INFLUENCE OF FIRST COB REMOVAL ON THE YIELD OF COMPOSITE AND HYBRID MAIZE

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CERTIFICATE

This is to certify that the thesis entitled "**INFLUENCE OF COB REMOVAL ON YIELD OF COMPOSITE AND HYBRID MAIZE**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **AGRONOMY**, embodies the result of a piece of *bona fide* research work carried out by **Palki Saha**, Registration number: **08-03160** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma. I further certify that any help or source of information, received during the course of this investigation has duly been acknowledged.

Dated:
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DEDICATED TO

MY

BELOVED PARENTS

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ABSTRACT

The experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from November 2013 to March 2014 to study the influence of first cob removal on the yield of composite and hybrid maize. The experiment comprised as two factors. Factor A: Cob removal- 2 levels; C_0: No cob removal and C_1: Cob removal. -Factor B: Maize variety - 6; V_1: Baby corn; V_2: Khaibhutta; V_3: BARI bhutta 6; V_4: BARI hybrid bhutta 7; V_5: BARI hybrid bhutta 9 and V_6: BARI sweet corn. The experiment was laid out in a split-plot design with three replications. Data on different growth parameters, yield attributes and yield were recorded and analyzed. The result revealed that higher grain yield (11.50 t ha^{-1}) was recorded from the cob removal treatments which was 9.73% higher than no cob removal (10.48 t ha^{-1}). BARI hybrid bhutta 9 gave the highest grain yield (12.10 t ha^{-1}) which was similar with BARI hybrid bhutta 7 and gave 20.75% higher grain yield than Khaibhutta. The interaction effect showed that BARI hybrid bhutta 9 in combination with cob removal gave the highest grain yield (12.24 t ha^{-1}), which was 48.90% higher than the treatment combination of BARI sweet corn with no cob removal. Again, the treatment with no cob removal gave only the grain yield at harvest but the treatment with cob removal produced baby corn at early stage and at the same time, the grain yield at harvest. So, the total return was higher for all varieties in combination with cob removals than the treatments with no cob removal. As a result, if the cob removal practices were adapted by the farmers, they can get additional income from selling out baby corn with the cob removal at early stage and grain yield at harvest.

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CHAPTER I

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world both as food for human and feed for animals. It has very high yield potential. There is no cereal on the earth which has so immense potentiality and that is why it is called “Queen of Cereals”. It is considered as third cereal crop in Bangladesh after rice and wheat (BBS, 2011). Maize also ranks third in terms of production among the world major cereal crops, following closely behind wheat and rice. More than 70 countries have each over one million hectares of maize making it the worlds most widely distributed crop (CIMMYT, 1981).

Maize crop has been included as a major enterprise in the crop diversification and intensive cropping programs (Kaul and Rahman, 1983). It is the most efficient crops which can give high biological yield as well as grain yield in a relatively short period of time due to its unique photosynthetic mechanism of C_4 pathway. The area and production of maize in 2010 were 409070 acres and 101828 tons, respectively (BBS, 2011). The production of maize is likely to grow up by 19% to touch 20 million tons in 2010-2011 because of both increase in acreage and yield. Its grain has high nutritive value containing 66.2% starch, 11.1% protein, 7.12% oil and 1.5% minerals. Moreover, 100 g maize grains contain 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamin and 0.1 mg riboflavin (Chowdhury and Islam, 1993).

Maize oil is used as the best quality edible oil. Green parts of the plant and grains are used as the feed of livestock and poultry. Stover and dry leaves are used as good fuel (Ahmed, 1994). The important industrial use of maize includes in the manufacture of starch and other products such as glucose, high fructose sugar, maize oil, alcohols, baby foods and breakfast cereals (Kaul, 1985). Maize seed has much higher grain protein content than in rice.

In Bangladesh, the cultivation of maize was started in the late 19th century with gaining the momentum as the grains were largely been used in poultry industries.

As per report of BARI (2000), some 3,00,000 tons maize grain is necessary to feed the poultry birds and fishes.

Loamy soil with nearly neutral p^H is most suitable for production of maize. It can be grown all the year round in Bangladesh and fitted in the gap between the main cropping seasons without affecting the major crops. It can also be grown in flood prone areas under no tillage and with no inputs (Efferson,1982). With its multipurpose properties, it will undoubtedly play a vital role in reducing the food shortage around the world, especially in Bangladesh. Development of maize varieties having high yields with shorting the growing period may go a long way to supplement food and fodder shortage in Bangladesh. Yield is a complex character which is dependent on a number of agronomic characters and is highly influenced by many genetic and environmental factors (Joarder *et al*., 1978).

Bangladesh is facing a problem of malnutrition due to her high population growth rate and low productivity of crops. The traditional crop including rice and wheat seems quite unable to meet the nutritional requirement. Maize can be a potential crop for bringing nutritional balance and may offer a partial solution to the food shortage if its present yield level and total production can further be raised.

To increase the productivity of maize in developing countries like Bangladesh, new high yielding varieties have to be evolved. The demand of maize hybrid varieties is increasing among the farmers due to their high yield potentialities. Hybrid and composite maize varieties can play an important role in increasing food production of Bangladesh. Now-a-days in world climate, “Global Warming” is a burning issue due to which CO_2 is increasing day by day. To reduce CO_2 emission, it is preferable to adapt C_4 crops like maize than C_3 crops like rice and wheat. In recent years some NGO’s have been importing hybrid seeds of maize but those are very expensive. Leaf removal at early stages of growth had no effect on the performance of maize. Remision (1982) evidenced that complete defoliations of all leaves and those at the upper half of the plant were the most severe in reduction of yield and its components, as well as increasing percentage of lodged plants. Among ear characters, ear size was the most affected by defoliation.

Generally 1-2 cobs/plant is available in maize plant though it has the potentiality to produce more as rudimentary buds remain almost in all nodes but those cannot form effective cob might be due to source limitation. The first formed immature cob can be removed to utilize for human consumption as vegetable like baby corn. Report showed that cobs should be picked for vegetable use within 5 days of silking (http://www. evergreen seeds. com/babycorn.html). If not harvested at this stage, cobs will develop into full sized regular corns. In our country, Tk.100 million is expending every year for importing baby corn for different Chinese restaurants (Fakir and Islam, 2008). Almost all varieties of maize are suitable as baby corn but they have to produce more cobs plant^{-1}. Harvesting first one cob encourages to develop other cob (Miles and Leslie, 2005) but the behavior among varieties is yet to understand and explore the potential of baby corn.

The present study was therefore, undertaken to explore the possibility of finding out the beneficial effect of first cob removal on composite and hybrid maize varieties for yield and other attributes with considering the following objectives:

OBJECTIVES OF RESEARCH WORK

1. To find out the effect of first cob removal on maize yield.
2. To determine the yield variation of different maize varieties.
3. To find out the effect of first cob removal and variety on maize yield.
4. To calculate the economics of baby corn cultivation.

CHAPTER II

REVIEW OF LITERATURE

Maize is one of the common and most important cereal crops of Bangladesh and as well as many countries of the world. The growth and yield of maize are largely controlled by the environmental variables notably moisture regimes, temperature and varieties. Research works have been done by various workers in many parts of the globe to study the effect of irrigation, and quality variety on the growth and yield of maize. The crop has received much attention by the researchers on various aspects of its production and utilization for different consumers' uses. Many studies on the growth and yield have been carried out in many countries of the world. The work so far done in Bangladesh is not adequate and conclusive. Nevertheless, some of the important and informative works and research findings so far been done at home and abroad on this aspect have been reviewed in this chapter under the following headings:

2.1 Effect of variety on yield

Palafox *et al.* (2006) reported that during spring and summer seasons of 2004, four experiments of 3-way quality protein maize (QPM) hybrids were carried out in Camaron de Tejeda, Medellin de Bravo, Tlalixcoyan and San Andres Tuxtla, State of Veracruz, Mexico to characterize the yield and agronomic features of these hybrids, and identify those with best agronomic behaviour. Eleven QPM, 8 common hybrids and 2 checks were evaluated. Individual analysis for yield, days to tassel, days to silking, plant height and ear length, plant and ear aspect, and combined analysis for yield were conducted. The best hybrids in Medellin de Bravo were HC 1 and HC 2. In Camaron de Tejeda, HC 4 and HC 2 presented the best grain yield of 8-9 t/ha. HC 7 and HC 2 were the best hybrids in Tlalixcoyan with more than 6 t/ha. In San Andres Tuxtla, HC 1 and HC 4 registered the highest grain yield. Across the four locations, the best hybrids considering grain yield, adaptation, and plant and ear agronomic characteristics were HC 2, HC 4, and HC 1.

Sirisampan and Zoebisch (2005) reported that in northeast Thailand, maize (*Zea mays* L.) was mainly grown under rainfed conditions to identify and assess variety and cultivation-practice effects on the growth and yield of maize under temporary drought stress induced during the flowering stage. Under controlled soil-moisture conditions, three varieties (Suwan5 - open-pollinating; Big717 and Big949 - single-cross hybrids) and five cultivation practices (conventional (CT)); mungbean (*Vigna radiata* (L.) Wilzek) residue (Mn); spineless mimosa (*Mimosa invisa*) live mulch (Mi); manure (Ma); and plastic mulch (PI) were studied for two cropping seasons. The two hybrid varieties produced significantly higher grain yields than the open-pollinating variety, i.e., Big717 > Big949 > Suwan5. The effects of cultivation practices were less prominent and the highest average yields were produced by PI; the lowest by Ma.

Syed *et al*. (2002) conducted the field experiment during 2000 at Malakandher Research Farms, NWFP Agricultural University, Peshawar, Pakistan to study yield and yield components of different cultivars of maize as affected by various combinations of NP. Statistical analysis of the data revealed that days to 50% silking, 1000 grain weight, grain weight and biological yield were significantly affected by different varieties and fertilizer (NP) levels. Similarly, combination between varieties and NP had a significant effect on days to 50% tasselling, days to 50% silking, grain yield and biological yield. Maize variety Azam produced maximum 1000 grain weight, grain yield and biological yield when compared to other varieties. When the effect of different levels of NP was taken into account, it was revealed that plots treated with NP levels of 120:90 kg NP ha^{-1} produced maximum 1000 grain weight, grain yield and biological yield.

Olakojo and Iken (2001) evaluated nine improved open pollinated maize varieties and a local cultivar in five locations consisting of four agro-ecologies of Nigeria, for yield performance and stability estimates. The results showed that location (L), variety (V), and year (Y) were significant for yield. Similarly, location x variety (L x V) as well as location x variety x year (L x V x Y) interactions were significantly different in the tested genotypes at P= 0.05. The improved maize varieties significantly out yielded the local check entry by between 10.3 and 30.3%, thus ranking TZB and Posa Rica 7843 as the highest yielding varieties. Stability estimates in the tested varieties showed that local variety was the most stable variety with Bi=1.0. Other varieties appeared to be stable in poor environment with stability estimates of <1.0. TZB and Posa Rica 7843 recorded the least (0.38 and 0.64) stability estimates.

Ogunboded *et al.* (2001) evaluated seven early maturing open pollinated (OP) and five yellow hybrid maize varieties in 1996 in 22 locations representing the different agro ecologies of Nigeria. Significant location effects were observed for grain yield in the two sets of maize varieties tested. Grain yield was significantly higher in the northern/southern Guinea savanna agro ecologies when compared to the other agro ecologies. Highly significant varietals differences were found among the OPs and the yellow hybrids. The highest yielding OP variety was TZE Comp.4 DMR BC1 with an average grain yield of 2.43 t ha^{-1} while the best yellow hybrid was 8522-2 with a mean grain yield of 2.82 t ha^{-1}. Comparison of the results of the OPs and the hybrids showed that the hybrid had an average of 18.2% yield advantage over the OPs. The hybrid maize varieties and four of the seven OPs were stable in grain production across the locations.

Chaudhary *et al*. (2000) were conducted a series of on-farm experiments involving 18 farmers during kharif season of 1993 to 1995 under mid-hill sub-humid agro-climate in Mandi district of Himachal Pradesh to assess the relative effect and impact of different technological inputs on maize (*Zea mays* L.) productivity. The treatments consisted of farmers' practices with local variety (control), farmers' practices with improved variety, farmers' practices with improved variety and recommended fertilizer and improved practices with improved variety and recommended fertilizer. The results indicated that the grain yield (3795 kg ha^{-1}) and net return (Rs. 8069 ha^{-1}) were significantly higher on adoption of improved practices along with improved variety and recommended fertilizer over other treatments and an additional gain in grain yield due to this practice was 1262 kg ha^{-1} with 49.8% increase against farmers' practices with local variety.

Tusuz and Balabanl (1997) conducted a study in the Antalya-Manavgat region during 1993-94, 8 hybrid maize varieties (P.3165, TTM813, TTM815, TTM81-19, ANT90, ANT-BEY, TUM82-6 and TUM82-7) were grown to determine changes in characters (50% silking date, plant height, ear height and moisture percentage at harvest) affecting grain yield. Over the two years of the experiment, heritability in the broad sense was highest for 50% silking (0.93), and low for plant height (0.12), ear height (0.31), harvest moisture percentage (0.03) and for yield (0.06). Yield was significantly correlated with 50% silking date (r = 0.67), plant height (r = 0.50), ear height (r = 0.42) and harvest moisture percentage (r = 0.43). Adaptation was very good for all of the tested varieties. Grain yield was highest for P.3165 (1343 kg da^{-1}) and ANT90 was the earliest variety. The yield potential of all of the varieties changed from year to year and a significant environmental effect was observed.

Babu *et al*. (1996) reported the performance of maize Ksheeramrutha, derived from South African maize, and its hybrids with Deccan 101, grown in the field at Karnataka during 1975-86. Ksheeramrutha was quick growing, leafy, tall and high yielding compared with the other genotypes tested. It produced good quality fodder, had high protein content and performed well in mixtures with black soya and cowpeas. It was released for cultivation in Karnataka in 1989.

Smale *et al*. (1995) reported that farmer adoption of seed/fertilizer technology could be characterized in terms of three simultaneous choices: whether to adopt the components of the recommended package; land allocation to new and old varieties; and the level of inputs such as fertilizer. Two distinctive features of maize technology adoption in Malawi are: land allocation to both traditional and hybrid maize varieties; and application of a modern input (fertilizer) to a traditional variety.

An experiment was conducted at the Regional Agricultural Research Station, Jamalpur during rabi season, 1994-1995 to study the effect of composite variety on the grain and fodder yield of maize by thinning plants and leaf removal. The objective was to find out the suitable maize variety (Mohor and Synthetic) for higher grain and fodder yield by thinning plants and leaf removal. The treatment combinations were: 1) normal thining 1 plant hill^{-1} at 10-15 DAE var. Mohor, 2) Thinning down 1 plant hill^{-1} at 60 DAE var. Mohor, 3) Thinning down 2 plants hill^{-1} at 60 DAE var. Mohor, 4) Thinning down 2 plants hill^{-1} at 60 DAE + removal of lower leaves at 100 DAE var. Mohor, 5) Normal thinning 1 plant hill^{-1} at 10-15 DAE var. Mohor + Thinning alternate plants 60 DAE (75 cm × 12.5 cm) at 100 DEA variety Mohor, 6) Normal thinning 1 plant hill at 10-15 DAE var. Mohor, 7) Normal thinning 1 plant hill^{-1} at 60 DEA synthetic, 8) Thinning down 1 plant hill^{-1} at 60 DAE, synthetic, 9) Thinning down two plant hill^{-1} at 60 DAE synthetic, 10) Thinned down two plants hill^{-1} at 60 DAE + removal of lower leaves at 100 DAE synthetic, 11) Normal thinning 1 plant hill^{-1} at 10-15 DAE synthetic + Thinning alternate plants 60 DAE (75 cm × 12.5 cm) at 100 DAE synthetic, 12) Normal thinning 1 plant hill^{-1} at 10-15 DAE synthetic + thinning alternate rows 60 DAE (37.5 cm × 25 cm) at 100 DAE synyhetic. Grain yield of maize was not significantly affected by thinning and leaf removal but plant thinned down 2 plants hill^{-1} at 60 DAE with synthetic showed reasonable good yield (5.66 ton ha^{-1}) with green stover yield of 13.06 ton ha^{-1}. (BARI, 1998).

