

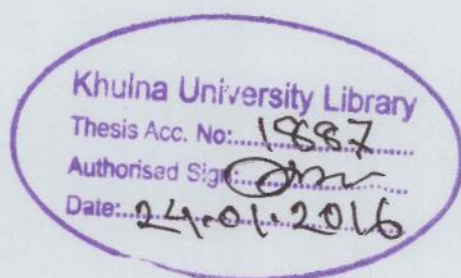
**YIELD AND QUALITY CHARACTERS OF LOCAL *BORO* RICE
VARIETIES OF SOUTH-WEST REGION OF BANGLADESH**

A Thesis

Submitted to

Agrotechnology Discipline

Khulna University



By

Swapan Kumer Roy

EXAMINATION ROLL NO. MS 100819

**In partial fulfillment of the requirement for the degree of
MASTER OF SCIENCE IN AGRONOMY**

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Khulna, Bangladesh**

OCTOBER, 2012

KHULNA UNIVERSITY
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FINAL ORAL EXAMINATION OF THE
MASTER OF SCIENCE IN AGRONOMY THESIS

The undersigned certify that they have read, and recommended to the Agrotechnology
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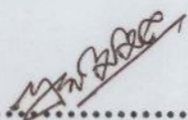
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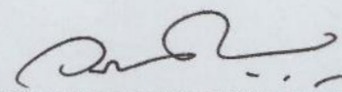
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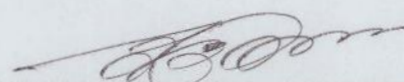
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OCTOBER, 2012

**DEDICATED TO
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ABSTRACT

The research work was conducted at the Professor Purnendu Gain Field Laboratory and Agronomy Laboratory of Agrotechnology Discipline, Kuhlana University, Kuhlana during November 2011 to May 2012 to study the growth, yield performance and grain quality characteristics of local *boro* rice varieties collected from south-western region of Bangladesh. Twelve local *boro* rice varieties were included viz. Nayon moni, Tere bale, Bere ratna, Ashan boro, Kajol lata, Kojore, Kali boro, Bapoy, Latai balam, Choite boro and Sylhety boro. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. In this experiment, growth parameter viz. plant height and number of tillers hill⁻¹ (at different days after transplanting); yield contributing characters such as effective tillers hill⁻¹, panicle length, number of grains panicle⁻¹, filled grains panicle⁻¹, thousand grain weight, grain yield, straw yield, biological yield and harvest index were recorded. Plant height and number of tillers hill⁻¹ at different days after transplanting varied significantly among the varieties. The plant height for all the varieties and number of tillers hill⁻¹ for most of the varieties increased up to harvest. At harvest, the tallest plant (123.80 cm) was recorded in Bapoy and the shortest (81.13 cm) was found in GS one. The maximum number of tillers hill⁻¹ (46.00) was observed in Sylhety boro and the minimum (19.80) in Bere ratna. All of the parameters of yield and yield contributing characters differed significantly at 1% level except grain yield, biological yield and harvest index. The maximum number of effective tillers hill⁻¹ (43.87) was recorded in the variety Sylhety boro and the minimum (17.73) was found in Bere ratna. The highest (110.57) and the lowest (42.13) number of filled grains panicle⁻¹ was observed in the variety Kojore and Sylhety boro respectively. Thousand grain weight was the highest (26.35g) in Kali boro and the lowest (17.83 g) in GS one. Grain yield was not differed significantly among the varieties but differed numerically the highest grain yield (5.01 t ha⁻¹) was found in the variety Kojore and the lowest in G.S.one. In case of grain quality, five types of hull color and three types of pericarp color were investigated among the tested varieties. Out of twelve varieties, awn was observed in five varieties such as Kojore, Nayonmoni, Choite boro, Sylhety boro and Kali boro. Physical and Chemical parameters of grains were differed significantly. The longest grain (6.65mm) was found in the variety Latai balam and the shortest grain (5.46 mm) was in GS one. The highest grain width was recorded in Kali boro (2.74 mm) and the lowest (1.97 mm) was in Latai balam. The maximum grain shape (3.37) was observed in Latai balam which was statistically similar to Kajol lata. All the varieties exhibited low alkali digestibility i.e. alkali spreading score 1 and 2 except Tere bale which was showed intermediate alkali digestibility i.e. alkali spreading score 3. All the varieties exhibited soft gel consistency.

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October, 2012.

The Author

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CHAPTER I

INTRODUCTION

Rice (*Oryza sativa* L.) is the main cereal food grain for more than half of the population in the world. There are about 111 rice growing countries in the world covering about 146.5 million hectares of land, of which more than 90 % is in Asia (Anonymous, 1999). It is the staple food for more than two billion people in Asia and many millions in Africa and Latin America. About 95 % of the world rice is consumed by the Asian (Rotshied, 1996). Among the rice growing countries of the world, Bangladesh ranks third in area and fourth in production (Huke and Huke, 1990).

Bangladesh is an agro-based country where agriculture is the single largest sector and the mainstay of the country's economy. Agriculture in Bangladesh is predominated by intensive rice (*Oryza sativa* L.) cultivation.

The national average yield of rice in Bangladesh is low (2.77 t ha^{-1}), while yields of the other rice growing countries of Asia such as, China, Taiwan, Indonesia, and Japan are 5.72, 4.60, 4.38, and 5.97 t ha^{-1} , respectively (Quayum *et al.*, 1996). In Bangladesh, the area under rice cultivation was 4706875 hectares in *boro* season in 2009-2010, which produced 18058962 MTs of grains with an average yield of 3.837 MTs from one hectares of land (BBS, 2010).

More than 90% of the population derives 76% of their daily calories and 66% of their proteins needs from rice. Rice alone contributes 18% of GDP and accounts for 55% of labor employment in its production, processing and marketing sectors (Nasiruddin and Hassan, 2009).

Nearly 10,000 land races of rice are considered to exist in Bangladesh (Haque and Miah, 1990). With the expansive culture of modern varieties, the number of traditional rice cultivars reduced. The promotion of high yielding variety (HYV) rice mono-culture has led to loss of diversity including 7000 traditional rice varieties (Singh *et al.*, 2000). For preserving genetic diversity in order to use for variety improvement programs in future, the threatened rice varieties need to be collected, conserved and evaluated.

Evaluation of genetic diversity is a prerequisite for successful germplasm exploitation through breeding. Effective utilization of germplasm in breeding programs is enhanced if the variations are properly characterized and described (Ouendeba *et al.*, 1995).

The local rice varieties are usually poor yielder but they are superior to modern varieties in terms of stability, resistance to biotic and abiotic factors, quality characters, etc. A number of reports showed that indigenous rice cultivars from Bangladesh possess a wide diversity in ecological, morphological and physiological characteristics (Bhowmick, 2000; Islam, 1990; Jahan, 2003).

Quality of rice grain has been an important factor in rice production. Some of the key components of rice quality are milling quality, grain size, shape and appearance, cooking, eating and processing quality, and nutritive quality, etc. of the grain (Cruz and Khush, 2000). The cooking and eating, and nutritive qualities are the major components of rice grain quality. Cooking and eating characteristics are largely determined by the properties of starch that makes up 90% of milled rice. Gelatinization temperature, amylose content and gel consistency are the important starch properties that influence cooking and eating characteristics (Cruz and Khush, 2000). The consumer preference of local varieties to the modern varieties is mainly for the superior grain properties (Choudhury, 1991).

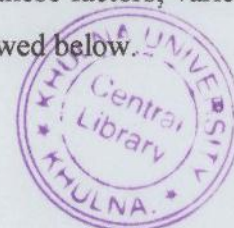
Hence, the present study was undertaken to fulfill the following objectives:

1. To observe the growth and yield performance of local *boro* rice varieties.
2. To find out the grain quality of local *boro* rice varieties.

CHAPTER II

REVIEW OF LITERATURE

Rice has remarkable adaptability to different environmental conditions as is evident from the worldwide distribution. Growth, development, yield and quality of rice are greatly influenced by the environmental factors, variety and agronomic practices. Among these factors, variety itself is very important. In this chapter, the available information is reviewed below.



2.1 Varietal differences in growth parameters

Babiker (1986) carried out an experiment with rice and observed that total tillers hill⁻¹ was significantly affected by the cultivars.

Sawant *et al.* (1986) conducted an experiment with the new rice cv. R-73-1-1, R-711 and the traditional cv. Ratna and reported that the traditional cv. Ratna was the shortest.

Shamsuddin *et al.* (1988) observed that plant height differed significantly among the varieties.

Hussain *et al.* (1989) reported from a field trial on rice cv. Basmati 370 in Faisalabad, applying 0, 30, 60, 120 or 150 kg N ha⁻¹ in single or in equal split application at sowing and at panicles initiation. The number of tillers hill⁻¹ increased up to 16.40 with increasing nitrogen rates.

Anonymous (1991) reported that plant height of rice differed among the varieties.

Anonymous (1993) evaluated the performance of four rice varieties / advance lines IRATOM, BR 14, BINA 13 and BINA 19 and noticed that varieties / advance lines differed significantly for plant height.

