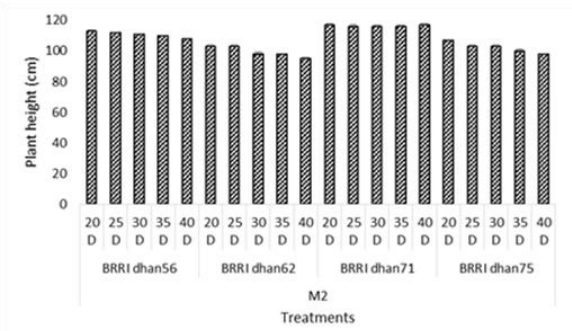


Figure 2: Effect of nitrogen management on plant height of short duration T. Aman rice varieties with aged seedlings

Panicle m^{-2}

In panicle number, there was no significant difference for different nitrogen management. Panicle number gradually reduced from 20 day to 40 day old seedling in BRRI dhan56 and BRRI dhan75 for both nitrogen managements (Figure 3). Liu et al., (2017) reported that with increasing seedling age the numbers of panicles per square meter decreased. But in BRRI dhan62 highest panicle number was found in 25 day old seedling than it reduced. In BRRI dhan71 thirty-five-day-old seedling produced highest panicle in M_1 but in M_2 thirty-day-old seedling produced highest panicle which is similar to thirty-five-day-old seedling. BRRI dhan62 gave higher panicle m^{-2} compare to other varieties.

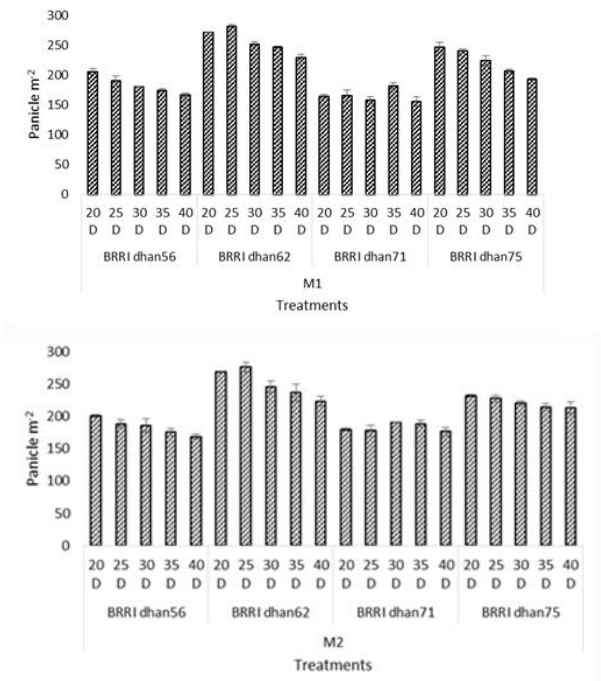


Figure 3: Effect of nitrogen management on panicle m^{-2} of short duration T. Aman rice varieties with aged seedlings

Grains $panicle^{-1}$

There was significant difference in grains $panicle^{-1}$ for different nitrogen management. For BRRI dhan56, BRRI dhan62 and BRRI dhan71, M_1 produced more grains $panicle^{-1}$ than M_2 (Figure 4). Krishnan and Nayak (2000) reported that high number of grains was obtained when nitrogen was applied in three splits as basal, active tillering and panicle initiation. But in BRRI dhan75 thirty to forty-day-old seedling produced more grains $panicle^{-1}$ with M_2. Result reflect that, optimum dose of N fertilizer inthree split application may increase the grain production in BRRI dhan56, BRRI dhan62, BRRI dhan71 and young seedling of BRRI dhan75 but old seedling of BRRI dhan75 produce more grain with higher dose of N fertilizer. For different seedling aged BRRI dhan62 and BRRI dhan71 gave similar grains $panicle^{-1}$. In M_2 BRRI dhan75 produce similar grains $panicle^{-1}$ with different seedling age. Compare to other variety BRRI dhan62 produce lowest grains $panicle^{-1}$.