BARI (1989) conducted a field experiment at Joydebpur during rabi 1989-90 to determine the response of Nitrogen on grain and cob growth of two varieties Barnali and Khoibhutta. Nitrogen was applied in three equal splits at two different time. In both the treatments, 1/3 nitrogen was applied at basal during land preparation. In one treatment 1/3 nitrogen was applied at4th leaf stages (25DAE) and the rest 1/3 was applied at tassel primodium initiation stages (50

DAE). On the other hand in another treatment 1/3 nitrogen was applied at tassel primodium initiation stage (50 DAE) and rest 1/3 at tassel visible stage (75 DAE). The variety Barnali produced higher yield over Khoibhutta. Split N application at 50 and 75 DAE produced higher yield than 25 and 50 DAE.

An experiment was laid out in factorial RCBD with four replications during rabi, 1986-88 at BARI, Joydebpur to find out the effect of nitrogen application at defined growth stages of two varieties of maize, Barnali and Khoibhutta. Nitrogen application in three equal splits viz. , 1/3 at sowing, 1/3 at tassel primordial initiation (50 DAS) and 1/3 at tassel visible (75 DAS) produced higher grain (3.48 ton/ha) in both the year over N2 treatment (3.53 ton ha-1) i. e. 1/3 N at sowing, 1/3 at 25 DAS and 1/3 at 50 DAS. This higher yield was probably due to increase in 1000 grain weight, numbers of grains per cob. Application of nitrogen at defined stages probably met the nitrogen requirements throughout the critical growth stages adequately and thus resulted in higher grain yield. It was found that Barnali produced higher yield (4.01 ton ha^{-1}) over Khoibhutta (3.36 ton ha^{-1}) which might be due to increased in 1000 grain weight, weight of grains per cob and cob per plant. (BARI, 1988).

BARI (1985) conducted a field experiment at Joydebpur during kharif , 1985 and rabi 1986 with ten growth stages (i.e. collar of 4th, 8th and 12th leaf, tip tassel visible, silk visible, cob full size, kernel dough, kernel partially dented, kernel fully dented and maturity) in four maize varieties (viz. , Across7740, Sadaf, Amberpop and Pirsabak 8146). No variation in duration of growth stages was noticed upto 12th leaf stages among the varieties during kharif season. Their maturity period ranged from 78 days (Pirsabak 8146) to 93 days (Across 7740). Distinct differences were observed from 7th leaf stages during rabi season. The same varieties took 123 days (Pirsabak) to 138 days (Across 7740) to attain maturity in rabi season. The yield ranged from 1.94 to 2.84 ton/ha in kharif and 4.13 to 5.52 ton/ha in rabi. Variations in yield both in kharif and rabi might be due to seasonal variation.

A field experiment was conducted under irrigated condition to determine the effect of row spacing on three maize cultivars (Pirsabak 4186, Lamaquina 7827 and Amberpop) at Joydebpur and Hathazari during rabi, 1985-86. Three row spacing (60, 75 and 90 cm) with fixed plant spacing of 25 cm and fertilizers at 120, 70 and 40 kg of N_2, P_2O_5 and K_2O, respectively as Urea, TSP and MP were employed. Grain yield and yield attributes were affected significantly by spacing and cultivars at Joydebpur. The highest grain yield (5.12 ton/ha) was produced by Pirsabak 8146 at 60 cm spacing which was identical to Lamaquina 7827. Amberpop did not respond significantly to different row spacings. At Hathazari, grain yield and yield attributes were not significantly different due to spacing and cultivars. Increasing row spacing had decreased grain yield in all three cultivars. All the cultivars produced higher grain yield at 60 cm row spacing (BARI, 1988).

2.2 Effect of variety on dry matter production

Waes and Bockstaele (1997) tested approximately 150 varieties with a broad range for earliness over 4 years in different agricultural regions in Belgium. For corn maize, the consistency for earliness was in general good across locations and years, while yield was more influenced by location and year. Earliness of silage maize was also very consistent over locations. Dry matter yield was more influenced by location, but not as much as in corn maize. Digestibility and starch content were generally consistent over the years. Most corn and silage maize varieties had a moderate to good stability.

Akiyama and Takeda (1975) examined the effect of leaf photosynthetic rate on DM production in 4 maize cultivars, the rate being measured at 10 and 60 klx at various states of growth. The DM yield of each cultivar was measured at controlled LAI by varying the distance between pots. Leaf photosynthetic rates varied between cultivars; some attained a high capacity at high light intensity, while others were saturated at relatively low light intensities. Under these conditions cultivars which were adapted to low light intensity had the highest DM yields. Positive relationships were found between NAR and rate of leaf photosynthesis at all stages of growth. In particular, the photosynthetic rate of the youngest fully-expanded leaf at 60 klx was closely correlated with NAR at an early stage of growth, whereas the rate at 10 klx was highly correlated with NAR during active growth.

Egharevba (1974) reported that in 3 maize hybrids, complete defoliation 10 days after 50% silking decreased DM accumulation, the decrease being apparent 10 days after defoliation. Any degree of defoliation at any time up to 30 days after 50% silking gave a significant decrease in DM yield. Leaves above and below the dough stage reduced DM accumulation, grain yield, yield components and grain quality. Complete defoliation caused the black-layer stage to be reached 16 days earlier.

2.3 Effect of variety on grain quality

Wu *et al*. (2004) conducted a field experiment with a high-protein (Zhongdan 9409), a high-oil (Jiyou No. 1) and a common (Simi 25) maize variety in Changchun, Jilin, China. The kernel yields of the high-protein maize (HPM) and the high-oil maize (HOM) were 24.91 and 12.49% lower, the protein yield/ha of HPM was 13.5% higher, and the fat yield/ha of the HOM was 30.84% higher, as compared with those of the common maize (CM), respectively. Moreover, the kernel volume weights and the water content in kernels of the HPM and the HOM were lower and higher than those of the CM, respectively. The biggest kernel volume and the highest dry matter accumulation were recorded in the HPM, followed by the CM.

Paulsen *et al*. (2003) reported that Maize starch yield was affected by variety, environmental growing conditions, and drying conditions. One-hundred gram starch yield tests that predict actual wet milling starch yield were used as a reference method for developing an extractable starch calibration on a NIR Systems Model 6500 spectrophotometer. A maize starch yield calibration was developed from 940 samples and used to predict a validation set of 304 samples. It had a standard error of prediction (SEP) of 1.06, a coefficient of determination r2 of 0.77 and a ratio of performance to deviations (rpd) of 2.1. This indicates about 95% of similar samples could have starch yield predicted by near-infrared reflectance within about +or-2.1%. The calibration should be successful in segregating maize lots for high and low starch yield percentages.

Almeida *et al.* (1999) selected 19 maize cultivars for lodging, breaking and yield, and 9 were selected for further study. There were no significant differences among these 9 cultivars for dry matter yield, ear percentage, contents of neutral detergent fibre (NDF) and acid detergent fibre (ADF), or in vitro dry matter digestibility (IVDMD), while crude protein (CP) and soluble carbohydrate contents varied slightly. In silage produced from these cultivars, NDF, ADF, ammonium-N and IVDMD varied between cultivars, while CP and lactic acid contents and pH did not.

2.4 Effect of variety on soil

Tahir *et al.* (2002) conducted a pot experiment to evaluate the growth response of 2 maize cultivars (Magic and Golden) to compaction in sandy loam, sandy clay loam soils during spring 2001. Results revealed that soil compaction had an adverse effect on fresh weight of shoot; P concentration and N and P uptake in shoot, while soil texture has significant effect on plant height, fresh shoot weight and concentration and its uptake. Interaction between soil texture and compaction was significant for fresh weight of maize fodder as well as P and K concentration and their uptake in shoot. Varietal response under compacted and non-compacted conditions was also found statistically significant in some areas, but interaction between soil texture and variety and their combined effect was non-significant for all the growth parameters.

Andreotti *et al*. (1999) conducted a greenhouse experiment to study soil fertility changes and dry matter yield of maize (hybrid 'Zeneca 8392') grown in pots with

3 types of soil (Quartzpsamment and two alic dark red latosol - Haplorthox soils) as a function of potassium fertilizer application (0, 2.17, 4.34, and 8.68 g K_2O pot^{-1}) and base saturation (40 and 70%) on soil. Potassium content in the soil was adjusted by applying 0 (control), 3.62, 7.24 or 14.48 g KCl pot^{-1}. Phosphorus (200 mg kg^{-1}) and zinc (5 mg kg^{-1}) were applied to all treatments at sowing time. Nitrogen was applied at sowing time (83.7 mg kg^{-1}) as well as top dressing, 25 and 40 days after seedling emergence, a total of 200 mg kg^{-1}.Result revealed that the soil buffering capacity decreased the effect of elevation base saturation of soil on exchange and residual acidity. The increase in base saturation allowed elevation of Ca and Mg levels, base saturation and CEC values independently of soil texture. The effect of elevation of base saturation in the increase of pH was larger in clayey soils.

2.5 Effect of leaf removal

Khaliliaqdam *et al*. (2012) conducted an experiment to study many factors are involved in estimating total loss of yield potential. These include effects from defoliation, stand loss and plant bruising and environmental condition during the remainder of growing season. Therefore, to evaluate the influence of leaf defoliation on agronomical trials of corn (*Zea mays* (L.)), a factorial experiment (design: RCB), consisting of three growth stages of maize(vegetative, tasseling and flowering) and five levels of leaf defoliation (0,25,50,75 and 100%) replicated three times in 2011 at agricultural meteorological station of miandoab (West Azar. Iran). Results revealed that plant height and ear height was significantly affected by leaf defoliation. Interaction of leaf defoliation×growth stages on seed depth, 1000-grain weight and grain yield was significant. Seed depth decreased significantly by increasing leaf defoliation only in flowering stage (-0.03 mm/1%D). Leaf defoliation diminished 1000-grain weight and grain yield in all growth stages, thought slope of decreasing in flowering stage was more than others stages. Overall, research demonstrated that flowering stage is more sensitive to leaf defoliation than tasseling and vegetative stage in corn.

Remison (1982) carried out an experiment to examine the effect of time of leaf blade removal on maize (*Zea mays* L.) cv. FARZ 23. Defoliations were started 6 weeks after planting and carried on till after mid-silk. Defoliation reduced weight of ears, grains, total dry matter above ground and grain-moisture. Leaf removal at early stages of growth had no effect on the performance of maize. Complete defoliations of all leaves and those at the upper half of the plant were the most severe in reduction of yield and its components, as well as increasing percentage of lodged plants. Among ear characters, ear size was the most affected by defoliation.

Shakoofa *et al*.(2012) conducted an experiment to study the effect of source reduction on yield and yield components of three maize hybrids at three plant densities was studied under agro-climatic conditions in southern Iran. Defoliation treatments, which consisted of removing all the leaves from one side of the maize plants, were imposed when plants were at the silking stage. Silking was taken as the time when 50% of the plants in a row presented visible silks. Partial defoliations included control, and 50% defoliation at 25 and 35 days after silking (defoliation treatments were applied to all plants in each plot). Dry matter accumulation was assessed by sampling ears at 7-day intervals from the mid-silking stage to black layer formation. Defoliation treatments decreased grain yields significantly in both years. The highest grain yield in 2008 (19 t ha^{-1}) was obtained from hybrid Maxima '524' and in 2009 (14 t ha^{-1}) from hybrid 704 at 95,000 plants ha^{-1} density. Defoliation treatments decreased grain yields due to a reduction in the number of kernels per ear, as well as mean kernel weight. Some other measured parameters including stalk, shank, husk and cob dry weights, and cob and ear lengths were also decreased under defoliation treatments. If 50% of the photosynthetic area after silking was removed, the quantity of retransferred assimilates from stalk to kernel was increased. Finally, partial defoliation, 25 days after silking, reduced all the yield components more than any other treatments.

Pearson and Fletcher (2009) conducted an experiment to determine the effect of timing of total maize plant defoliation by ground level cutting on crop growth and yield. Two trials were conducted in the 2007-08 season (Hawkes Bay and Canterbury). At each site, defoliation at maize growth stages V_2, V_4, V_6 and V_8 were compared with an uncut control. There was no grain yield loss when plants were cut up to growth stage V_4 but defoliation delayed maturity resulting in higher grain moisture content. Defoliation at V_6 severely reduced grain yield by 60% in Hawke's Bay and 20% in Canterbury. The crop did not recover when plants were defoliated at growth stage V_8. Defoliation of maize up to growth stage V_4 will have minimal effect on grain yield but may delay maturity, and defoliation by cutting does not take into account other impacts associated with defoliation in field situations such as compaction, freezing, shear stress, bruising and other secondary impacts.

Fasae *et al*. (2009) conducted a study aimed to develop a dry season feed for ruminants based on the production of hay from maize defoliation. Shortage of feed during a dry season has remained a challenge to improving ruminant production in Nigeria. Five maize defoliation treatments of maize at 4, 8, 12 and 16 weeks after planting as well as the undefoliated treatment was used to assess the leaf yield, quality and storage of maize leafs in a randomized complete block design with three replicates. Results showed that maize defoliation on or before 12 weeks after planting (WAP) reduced ($P < 0.05$) leaf and grain yields but produced the highest leaf dry matter (DM) with the highest level of crude protein. However, maize defoliated at 12WAP produced more leaf DM/ha and a crude protein content of about 12% with no reduction ($P > 0.05$) in grain yield. The crude protein content of maize leafs decreases ($P< 0.05$) with delayed defoliation while the fiber contents increased ($P< 0.05$). Storing maize leafs for 4 months did not have any significant effect ($P > 0.05$) on the DM and crude protein content as well as the weight of the leafs. It was therefore, concluded that the production of quality hay from maize leafs for dry season feeding of ruminants could be obtained by defoliating maize from 12 WAP and stored for a period of four months without significantly ($P < 0.05$) affecting the maize grain yield.

2.6 Effect of tiller removal

Akman (2002) conducted an experiment to study the effects of plant density and tiller removal were determined on yield and agronomic characters of 3 sweet corn cultivars during the growing periods in 1997 and 1998 in Sparta plain in Turkey. Ear yield varied depending on cultivars and the highest ear yield was obtained for cv. Merit in 1997 and 1998 (13.8 and 11.8 t ha^{-1}, respectively). Number of tiller $plant^{-1}$, ear length, ear diameter and filled ear length decreased in high plant density (9.5 plants/m^2). Plant height and ear yield increased as the plant density increased. While tiller removal did not affect statistically significant any characters except the filled ear length in sweet com varieties in 1997. It reduced plant height and ear yield in the second experimental year.