Om *et al.* (1998) found taller plants, more productive tillers in ORI 161 in PMS2A × IR 31802.

Huang *et al.* (1999) observed that the two hybrid rice lines had a plant height of about 115.80 cm and a culm height of 105.40 cm with thick and erect V-shaped leaves of deep green color.

2.2 Varietal differences in yield and yield contributing characters

Babiker (1986) reported that panicle length differed among the rice varieties.

Shamsuddin *et al.* (1988) observed that the variable effect of cultivar on the number of panicles hill⁻¹.

Kamal *et al.* (1988) carried out an experiment with BR 3, IR 20 and Pajam-2 and found that the number of grains per panicle were 170.6, 123.0 and 170.9 respectively, for the three varieties.

Rafey *et al.* (1989) conducted an experiment with three different rice cultivars and reported that weight of 1000-grain differed among the cultivars studied.

Idris and Matin (1990) conducted an experiment with six different rice varieties and found that panicle length differed among the varieties and it was greater in IR 20 than in high yielding varieties (HYVs).

Anonymous (1993) evaluated the performance of four varieties / advance lines IRATOM, BR 14, BINA 13 and BINA 19. They found that varieties differed significantly in panicle length and sterile spikelets panicle⁻¹.

Chowdhury *et al.* (1993) found that Pajam produced significantly higher number of grains panicle⁻¹ than that of BR 23.

Anonymous (1994) studied the performance of BR 14, Pajam and Tulsimala and reported that Tulsimala produced the highest number of grains panicle⁻¹ and BR 14 produced the lowest number of grains panicle⁻¹.

Shamsuddin *et al.* (1988) reported that 1000-grain weight of nine cultivars ranged from 21.1 g to 31.4 g.

Bhowmik and Nayak (2000) found that hybrid rice varieties gave higher grain and straw yield than HYVs.

Jing *et al.* (2000) conducted a research the correlation of harvest index (HI) with morphological characteristics and leaf colour was examined using 60 Japanese varieties (J group) and 20 high-yielding varieties bred in Asian countries (H group). In the J group, HI showed a positive correlation with leaf colour (SPAD value, SV) and a negative correlation with plant length (height) (PL) at the heading time.

Kabir *et al.* (2004) reported that Chinigura-1 produced the highest grain yield (2.47 t ha⁻¹) followed by Kalijira (2.15 t ha⁻¹) and Begunbitchi (0.92 t ha⁻¹). The yield of Chinigura-1 obtained in the study was almost similar to that of national average (2.40 t ha⁻¹). Chinigura-1 may be a potential aromatic rice variety in the coastal medium high lands of Bangladesh.

Awal *et al.* (2007) has conducted a research on comparative performances of hybrid and conventional rice varieties in aman season to evaluate the comparative performance of two hybrid rice varieties, Sonarbangla-2 and Sonarbangla-3 with three conventional modern commercial varieties BRRI dhan32, BRRI dhan33 and BR 11 in Transplanted aman season of 2003. The highest grain yield (6.20 t ha⁻¹) was recorded from the hybrid Sonarbangla-3 followed by BRRI dhan32 (5.70 t ha⁻¹) and the lowest in BRRI dhan33 (4.17 t ha⁻¹) and these differences were statistically significant.

Ashrafuzzaman *et al.* (2009) completed a research to evaluate the growth performance and grain quality of six aromatic rice varieties viz. BRRI dhan34, BRRI dhan38, Kalizira, Chiniatop, Kataribhog and Basmati grown under rainfed conditions. The rice varieties differed significantly with respect to leaf chlorophyll content, plant height, internode length, thousand grain weight, grain yield and straw yields. Varieties differed in morphological and yield and yield contributing traits. Thousand grain weight and grain yields both were highest in BRRI dhan38. Basmati required shorter days to maturity and Kalizira longest days to maturity. Different varieties exhibited significant differences in grain yield. BRRI dhan34 produced the maximum grain yield and Basmati produced the lowest.

Biswas *et al.* (1998) reported that of the varietal differences of grain yield in rice.

Kusutani *et al.* (2000) reported that the genotypes, which produced higher number of effective tillers per hill and higher number of grains per panicle also showed higher grain yield in rice. There was significant difference of 1000- grain weight among the varieties. The highest 1000-grain weight was recorded in BRRI dhan38 (20.13 g) and the lowest was recorded in BRRI dhan34 (12.17 g).

BRRI scientists reported that 1000-grain weight differed among the rice cultivars (BRRI, 1997).

Mondal *et al.* (2005) studied 17 modern cultivars of transplant aman rice and reported that 1000- grain weight differed significantly among the cultivars studied.

Hasamuzzaman *et al.* (2009) reported the effects of different salinity levels on germination, growth and yield of four irrigated rice cultivars. The experiment was performed with 6 NaCl concentrations viz. 0, 30, 60, 90, 120 and 150 mM. It was observed that seed germination, plant height, tiller number and leaf area index are negatively influenced by different salinity levels in all the rice varieties. All the yield components that is number of panicles, panicle length, spikelets per panicle, filled grain and grain weight also significantly decrease with the increased salinity stress. An increase of NaCl concentration up to 150 mM decreased 36-50 % of the yield of all the four rice varieties. Among the varieties BRRI dhan41 showed better performance at salinity stress up to a certain level.

2.3 Varietal differences in quality characters

Kaul *et al.* (1978) reported that grain length width ratio of 54 local and 6 improved rice cultivars from Bangladesh ranged between 1.75 and 4.07 with the mean value of 2.47.

Lahiri *et al.* (1993) reported that apparent amylose content from 10 artificial mutants developed from two Bangladesh rice cultivars varied between 17.5 to 26.0% and the alkali spreading scores was recorded between 2 to 6.

Dutta *et al.* (1998) analyzed the physico-chemical characteristics of grain such as analysis of length, breadth, length-breadth (L/B) ratio of kernels, 1000 kernels weight (TKW), protein and starch contents aroma of the grain of seven varieties of aromatic and non aromatic rice. The results revealed that wide variation existed in L/B ratio.

Dipti *et al.* (2003) studied on 11 *Beruin* Rice Varieties of Bangladesh. Length and breadth of all the *Beruin* varieties was higher than that of check *Ranga Bini* except *Push Beruin*. Highest length (5.7 mm) was observed in *Mow Beruin* followed by *Khara Beruin* (5.5 mm). Highest breadth (2.4 mm) was observed in *Kalo Beruin* followed by *Lekka Beruin* (2.3 mm). Among the *Beruin* varieties lowest length and lowest breadth were measured in *Push Bruin* and *Lal Beruin*, respectively. Highest length breadth ratios were measured in *Lal and Khara Beruin*. The lowest was *Push Beruin*. Most of the tested *Beruin* rice varieties were medium bold except (*push Beruin*) which was short bold. All the *Beruin* rice varieties showed high alkali spreading value than the check *Ranga Binni* and ranged from 6.3- 7.0. Highest alkali spreading value was found in five *Beruin* varieties and the lowest was in *Hatidat Beruin*.

Jahan *et al.* (2006) studied the quality characteristics of 369 local rice varieties of Bangladesh. They found that 280 having yellowish hull color, 58 brownish hull color, 29 light black and 2 varieties with dark black hull color. In their experiment red and white pericarp color was found. They also found grain length of local rice varieties which ranges between 2.71 mm and 8.08 mm with an average value of 5.4 mm.

Islam *et al.* (2009) studied six local aromatic rice cultivars and found three cultivars with yellowish hull color, two having black. The rest one possesses black hull color.

Shahidullah *et al.* (2009) conducted in a study with forty genotypes composed of 32 local aromatic, five exotic aromatic and three non-aromatic rice varieties. The trials associated with grain quality and nutrition of forty rice genotypes showed highly significant variations among the genotypes for all the traits ($p \leq 0.01$). Maximum grain length was recorded 12.16 mm in Elai, followed by 11.68 mm in Neimat and minimum was 5.81 mm in Rajbhog. Kernel length of Neimat was the highest (7.87 mm) followed by Elai (6.75 mm). The breadth of grain ranged from 2.24 to 3.60 mm. Lowest breadth was found in Sarwati (2.24 mm). Gandho kasturi (3.6 mm) showed the highest grain length.

Shilpa *et al.* (2010) reported that among the rice varieties studied, the L/B ratio ranged from 1.5-3.5. The traditional rice variety Tamde Jyoti recorded the highest L/B ratio and lowest in Novan. The L/B ratio in high yielding varieties ranged from 2.10 to 3.31. The grain size and shape of most high yielding rice varieties is short to medium bold with translucent appearance.



CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials used and methodology followed in conducting the experiment. The location of the study area and its climates, materials used, methods followed in different operations during the experiment (November 2011 to May 2012) as well as in data collection has been described here under the following sub-heading.

