Effect of Culm Cutting Height and Nitrogenous Fertilizer on the Yield of Ratoon of Late Boro Rice

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Abstract: In ratoon, crop cutting height of culm at above 15 cm was found to be favourable for plant attributes especially 1000 grains weight, grain yield and straw yield. On the other hand, 120 kg N ha$^{-1}$ noticed for the tallest plant, the highest bearing tillers hill$^{-1}$; sterile spikelets panicle$^{-1}$; 1000 grains weight, grain yield and straw yield. In treatment combination of 15 cm culm cutting height of culm and 120 kg N ha$^{-1}$ was found to produce also the highest grain yield. The highest grain yield (1.56 t ha$^{-1}$) resulted from ratoon crop was 25.16% of the primary crop. The yield and most of the other plant attributes were lower and field duration was also shorter in ratoon crop than those of the primary crop.

Key words: Culm cutting height, nitrogenous fertilizers, ratoon, late boro rice

Introduction
Ratooning or less a general practice of sugar-cane production in Bangladesh. Though in Bangladesh not much of rice ratooning have been done and it has not yet attracted the attention of researchers but in some advanced countries of the world like USA, Japan, Formosa, India, Swaziland and China specially in Hunan, Hupel, Szechuan and Kweichow province (Yang, 1940) the ratooning of rice is being practiced to some extent and its advantages realized. It is known as stubble rice in USA, regeneratice rice in China, second flowering in rice in London, UK and ratoon rice in India and Bangladesh. Rice ratooning has a great economic advantage as an alternative to double cropping in monsoon areas and increase in rice production in Asia (Krishnamurthy, 1988). Ratooning means the production of a second crop from the stubble through formation of new tillers at branches at the base and nodes of the harvested plant of the previous crops with or without land tillage being done. The factors which affect ratooning ability and grain yield i.e. cutting height, maturity of main crop at harvest, main crop cultural practices (spacing, fertilizer, water management) temp., light intensity etc. (Vergara et al., 1988). Reddy et al. (1988) found that the ratoon crop yields were 42-61% of the main crop yields. He also found from another field study, 24% shorter growth duration and 59% higher mean yield than the main crop. Applying N after the main crop harvest consistently increased ratoon crop yields (Turner and Muthra, 1988). Although the yield of ratoon crop is less but it saves time, cost of land preparation, seedlings and planting, realize economic use of machineries and irrigation problem than the primary crop. Ratoon crop gives satisfactory yields if the stubble of the primary crop is left with 2-3 stem nodes (Volokova and Smetanin, 1970). Like the normal method of rice culture, ratoon crop also responds positively with the fertilization. Increasing N application increased yields, while stubble height had no effect on ratoon yields (Balasubramanian and Ali, 1990). Bollich et al. (1998) showed that, with good management, newly developed high yielding semidwarf cultivars can produce significantly higher ratoon crop yields. Mahadeveappa et al. (1988) shown that varieties differ widely in ratooning ability, type of tillers produced, growth period duration, grain quality and yield. The ratoon crop matured in 70 days and produced grain yields of up to 3.0 t ha$^{-1}$, compared with a maturity time of 102 d and a grain yield of 3.9 t ha$^{-1}$ in the preceding main crop (Setty et al., 1993).

After harvesting field remains season fallow for two to three months. Ratoon crop can be grown in this lean period. Boro rice is damaged often by northwester and hailstorm. This damage could be partially compensated by ratooning in Bangladesh. In late boro ratooning is advantageous, when there are possibilities of damage of harvestable crop by flood because ratooning requires less growth duration than main crop. However, the farmers in the country are not familiar with the ratooning practices in boro rice. Sufficient information based on research works is still lacking on this regard in both home and abroad. Considering the above facts, the present research has been undertaken. It also helps to see the effect of culm cutting height of ratoon and nitrogen fertilizer dose on ratoon seedling production efficiency and to assess the yield potential and economics of the ratoon crop in late boro rice.