2.7 Effect of tassel removal

Ferguson (2012) conducted an experiment in which baby corn (*Zea mays* L.) consists of unfertilized young ears harvested at silk emergence. The objective was to compare the effect of tassel removal on baby corn (BC) production on four cultivars of corn, two field (‘N77P-3000GT’, ‘N68B-3000GT’) and two sweet (‘Silver Queen’, ‘Peaches N Cream’). Results indicated that tassel removal gave significant increases ($P<0.01$) of BC ears across harvests (H) and cultivars; however, the effect was not consistent over treatments. For harvests, the difference due to detasseling was significant ($P<0.05$) for H2 and H3, but not significant ($P>0.05$) for H1 or H4. For cultivars, numerical values were higher for detasseled than non-detasseled treatments in the first three harvests for each cultivar, but significant ($P<0.05$) only for ‘Peaches n’ Cream’. Quality of BC from both tassel treatments decreased in H3 and H4. Based upon the increased number of ears resulting from detasseling, additional labor costs would be more than covered. Baby corn has excellent potential as a niche crop for producers and consumers in Central Kentucky.

2.8 Effects of Removing Redundant Organs

Wang and Kai (2015) found out that in the light of the actual conflict between "population" and "individual quality" increases the maize yield, during summer maize seasons from 2013 to 2014 (June-early October). A field experiment was conducted to study the effects of removing redundant organs on yield and photosynthesis of high-yielding summer maize, and the objectives of this study was to search out a new method to harmonize the relationship between maize "population" and "individual quality", conventional maize planting as control. The results showed that removing tassel and lower leaves increased the net photosynthetic rate and maximum grain-filling rate, and promoted matter transport from vegetative organs to grains. Tassel removal could improve light distribution in canopy. Lower leaves removal may prolong grain-filling period and decrease water consumption or relief water-stress in dry year. Compared with the control, in 2013(rainy year)tassel removal, leaves removal and tassel & leaves removal could increase grain yield by 12.3%,2.6% and 3.0% respectively; in 2014 (dry year) leaves removal and tassel & leaves removal increased yield by 6.1% and 8.8%,but tassel removal had no effect on yield. Furthermore, with redundant leaves removal the water consumption was decreased by 34.5-42.5 mm, water use efficiency was increased by 14.3%-17.2% compared with the control. So tassel removal and lower leaves removal should be regarded as a new method to further increase grain yield of high-yielding summer maize.

CHAPTER III

MATERIALS AND METHODS

The field experiment was conducted during the period from November 2013 to March 2014 to study the influence of cob removal on yield of composite and hybrid maize. The materials and methods of this experiment are presented in this chapter under the following headings -

3.1 Experimental site

The experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh, which is situated in $23^{0}41^{/}$N latitude and $90^{0}22^{/}$E longitude (Anon., 1989).

3.2 Soil of the experimental field

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) corresponding AEZ No. 28 and was shallow red brown terrace soil. The land of the selected experimental plot was medium high under the Tejgaon series. The characteristics of the soil under the experimental plot were analyzed in the Soil Testing Laboratory, SRDI, Dhaka and have been presented in Appendix II.

3.3 Climate

The experimental area under the sub- tropical climate that is characterized by high temperature, high humidity and high rainfall with occasional gusty winds in kharif season (April-September) and less rainfall associated with moderately low temperature during rabi season (October-March).

3.4 Planting materials

In this research work, all the seeds of different maize varieties were collected from Bangladesh Agricultural Research institute except baby corn that was collected from Kushtia Seed Store. The purity and germination percentage were leveled as around 98 and above 95, respectively.

3.5 Factors and treatments of the experiment

The experiment comprised as two factors.

Factor A: Cob removal (2):

i. C_0=Control (no cob removal)

ii. C_1 = Removal of 1st cob

Factor B: Variety (6):

i. V_1= Baby corn

ii. V_2= Khaibhutta

iii. V_3= BARI bhutta 6

iv. V_4= BARI hybrid bhutta 7

v. V_5= BARI hybrid bhutta 9

vi. V_6= BARI sweet corn

As such there were 12 (2 × 6) treatment combinations viz., C_0V_1, C_0V_2, C_0V_3, C_0V_4, C_0V_5, C_0V_6, C_1V_1, C_1V_2, C_1V_3, C_1V_4, C_1V_5, C_1V_6.

3.6 Layout of the experiment

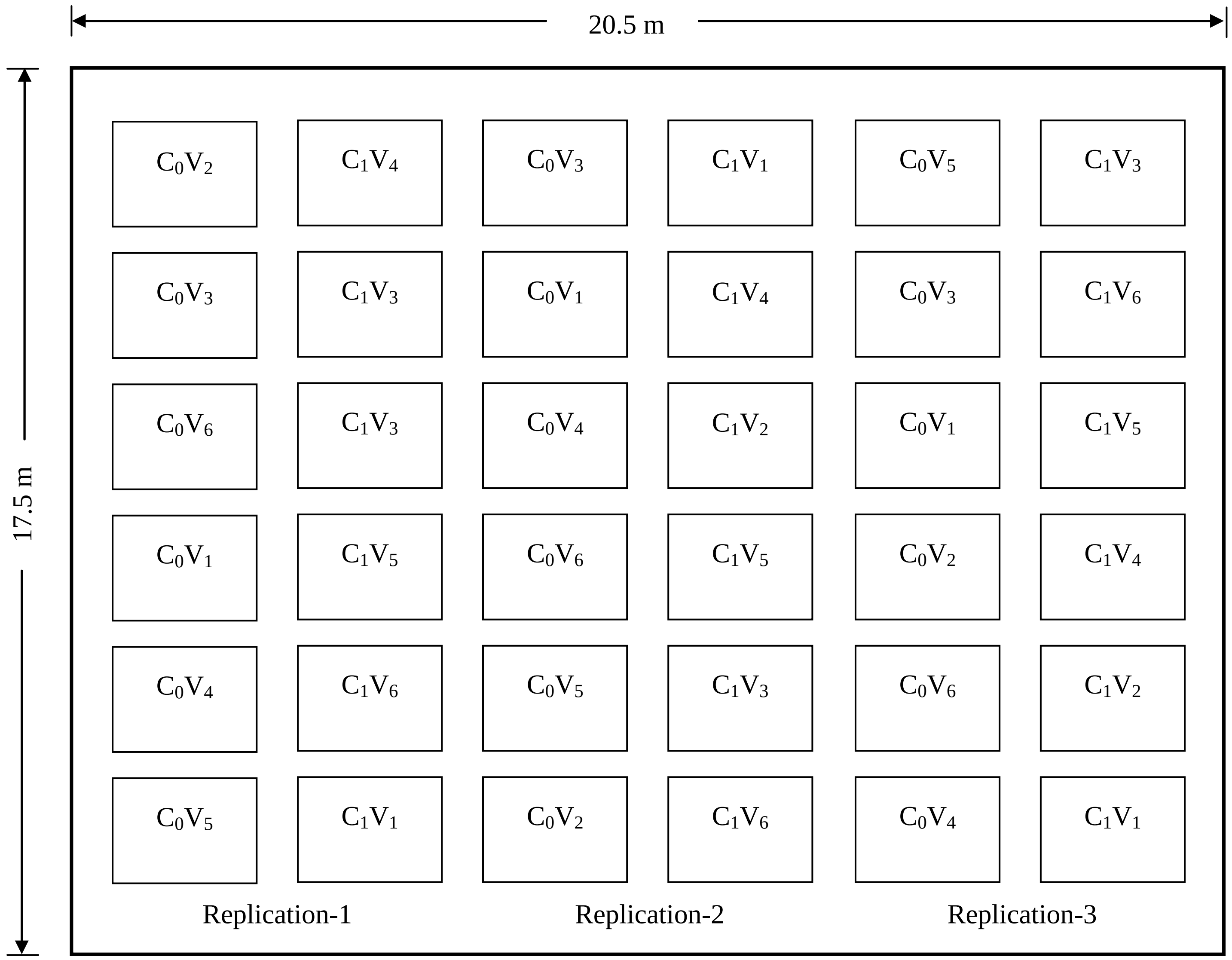
The experiment was laid out in split-plot design with three replications where cob removal was assigned in the main plot and variety in the sub-plots. The layout of the experiment was prepared for distributing the combination of variety and cob removal of maize. There were 12 plots of size 3 m × 2.5 m in each of 3 replications. The cob removal and variety of the experiment were assigned at random into main plot and sub-plot, respectively for each replication (Figure 1).

3.7 Preparation of the main field

The plot selected for the experiment was opened in the first week of November 2013 with a power tiller, and was exposed to the sun for a week, after one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain a good tilth. Weeds and stubbles were removed, and finally obtained a desirable tilth of soil for planting of maize seeds. The experimental plot was partitioned into the unit plots in accordance with the experimental design mentioned in 3.6. Recommended doses of well-rotten cow-dung manure and chemical fertilizers as indicated in 3.8 were mixed with the soil of each unit plot.

3.8 Application of manure and fertilizers

Decomposed organic matter was used @ 6.0 ton /hectare before final land preparation. The chemical fertilizers as Urea, TSP, MoP, Gypsum, Boric acid and Zinc sulphate were applied at the rate of 138-16-60-27-1.7 and 1.8 kg/ha of N-P-K-S-B-Zn respectively in case of composite variety and 230-20-100-45-1.7-1.8 kg/ha were applied in case of hybrid variety. The whole amounts of fertilizers were applied as basal dose except Urea. One-third Urea was applied as basal dose and rest amount was applied at 30 DAS.



Plot size: 3 m × 2.5 m

Plot spacing: 0.5 m

Between replication: 0.5 m

Factor A: Cob removal (main plot)

C_0: No cob removal

C_1: Removal of 1st cob

Factor B: Variety (sub-plot)

V_1: Baby corn

V_2: Khai bhutta

V_3: BARI bhutta 6

V_4: BARI hybrid bhutta 7

V_5: BARI hybrid bhutta 9

V_6: BARI sweet corn

Figure 1. Field layout of the experiment in the split-plot design

3.9 Sowing of seeds in the field

The maize seeds were planted in lines each having a line to line distance of 60 cm and plant to plant distance of 20 cm having 2 seeds $hole^{-1}$ under direct sowing in the well prepared plot on 13 November 2013.

3.10 After care

When the seedlings started to emerge in the beds it was always kept under careful observation. After emergence of seedlings, various intercultural operations were accomplished for better growth and development of the maize seedlings.

3.10.1 Irrigation

First irrigation was given on 13 December, 2013 which was 30 days after sowing. Second irrigation was given on 12 January, 2014 which was 60 days after sowing. Third irrigation was given on 22 February, 2014 which was 100 days after sowing.

3.10.2 Thinning and gap filling

The excess plants were thinned out from all of the plots at 20 days after sowing (DAS) for maintaining optimum population of the experimental plots.

3.10.3 Weeding and mulching

Weeding and mulching were done to keep the plots free from weeds, easy aeration of soil and to conserve soil moisture, which ultimately ensured better growth and development. The weeds were uprooted carefully after complete emergence of maize seedlings as and whenever necessary. Breaking the crust of the soil, when needed was done through mulching.

3.11 Plant protection

After 30 days of planting, first spray of darsban was done against the pest such as cut worm. Ripcord was applied to control leaf feeder caterpillar during entire vegetative periods at times.

3.12 Harvesting, threshing and cleaning

A single and first formed immature cob $plant^{-1}$ was removed during the emergence of silks from respective treatments. The mature cobs were harvested when the husk cover was completely dried and black coloration was found in the grain base. The cobs of five randomly selected plants of each plot were separately harvested for recording yield attributes and other data. The inner two lines were harvested for recording grain yield and stover yield.

3.13 Data recording

3.13.1 Plant height

The height of plant was recorded in centimeter (cm) at the time of 25, 50, 75, 100 DAS (days after sowing) and at harvest. Data were recorded as the average of 05 plants selected at random from the inner rows of each plot. The height was measured from the ground level to the tip of the plant.

3.13.2 Leaf number

Leaf number was count from the top to bottom of the plant. Data were recorded as the average of 05 plants selected at random from the inner rows of each plot.

3.13.3 Leaf area index

LAI was measured by leaf area meter (LICOR 3000, USA) at the time of 25, 50, 75 and 100 DAS. Data were recorded as the average of 05 plants selected at random from the inner rows of each plot.

3.13.4 Dry matter content in shoot

Dry matter content in shoot was collected at 25, 50 DAS and at harvest. The shoot sample was collected from randomly selected two plants $plot^{-1}$ in each time and sliced into very thin pieces those put into envelop and placed in oven maintaining at $70^{0}C$ for 72 hours. The shoot sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken.

3.13.5 Dry matter content in root

Dry matter content in root was collected 25, 50 DAS and at harvest. The root sample was collected from randomly selected two plants plot^{-1} in each time through uprooting of plants having sufficient surrounding soils and then washed out the soil, dried and put into envelop and placed in oven maintaining at 70^{0}C for 72 hours. The root sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken.

3.13.6 Dry matter content ratio in shoot and root

Dry matter content ratio in shoot and root was calculated at 40 and 60 DAS with dividing dry matter content in shoot by dry matter content in root.

3.13.7 Number of corn harvested at early stage

Cob removal treatments were assigned in main plot. All the first cob of all plants of respective treatments were removed within 1-5 days after silking. This removal was done by six days and count all cobs which were obtained from each plot.

3.13.8 Weight of corn harvested at early stage

Total weight of harvested cobs at early stage was taken in each plot.

3.13.9 Number of cobs plant^{-1} at harvest

The mature cob was counted at each of the five randomly selected plants in each plot at harvest and averaged.

3.13.10 Number of rows cob^{-1}

The number of rows of five cobs was counted at each of the five randomly selected plants in each plot and averaged.

3.13.11 Cob length

Cob length was measured in centimeter from the base to the tip of the ear.

3.13.12 Cob breadth

Cob breadth measured in centimeter from the base, middle and top portion of the ear and averaged.

3.13.13 Number of grains cob^{-1}

Grain number of five randomly selected cobs plot^{-1} were counted for total grains from the base to tip of the ear and finally averaged.

3.13.14 1000-grains weight

From the composite sample of ears of five randomly selected plants in each plot, 1000-grains was taken and weighted.

3.13.15 Shelling percentage

Shelling percentage was calculated dividing grain weight by total cob weight and multiply with hundred.

Shelling percentage = $\frac{\text{Grain weight}}{\text{Cob weight}} \times 100$

3.13.16 Grain yield ha^{-1}

Weighted cleaned and well dried grains collected from each plot were taken and converted into hectare and were expressed in t ha^{-1}.

3.13.17 Stover yield ha^{-1}

Weighted cleaned and well dried stover were collected from each plot were taken and converted into hectare and were expressed in t ha^{-1}.

3.13.18 Biological yield (t ha^{-1})

Grain yield and stover yield were all together regarded as biological yield. Biological yield was calculated with the following formula:

$$\text{Biological yield (t ha}^{-1}\text{)} = \text{Grain yield (t ha}^{-1}\text{)} + \text{Stover yield (t ha}^{-1}\text{)}$$

3.13.19 Harvest Index (%)

It denotes the ratio of economic yield to biological yield and was calculated with following formula (Donald, 1963; Gardner *et al*., 1985).

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

3.14 Economic Return

Return was calculated by estimating the price of immature cobs and grain as per market price basis to compare the total returns given by each treatment.