3.1 Experimental site

The study was conducted at the Professor Purnendu Gain Field Laboratory of Agrotechnology Discipline, Kuhlana University, Kuhlana. The experimental field was typical rice growing medium high land of loamy soil and it is situated in the Agro ecological Zones (AEZ) 13, i.e., Gangetic Tidal Floodplain. The geographical situation of the experimental field is at latitude of 22°47' N and longitude of 89°34' E having subtropical climate characterized by moderately high temperature and heavy rainfall during *khari*f season (March to October) and low rainfall and low temperature during the *robi* season (November to February).

3.2 Soil

The experimental field was typical rice growing medium high land of clay-loam with black colour and pH was 8. Soil samples of 0-15 cm depth from surface were collected from the experimental field. Chemical compositions of the soil sample were examined at SRDI laboratory, Daulatpur, Khulna and had been presented in Appendix I.

3.3 Climatic Condition

The records of climatological observations during the season of the experiment (November 2011 – April 2012) have been presented in Appendix 2.

3.4 Experimental Design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The selected field was firstly divided into three equal blocks and each block was further divided into twelve unit plots. The size of unit plot was 10 m² (4 m x 2.5 m). The total

number of plots was thirty six. The distance between block to block was 1.0 m and plot to plot distance was 50 cm.

3.5 Experimental treatment

Twelve indigenous boro rice varieties were used as treatment in this experiment which are as follows:

Nayon moni

Koijore

Tere bale

Kali boro

Bere ratna

Bapoy

Ashan boro

Latai balam

Kajol lata

Choite boro

GS One

Sylheti boro

3.6 Cultivation Practices

3.6.1 Seedbed preparation

A piece of medium high land was selected for seedbed preparation at the Dr. Purnendu Gain Field Laboratory of Agrotechnology Discipline. The bed was prepared as per BRRI recommendation. The length of seedbed was 2 m and width was 1.25 m and space between the beds was 0.5 m. Seedbed was made ready by ploughing 4 times with power tiller followed by laddering.

3.6.2 Raising of the seedlings

Before sowing in the seedbed, seeds were soaked for 24 hours for sprouting. Pregerminated seed were sown in the wet seedbed during *boro* season on 26th November, 2011. Appropriate care was taken to ensure that there was no infestation of pests and diseases and no damage by birds. The bed was kept wet by irrigation as and when required.

3.6.3 Main land preparation

The experimental field was prepared 15 days before transplanting by power tiller and ladder. It was ploughed sufficiently in order to make the soil nearly ready for transplanting. It was done thoroughly by repeated ploughing and cross ploughing and leveled by laddering. Weeds and stubbles were removed and the field was then divided into unit plots measuring 10 m² (4 m x 2.5 m) that were spaded one day before transplanting for incorporating the basal fertilizers.

3.6.4 Transplanting

Transplanting was done with three seedlings hill⁻¹ maintaining 20 cm hill to hill and 25cm line to line spacing on 16th January, 2012.

3.6.5 Fertilizer application

Name of Fertilizer	Rate of Fertilizer (kg ha⁻¹)
Urea	110
TSP	60
MoP	45
Gypsum	30
Zinc Sulphate	10

The total TSP, MoP, Gypsum and one third of Urea were applied as basal dose. The rest of the urea was applied at two equal split doses at 30 days after transplanting (DAT) and at 50 DAT.

3.6.6 Weeding

Two hand weeding were done to check weed infestation in the experimental field at 25 DAT and 40 DAT.

3.6.7 Irrigation and drainage

The experimental field was irrigated regularly up to dough stage depending upon the moisture content of the field and flood irrigation method was practiced.

3.6.8 Pest control

During the experimentation some insect pests like grass hopper, stem borer, rice bug and nematode were infested in the crop. Sencup 50 EC @ 1L ha⁻¹ was applied to control grass hopper, stem borer, rice bug and nematode was controlled by application of Furadan 5G @ 10 kg ha⁻¹.

3.6.9 Harvest and post harvest operations

The crops were harvested at their full maturity when more than 90% of the grains turned into golden colour. Nayanmoni, Ashan boro, Kajol lata, Bapoy, Latai balam and Choite boro were harvested on 23rd April, 2012 and Bere ratna, GS one, Kali boro were harvested 2nd May 2012 and Sylhety boro, Koijore, Tere bale were harvested on 5th May 2012. The harvested crop of each plot was bundled separately, tagged properly and brought to the clean threshing floor. The bundles were dried in open sunshine. Threshing was done with the help of a paddle thresher. After threshing the grains were cleaned. The grain and straw weight for each plot were recorded after proper drying.

3.7 Sampling and Data Collection

Before harvesting 5 hills were collected randomly from each plot for data collection. Data were collected on the following parameters.

3.7.1 Growth parameters

3.7.1.1 Plant height

Plant height was recorded before harvest at three times viz. 50, 65 and 80 DAT and at harvest.

3.7.1.2 Number of tillers hill⁻¹

Number of tillers hill⁻¹ was recorded before harvest at three times viz. 50, 65 and 80 DAT and at harvest.

3.7.2 Yield and yield contributing characters

3.7.2.1 Effective tillers hill⁻¹

The number of effective tillers hill⁻¹ of 5 hills were counted and the means were calculated.

3.7.2.2 Panicle length

Panicle length was measured and the means were calculated.

3.7.2.3 Total grains per panicle

Grains of each panicle were counted and the numbers of filled and unfilled grains were separated. The counting of grains was done manually.

3.7.2.4 Filled grains and unfilled grains per panicle

The number of filled grain and unfilled grains per panicle were counted manually.

3.7.2.5 Thousand grain weight

Thousand clean dried grains from the seed stock of each plot were counted separately and weighted by an electric balance and adjusted at 14 % moisture content (MC) by using following formula.

$$\text{Thousand grain weight at 14\% MC} = \frac{(100 - \text{SampleMC}) \times \text{Thousand grain weight at sample MC}}{(100 - 14)}$$

3.7.2.6 Grain yield

Grain yield from each plot was measured with the help of a top pan balance and converted the yield into 14% moisture level by using the formula mentioned below:

$$\text{Yield (at 14\% moisture content)} = \frac{10 (100 - \text{FMC})}{(100 - 14)} \times \frac{\text{plot yield (g)}}{\text{plot area (m}^2\text{)}}$$

3.7.2.7 Straw yield

Total straw yield of each plot was determined. Sample straw of each plot was adjusted to 14% moisture level.

3.7.2.8 Biological yield

Grain yield and straw yield are altogether regarded as biological yield. The biological yield was calculated with the following formula:

Biological yield = Grain yield + Straw yield.

3.7.2.9 Harvest index (%)

It is the ratio of economic yield to biological yield and was calculated with the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

3.8 Grain quality test

All the twelve local *boro* rice varieties were collected after harvest and these were tested for grain quality characters in Agronomy Laboratory of Agrotechnology Discipline, Khulna University.

3.8.1 Physical parameters

Measurements were done for length, width and thickness of de hulled grains, using ten grains of each variety. The distance between the tip and the bottom of the grain was taken as the length and widest part from the abdomen to the back as the width of the rice grain were taken under each replication. Moreover, were done on the ratio of 'length to width' using average values of respective characters. Hull & pericarp colors and awnness were recorded by visual observation.

3.8.2 Chemical parameters

3.8.2.1 Detection of Alkali spreading score

The alkali spreading for each grain was determined with three replications according to the method of Little *et al.* (1958). A single de hulled grain was halved vertically and was put into

a well Petridis. The disintegration of starch granules were detected by standing the grain in 1 ml well⁻¹ 1.7% (w/v) KOH solution for 24 hours at room temperature.

3.8.2.2 Determination of gel consistency

Ten whole milled rice grains were ground with the help of a mortar and pestle to give fine flour (100 meshes). One hundred mg (± 1 mg) of powder was weighed and triplicate into the culture tube (13×100 mm), then 0.2 ml of 95% ethyl alcohol containing 0.025% thymol blue was added. 2.0 ml of 0.2 N KOH was added. Contents were mixed well. The test tubes were covered with glass marbles to prevent steam loss and to reflux the samples. The samples were cooked in vigorously boiling water bath for 8 minutes, making sure that the tube contents reach $\frac{2}{3}$ th the height of the tube. The test tubes were removed from the water bath and let stand at room temperature for 5 minutes. The tubes were cooled in an ice bath for 20 minutes and laid horizontally on a laboratory table lined with millimeter graphing paper. The total length of the gel is measured in mm from the bottom of the tube to the gel front.

3.8.3.3 Measurement of gelatinization property of starch:

Five mature seed kernels of average size from each variety were taken and the embryos were removed. The kernels were ground with a mortar and pestle, and 20 mg of the powder was added with 1 ml of a solution of 0 to 9 M urea, the P^H of which had been to 6.0 with acetic acid, in a 1.5 ml Eppendorf tube. The mixture was incubated at room temperature for 24 hours. The suspension was centrifuged for 1 hour. The gelatinization of the starch granule in urea solution was expressed in terms of the volume of the swollen sediment, which was calculated by subtracting the volume of supernatant from the urea solution (1 ml).

3.9 Data analysis

All the collected data were analyzed following the analysis of Variance (ANOVA) technique and mean differences were adjudged by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) using a computer operated program named MSTAT-C.