Materials and Methods
The study was conducted at the net house of the Department of Agronomy, Bangladesh Agricultural University, Mymensingh. The experiment was carried out in pots. The rice variety BR2 (mala) was selected for experimental work. The growth period was from July to September, 1998. The yield range between 5.5-6.5 t ha$^{-1}$ in boro season. The experiment comprised of the following treatments:

A. Culm cutting height of plant (cm)
H$_1$ = 5
H$_2$ = 10
H$_3$ = 15

B. Level of N fertilization (kg ha$^{-1}$)
N$_{0}$ = Control
N$_{40}$ = 40
N$_{80}$ = 80
N$_{120}$ = 120

The experiment was laid out in RCB design. The unit pot size was 204 m$^2$ in diameter and 36 pots were included in the experimental work. Only N-fertilizer was applied into three splits after cleaning the pots in the ratoon crop according to the treatments. The crops were infested with weeds which were controlled by uprooting by hand as and when required. The crop was attacked by grass hopper (Nephotettix nigropictus). Dimecron 100 EC was applied @ 1.5 t ha$^{-1}$ to control the insects. The pots were observed frequently to notice any change in plant characters throughout the field duration of crop.

The ratoon crop was harvested plot wise when 80% of grain was ripened. The harvested crop was threshed, cleaned and sun dried. The grain was finally dried in an electric oven until its moisture content reduced to 12%. Observations were made on the following plant characters from each pot: i) plant height (cm), ii) number of total tillers hill$^{-1}$, iii) number of effective tillers hill$^{-1}$, iv) panicle length (cm), v) number of grains panicle$^{-1}$, vi) number of sterile spikelets panicle$^{-1}$, vii) 1000 grains weight (g), viii) grain yield (kg) and ix) straw yield (kg).

All data were analyzed statistically. The significance of mean difference were adjusted by Duncan’s multiple range test (Gomez and Gomez, 1984).