3.15 Statistical analysis

The data obtained for different characters were statistically analyzed using MSTATC software to find out growth and yield of composite and hybrid maize as affected by cob removal. The mean values of all the characters were evaluated and analysis of variance was performing by the 'F' test. The significance of the difference among the treatments means was estimated by the Least Significant Difference Test (LSD) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

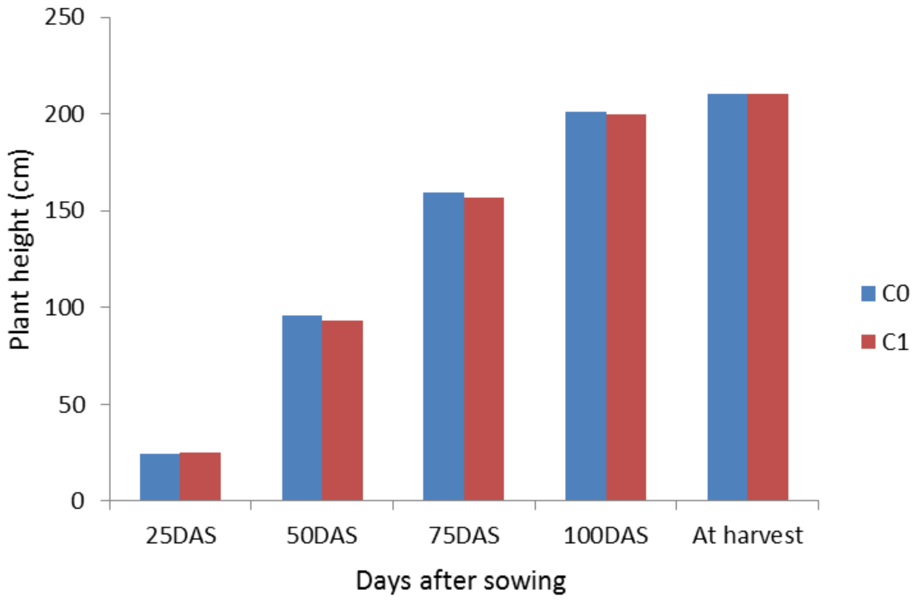
The experiment was conducted to determine the growth and yield of composite and hybrid maize as affected by cob removal at early stage. Data on different growth and other parameter, yield attributes and yield were recorded. The analyses of variance (ANOVA) of the data on different parameters are presented in Appendix IV-XII. The results have been presented with the help of graphs and table and possible interpretations given under the following headings:

4.1 Plant height

Plant height is an important morphological character that acts as a potent indicator of availability of growth resources in its vicinity.

4.1.1 Effect of cob removal

Plant height showed no significant difference at different durations for cob removal (Appendix IV and Figure 2). At 50, 75 and 100 DAS numerically taller plant (95.87 cm, 159.48 cm and 201.35 cm, respectively) were recorded from C_0 (No cob removal), while shorter plant (93.4 cm, 156.78cm and 200 cm respectively) from C_1 (Cob removal). Again at 25 DAS and at harvest taller plant (25.27 cm and 210.67 cm), respectively was recorded from C_1, while shorter plant (24.51 cm and 210.37 cm) from C_0.



C_0 = No cob removal, C_1 = Cob removal

Figure 2. Effect of cob removal on plant height of maize

4.1.2 Effect of variety

Different composite and hybrid maize variety showed significant differences on plant height at 25, 50, 75, 100 DAS and at harvest (Appendix IV and Figure 3). At 25 DAS, the tallest plant (27.20 cm) was observed from V_4 (BARI hybrid bhutta 7) which was statistically similar with V_2 (26.67 cm) V_3 (26.43 cm) and V_5 (26.33 cm), (Khaibhutta, BARI bhutta 6 and BARI hybrid bhutta 9) and the shortest (20.77 cm) from V_6 (BARI sweet corn) which was statistically similar with V_1 (Baby corn). At 50 DAS, the tallest plant (107.1 cm) was observed from V_5 which was statistically similar with $V_{1,}$ $V_{2,}$ V_3 and V_4 and the shortest (78.53 cm) from V_6 which was statistically similar with V_1 and $V_{3.}$ At 75 DAS, the tallest plant (175.8 cm) was observed from V_4 which was statistically similar with $V_{2,}$ V_3 and V_5 and the shortest (139.6 cm) from V_6 which was statistically similar with V_1 and $V_{3.}$ At 100 DAS and at harvest, the tallest plant (209.9 cm and 231.4 cm) was observed from V_5 which was statistically similar with $V_{2,}$ V_3 and V_4 and the shortest (181.6 cm and 190.8 cm) from V_6 which was statistically similar with $V_{1.}$ Ogunboded *et al.* (2001) reported the results of the OPs and the hybrids and showed that the hybrid had an average of 16.1% growth advantage over the OPs. The hybrid maize varieties and four of the seven OPs were stable in growth across the locations. Olakojo and Iken (2001) reported that the improved maize varieties significantly out growth the local check entry by between 10.3 and 30.3%, thus ranking TZB and Posa Rica 7843 as the tallest varieties.

Table 1. Effect of variety on plant height of maize

Treatments	Plant height (cm) at different DAS				
	25	**50**	**75**	**100**	**At harvest**
V_1	21.93 b	85.33 ab	145.4 bc	193.8 bc	195.2 b
V_2	26.67 a	105.2 a	163.8 ab	204.5 ab	214.7 a
V_3	26.43 a	85.20 ab	154.4 a-c	208.8 a	216.7 a
V_4	27.20 a	106.4 a	175.8 a	205.4 ab	214.2 a
V_5	26.33 a	107.1 a	169.8 a	209.9 a	231.4 a
V_6	20.77 b	78.53 b	139.6 c	181.6 c	190.8 b
LSD $_{(0.05)}$	2.684	22.73	22.22	13.9	17.39
CV (%)	8.95	19.94	11.67	5.75	6.86

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.1.3 Interaction effect of variety and cob removal

Interaction effect of variety and cob removal showed significant differences on plant height at 25, 50, 75,100 DAS and at harvest (Appendix IV and Table 2). At 25, 75 and 100 DAS , the tallest plant (28.43 cm, 179.0 cm and 216.3 cm) was observed from C_1V_4 (Cob removal + BARI hybrid bhutta7), again the shortest (20.27 cm, 132.9 cm and 179.0 cm) from C_1V_6 (Cob removal + BARI sweet corn). At 50 DAS, the tallest plant (111.9 cm) was observed from C_0V_5 (No cob removal +BARI hybrid bhutta 9) which was statistically identical with C_0V_2 as the shortest plant (77.47 cm) was observed from C_0V_6 (No cob removal +BARI sweet corn) which was statistically similar with C_1V_6. At harvest, tallest plant (240.7cm) was observed from C_1V_5, which was statistically similar with C_1V_4, C_0V_2, C_0V_3 and C_0V_5, while the shortest plant (187.8cm) was observed from C_1V_1 that statistically similar with C_1V_6, C_0V_6, C_0V_1, C_0V_4 and C_1V_2. At harvest, the tallest plant was 28.17% taller than shortest plant.

Table 2. Interaction effect of cob removal and variety on plant height of composite and hybrid maize

Treatments	Plant height (cm) at different interval				
	25 DAS	50 DAS	75DAS	100 DAS	Harvest
C_0V_1	20.57 c	80.93 ab	138.6 cd	199.5 a-d	202.7 b-d
C_0V_2	26.03 ab	111.9 a	168.2 a-c	207.5 a-c	219.5 ab
C_0V_3	26.40 ab	88.93 ab	156.2 a-d	213.4 ab	219.7 ab
C_0V_4	25.97 ab	104.1 ab	172.7 ab	194.5 b-e	207.9 b-d
C_0V_5	26.80 ab	111.9 a	174.9 ab	209.1 ab	222.2 ab
C_0V_6	21.27 c	77.47 b	146.3 b-d	184.1 de	190.2 cd
C_1V_1	23.30 bc	89.73 ab	152.2 a-d	188.1 c-e	187.8 d
C_1V_2	27.30 a	98.60 ab	159.3 a-d	201.6 a-d	210.0 b-d
C_1V_3	26.47 ab	81.47 ab	152.6 a-d	204.2 a-c	213.7 bc
C_1V_4	28.43 a	108.7 ab	179.0 a	216.3 a	220.5 ab
C_1V_5	25.87 ab	102.3 ab	164.7 a-c	210.8 ab	240.7 a
C_1V_6	20.27 c	79.60 b	132.9 d	179.0 e	191.3 cd
$LSD_{(0.05)}$	3.796	32.15	31.43	19.65	24.6
CV (%)	8.95	19.94	11.67	5.75	6.86

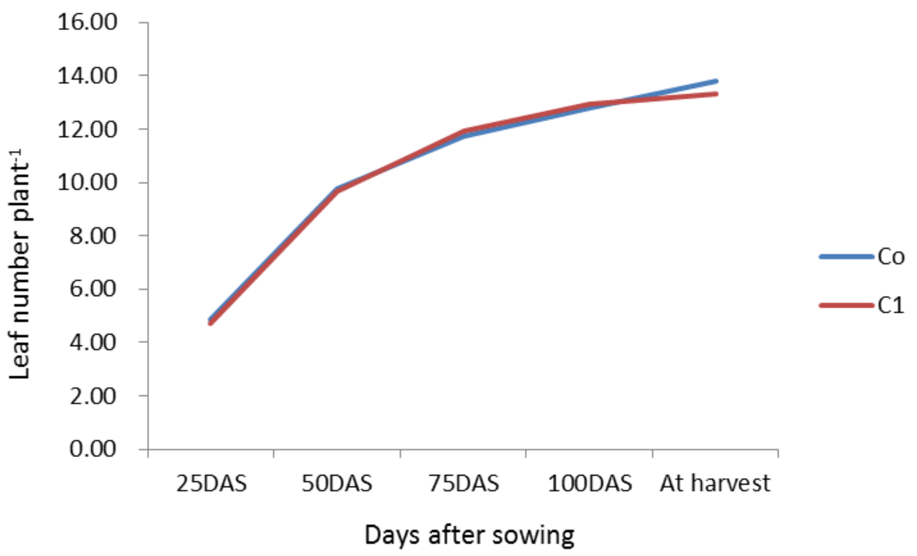
In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_4: BARI hybrid bhutta 7
V_2: Khaibhutta
V_5: BARI hybrid bhutta 9
V_3: BARI bhutta 6
V_6: BARI sweet corn

4.2 Leaf number

4.2.1 Effect of cob removal

Significant variation was recorded for leaf number at harvest and non-significant at 25, 50, 75 and 100 DAS for cob removal (Appendix V and Figure 3). At 25 and 50 DAS higher leaf number (4.84 and 9.74 respectively) was observed from C_0, while lower leaf number (4.73 and 9.68 respectively) from C_1. At 75 and 100 DAS higher leaf number (11.90 and 12.93 respectively) was observed from C_1, while lower leaf number (11.72 and 12.77 respectively) from C_0. At harvest the higher leaf number (13.8) was obtained from C_0, whereas the lowest (13.3) recorded from C_1. The C_0 showed 3.76% higher leaf plant^{-1} than C_1 at harvest.



C_0 = No cob removal C_1 = Cob removal

Figure 3. Effect of cob removal on leaf number ($LSD_{0.05}$ = 0.30 at harvest)

4.2.2 Effect of variety

Leaf number for different composite and hybrid maize varieties showed significant differences at 25, 50, 75,100 DAS and at harvest (Appendix V and Table 3). At 25 DAS, the highest leaf number (5.07) was found from V_4 which was statistically similar with V_2 (5.00) and the lowest (4.18) from V_6. At 50 DAS, the highest leaf number (10.30) was found from V_5 which was statistically similar with V_1, V_2 and V_4 and the lowest (8.77) from V_6 which was statistically similar with V_3 (9.2). At 75, 100 DAS and at harvest the highest leaf number (12.77, 15.10 and 14.53 respectively) was found from V_1 and the lowest (10.87, 11.07 and 11.47 respectively) from V_6.

Table 3: Effect of variety on leaf number of maize

Treatments	Leaf number at different DAS				
	25	50	75	100	At harvest
V_1	4.80 a	10.00 ab	12.77 a	15.10 a	14.50 a
V_2	5.00 a	9.97 ab	11.70 a-c	12.00 bc	13.30 b
V_3	4.87 a	9.20 bc	11.60 bc	12.93 b	13.83 ab
V_4	5.07 a	10.00 ab	11.73 a-c	13.03 b	14.00 ab
V_5	4.82 a	10.30 a	12.22 ab	12.95 b	14.18 ab
V_6	4.18 b	8.77 c	10.87 c	11.07 c	11.47 c
LSD $_{(0.05)}$	0.560	0.910	1.165	1.2	1.048
CV (%)	9.71	7.79	8.19	7.76	6.42

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.2.3 Interaction effect of cob removal and variety

Statistically significant variation was recorded for interaction effect of cob removal and variety on leaf number at 25, 50, 75, 100 DAS and at harvest (Appendix V and Table 4). At 25 DAS, the highest leaf number (5.13) was found from C_0V_4 which was statistically similar with all other treatments except C_1V_6 (4.13) and C_0V_6 (4.23) those showed statistically lowest number of leaves plant^{-1}.At 25 DAS, C_1V_6 showed 19.49% lower leaf number plant^{-1} compare to that of C_0V_4. At 50 DAS, the highest leaf number (10.47) was found from C_1V_4 that similar with C_0V_5, C_1V_5 and C_1V_1. The lowest (8.67) number of leaves plant^{-1} was found from C_1V_6, which was statistically similar with C_1V_3. At 75, 100 DAS and at harvest the highest leaf number (12.80,15.60 and 14.93 respectively) was found from C_0V_1 and the lowest (10.87, 10.53 and11.40 respectively) from C_0V_6 which was statistically similar with C_1V_6.

Table 4. Interaction effect of cob removal and variety on leaf number of composite and hybrid maize

Treatments	Leaf number at different interval				
	25 DAS	50 DAS	75DAS	100 DAS	Harvest
C_0V_1	4.73 a-c	9.80 a-c	12.80 a	15.60 a	14.93 a
C_0V_2	5.07 a	10.13 ab	11.27 ab	11.87 c-e	13.87 ab
C_0V_3	4.87 a-c	9.67 a-c	11.73 ab	13.33 bc	14.07 ab
C_0V_4	5.13 a	9.53 a-c	11.53 ab	12.87 cd	14.20 ab
C_0V_5	5.03 a	10.40 a	12.13 ab	12.40 cd	14.33 a
C_0V_6	4.23 bc	8.87 bc	10.87 b	10.53 e	11.40 c
C_1V_1	4.87 a-c	10.20 a	12.73 a	14.60 ab	14.13 ab
C_1V_2	4.93 ab	9.80 a-c	12.13 ab	12.13 c-e	12.73 bc
C_1V_3	4.87 a-c	8.73 c	11.47 ab	12.53 cd	13.60 ab
C_1V_4	5.00 ab	10.47 a	11.93 ab	13.20 b-d	13.80 ab
C_1V_5	4.60 a-c	10.20 a	12.30 ab	13.50 bc	14.03 ab
C_1V_6	4.13 c	8.67 c	10.87 b	11.60 de	11.53 c
$LSD_{(0.05)}$	0.792	1.287	1.648	1.697	1.482
CV (%)	9.71	7.79	8.19	7.76	6.42

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.3 Leaf area index

Leaf area index (LAI) expresses the ratio of leaf surface area to the ground area. It is one of the important determinants of dry matter (DM) production. Crop production practically means the efficient interception of photo synthetically active radiation (PAR) and its conversion into food & other useable materials. Efficient interaction of PAR by a crop canopy requires adequate leaf area expansion. Leaf area is made up of the total green lamina of emerged leaves (Kerting and Carberry, 1993). According to Gay and Bloc (1992), LAI values above 5.0 under typical conditions in Europe are suggestive of a high yield potential of maize. On the other hand, Gardner *et al.* (1985) reported that in general, photosynthesis increase until nearly all incident solar radiation is intercepted by photosynthetic surfaces and any further increase in leaf area only increase shading of the lower leaves with little benefit to the plant.