CHAPTER IV

RESULTS AND DISCUSSION

Results of all parameters obtained from the present investigation have been presented and discussed in this chapter. The data have been presented in table(s) for ease of discussion, comprehensions and understanding. The result of each parameter has discussed and interpretations have been given wherever necessary.

4.1 Growth parameters

4.1.1 Plant height

It was evident from the result of the experiment that plant height significantly varied among the varieties (Table 1). Plant height increased progressively reaching a maximum at harvest. The tallest (123.80 cm) plant was found in the variety Bapoy followed by Choite boro (122.93 cm) and the shortest plant was recorded from the variety G.S one (81.13 cm) preceded by Tere bale (86.00 cm) and Kojore (91.33 cm). Variation in plant height might be due to the differences in their genetic makeup. This results were in consistent to those of Sawant *et al.* (1986), Shamsuddin *et al.* (1988), Hossain *et al.* (1991), Khatun (2001) and Das *et al.* (2012) who observed variable plant height among the rice varieties.

4.1.2 Number of tiller hill⁻¹

Tiller production was affected markedly among the local boro rice varieties. Tiller number in most of the treatments increased almost exponentially up to 80 DAT although it was the highest at harvest (Table 2). After panicle initiation tiller number generally declines but here tiller number is increased up to harvest. Because of saline soil, lack of irrigation and heavy cold weather at the early stage of transplanting. The maximum number of tillers hill⁻¹ (46.13) was recorded in the variety Sylhety boro followed by Nayon moni (33.00). The minimum number of tillers (18.13) was observed in the variety Kojore. Variation in the tiller number among the varieties might be due to differences in their genetics characters. Similar result was also reported by Ramasamy *et al.* (1987) who stated that number of tillers hill⁻¹ differed due to varietal variation.



Table 1. Plant height of different local *boro* rice varieties at different days after transplanting

Variety	Plant height (cm) at			
	50 DAT	65 DAT	80 DAT	Harvest
Nayonmoni	62.06bc	75.00d-g	104.73bc	111.40bc
Tere bale	51.13cd	63.00fgh	79.00ef	86.00fg
Bere ratna	67.93ab	78.80cde	95.20cd	97.60de
Ashan boro	62.80bc	73.33e-h	88.20de	92.13ef
Kajol lata	71.26ab	91.13bc	103.86bc	108.67bc
GS one	47.26d	59.20h	70.93f	81.13g
Koijore	49.00d	61.20gh	76.06f	91.33efg
Kali boro	61.93bc	76.86c-f	108.53ab	114.87ab
Bapoy	68.80ab	88.26bcd	116.20a	123.80a
Latai balam	67.93ab	95.33b	110.13ab	117.20ab
Choite boro	77.33a	110.00a	117.73a	122.93a
Sylhety boro	51.53cd	62.06gh	95.46cd	103.47cd
Level of significance	0.01	0.01	0.01	0.01
CV (%)	8.19	7.82	4.73	4.33

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly

DAT = Days after transplanting

Table 2. Number of tillers hill⁻¹ of different local *boro* rice varieties at different days after transplanting

Variety	Number of tillers hill ⁻¹ at			
	50 DAT	65 DAT	80 DAT	Harvest
Nayon moni	20.36abc	25.66b	29.66bc	33.00b
Tere bale	12.66c	21.87bc	31.26b	29.80bc
Bere ratna	15.00bc	16.60c	19.13de	19.80e
Ashan boro	17.00abc	19.86bc	20.40cde	22.07de
Kajol lata	19.66abc	23.86bc	24.73b-e	29.60bc
GS one	18.46abc	24.26bc	23.40b-e	24.47cde
Koijore	23.93a	20.53bc	18.13e	20.40e
Kali boro	22.20ab	26.26b	27.26b-e	29.13bc
Bapoy	19.20abc	27.00b	28.20bcd	29.93bc
Latai balam	20.86abc	22.33bc	23.80b-e	25.60cd
Choite boro	25.00a	23.33bc	27.00b-e	27.27bcd
Sylhety boro	25.40a	36.33a	46.13a	46.00a
Level of significance	0.05	0.01	0.01	0.01
CV (%)	22.34	13.33	14.68	9.12

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly

DAT = Days after transplanting

4.2 Yield and yield contributing characters

4.2.1 Number of effective tillers hill⁻¹

Variety had significant effect on effective tillers hill⁻¹ (Table 3). The highest (43.87) number of effective tillers hill⁻¹ was produced by Sylhety boro. The lowest (17.73) number of effective tiller hill⁻¹ was observed in Bere ratna which was preceded by Kaijore and Ashan boro. The reason of difference in number of effective tiller hill⁻¹ is the variation in the genetic makeup of the variety. This result was supported by Choudhury *et al.* (1993) and Anonymous (1991) who stated that effective tillers hill⁻¹ varied with variety.

4.2.2 Panicle length

Panicle length was found to be influenced by the varieties (Table 3). The highest (21.62 cm) panicle length was recorded in the variety Bapoy which was followed by the variety Kajol lata and Bere ratna. The lowest panicle length (15.13 cm) was found with the variety Sylhety boro which was preceded by Nayon moni, GS one, Kali boro and Choite boro. The variation as assessed might be mainly due to genetic background of the variety. Similar results were also recorded by Idris and Matin (1990) and Anonymous (1993) who reported that panicle length influenced by variety.

4.2.3 Number of grains panicle⁻¹

Number of grains panicle⁻¹ was found highly significant (Table 3). It was evident from the result of the experiment that number of grains panicle⁻¹ was the highest (132.80) with the variety Koiore which was statistically identical with Bere ratna and GS one. The lowest (45.32) number of grains panicle⁻¹ was recorded with the variety Kali boro which was statistically identical with Nayon moni and Latai balam. The reason of the difference in the number of grains panicle⁻¹ is due to the differences of genetic constituents among the varieties.

4.2.4 Number of filled grains panicle⁻¹

Number of filled grains panicle⁻¹ was differed significantly at 1% level (Table 3). The results revealed that number of filled grains panicle⁻¹ was the highest (110.57) with the variety

Kojore which was statistically identical with Bere ratna. The lowest (40.52) number of filled grains panicle⁻¹ was recorded with the variety Kali boro which was statistically to Sylhety boro. Anonymous (1994) reported that the number of filled grains panicle⁻¹ varied significantly due to variety. The results were also supported by Singh and Gangwer (1989) who stated that varietal differences regarding the number of filled grains panicle⁻¹ might be due to their differences in genetic constituents.

4.2.5 1000-grain weight

It was observed from the present study that varieties differed significantly in respect of 1000-grain weight (Table 3). Among the tested varieties the highest 1000-grain weight (26.35 g) was produced by the variety Kali boro which might be due to its larger grain size and that was statistically similar to Nayon moni and Latai balam. The lowest 1000-grain weight (17.83 g) was found in GS one for its smaller grain size which was also statistically similar to Kojore. This might be due to varietal difference. Similar results were reported by Gupta and Sharma (1991).

4.2.6 Grain yield

Grain yield of rice mainly depends on the number of effective tillers per hill, filled grains per panicle and individual grain weight. Results showed that (Table 3) the grain yield did not vary significantly among the varieties but was varied numerically. The highest (5.01 t ha⁻¹) grain yield was recorded in Kojore which might be due to its highest number of filled grains panicle⁻¹ and the lowest (3.17 t ha⁻¹) was found in GS one (Fig. 1).

4.2.7 Straw yield

The varietal effect on straw yield was significant at 1% of probability (Table 3). The highest (5.44 t ha⁻¹) straw yield was obtained from the variety Sylhety boro which might be due to its highest number of tillers hill⁻¹. The lowest straw yield (2.77 t ha⁻¹) was observed in the Kajol lata. The result was supported by Hossain (2002).

4.2.8 Biological yield

It was found from the results of the present study that biological yield did not vary significantly due to variety (Table 3). However, numerically the highest (10.11 t ha⁻¹) biological yield was obtained from the variety Sylhety boro. The lowest biological yield (6.45 t ha⁻¹) was found in the Kajol lata. The result was supported by Sohel *et al.* (2009).

4.2.9 Harvest index

From the results (Table 3) it was revealed that harvest index did not follow any regular trend and was not varied significantly due to different varieties. However, numerically the highest (57.52%) harvest index was recorded from the variety Ashan boro and that of the lowest (46.07%) was recorded in Sylhety boro. The result was supported by Sohel *et al.* (2009).