Results and Discussion
Culm cutting height significantly affected the plant height, total tillers and effective tillers hill$^{-1}$ and grain yield (Table 1). Su et al. (1988) concluded that when a ratoon crop is required, the cutting height of the first crop should be determined in accordance with the cultivar used. Andrade et al (1988) work with some cultivars at different cutting heights. He found that cutting at 10 cm reduced the ratooning ability of all cultivars tested. The best ratoon yields occurred with a cutting height of 30 cm. The tallest plant (105.21 cm) was obtained from the culm cutting height of 15 cm. On the contrary, the shortest plant (95.04 cm) was...
produced from the 5.0 cm of culm cutting height. This might be due to more nutrient stored in 15 cm cutting height of culm than 5.0 cm for the nourishment of plant. Results indicated that the highest number (6.74) of taller tillers hill$^{-1}$ was recorded in 10 cm cutting height of culm. On the other hand, the lowest number (4.47) of total tillers hill$^{-1}$ was found in 5.0 cm cutting height of culm. Gupta et al. (1987) work with some photoperiod-sensitive varieties for ratooning ability on the basis of some plant attributes like viable buds, ratoon tillers etc. He found that variational differences in ratoon tillering were not significant, but cutting height effect and variety x cutting height interaction effects were significant. A higher cutting height value resulted in a higher ratoon tillering. Prakash et al. (1989) found the main crop was cut 15 cm above the ground, the number of tillers produced was highest in genotypes which had high main crop yields. The highest number (4.22) of effective tillers hill$^{-1}$ was observed in 15 cm cutting height of culm. This was perhaps due to more food material received in rice plant during the production of ratoon crop. On the other hand, the lowest number (2.82) of effective tillers hill$^{-1}$ was produced in 5.0 cm cutting height of culm. Cutting height of culm did not show any significant variation on panicle length, grains panicle$^{-1}$, sterile spikelets panicle$^{-1}$, 1000 grains weight and straw yield. The longest panicle (18.61 cm) was produced from 10 cm cutting height of culm and the shortest panicle (18.49 cm) was produced in 5.0 cm culm cutting height. It happened due to some residual effect of fertilizers which were applied in the previous crop. Organic manures releases nutrients very slowly. Therefore combined application of organic and chemical fertilizers exerts a considerable residual effect on the succeeding crop. Rathore et al. (1995) investigated the residual effect of organic and inorganic fertilizers applied in rice field and found that the yield of succeeding crop significantly increased. The highest number (177.60) of grains panicle$^{-1}$ was found in 10 cm cutting height of culm. The lowest number (74.75) of grains panicle$^{-1}$ was produced in 15 cm cutting height of culm. Yoshida (1981) reviewed some works on the relationships among the yield components and concluded that, though these were mostly governed by the genotype, nutrient variations may affect the number of grains/panicle to some extent. The highest number (26.35) of sterile spikelets panicle$^{-1}$ was found in 5.0 cm cutting height of culm. It might be due to some unknown physiological disorder occurred in plant body to accumulate food material to grains. The lowest sterile spikelets panicle$^{-1}$ (26.68) was observed in 15 cm cutting height of culm. The highest 1000 grains weight (21.14 g) was produced where culm cutting height was maintained 15 cm. The lowest 1000 grains weight (20.95 g) was observed in both 5.0 cm and 10 cm cutting height. The highest grain yield (1.30 t ha$^{-1}$) was obtained from 15 cm cutting height of culm due to more accumulation of food material into grain from comparatively vigorous plants; while the lowest grain yield (0.68 t ha$^{-1}$) was produced at 10 cm cutting height of culm. In a treatment with cow dung and other sources of plant nutrients. Ahmed and Rahman (1991) found significantly higher yield in the following crop from the plots which received cow dung in the previous rice crop. The lowest straw yield (1.80 t ha$^{-1}$) was produced in 5.0 cm height; while the highest straw yield (1.65 t ha$^{-1}$) was obtained from the both 10 and 15 cm cutting height of culm. Cutting height had a significant effect on ratoon crop maturity, height and yield (Jones, 1988). In a field trial in Japan, Mochizuki et al. (2000) showed that grain yield of ratoon rice was highest with the higher cutting height. Nitrogen fertilizer affected the plant height, tillers hill$^{-1}$, panicle length, grains panicle$^{-1}$, grain yield and straw yield at 1% level of significance. The tallest plant (106.80 cm) was observed in the treatment received 1.20 kg N ha$^{-1}$; while the shortest plant (96.17 cm) was produced in control. Bhuyan et al. (1989) also reported...
the similar results where the tallest plants were obtained from the highest dose of N fertilizer. The highest number of tillers hill⁻¹ was produced from the treatment received 120 kg N ha⁻¹ (Table 2). On the contrary, the lowest (4.40) tillers hill⁻¹ was observed in N control. This finding is in good agreement with that of Reddy et al. (1985) who reported that, nitrogen application from 0 to 1.20 kg ha⁻¹ in three split dressings increased number of tillers hill⁻¹. The crop responded positively due to application of different levels of N fertilizer. Results indicate that the highest (5.03) effective tillers hill⁻¹ was recorded with the application of 120 kg N ha⁻¹ (Nj). Dixit and Singh (1979) reported the similar results where nitrogen application increased the effective tillers hill⁻¹. The lowest (2.68) effective tillers hill⁻¹ was found in control. The lowest productivity (18.57 cm) was produced due to application of 80 kg N ha⁻¹ (Nj); while the shortest productivity (18.10 cm) was found in 40 kg N ha⁻¹ (N). The highest grain percentage (78.78) was produced in control; while the lowest (73.00) grains percentage was recorded in 40 kg N ha⁻¹. The highest number (36.44) of sterile spikelets percentage was produced in both of the control and N fertilizer applied at 120 kg ha⁻¹ respectively. On the other hand, the lowest number (34.22) of sterile spikelets percentage was observed in 40 kg N ha⁻¹. The highest grain yield (1.07 t ha⁻¹) was produced from 120 kg N ha⁻¹; Singh and Yadav (1985) observed that paddy yield was continuously increased by addition of N from 0-150 kg ha⁻¹. This finding may also be supported by the finding of Bhulanyan (1980) who reported that grain yield of rice increased with the addition of nitrogen up to a certain level. The lowest (0.86 t ha⁻¹) grain yield was recorded in control. The highest straw yield (1.86 t ha⁻¹) was observed from 120 kg N ha⁻¹ and the lowest straw yield (1.42 t ha⁻¹) was in control. Results also confirm the findings of Thakur (1991), who obtained increased straw yield of rice with the increasing nitrogen levels.