4.3.1 Effect of cob removal

Non-significant variation was recorded for leaf area index at different interval for composite and hybrid bhutta (Appendix VI and Table 5). At 25 DAS maximum leaf area index (0.21) was recorded from C_0 (No cob removal) and minimum leaf area index (0.20) from C_1 (Cob removal). At 50, 75 and 100 DAS maximum leaf area index (3.46, 7.7 and 7.67, respectively) was obtained from C_1 (Cob removal), whereas the minimum (3.05, 7.70 and 6.68, respectively) recorded from C_0 (No cob removal).

4.3.2 Effect of variety

Leaf area index for different composite and hybrid maize showed significant differences at 25, 50, 75 and 100 DAS (Appendix VI and Table 5). At 25 DAS, the highest leaf area index (0.26) from V_3 which was statistically similar with V_4

and V_5, while the lowest (0.16) from V_1 similar with V_2 and V_6. At 50, 75 and 100 DAS, the highest leaf area index (4.13, 9.43 and 8.98, respectively) was found from V_5 (BARI hybrid bhutta 9) and the lowest (2.17, 6.29 and 5.45, respectively) from V_6 (BARI sweet corn). Halder (2009) and Nur (2008) also agree with the hybrid variety that gave higher leaf area index than composite variety.

4.3.3 Interaction effect of cob removal and variety

Statistically significant variation was recorded for interaction effect of cob removal and variety on leaf area index at 25, 50, 75 and 100 DAS. (Appendix VI and Table 6). At 25 and 50 DAS, the highest leaf area index (0.28 and 4.19, respectively) was attained from C_0V_5 (No cob removal + BARI hybrid bhutta 9), while the lowest (0.14 and 2.12, respectively) from C_0V_2 and C_0V_6. At 75 DAS, the highest leaf area index (9.63) was attained from C_1V_5 (Cob removal + BARI hybrid bhutta 9), which was statistically similar with (9.23) from C_0V_5. While the lowest (5.94) from C_1V_6 similar with C_0V_1, C_0V_6 and C_1V_3. At 100 DAS, the highest leaf area index (9.42) was attained from C_1V_4 (Cob removal + BARI hybrid bhutta 7), while the lowest (5.18) from C_1V_6. The highest leaf area index was 44.97 and 85.36 % higher than the lowest.

Table 5. Effect of cob removal and variety on leaf area index of maize

Treatments	Leaf area index at			
	25 DAS	50 DAS	75 DAS	100 DAS
Cob removal				
C_0	0.21	3.04	7.69	6.68
C_1	0.20	3.46	7.70	7.67
$LSD_{(0.05)}$	NS	NS	NS	NS
CV (%)	8.68	16.25	20.08	10.16
Variety				
V_1	0.16 b	3.02 bc	7.17c	6.72 bc
V_2	0.16 b	3.21 a-c	7.29 bc	7.40 a-c
V_3	0.26 a	3.02 bc	7.56 bc	6.52 bc
V_4	0.23 a	3.96 ab	8.46 ab	7.99 ab
V_5	0.23 a	4.13 a	9.43 a	8.98 a
V_6	0.18 b	2.17 c	6.29 c	5.45 c
$LSD_{(0.05)}$	0.05	1.091	1.287	2.183
CV (%)	20.6	27.83	13.89	25.26

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

Table 6. Interaction effect of cob removal and variety on leaf area index of composite and hybrid maize

Treatments	Leaf area index at different interval			
	25 DAS	50 DAS	75DAS	100 DAS
C_0V_1	0.16 bc	2.13 b	6.91 de	6.72 a-c
C_0V_2	0.14 c	2.94 ab	7.13 c-e	6.93 a-c
C_0V_3	0.24 ab	3.03 ab	8.16 a-d	5.48 c
C_0V_4	0.28 a	3.88 a	8.07 a-d	6.56 a-c
C_0V_5	0.28 a	4.19 a	9.23 ab	8.67 ab
C_0V_6	0.19 bc	2.12 b	6.64 de	5.71 bc
C_1V_1	0.16 bc	3.91a	7.43 b-e	6.72 a-c
C_1V_2	0.19 bc	3.49 ab	7.44 b-e	7.87 a-c
C_1V_3	0.28 a	3.03 ab	6.96 de	7.56 a-c
C_1V_4	0.19 bc	4.04 a	8.84 a-c	9.42 a
C_1V_5	0.19 bc	4.08 a	9.63 a	9.29 a
C_1V_6	0.17 bc	2.22 b	5.94 e	5.18 c
$LSD_{(0.05)}$	0.072	1.542	1.821	3.087
CV (%)	20.6	27.83	13.89	25.26

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal

C_1= Cob removal

V_1: Baby corn

V_2: Khaibhutta

V_3: BARI bhutta 6

V_4: BARI hybrid bhutta 7

V_5: BARI hybrid bhutta 9

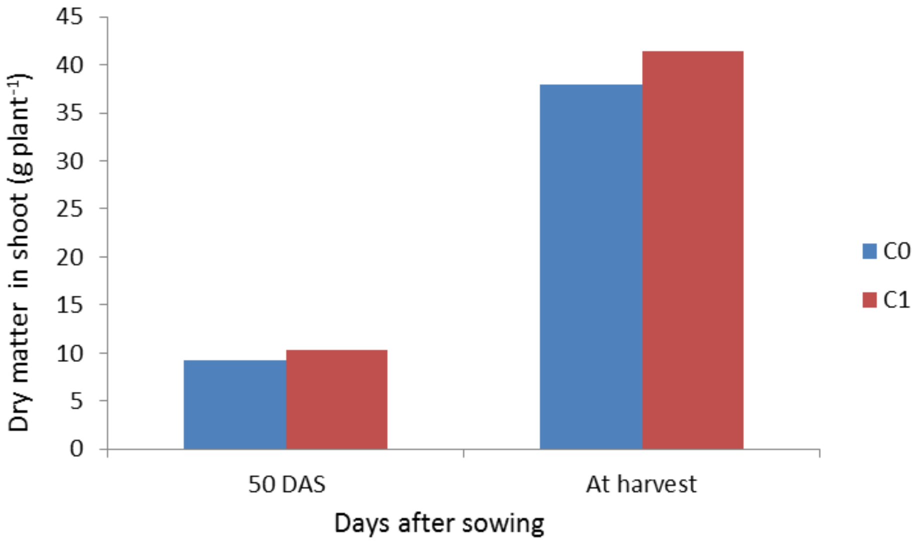
V_6: BARI sweet corn

4.4 Dry matter in plant

Dry matter production of crop plants was directly related to the utilization of solar radiation. It was observed that the effect of canopy was a major determinant of photosynthetic efficiency and growth (Donald, 1963 and Williams *et al*., 1968).

4.4.1 Effect of cob removal

Significant variation was observed for dry matter content in shoot at harvest and non-significant for 50 DAS for composite and hybrid bhutta (Appendix VII and Figure 4). At 50 DAS maximum dry matter (10.35 g plant^{-1}) was recorded from C_1 and minimum dry matter (9.20) from C_0. At harvest the higher dry matter content in shoot (41.39 g plant^{-1}) was found from C_1 (Cob removal), again the lower (37.9 g plant^{-1}) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 4. Effect of cob removal on dry matter content of maize in shoot

($LSD_{0.05}$ = 1.42 at harvest)

4.4.2 Effect of variety

Different composite and hybrid maize showed significant differences in terms of dry matter content in shoot at 50 DAS and non significant at harvest (Appendix VII and Table 7). At 50 DAS, the highest dry matter content in shoot (12.28 g $plant^{-1}$) was recorded from V_4 (BARI hybrid bhutta 7), which was similar with V_1, V_2, V_3 and V_5. Consequently the lowest (5.5 g $plant^{-1}$) was found from V_6 (BARI sweet corn) that similar with V_1, V_2, V_3 and V_5. At harvest, the maximum dry matter (46.87 g $plant^{-1}$) was recorded from V_3 and minimum dry matter (34.23 g $plant^{-1}$) fromV_6. The V_3 produced 40.47% higher dry matter than V_6. Halder (2009) and Nur (2008) also reported that the hybrid variety gave higher dry matter content in shoot than composite variety.

4.4.3 Interaction effect of cob removal and variety

Dry matter content in shoot showed significant differences due to the interaction effect of cob removal and variety at 50 DAS and at harvest (Appendix VII and Table 8). At 50 DAS and at harvest, the highest dry matter content in shoot (13.61 and 48.50 g $plant^{-1}$, respectively) was obtained from C_0V_4 and C_1V_3, which was statistically similar with C_1V_3 and C_0V_3. While the lowest (3.91 and 25.70 g $plant^{-1}$, respectively) from C_0V_6 , similar with C_1V_6 and C_0V_2.

Table 7. Effect of variety on dry matter content in shoot and root of composite and hybrid maize

Treatments	Dry matter content (g $plant^{-1}$)			
	Shoot		Root	
	50 DAS	At harvest	50 DAS	At harvest
V_1	9.217 ab	39.33	4.907	13.15 a
V_2	9.605 ab	37.48	6.600	10.93 ab
V_3	11.21 ab	46.87	6.183	13.55 a
V_4	12.28 a	39.87	7.518	14.50 a
V_5	10.84 ab	40.08	4.552	13.58 a
V_6	5.507 b	34.23	5.34	5.517 b
$LSD_{(0.05)}$	5.83	NS	NS	7.33
CV (%)	47.49	51.26	49.54	30.84

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

Table 8. Interaction effect of cob removal and variety on dry matter content in shoot and root of composite and hybrid maize

Treatments	Dry matter content (g $plant^{-1}$)			
	Shoot		Root	
	50 DAS	At harvest	50 DAS	At harvest
C_0V_1	8.737 ab	40.77 ab	5.133	11.03 ab
C_0V_2	8.457 ab	34.07 ab	7.600	12.97 ab
C_0V_3	9.297 ab	45.23 ab	5.930	12.23 ab
C_0V_4	13.61 a	39.57 ab	8.260	14.87 ab
C_0V_5	11.21 ab	42.07 ab	5.027	14.50 ab
C_0V_6	3.913 b	25.70 b	4.903	4.800 b
C_1V_1	9.697 ab	37.90 ab	4.680	15.27 a
C_1V_2	10.75 ab	40.90 ab	5.600	8.900 ab
C_1V_3	13.13 a	48.50 a	6.437	14.87 ab
C_1V_4	10.95 ab	40.17 ab	6.777	14.13 ab
C_1V_5	10.47 ab	38.10 ab	4.077	12.67 ab
C_1V_6	7.100 ab	42.77 ab	5.777	6.233 ab
$LSD_{(0.05)}$	8.25	20.83	NS	10.37
CV (%)	49.54	30.84	47.49	51.26

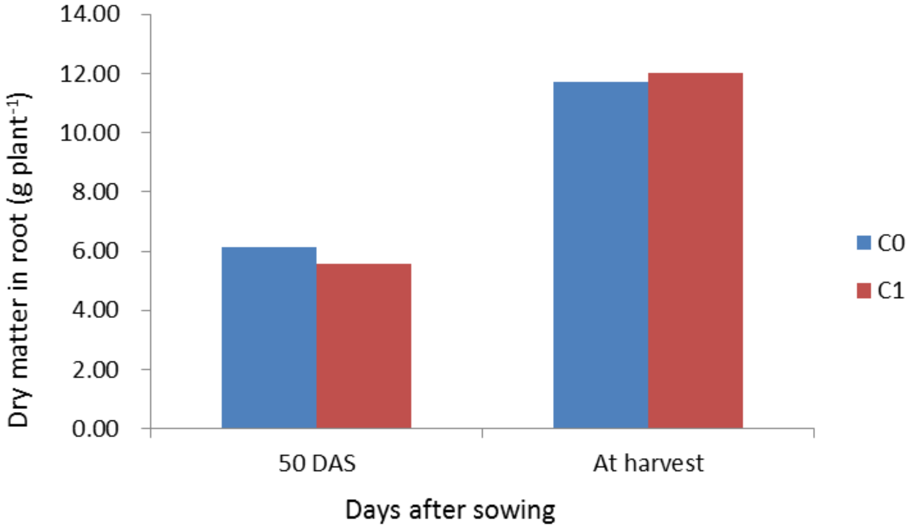
In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_4: BARI hybrid bhutta 7
V_2: Khaibhutta
V_5: BARI hybrid bhutta 9
V_3:BARI bhutta 6
V_6: BARI sweet corn

4.5 Dry matter content in root

4.5.1 Effect of cob removal

Composite and hybrid bhutta varied non-significantly for dry matter content in root for 50 DAS and at harvest (Appendix VII and Figure 5). At 50 DAS the maximum dry matter content in root (6.14 g plant^{-1}) was observed from C_0, whereas the minimum (5.56 g plant^{-1}) from C_1. At harvest the maximum dry matter content in root (12.01 g plant^{-1}) was observed from C_1, whereas the minimum (11.73 g plant^{-1}) from C_0.



C_0 = No cob removal C_1 = Cob removal

Figure 5. Effect of cob removal on dry matter content of maize in root

4.5.2 Effect of variety

Different composite and hybrid maize showed significant differences in terms of dry matter content in root at harvest and non significant at 50 DAS (Appendix VII and Table 7). At 50 DAS, maximum dry matter (7.51 g plant^{-1}) was recorded from V_4 and minimum (4.55 g plant^{-1}) from V_5. At harvest, the highest dry matter content in root (14.5 g plant^{-1}) was recorded from V_4 (BARI hybrid bhutta 7) which was statistically similar withV_1, V_2, V_3 and V_5, consequently the lowest (5.5 g plant^{-1}) was found from V_6 (BARI sweet corn), which was similar with V_2. The V_6 produced 62% lower dry matter than V_4.