Table 3. Yield and yield contributing characters of different indigenous *boro* rice varieties

Treatment	No. of effective tiller hil ⁻¹	Panicle length (cm)	No. of grains panicle ⁻¹	No. of filled grains panicle ⁻¹	1000 grain wt. (g)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
Nayonmoni	30.73b	17.71c	53.77e	46.51de	26.28a	3.72	3.68bc	7.42	50.08
Tere bale	27.13bc	19.11bc	74.01cde	61.36cde	20.92cd	3.36	3.21bc	6.57	51.26
Bere ratna	17.73f	20.22ab	113.17ab	97.42ab	22.02bc	4.24	3.31bc	7.55	55.68
Ashan boro	20.00def	18.82bc	96.57bc	83.29bc	21.86bc	4.34	3.15bc	7.49	57.52
Kajol lata	26.13bcd	21.54a	88.17bcd	74.96bc	24.80ab	3.68	2.77c	6.45	56.74
GS one	22.00c-f	18.32c	108.95ab	83.36bc	17.83e	3.17	3.37bc	6.77	51.48
Koijore	18.00ef	18.58bc	132.80a	110.57a	18.88de	5.01	4.46ab	9.47	53.01
Kali boro	27.13bc	17.66c	45.32e	40.52e	26.35a	3.72	3.66bc	7.39	49.85
Bapoy	27.06bc	21.62a	86.75bcd	66.69cd	24.34ab	3.67	3.76bc	7.43	49.38
Latai balam	23.60c-f	18.26c	55.81e	49.17de	25.74a	3.94	3.10bc	7.04	56.13
Chcrite boro	24.53b-e	18.34c	62.81de	48.64de	24.34ab	4.78	3.99abc	8.77	54.52
Sylhety boro	43.87a	15.13d	47.69e	42.13e	24.19ab	4.67	5.44a	10.11	46.07
CV (%)	10.61	3.98	14.59	14.44	5.50	22.65	17.76	18.28	8.36
Level of significance	0.01	0.01	0.01	0.01	0.01	NS	0.01	NS	NS

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly

4.3 Grain physical parameters

4.3.1 Hull and pericarp color and awnness

Five types of hull color were found in tested rice varieties, namely yellowish, yellowish brown, blackish, brownish and straw (Plate 1 and Table 4a). Among the five hull colors recognized, yellowish was found in the six varieties such as Bere ratna, Aashan boro, Kajol lata, GS one, Latai balam and Bapoy; blackish was found in the three varieties such as Kojore, Nayonmoni and Kali boro; yellowish brown, brownish and straw color was observed in Choite boro, Sylhety boro and Tere bale. Three types of pericarp color were investigated among the tested varieties (Plate 2 and Table 4a). Whitish color was observed in Bere ratna, Aashan boro, Kajol lata, GS one and Latai balam among the varieties. Only Tere bale variety was showed cream color and rest of the tested varieties showed redish color. Out of twelve varieties, awn was observed in five varieties (Plate 1 and Table 4a) such as Kojore, Nayonmoni, Choite boro, Sylhety boro and Kali boro. Islam (1990) reported that straw and red color of the hulls and pericarps, respectively, were the most frequently occurring color in about 500 DWR (Deep Water Rice) varieties from Bangladesh.

4.3.2 Grain size

Grain size differed significantly at 1% level and it ranged between 5.46 mm and 6.65 mm (Table 4b). The longest grain (6.65 mm) was found in the variety Latai balam which differed significantly from grain size of other varieties. GS one variety had the shortest grain (5.46 mm) which was statistically similar to Choite boro. Based on size, the grains are grouped into different grain size classes according to the classification by Cruz and Khush (2000) as very long (> 7.50 mm), long (6.61-7.50 mm), medium (5.51-6.60 mm) and short (≤ 5.50 mm) (Table 6). All of the tested varieties exhibited medium grain size. Jahan *et al.* (2006) found grain size of 369 de hulled rice varieties from Bangladesh ranged between 2.71 to 8.08 mm with an average value of 5.84 mm.

4.3.3 Grain width

Grain width among the tested varieties differed significantly (Table 4b). The longest grain width was recorded in Kali boro (2.74 mm) and the shortest (1.97 mm) in Latai balam which differed significantly from grain width of other varieties. Dipti *et al.* (2003) reported a mean width was 2.08 mm of 11 *Beruin* rice varieties of Bangladesh.

4.3.4 Grain thickness

Grain thickness was varied significantly at 1% level and it ranged between 1.56 mm and 1.93 mm (Table 4b). The highest grain thickness (1.93 mm) was found in Kali boro which was statistically similar to Nayon moni and the lowest grain thickness (1.56 mm) was recorded in Kajol lata which was statistically differed from other tested varieties. Satoh *et al.* (1990b) reported a mean grain thickness of 1.88 mm of 99 cultivated rice varieties from Madagascar.

4.3.5 Length width (L/W) ratio

Ratios of grain length to grain width were significantly differed among the varieties. The L/W ratio was varied between 2.24 to 3.37 (Table 4b). The L/W ratio was the highest (3.37) in Latai balam which was statistically similar to Kajol lata. The lowest L/W ratio (2.24) was recorded in Sylhety boro which was statistically similar to Kali boro. Based on length width (L/W) ratios, the rice varieties tested were classified into shape groups as bold (L/W ratio ≤ 2.00), medium (L/W ratio 2.1-3.00) and slender (L/W ratio >3.00) (Cruz and Khush, 2000). Kajol lata and Latai balam showed slender grain shaped and rest of the tested varieties exhibited medium shaped grains (Table 5). Islam *et al.* (2009) studied on six aromatic local rice varieties and found a mean value of L/W ratio of 2.17 with 0.13 standard deviation.

To establish relationship among length, width, thickness and L/W ratio of the dehulled grain, correlation coefficient among them were calculated. Correlation coefficients of grain size and grain thickness; grain size and grain width and grain size and L/W ratio of de hulled grains were calculated as -0.127, -0.260 and -0.187 respectively, suggesting that a negative correlation exists among them (Fig. 2,3 &4).



Table 4a. Grain physical characteristics of local *boro* rice varieties.

Name of variety	Hull color	Name of cultivar	Pericarp color	Awn
Bereratna	Yellowish	Latai balam	Whitish	No
Aashan boro	Yellowish	Tere bale	Whitish	No
Kajol lata	Yellowish	Bereratna	Whitish	No
GS one	Yellowish	Aashan boro	Whitish	No
Latai balam	Yellowish	G.S.one	Whitish	No
Bapoy	Yellowish	Koijore	Radish	No
Koijore	Blackish	Kaliboro	Radish	Yes
Nayonmoni	Blackish	Bapoy	Radish	Yes
Kaliboro	Brownish	Choite boro	Radish	Yes
Sylhety boro	Brownish	Sylety boro	Radish	Yes
Choite boro	Yellowish brown	Nayonmoni	Radish	Yes
Tere bale	Straw	Kajol lata	Cream	No

Table 4b. Grain physical characteristics of local *boro* rice varieties

Variety	Grain length (mm)	Grain width (mm)	Grain thickness (mm)	L/W ratio
Nayonmoni	5.97d	2.62b	1.92a	2.28ef
Tere bale	5.72e	2.48bc	1.77b	2.31ef
Bereratna	5.80de	2.39bcd	1.77b	2.42de
Aashan boro	6.10bc	2.33d	1.73bc	2.61c
Kajol lata	6.09bc	1.84g	1.56e	3.32a
G.S.one	5.46f	2.11e	1.66cd	2.59c
Koijore	5.77de	2.49b	1.75b	2.31ef
Kaliboro	6.21b	2.74a	1.93a	2.26f
Bapoy	5.64e	2.40bcd	1.75b	2.36ef
Latai balam	6.65a	1.97f	1.65d	3.37a
Choite boro	5.55f	2.38cd	1.79b	2.49cd
Sylhety boro	5.62e	2.51b	1.84b	2.24f
Level of significance	0.01	0.01	0.01	0.01
CV (%)	1.46	1.94	1.97	2.04

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly

Table 5. Categories of grain based on length and L/W ratio of different indigenous *boro* rice varieties

Cultivars	Grain length (size)	L/W ratio (Shape)
Nayonmoni	Medium	Medium
Tere bale	Medium	Medium
Bereratna	Medium	Medium
Aashan boro	Medium	Medium
Kajol lata	Medium	Slender
G.S.one	Medium	Medium
Koijore	Medium	Medium
Kaliboro	Medium	Medium
Bapoy	Medium	Medium
Latai balam	Medium	Slender
Choite boro	Medium	Medium
Sylhety boro	Medium	Medium

Grain size	Length (mm)	Grain shape	L/W ratio
Very long	>7.50	Slender	>3.0
Long	6.61-7.50	Medium	2.1-3.0
Medium	5.51-6.60	Bold	≤2.0
Short	≤5.50		

(Cruz and Khush, 2000)

4.4 Disintegration of rice kernels in 1.7% KOH solution

Based on disintegration behavior, rice kernels can be classified broadly into 3 groups, i.e. low, intermediate and high alkali digestibility (Jahan *et al.* 2006). Kernels with high alkali digestibility are disintegrated almost completely in 1.7% KOH solution, kernels having intermediate digestibility show partial disintegration in 1.7% KOH solution and kernels with low alkali digestibility are unaffected in 1.7% KOH solution. Within individual groups, significant difference can be observed in the degree of spreading (disintegration) for rice kernels. Therefore, each of the alkali digestibility group is divided further for better characterization. Low alkali digestibility consisted of the alkali spreading scores 1 and 2 as determined by the degree of spreading of rice kernels in 1.7% KOH solution after 24 hours of immersion at room temperature. Intermediate alkali digestibility consisted of the alkali spreading scores 3, 4 and 5 and high alkali digestibility consisted of the alkali spreading scores 6 and 7.