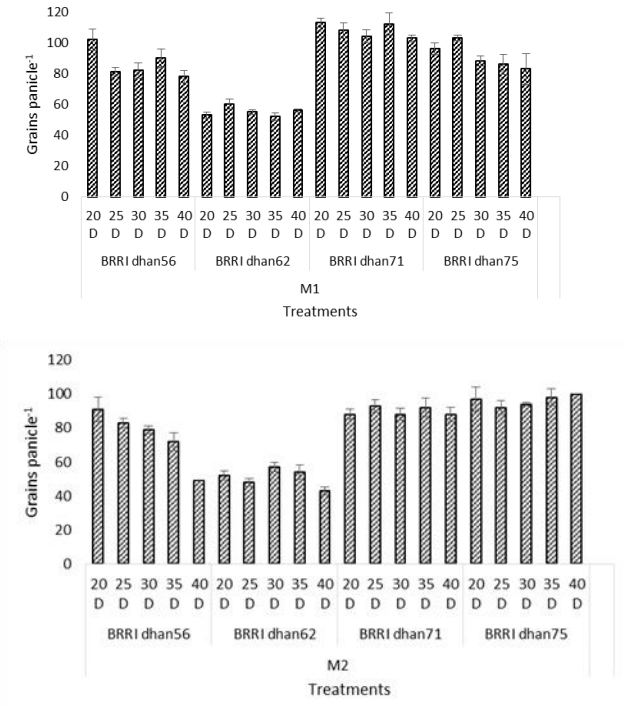


Figure 4: Effect of nitrogen management on grains $panicle^{-1}$ of short duration T. Aman rice varieties with aged seedlings

1000 Grains Weight

Specific variety gave similar thousand grains weight for the variation of N management and seedling age (Figure 5). Thousand grains weight depends largely on genetic makeup and hardly varies with cultural

practices sothe seedling age did not affect the weight of 1000 grains (Ashraf et al., 1999). Chamely et al., (2015) found that 1000-grain weight (g) wasnot significantly influenced due to interaction of variety and level of nitrogen. Brar et al. (2012) reported that seedling age had no significant effect on 1000-kernel weight and seedlings of 30, 45 and 60 days conceived statistically similar thousand kernel weight.

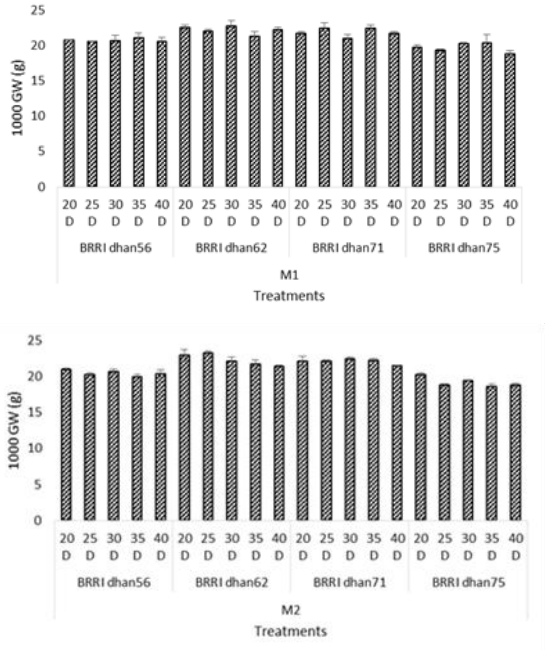


Figure 5: Effect of nitrogen management on 1000 grain weight of short duration T. Aman rice varieties with aged seedlings

Yield

There was significant difference among the treatments for grain yield.In BRRI dhan56 and BRRI dhan75 highest yield was found in 20 days seedling. In BRRI dhan62 and BRRI dhan71 highest yield was obtained in 25 days seedling (Figure 6). Comparatively higher rice yields were obtained in transplanting young seedlings than aged seedlings which is supported by the findings of Mobasser et al., (2007) and Sarwar et al., (2011). Old seedling of BRRI dhan75 performed better with M_2. May beold seedling of BRRI dhan75responsive to higher dose of N fertilizer. M_1 gave comparatively higher yield than M_2. Three times of N splitting is important for higher yield of short duration T. Aman rice even in aged seedlings. Kaushal et al., (2010) reported that for achieving higher grain yield of modern rice varieties the application of N into three splits at planting, tillering, and panicle initiation stages is most beneficial. Irshad et al., (2000) suggested that for getting maximum yield at least some nitrogen must be applied at tillering stage. N application in aged seedling helps todelay flowering time and increased rice growth which help in increased yield by aged seedling. The purpose of using short duration variety may be hampered in that case. But in adverse condition when seedlings become aged than judicial application of N may contribute to increase rice yield. The overall yield was poor because of lodging by heavy wind storm.