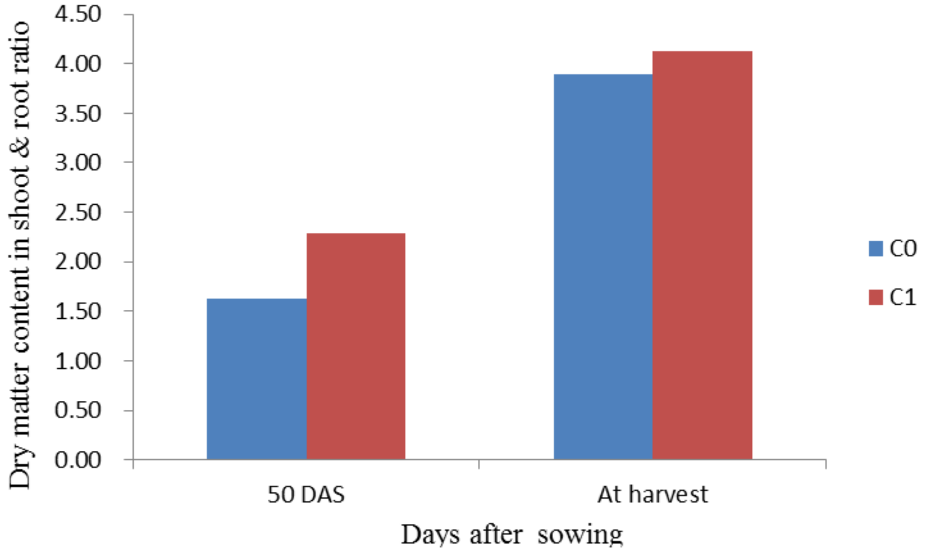
4.5.3 Interaction effect of cob removal and variety

Dry matter content in root showed significant differences due to the interaction effect of cob removal and variety at harvest and non-significant at 50 DAS (Appendix VII and Table 8). At 50 DAS, numerically maximum dry matter content in root (8.26 g plant^{-1}) was recorded from C_0V_4 which was similar with C_0V_2 and minimum (4.07 g plant^{-1}) was recorded from C_1V_5, which was statistically similar with C_0V_6 and C_1V_1. At harvest, the highest dry matter content in root (15.27 g plant^{-1}) was obtained from C_1V_1, similar with C_0V_4 and C_1V_3 while the lowest (4.80 g plant^{-1}) from C_0V_6 that similar with C_1V_6. The combination of C_0V_6 showed 70.33% lower dry matter compared to that of C_1V_1.

4.6 Dry matter content ratio for shoot and root

4.6.1 Effect of cob removal

Dry matter content ratio in shoot and root showed non significant differences at 50 DAS and at harvest for composite and hybrid bhutta (Appendix VIII and Table 9). At 50 DAS and at harvest numerically maximum dry matter content ratio in shoot and root (2.29 and 4.12, respectively) was found from C_1 (Cob removal) and the minimum (1.63 and 3.89, respectively) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 6: Effect of cob removal on dry matter content in shoot and root ratio

4.6.2 Effect of variety

Different composite and hybrid maize showed non-significant differences at 50 DAS and significant at harvest on dry matter content ratio in shoot and root (Appendix VIII and Table 9). At 50 DAS numerically maximum dry matter content ratio in shoot and root (2.42) was recorded from V_5 and minimum (1.10) fromV_6. At harvest, the highest dry matter content ratio in shoot and root (6.05) was observed from V_6 which was statistically similar with V_3 (4.13). The lowest (3.13) from V_1 which was similar with V_2,V_3,V_4 and V_5. At harvest, V_6 showed 93.29% higher dry matter content of shoot and root ratio compared to that of V_1.

4.6.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences at 50 DAS and at harvest on dry matter content ratio in shoot and root (Appendix VIII and Table 10). At 50 DAS, the highest dry matter content ratio in shoot and root (2.95) was attained from C_1V_2, which was similar with C_1V_1 (2.52) and the lowest (0.80) from C_0V_6 that similar with C_0V_2 and C_1V_6. At harvest, the highest dry matter content ratio in shoot and root (6.69) was attained from C_1V_6 which was statistically similar with C_1V_4, C_1V_2, C_0V_6 and C_0V_3 while the lowest (2.5) from C_1V_1 that similar with C_0V_2 and C_0V_4. The lowest dry matter content ratio in shoot and root of C_1V_1 was 62.63% lower than the highest value of C_1V_6.

Table 9. Effect of variety on dry matter content ratio in shoot and root of composite and hybrid maize

Treatments	Dry matter content ratio in shoot and root	
	50DAS	**At harvest**
V_1	2.125	3.135 b
V_2	2.213	3.810 b
V_3	2.163	4.157 ab
V_4	1.750	3.330 b
V_5	2.422	3.538 b
V_6	1.105	6.058 a
$LSD_{(0.05)}$	NS	2.02
CV (%)	60.64	41.79

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

V_1: Baby corn

V_2: Khaibhutta

V_3: BARI bhutta 6

V_4: BARI hybrid bhutta 7

V_5: BARI hybrid bhutta 9

V_6: BARI sweet corn

Table 10. Interaction effect of cob removal and variety on dry matter content ratio in shoot and root of composite and hybrid maize

Treatments	Dry matter content ratio in shoot and root	
	50 DAS	At harvest
C_0V_1	1.730 ab	3.700 b
C_0V_2	1.473 ab	2.717 b
C_0V_3	2.037 ab	4.897 ab
C_0V_4	1.723 ab	2.777 b
C_0V_5	2.033 ab	3.823 b
C_0V_6	0.8033 b	5.420 ab
C_1V_1	2.520 ab	2.570 b
C_1V_2	2.953 a	4.903 ab
C_1V_3	2.290 ab	3.417 b
C_1V_4	1.777 ab	3.883 ab
C_1V_5	2.810 ab	3.253 b
C_1V_6	1.407 ab	6.697 a
$LSD_{(0.05)}$	2.03	2.85
CV (%)	60.64	41.79

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.7.1 Number of cob harvested at early stage

This analysis was done by Randomized Complete Block Design (RCBD) as only the cob removal treatments were considered for their parameter. Different composite and hybrid maize showed significant differences on number of baby corn harvested (Appendix IX and Figure 7). The highest number of baby corn (81110 ha^{-1}) was harvested from V_5 (BARI hybrid bhutta 9), while the lowest (78890 ha^{-1}) was harvested from V_2 (Khaibhutta). BARI hybrid bhutta 9 variety gave 2.81% higher immature cob ha-1 compared to that of the lowest immature cob harvested variety khaibhutta.

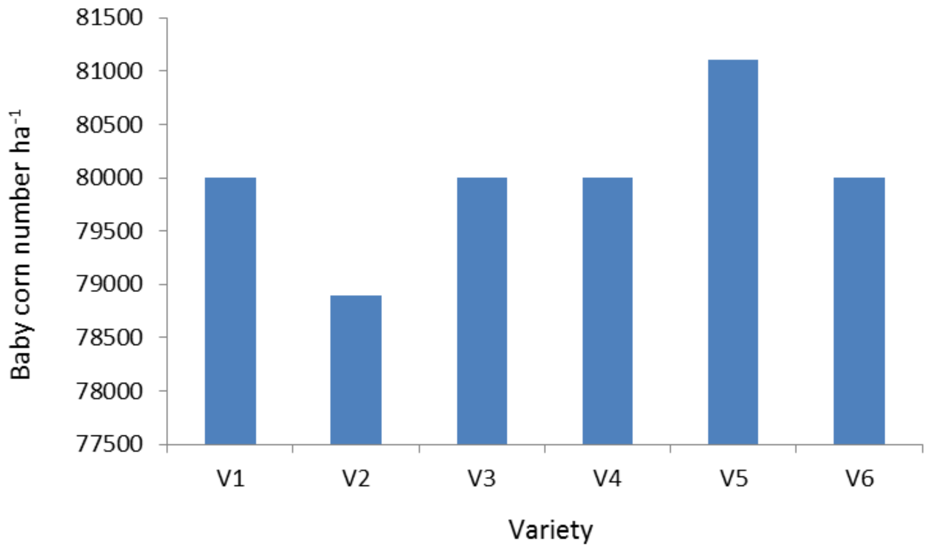


Figure 7. Number of immature cob harvested at early stage from different varieties of maize (LSD=121.71)

V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.7.2 Weight of cob harvested at early stage

This analysis was done by Randomized Complete Block Design (RCBD). Different composite and hybrid maize showed significant differences on yield of baby corn harvested (Appendix IX and Figure 8). The highest yield of immature cob (7.27 t ha^{-1}) was observed from V_6 (BARI sweet corn), while the lowest (5.16 t ha^{-1}) was observed from V_1 (Baby corn). The highest weight of baby corn was 40.89% higher than the lowest value. The lower yield of baby corn variety might be due to its smaller cob size. The sweet corn variety gave 40.89% higher yield of immature cob compared to that of the poor yield of baby corn variety.

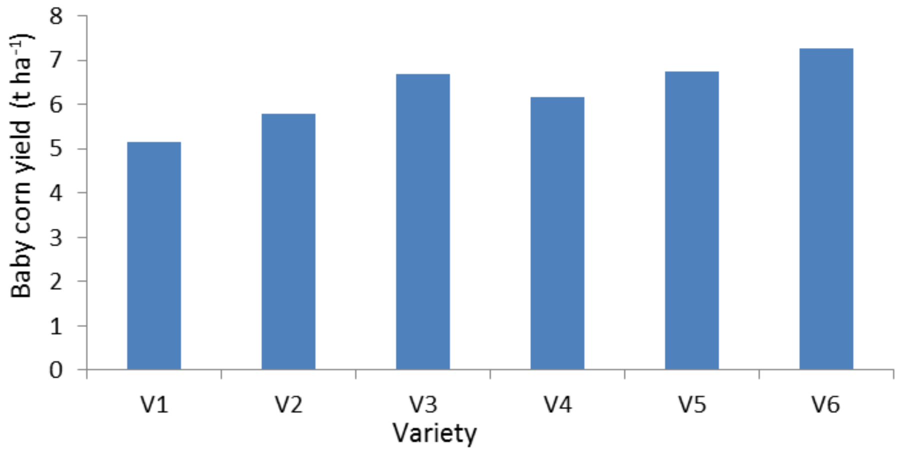


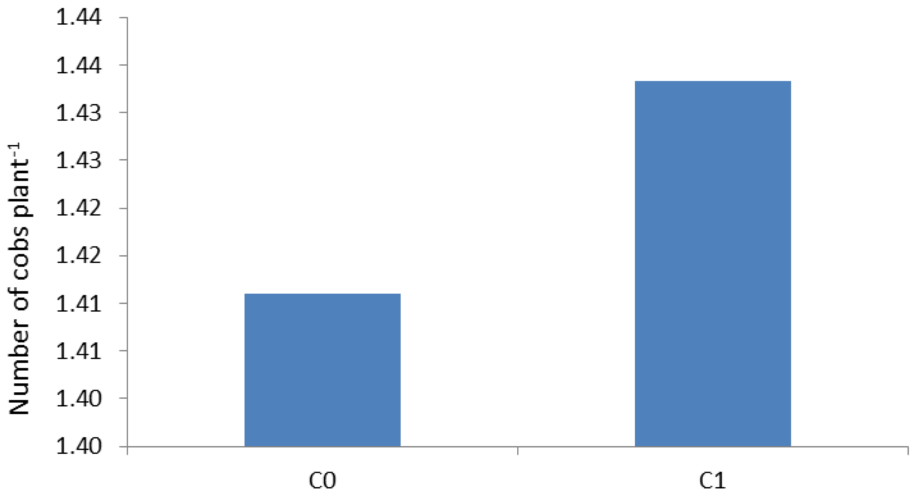
Figure 8. Yield of immature cob harvested at early stage from different varieties of maize (LSD=0.351)

V_1: Baby corn	V_4: BARI hybrid bhutta 7
V_2: Khaibhutta	V_5: BARI hybrid bhutta 9
V_3:BARI bhutta 6	V_6: BARI sweet corn

4.8 Number of cobs plant^{-1}

4.8.1 Effect of cob removal

Number of cobs plant^{-1} varied non-significantly for no cob removal and cob removal (Appendix X and Figure 9). The higher number of cobs plant^{-1}(1.43) was attained from C_1 (Cob removal), while the lower number of cobs (1.41) from C_0 (No cob removal). It was interesting to mention that even harvesting of one immature cob plant^{-1}, the cob removal treatment showed higher number of cobs plant^{-1} (1.42%) at harvest compared to that of no cob removal treatment.



C_0 = No cob removal C_1 = Cob removal

Figure 9. Effect of cob removal on number of cobs plant^{-1} of maize at harvest

4.8.2 Effect of variety

The composite and hybrid maize showed significant differences on number of cobs plant^{-1} (Appendix X and Table 11). The highest number of cobs plant^{-1} (1.9) was found from V_1 (Baby corn), which was statistically similar with V_2 (1.66) and the lowest (1.13) from V_4 (BARI hybrid bhutta 7), which was similar with V_3,V_5 and V_6. The baby corn variety gave 68.14% higher number of cobs plant^{-1} compared to that of BARI hybrid bhutta 7 variety.

4.8.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on number of cobs plant^{-1} (Appendix X and Table 12). The highest number of cobs plant^{-1} (1.93) was obtained from C_0V_1 (No cob removal + Baby corn), which was statistically similar with C_1V_1 (1.86), C_1V_2, C_0V_2, C_0V_3 and the lowest (1.06) from C_0V_4 (No cob removal + BARI hybrid bhutta 7),which is similar with C_0V_5, C_0V_6, C_1V_3, C_1V_4 , C_1V_5 and C_1V_6. The C_0V_1 produced 82.07% higher number of cobs plant^{-1} compared to that of the poor cob producing variety C_0V_4.

Table 11. Effect of variety on yield contributing characters of composite and hybrid maize

Treatments	No. of cobs plant^{-1}	No. of rows cob^{-1}	Cob length (cm)	Cob breadth (cm)
V_1	1.900 a	14.67 bc	23.98 c	18.40 c
V_2	1.667 ab	15.33 ab	28.9 b	16.17 d
V_3	1.300 c	14.67 bc	28.9 b	20.01 ab
V_4	1.133 c	16.33 a	30.70 ab	20.95 a
V_5	1.167 c	15.00 bc	33.57 a	18.61 bc
V_6	1.367 bc	14.00 c	28.7 b	17.99 c
$LSD_{(0.05)}$	0.332	1.331	3.693	1.465
CV (%)	19.44	7.37	10.53	6.51

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1: Baby corn
V_2: Khaibhutta
V_3:BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

Table 12. Interaction effect of cob removal and variety on yield contributing characters of composite and hybrid maize

Treatments	No. of cobs plant^{-1}	No. of rows cob^{-1}	Cob length (cm)	Cob breadth (cm)
C_0V_1	1.933 a	14.67 b	23.47 e	18.25 b-e
C_0V_2	1.533 a-d	15.33 b	30.23 a-c	16.12 f
C_0V_3	1.467 a-d	14.67 b	28.50 b-e	20.32 ab
C_0V_4	1.067 d	15.3 b	27.73 c-e	21.23 a
C_0V_5	1.133 d	15.33 b	31.80 a-c	17.61 d-f
C_0V_6	1.333 cd	14.00 b	29.80 bc	18.13 c-f
C_1V_1	1.867 ab	14.67 b	24.50 de	18.54 b-d
C_1V_2	1.800 a-c	15.33 b	27.60 c-e	16.23 ef
C_1V_3	1.133 d	14.67 b	29.33 b-d	19.70 a-c
C_1V_4	1.200 d	17.33 a	33.67 ab	20.67 a
C_1V_5	1.200 d	14.67 b	35.3 a	19.62 a-d
C_1V_6	1.400 b-d	14.00 b	27.60 c-e	17.85 c-f
$LSD_{(0.05)}$	0.4695	1.883	5.223	2.071
CV (%)	19.44	7.37	10.53	6.51

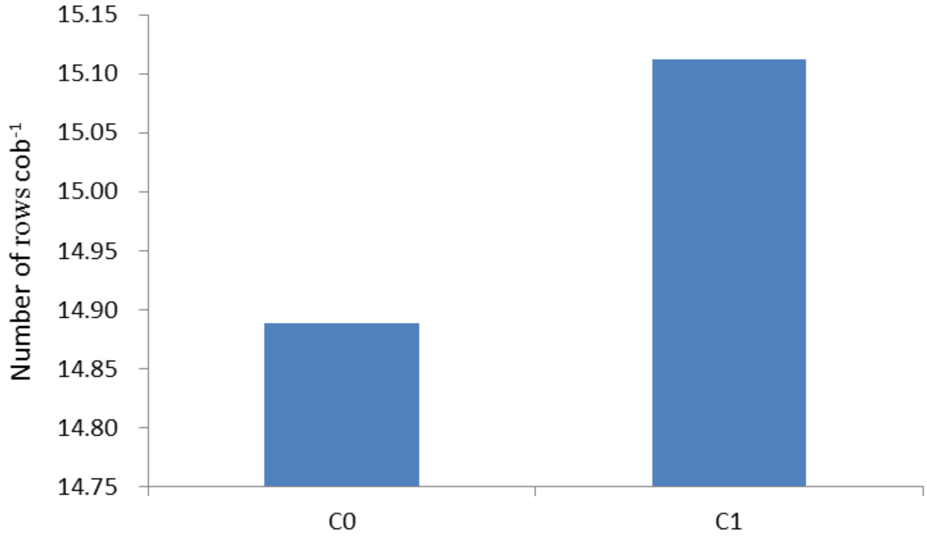
In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0: No cob removal
C_1: Cob removal
V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.9 Number of rows cob^{-1}

4.9.1 Effect of cob removal

Number of rows per cob varied non-significantly for no cob removal and cob removal (Appendix X and Figure 10). The higher number of rows per cob (15.11) was attained from C_1 (Cob removal), while the lower number of rows (14.89) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 10. Effect of cob removal on number of rows cob^{-1} of maize

4.9.2 Effect of variety

The composite and hybrid maize showed significant differences on number of rows cob^{-1} (Appendix X and Table 11). The highest number of rows cob^{-1} (16.33) was found from V_4 (BARI hybrid bhutta 7), which was statistically similar with V_2 (15.33) and the lowest (14.00) from V_6 (BARI sweet corn) which was similar withV_1, V_3 and V_5. The hybrid variety V_4 gave 16.64% higher number of rows cob^{-1} compared to the composite variety V_6.