The green biomass, effects of culm cutting height and fertilization significantly affected the plant height, total tillers hill⁻¹, panicle length, grains percentage, sterile spikelets percentage, thousand grain weight and grain yield. Interaction effects of culm cutting height and N- fertilizers on plant height, tillers number, panicle length, grains percentage, sterile spikelets per panicle, 1000 grains weight, grain and straw yield are presented in the Table 3. The tallest plant (116.10 cm) was noticed in the combination of 15 cm cutting height of culm and 120 kg N ha⁻¹ while the shortest plant was obtained in combination of 15 cm cutting height of culm and control. The lowest number of tillers hill⁻¹ observed in combination of 15 cm cutting height and control treatment of nitrogen, while the highest number (7.61) of total tillers hill⁻¹ was reported both in treatment combination of 10 cm cutting height of culm and 80 kg N ha⁻¹ and 15 cm cutting height of culm with 120 kg N ha⁻¹. Treatment combination of culm cutting height and level of N fertilization did not exert any significant effect on effective tillers hill⁻¹ and straw yield. Apparently the highest (5.89) effective tillers hill⁻¹ was observed in combination of 15 cm cutting height of culm and 120 kg N ha⁻¹. On the contrary, the lowest effective tillers hill⁻¹ was produced from the combination of 5.0 cm cutting height of culm and 0 kg N ha⁻¹. The shortest panicle (17.80 cm) was noticed in combination of 10 cm cutting height of culm and 80 kg N ha⁻¹, while the tallest panicle (19.47 cm) was noticed in the combination of 10 cm cutting height of culm and 40 kg N ha⁻¹. The lowest (71.00) grains percentage was found in treatment combination of 15 cm cutting height of culm and control fertilization. On the other hand, the highest (82.33) grains percentage was produced in combination of 10 cm cutting height of culm and 40 kg N ha⁻¹. The highest sterile spikelets percentage (40.00) was found in 10 cm cutting height of culm and 80 kg N ha⁻¹; while the lowest sterile spikelets percentage (32.67) were observed in treatment combination of 5.0 cm cutting height of culm and 120 kg N ha⁻¹. The highest 1000 grains weight (20.67 g) was obtained at 15 cm cutting height of culm and 80 kg N ha⁻¹. On the contrary, the lowest 1000 grains weight (20.63 g) was produced in 5.0 cm cutting height with 40 kg N ha⁻¹. The highest grain yield (1.68 t ha⁻¹) was obtained in 15 cm cutting height of culm with 120 kg N ha⁻¹. On the contrary, the lowest amount of grain (0.57 t ha⁻¹) was obtained from 10 cm cutting height and control. Results indicate that, the highest straw yield (2.51 t ha⁻¹) was obtained in 10 cm cutting height with 80 kg N ha⁻¹. On the other hand, the lowest straw yield (1.08 t ha⁻¹) was obtained with 5.0 cm cutting height of culm and control.

Culm cutting height and N-fertilizer have remarkable effects on yield and yield contributing characters in ratoon crop of rice. Therefore, optimum crop cutting height and N-fertilization could increase yield of ratoon rice and thus could be utilized shorter fallow after harvest of rice.

References