All of the studied varieties exhibited low alkali digestibility i.e. alkali spreading score 1 and 2 except Tere bale which was showed intermediate alkali digestibility i.e. alkali spreading score 3 (Plate3 and Table 6). The results of this experiment enjoyed the support from the findings of Jahan *et al.* (2002) who reported that more than 90% of Bangladeshi rice cultivars had low alkali digestibility with alkali spreading score between 1 and 2 after analyzing more than 500 indigenous rice cultivars from Bangladesh.

4.5 Gel consistency behavior

Difference in gel consistency exists among varieties of similar amylase content (Cruz and Kush, 2000). The gel consistency test is based on the consistency of the rice paste and differentiates among varieties with high amylase content. The test separates high amylose rice into three categories such as very flaky rices with hard gel consistency (length of gel, 40 mm or less); flaky rices with medium gel consistency (length of gel, 41 to 60 mm) and soft rices with soft gel consistency (length of gel, more than 61 mm).

All of the tested varieties exhibited soft gel consistency (Plate 4 and Table 6). Jahan *et al.* (2006) studied 276 local varieties of Bangladesh and found 73 varieties having soft gel consistency.

4.6 Urea gelatinization

Rice, than any other cereal, exhibits very wide ranges of cooking quality that is largely determined by the swelling and gelatinization characteristics of its starch. To examine the effect of the concentration of urea on the gelatinization of starch granules, endosperm starch from studied *boro* rice varieties were prepared and mixed them with solutions of urea at concentrations from 0 to 9M. In this study it was found that starch granules from varieties with low alkali digestibility started to gelatinize from 5 to 6 M urea concentration (Fig. 5-6) except variety Ashan boro and Bapoy which started to gelatinize from 4 to 5 M urea concentration (Fig. 4 and Plate 5). Variety Tere bale exhibited intermediate alkali digestibility started to gelatinize from 4M urea concentration.

Table 6. Alkali digestibility and gel consistency of different indigenous *boro* rice varieties

Cultivars	Alkali spreading score	Alkali digestion	Gell length (mm)	Category
Nayonmoni	1	Low	99.33a	Soft
Tere bale	3	Intermediate	90.00bc	Soft
Bereratna	2	Low	97.50a	Soft
Aashan boro	2	Low	90.00bc	Soft
Kajol lata	1	Low	93.33ab	Soft
G.S.one	1	Low	89.17bc	Soft
Koijore	1	Low	74.17d	Soft
Kaliboro	1	Low	97.50a	Soft
Bapoy	1	Low	94.17ab	Soft
Latai balam	2	Low	95.00ab	Soft
Choite boro	2	Low	95.00ab	Soft
Sylhety boro	2	Low	99.33a	Soft
Level of significance			0.01	
CV (%)			2.89	

In a column figures having similar letter(s) did not differ significantly where as dissimilar letter(s) differed significantly

Alkali digestion	Alkali spreading score	Category	Gell length (mm)
Low	1-2	Hard	≤40mm
Intermediate	3-5	Medium	41-60
High	6-7	Soft	≥61mm

(Cruz and Khush, 2000)