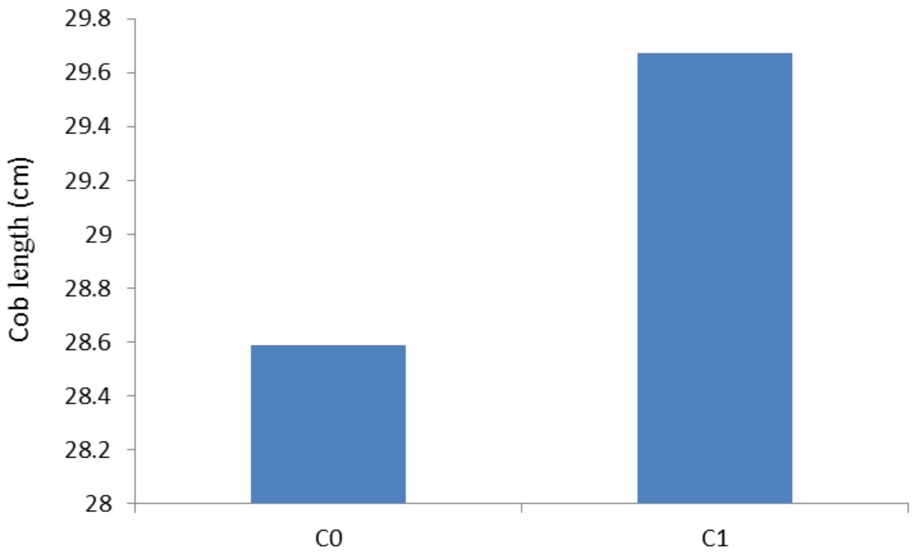
4.9.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on number of rows cob^{-1} (Appendix X and Table 12). The highest number of rows cob^{-1} (17.33) was obtained from C_1V_4 (Cob removal + BARI hybrid bhutta7). The lowest (14.00) was observed from C_0V_6 (No cob removal + BARI sweet corn) and C_1V_6 (Cob removal+ BARI sweet corn) those were similar with all other treatment combinations except C_1V_4. The highest number of rows cob^{-1} of C_1V_4 was 23.78% higher than C_0V_6 and C_1V_6 .

4.10 Cob length

4.10.1 Effect of cob removal

Statistically non-significant variation was recorded in terms of cob length for no cob removal and cob removal (Appendix X and Figure 11). The higher cob length (29.67 cm) was observed from C_1 (Cob removal). On the other hand the lower (28.59 cm) was found from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 11. Effect of cob removal on cob length of maize

4.10.2 Effect of variety

Cob length showed statistically significant variation for different composite and hybrid maize (Appendix X and Table 11). The highest cob length (33.57 cm) was recorded from V_5 (BARI hybrid bhutta 9) which was statistically similar (30.70cm) with V_4 (BARI hybrid bhutta 7), whereas the lowest (23.98 cm) from V_1 (Baby corn). The V_5 showed 39.99% higher cob length than V_1. It was revealed that maize plants used the residual soil moisture for its early vegetative growth; the subsequent growth was suffered in most cases.

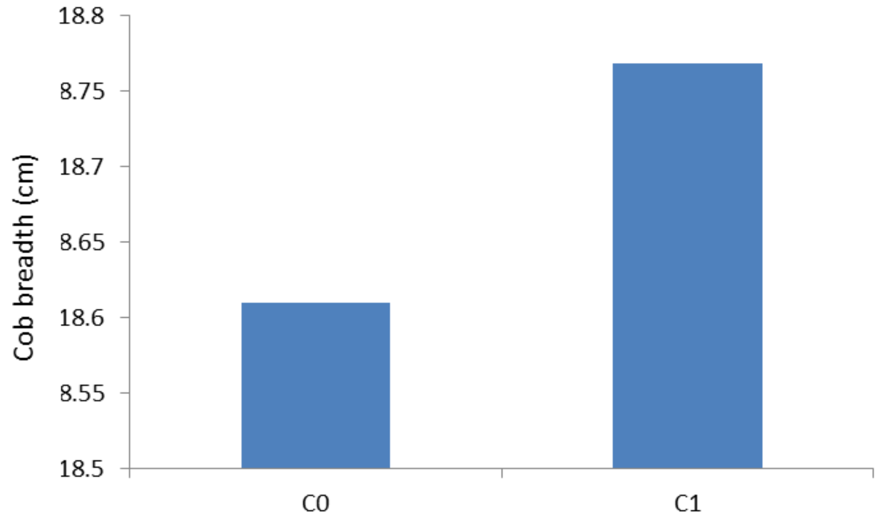
4.10.3 Interaction effect of cob removal and variety

Statistically significant variation was recorded for interaction effect of cob removal and variety in terms of cob length (Appendix X and Table 12). The highest cob length (35.33 cm) was found from C_1V_5 (Cob removal + BARI hybrid bhutta 9), which was statistically similar with C_1V_4 (33.67 cm), C_0V_2 and C_0V_5. The lowest cob length (23.47 cm) from C_0V_1 (No cob removal + Baby corn), which was similar with C_0V_3, C_0V_4, C_1V_1 and C_1V_2. The highest cob length of C_1V_5 was 50.53% higher than the lowest cob length of C_0V_1.

4.11 Cob breadth

4.11.1 Effect of cob removal

Statistically significant variation was recorded in terms of cob breadth for no cob removal and cob removal (Appendix X and Figure 12). The higher cob breadth (13.08 cm) was observed from C_1 (Cob removal). On the other hand the lower (9.97 cm) cob breadth was found from C_0 (No cob removal). Cob removal gave 31.19% higher cob breadth than no cob removal.



C_0 = No cob removal C_1 = Cob removal

Figure 12. Effect of cob removal on cob breadth of maize

($LSD_{0.05}$=2.62)

4.11.2 Effect of variety

Cob breadth showed statistically significant variation for different composite and hybrid maize varieties (Appendix X and Table 11). The highest cob breadth (20.95 cm) was recorded from V_4 (BARI hybrid bhutta 7) which was statistically similar (20.01 cm) with V_3 (BARI bhutta 6), whereas the lowest (16.17 cm) from V_2 (Khaibhutta). The hybrid variety gave 29.56% higher cob breadth than composite variety. Halder (2009) was agreed with this finding.

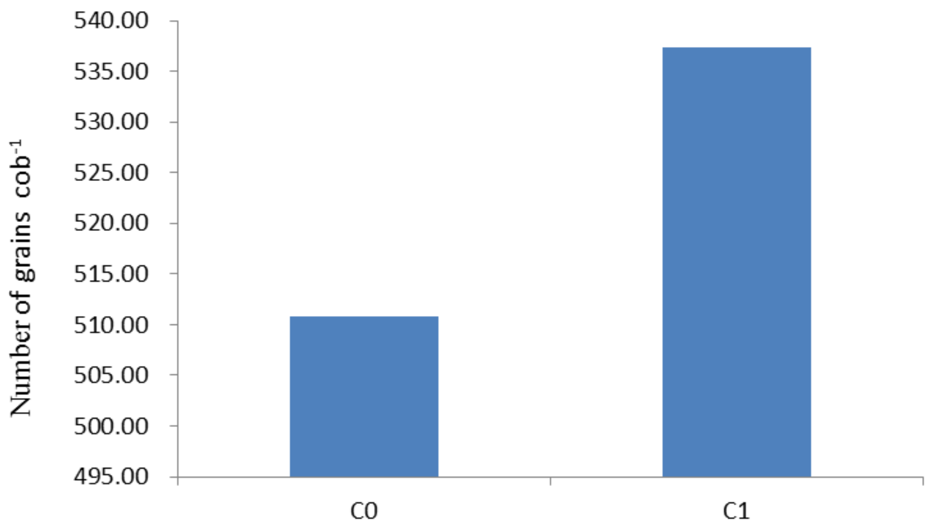
4.11.3 Interaction effect of cob removal and variety

Statistically significant variation was recorded for interaction effect of cob removal and variety in terms of cob breadth (Appendix X and Table 12). The highest cob breadth (21.23 cm) was found from C_0V_4 (No cob removal + BARI hybrid bhutta 7), which was statistically similar with C_1V_4 (20.67 cm), C_0V_3, C_1V_3 and C_1V_5. The lowest (16.12 cm) cob breadth from C_0V_2 (No cob removal + khaibhutta), which was similar with C_0V_5, C_0V_6, C_1V_2 and C_1V_6. The highest cob breadth of C_0V_4 was 31.69% higher than the lowest cob breadth of C_0V_2.

4.12 Number of grains cob^{-1}

4.12.1 Effect of cob removal

Number of grains cob^{-1} varied non-significantly for cob removal (Appendix XI and Figure 13). The higher number of grains cob^{-1} (537.33) was attained from C_1 (Cob removal), while the lower grains cob^{-1}(510.77) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 13. Effect of cob removal on number of grains cob^{-1} of maize

4.12.2 Effect of variety

The composite and hybrid maize showed significant differences on number of grains cob^{-1} (Appendix XI and Table 13). The highest number of grains cob^{-1} (571.0) was found from V_2 (Khaibhutta), which was statistically similar with V_1(568.0),V_5(551.3), V_4(514.3) and V_3(512.7).The lowest (427.0) from V_6 (BARI sweet corn),which was similar with V_3 and V_4. The highest number of grains cob^{-1} of V_2 was 33.72% higher than that of V_6.

4.12.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on number of grains cob^{-1} (Appendix XI and Table 14). The highest number of grains cob^{-1} (602.0) was obtained from C_1V_4 (Cob removal + BARI hybrid bhutta 7), which was statistically similar with all other interactions except C_0V_4 and C_0V_6. The lowest (424.7) number of grains cob^{-1} from C_1V_6 (Cob removal + BARI sweet corn) that similar to all other interactions except C_0V_1, C_1V_4 and C_1V_5. The lowest number of grains cob^{-1} of C_1V_6 was 29.45% lower than the highest grains cob^{-1} of C_1V_4.

Table 13. Effect of variety on yield contributing characters of composite and hybrid maize

Treatments	No. of grains cob^{-1}	1000-grains weight (g)	Shelling Percentage
V_1	568.0 a	219.7 a	59.53
V_2	571.0 a	199.8 a-c	64.18
V_3	512.7 ab	182.5 bc	54.85
V_4	514.3 ab	202.0 ab	52.75
V_5	551.3 a	168.0 c	57.64
V_6	427.0 b	181.0 bc	60.54
$LSD_{(0.05)}$	106.5	32.16	NS
CV (%)	16.87	13.9	17.35

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

V_1: Baby corn V_4: BARI hybrid bhutta 7
V_2: Khaibhutta V_5: BARI hybrid bhutta 9
V_3: BARI bhutta 6 V_6: BARI sweet corn

Table 14. Interaction effect of cob removal and variety on yield contributing characters of composite and hybrid maize

Treatments	No. of grains cob^{-1}	1000-grains weight (g)	Shelling Percentage
C_0V_1	600.0 a	219.0 ab	60.38 a-c
C_0V_2	570.0 a-c	226.7 a	61.07 a-c
C_0V_3	511.3 a-c	176.7 b-d	49.20 c
C_0V_4	426.7 bc	214.7 a-c	53.19 bc
C_0V_5	527.3 a-c	166.0 d	52.57 bc
C_0V_6	429.3 bc	165.3 d	49.09 c
C_1V_1	536.0 a-c	220.3 ab	58.69 a-c
C_1V_2	572.0 a-c	173.0 cd	67.29 ab
C_1V_3	514.0 a-c	188.3 a-d	60.50 a-c
C_1V_4	602.0 a	189.3 a-d	52.30 bc
C_1V_5	575.3 ab	170.0 cd	62.71a-c
C_1V_6	424.7 c	196.7 a-d	71.99 a
$LSD_{(0.05)}$	150.6	45.48	17.21
CV (%)	16.87	13.9	17.35

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal | C_1= Cob removal

V_1: Baby corn | V_4: BARI hybrid bhutta 7

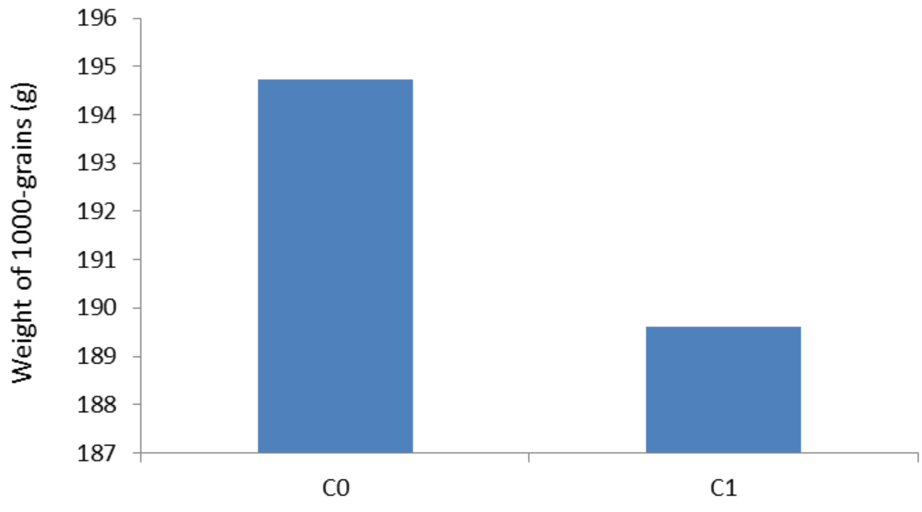
V_2: Khaibhutta | V_5: BARI hybrid bhutta 9

V_3: BARI bhutta 6 | V_6: BARI sweet corn

4.13 Weight of 1000- grains

4.13.1 Effect of cob removal

Non-significant variation was recorded in terms of weight of 1000-grains for composite and hybrid variety (Appendix XI and Figure 14). The numerically maximum weight of 1000-grains (194.73 g) was found from C_0 (No cob removal) and the minimum (189.6 g) from C_1 (Cob removal).The weight of 1000-grains was 2.70% higher in no cob removal than that of cob removal treatment.