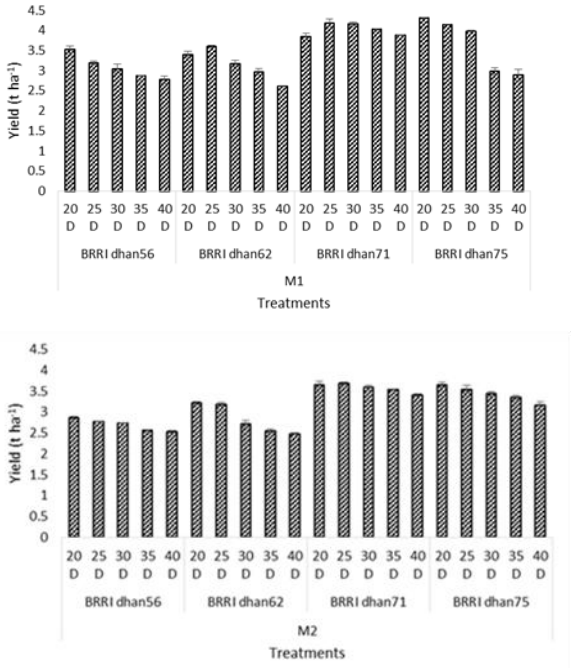
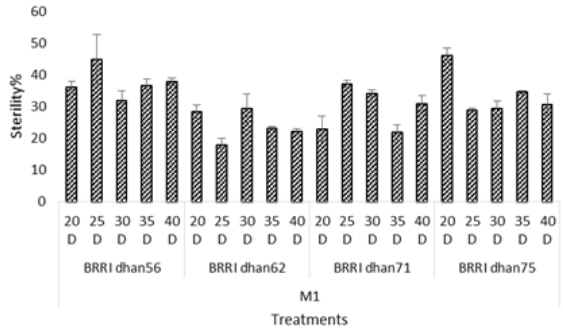


Figure 6: Effect of nitrogen management on yield of short durationT. Aman rice varieties with aged seedlings

Sterility (%)

Percent sterility was higher due to lodging before maturity by heavy wind storm. There was significant difference among the treatmentsin sterility. The sterility (%) was higher in M_2 than M_1 (Figure 7).



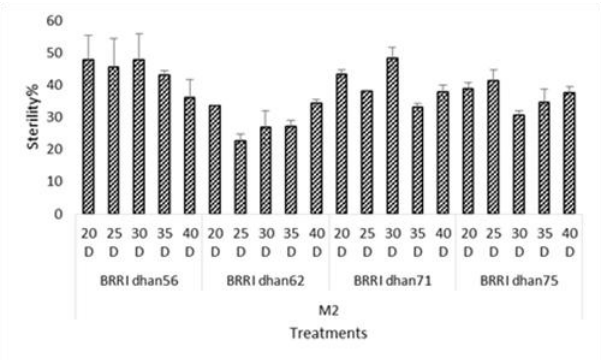


Figure 7: Effect of nitrogen management on sterility (%) of short durationT. Aman rice varieties with aged seedlings

Due to higher rate of N application in M_2, lodging percentage was higher in that treatment and for that reason sterility percentage was also higher. Excessive N fertilizer could lead to significantly higher lodging risks (Wu-jun et al., 2014).

CONCLUSION

In adverse situation when farmers have to use over-aged seedlings of short duration rice varieties they should maintain appropriate nitrogen management for optimum yield. Excess nitrogen application should be avoided and three split application of nitrogen should be practiced even in old seedlings of short duration rice variety. Farmersneed to find out appropriate agronomic managements for aged seedlings of short duration rice variety.

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