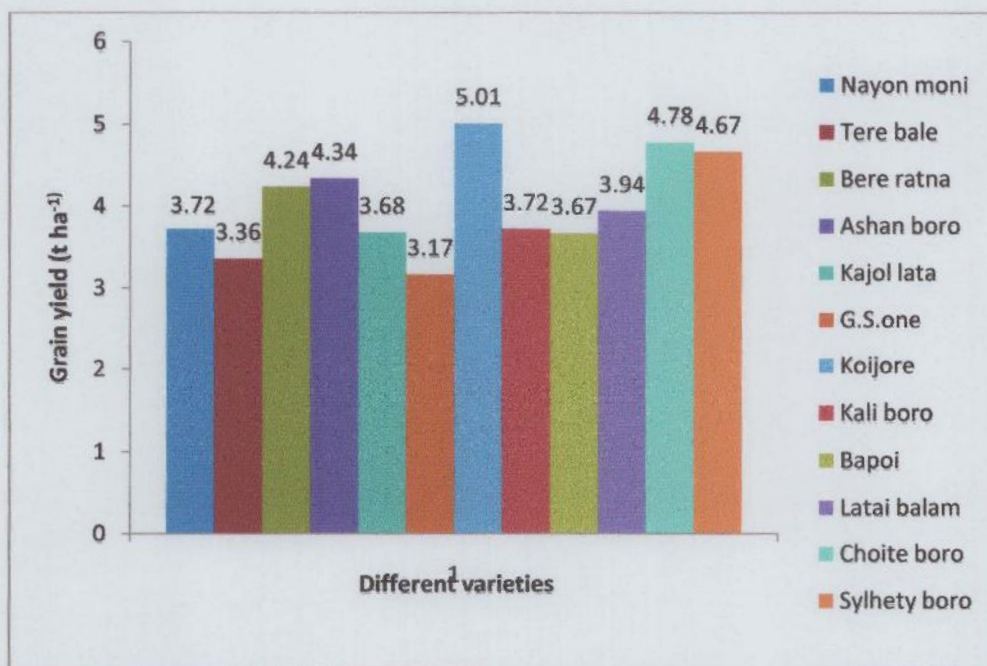


Fig. 1. Bar diagram of grain yield of different *boro* rice varieties

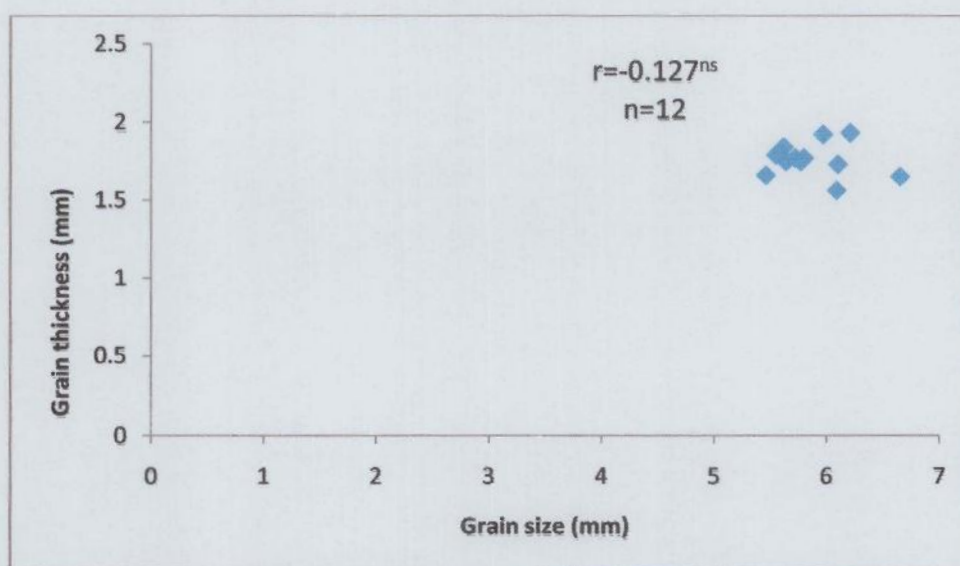


Fig. 2. Functional relationship between grain size and grain thickness

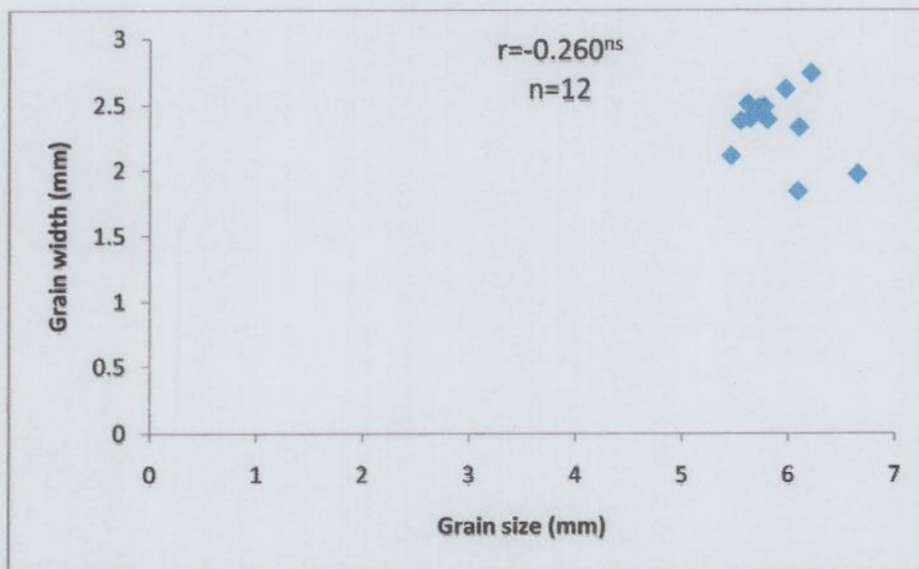


Fig. 3. Functional relationship between grain size and grain width

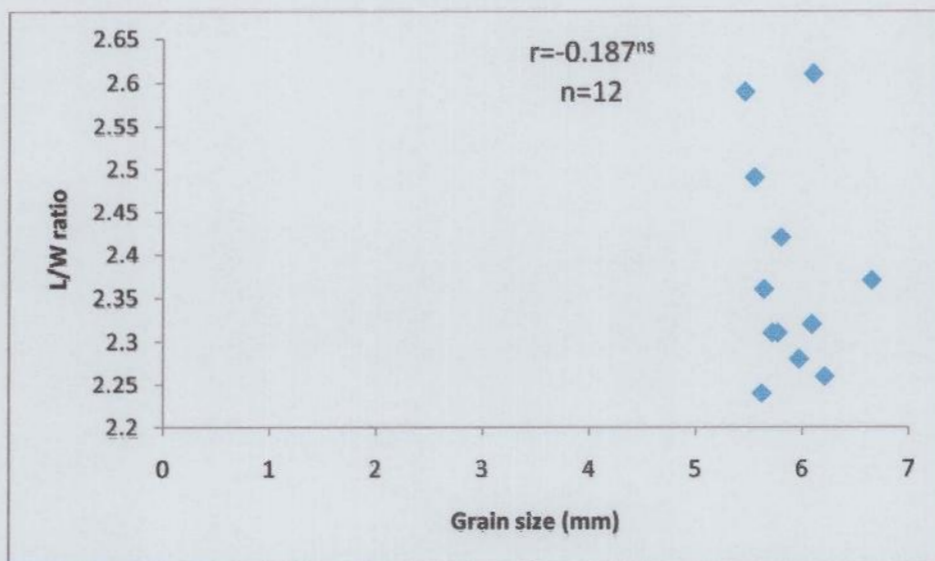


Fig. 4. Functional relationship between grain size and L/W ratio

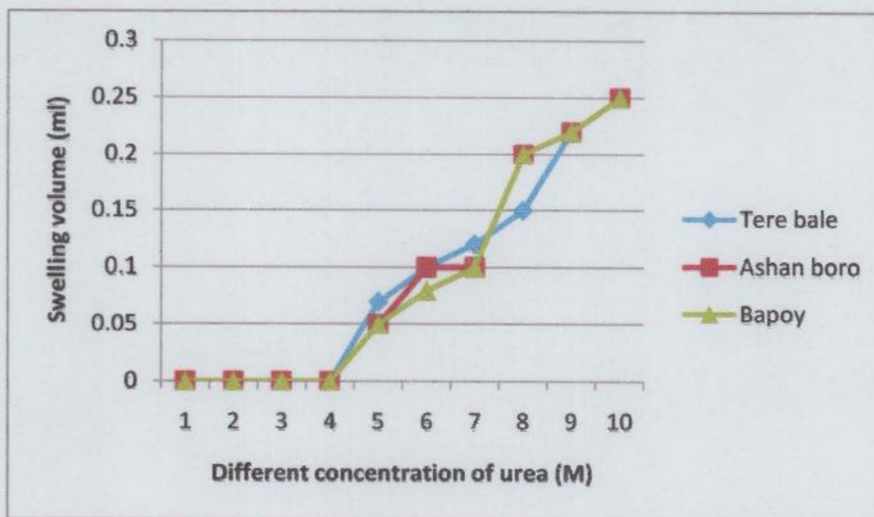


Fig. 5. Swelling volume of endosperm starch granules at various concentrations of urea from 0 to 9 M.

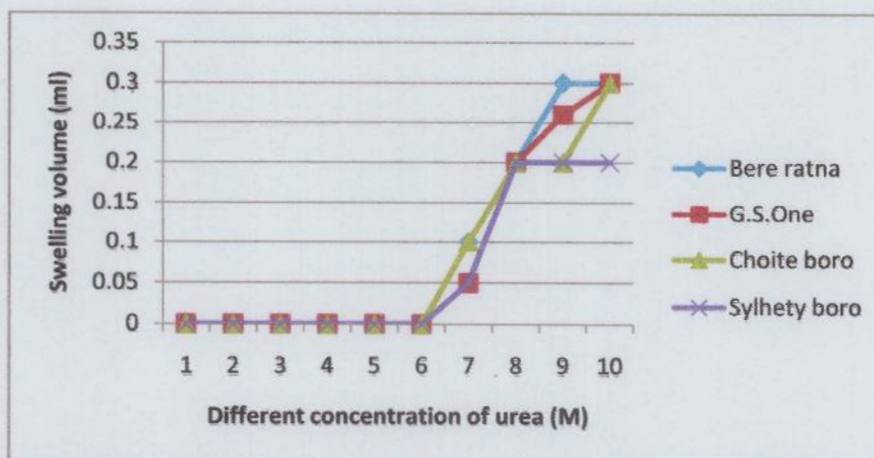


Fig. 6. Swelling volume of endosperm starch granules at various concentrations of urea from 0 to 9 M.

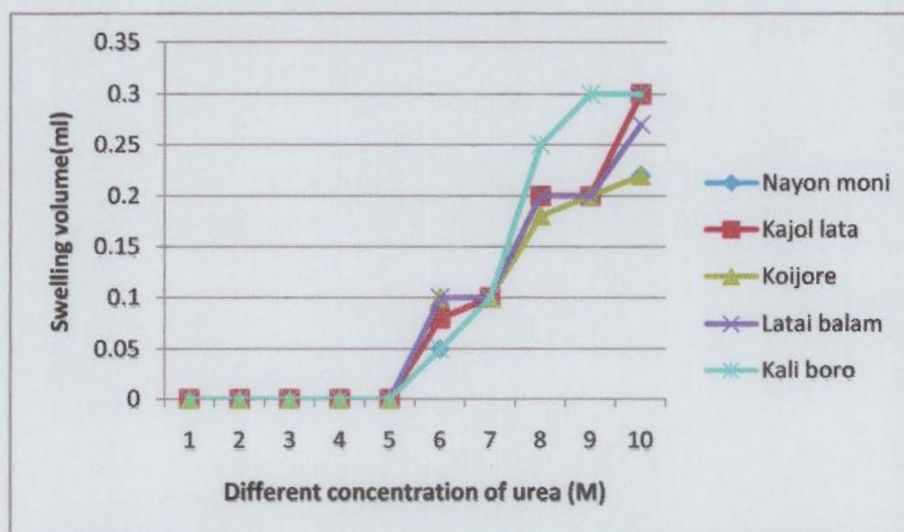


Fig. 7. Swelling volume of endosperm starch granules at various concentrations of urea from 0 to 9 M.



NAYONMONI



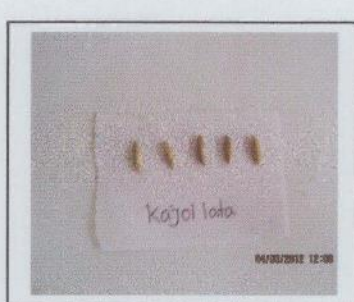
TERE BALE



BERE RATNA



ASHAN BORO



KAJOL LATA



G.S.ONE



KOIJORE



KALIBORO



BAPOY



LATAI BALAM



CHOITE BORO



SYLHETY BORO

Plate1. Variation in hull colors and awnness found in different local boro rice varieties



NAYON MONI



BERE RATNA



TERE BALE



ASHAN BORO



KAJOL LATA



G.S. ONE



KOIJORE



KALI BORO



BAPOY



LATAI BALAM



CHOITE BORO



SYLHETY BORO

Plate2. Variation in pericarp colors found in different local boro rice varieties



Plate 3. Alkali digestibility of different local *boro* rice varieties

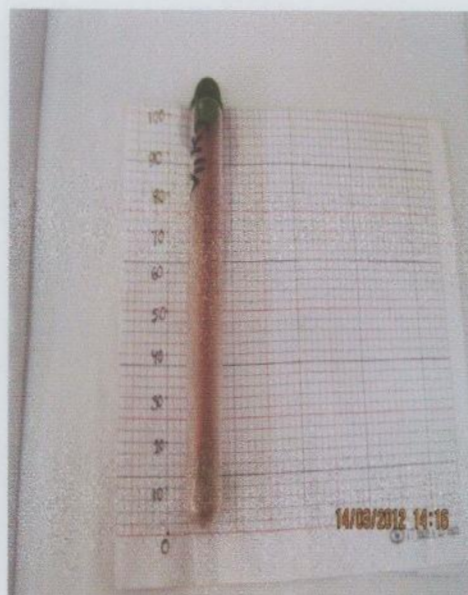
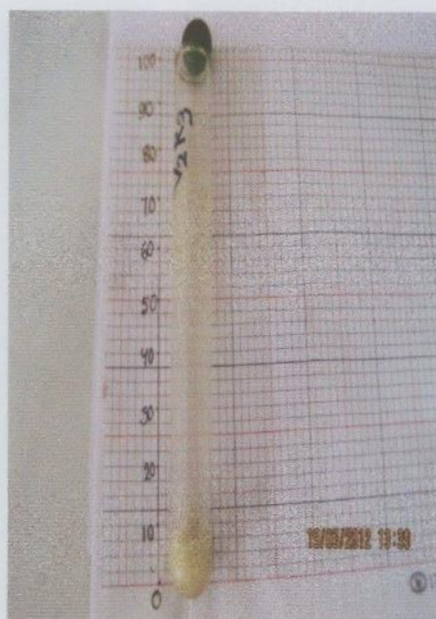


Plate 4. Gel consistency value of milled rice of different local *boro* rice varieties

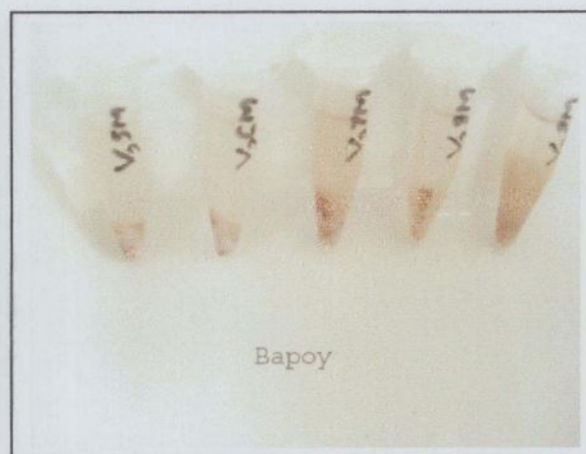
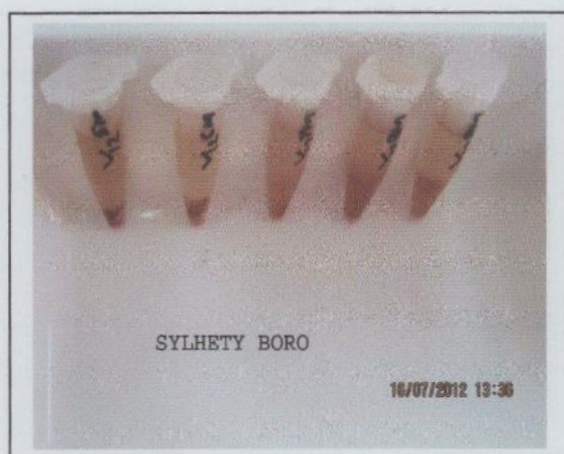
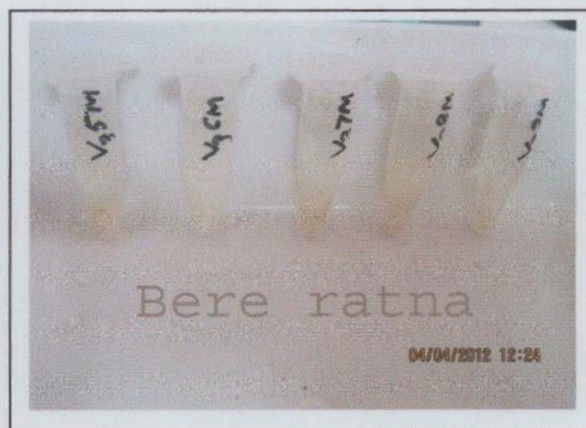


Plate 5. Effect of the concentration of urea (5-9M) on gelatinization of starch granules on different local *boro* rice varieties

CHAPTER V

SUMMARY AND CONCLUSION

The present research work was carried out to study on the yield performance and grain quality characteristics of local *boro* rice varieties in south west region of Bangladesh. The experiment was conducted at the Professor Purnendu Gain Field Laboratory and Agronomy Laboratory of Agrotechnology Discipline, Kuhlana University, Kuhlana during November 2011 to May 2012. The study included twelve local *boro* varieties viz. Nayon moni, Tere bale, Bere ratna, Ashan boro, Kajol lata, Koijore, Kali boro, Bapoy, Latai balam, Choite boro and Sylhety boro. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. In this experiment, growth parameter viz. plant height and number of tillers hill⁻¹ (at different days after transplanting); yield contributing characters such as effective tillers hill⁻¹, panicle length, number of grains panicle⁻¹, filled grains panicle⁻¹, thousand grain weight, grain yield, straw yield, biological yield and harvest index were recorded.

The plant height and number of tiller hill⁻¹ at different days after transplanting were differed significantly. The highest (123.80cm) and lowest (81.13cm) plant height at harvest was recorded in the variety of Bapoy and GS one respectively. The maximum (46.00) number of tiller hill⁻¹ was found in Sylhety boro and the minimum (19.80) was in Bere ratna.

The highest (43.87) number of effective tillers hill⁻¹ was produced by Sylhety boro. The lowest (17.73) number of effective tiller hill⁻¹ was observed in Bere ratna which was preceded by Koijore and Ashan boro. The highest (21.62 cm) panicle length was recorded in the variety Bapoy which was followed by the variety Kajol lata and Bere ratna. The lowest panicle length (15.13 cm) was found in the variety Sylhety boro which was statistically identical with Nayon moni, GS one, Kali boro and Choite boro. Number of grains panicle⁻¹ was found highly significant and it varied between 45.32 and 132.80. It was evident that number of grains panicle⁻¹ was the highest (132.80) in the variety Koijore which was statistically identical to Bere ratna and GS one. The lowest number of grains panicle⁻¹ (45.32) was recorded in the variety Kali boro which was statistically identical to Nayon moni and Lataibalam. The results revealed that the number of filled grains panicle⁻¹ was the highest (110.57) in the variety Koijore which was statistically identical to Bere ratna and the lowest (42.13) was recorded in the variety Sylhety

boro which was statistically similar to Latai balam and Choite boro (Table3). Among the tested varieties the highest 1000-grain weight (26.35g) was produced by the variety Kali boro which might be due to its larger grain size which was statistically similar to Nayon moni and Latai balam. The lowest 1000-grain weight (17.83g) was found in GS one for its smaller grain size which was statistically similar to Kojore. Grain yield, biological yield and harvest index did not vary significantly. Numerically the highest (5.01 tha^{-1}) grain yield was recorded in Kojore and the lowest was found in GSone (3.17 tha^{-1}). The highest (5.44 tha^{-1}) straw yield was obtained from the variety Sylhety boro and the lowest (2.77 tha^{-1}) was obtained from Kajol lata. The highest (10.11 tha^{-1}) biological yield was obtained from the variety Sylhety boro and the lowest (6.45 tha^{-1}) was found in the Kajol lata. The highest (57.52%) harvest index was recorded from the variety Ashan boro and the lowest (46.07%) was recorded in Sylhety boro.

In case of grain quality characters, five types of hull color and three types of pericarp color were investigated among the tested varieties. Out of twelve varieties, awn was observed in five varieties such as Kojore, Nayonmoni, Choite boro, Sylhety boro and Kali boro. The highest grain (6.65mm) was found in the variety Latai balam which differed significantly from grain size of other varieties. Variety GS one had the shortest grain (5.46 mm) which was statistically similar to Choite boro. All of the tested varieties exhibited medium grain length. The highest grain width was recorded in Kali boro (2.74 mm) which differed significantly from grain width of other varieties and the lowest (1.97mm) was in Latai balam (2.13 mm). The highest grain thickness (1.93 mm) was found in Kali boro which was statistically similar to Nayon moni and the lowest grain thickness (1.56 mm) was recorded in Kajol lata. The maximum grain shape (3.37) was observed in Latai balam which was also statistically similar to Kajol lata. The minimum grain shape (2.24) was recorded in Sylhety boro which was statistically similar to Kali boro. Kajol lata and Latai balam showed slender grain shaped and rest of the tested varieties exhibited medium shaped grains.

The alkali digestibility of the studied varieties was found low (ASS 1 and 2) except the Tere bale (ASS 3). This observation implies that most of the tested rice varieties are resistant to alkali and have high gelatinization temperature. This also suggests that more time is required to cook them.

In the present study, all of the rice varieties had soft gel consistency. All the varieties had low alkali digestibility except Tere bale which had intermediate alkali digestibility. It was found that

starch granules from varieties with low alkali digestibility started to gelatinize from 5 to 6M except variety Ashan boro and Bapoy. Starch granules from variety Tere bale exhibiting intermediate alkali digestibility started to gelatinize from 4M urea concentration.

From the findings of the research work, it can be concluded that

- Among twelve varieties, five varieties produced higher grain yield while the highest yield was in Kojore.
- All the varieties had medium grain size (grain length) and most of them had medium grain shape (L/W ratio).
- All the varieties possessed soft gel consistency and most of the varieties showed low alkali digestibility.

CHAPTER VI

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APPENDICES

Appendix I. Properties of the soil of selected site

Analyzed result							
pH	Salinity (dSm ⁻¹)	Organic matter (%)	Potassium (µm/100g)	Total Nitrogen (%)	Phosphorus (µm/g soil)	Sulphur (µm/g soil)	Zinc (µm/g soil)
8.0	5.4	2.03	0.35	0.125	9.31	129.65	0.31

Note: Soil analysis was performed in Soil Resources Development Institute (SRDI), Daulatpur, Khulna