C_0 = No cob removal C_1 = Cob removal

Figure 14. Effect of cob removal on 1000-grains weight of maize

4.13.2 Effect of variety

The composite and hybrid maize varieties showed significant differences on weight of 1000 grains (Appendix XI and Table 13). The highest weight of 1000-grains (219.7g) was recorded from V_1 (Baby corn) which was statistically similar with V_4 (202.0 g) and V_2 (199.8 g) and the lowest (168.0 g) from V_5 (BARI hybrid bhutta 9), which was statistically similar with V_2, V_3 and V_6. The weight of 1000-grains was 30.77% higher in composite variety V_1 than the hybrid variety V_5. The variation of grain weight among different maize varieties was also reported by Syed *et al.* (2002).

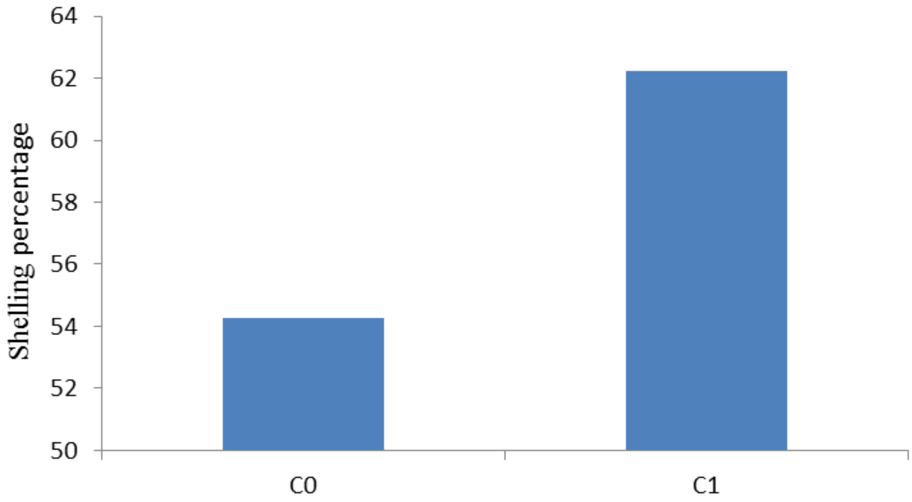
4.13.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on weight of 1000 grains (Appendix XI and Table 14). The highest weight of 1000-grains (226.7 g) was recorded from C_0V_2 (No cob removal + Khaibhutta) that similar to C_1V_1 (220.3 g), C_0V_1 (219.0 g), C_0V_4 (214.7 g), C_1V_6 (196.7 g), C_1V_4 (189.3 g) and C_1V_3 (188.3 g). The lowest (165.3g) from C_0V_6 (No cob removal + BARI sweet corn), which was similar with C_0V_5, C_1V_2 and C_1V_5. The highest weight of 1000 grains in C_0V_2 was 37.14% higher than the C_0V_6.

4.14 Shelling percentage

4.14.1 Effect of cob removal

The shelling percentage varied significantly for composite and hybrid variety of maize (Appendix XI and Figure 15). The higher shelling percentage (62.25) was attained from C_1 (Cob removal), while the lower (54.25) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 15. Effect of cob removal on shelling percentage of maize

($LSD_{0.05}$=5.13)

4.14.2 Effect of variety

The composite and hybrid maize varieties showed non-significant differences on shelling percentage (Appendix XI and Table 13). The numerically maximum shelling percentage (64.18) was recorded from V_2 (Khaibhutta) and the minimum (52.75) from V_4 (BARI hybrid bhutta 7). Nur (2008) reported that the shelling percentage was 9.99% lower in composite variety than that of hybrid variety.

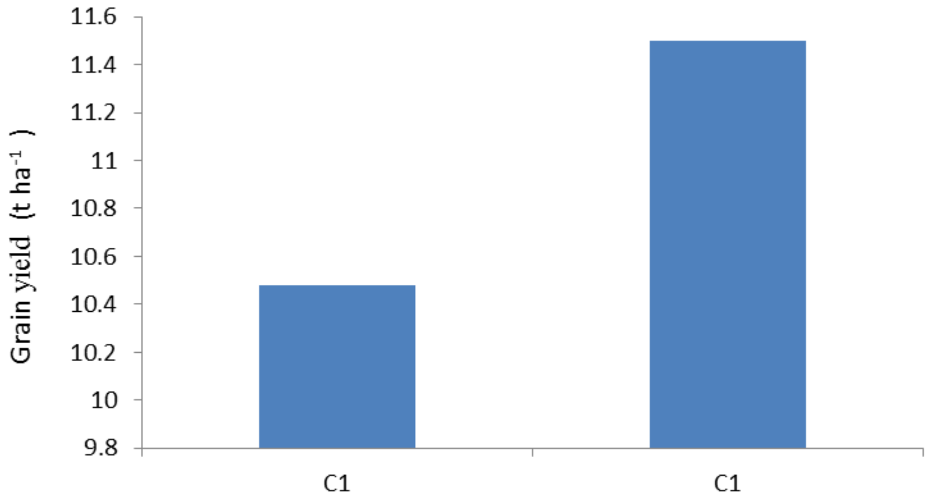
4.14.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on shelling percentage (Appendix XI and Table 14). The highest shelling percentage (71.99) was recorded from C_1V_6 (Cob removal +BARI sweet corn) that similar to C_1V_2 (67.29), C_0V_1 (60.38), C_0V_2 (61.07), C_1V_1 (58.69), C_1V_3 (60.50) and C_1V_5 (62.71). The lowest shelling percentage (49.09) from C_0V_6 (No cob removal + BARI sweet corn), which was statistically similar with C_0V_3, C_0V_4, C_0V_5 and C_1V_4. The highest shelling percentage of C_1V_6 was 46.64% higher than the C_0V_6.

4.15 Grain yield

4.15.1 Effect of cob removal

Grain yield showed non-significant differences for composite and hybrid variety (Appendix XII and Figure 16). The higher grain yield (11.50 t ha^{-1}) was found from C_1 (Cob removal), while the lower (10.48 t ha^{-1}) from C_0 (No cob removal). Cob removal gave 9.73% higher grain yield than no cob removal.



C_0 = No cob removal C_1 = Cob removal

Figure 16. Effect of cob removal on grain yield of maize

4.15.2 Effect of variety

The composite and hybrid maize varieties showed significant differences on grain yield (Appendix XII and Table 15). The highest grain yield (12.10 t ha^{-1}) was obtained from V_5 (BARI hybrid bhutta 9) which was statistically similar with V_4 (11.44 t ha^{-1}), V_3 (11.18 t ha^{-1}) and V_1 (11.03 t ha^{-1}). The lowest (10.02 t ha^{-1}) grain yield was observed from V_2 (Khaibhutta), which was similar with V_6,V_1,V_3 and V_4. BARI hybrid bhutta 9 gave 20.75% higher grain yield than Khaibhutta. Chaudhary *et al.* (2000) recorded maximum yield by using improved variety. The similar higher yield of hybrid variety was also reported by Sirisampan and Zoebisch (2005) and Ogunboded *et al.* (2001).

4.15.3 Interaction effect of cob removal and variety

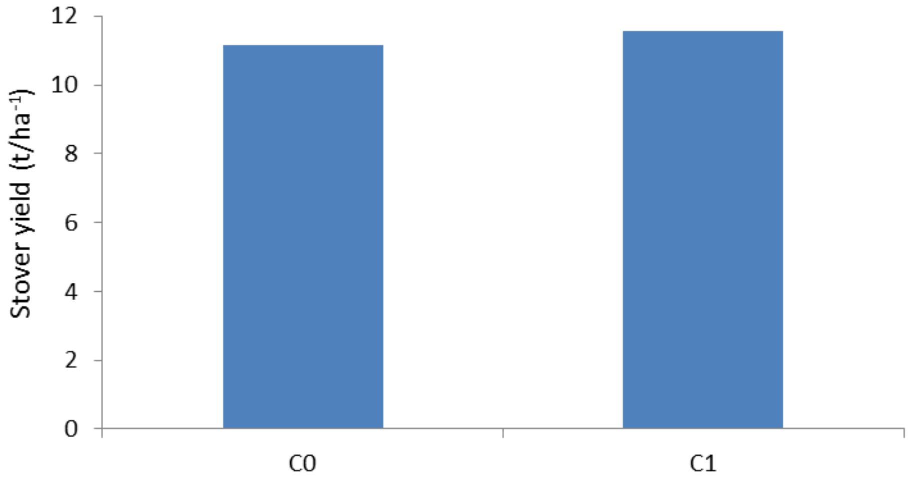
Interaction effect of cob removal and variety showed significant differences on grain yield (Appendix XII and Table 16). The highest grain yield (12.24 t ha^{-1})

was recorded from C_1V_5 (Cob removal + BARI hybrid bhutta 9) that similar to C_1V_6 (Cob removal + BARI sweet corn), C_1V_3, C_0V_4 and C_0V_5. The lowest (8.22 t ha^{-1}) from C_0V_6 (No cob removal + BARI sweet corn), which was similar with C_0V_2 (9.25 t ha^{-1}). The 48.90% higher grain yield was observed from cob removal and hybrid variety interaction C_1V_5 than no cob removal and composite variety C_0V_6.

4.16 Stover yield

4.16.1 Effect of cob removal

The stover yield showed non-significant differences for cob removal treatment (Appendix XII and Figure 17). The higher stover yield (11.56 t ha^{-1}) was recorded from C_1 (Cob removal) and the lower (11.15 t ha^{-1}) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 17. Effect of cob removal on stover yield of maize

4.16.2 Effect of variety

The composite and hybrid varieties of maize showed significant differences on stover yield (Appendix XII and Table 15). The highest stover yield (12.31 t ha^{-1}) was observed from V_5 (BARI hybrid bhutta 9) which was statistically similar with all other treatment except V_2 that showed significantly lowest stover yield (10.59 t ha^{-1}) which was also similar with all other treatments except V_5. The hybrid variety V_5 gave 16.24 % higher stover yield than composite variety V_2.

4.16.3 Interaction effect of cob removal and variety

Interaction effect of cob removal and variety showed significant differences on stover yield (Appendix XII and Table 16). The highest stover yield (12.59 t ha^{-1}) was observed from C_1V_5 (Cob removal + BARI hybrid bhutta 9) which was similar with all other interactions except C_1V_2 (10.19 t $^{-1}$) and C_0V_6 (9.59 t ha^{-1}) whereas the lowest (9.59 t ha^{-1}) stover yield from C_0V_6 (No cob removal + BARI sweet corn) that similar to C_1V_2, C_0V_1, C_0V_2 and C_1V_2. The highest stover yield of C_1V_5 was 31.41% higher than C_0V_6.

Table 15. Effect of variety on yield of composite and hybrid maize

Treatments	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1	11.03 ab	11.24 ab	22.28 ab	49.60
V_2	10.02 b	10.59 b	20.61 b	48.54
V_3	11.18 ab	11.57 ab	22.74 ab	48.87
V_4	11.44 ab	11.69 ab	23.14 ab	49.57
V_5	12.10 a	12.31a	24.41 a	49.58
V_6	10.15 b	10.72 ab	20.87 b	48.38
$LSD_{(0.05)}$	1.532	1.617	2.903	NS
CV (%)	11.58	11.82	10.79	5.00

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability. NS = Non significant.

V_1: Baby corn
V_4: BARI hybrid bhutta 7
V_2: Khaibhutta
V_5: BARI hybrid bhutta 9
V_3: BARI bhutta 6
V_6: BARI sweet corn

Table 16. Interaction effect of cob removal and variety on yield of composite and hybrid maize

Treatments	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
C_0V_1	10.76 ab	10.62 a-c	21.37 a-c	50.42 a
C_0V_2	9.25 bc	10.99 a-c	20.24 bc	45.60 c
C_0V_3	10.79 ab	11.35 a-c	22.14 ab	48.19 a-c
C_0V_4	11.91 a	12.31 ab	24.21 ab	49.25 a-c
C_0V_5	11.96 a	12.02 ab	23.98 ab	49.85 ab
C_0V_6	8.22 c	9.59 c	17.81 c	46.22 bc
C_1V_1	11.31 ab	11.87 ab	23.18 ab	48.77 a-c
C_1V_2	10.80 ab	10.19 bc	20.99 a-c	51.49 a
C_1V_3	11.56 a	11.78 a-c	23.35 ab	49.55 a-c
C_1V_4	10.98 ab	11.08 a-c	22.06 ab	49.89 ab
C_1V_5	12.24 a	12.59 a	24.83 a	49.32 a-c
C_1V_6	12.09 a	11.84 a-c	23.93 ab	50.55 a
$LSD_{(0.05)}$	2.167	2.286	4.105	4.176
CV (%)	11.58	11.82	10.79	5.00

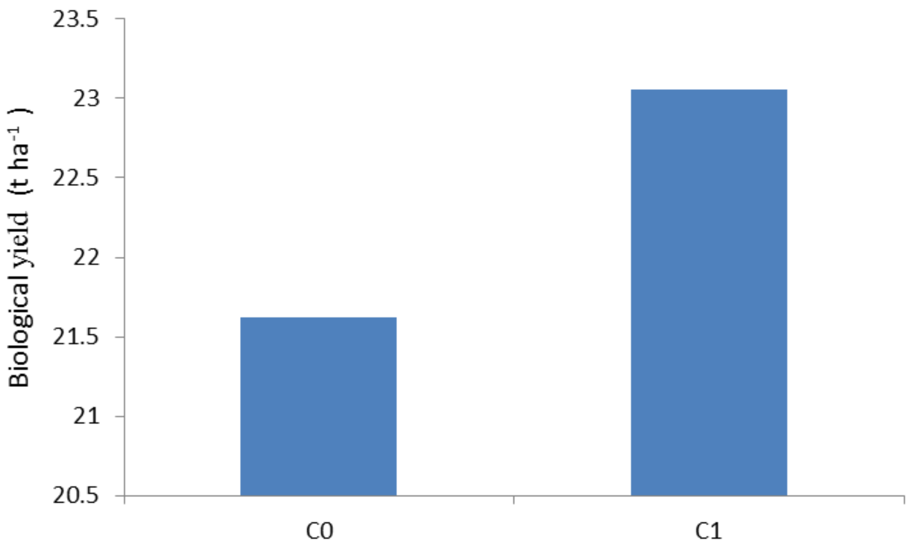
In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

C_0= No cob removal
C_1= Cob removal
V_1: Baby corn
V_2: Khaibhutta
V_3: BARI bhutta 6
V_4: BARI hybrid bhutta 7
V_5: BARI hybrid bhutta 9
V_6: BARI sweet corn

4.17 Biological yield

4.17.1 Effect of cob removal

The biological yield was not significantly influenced by cob removal (Appendix XII Figure 18). Numerically higher biological yield (23.06 t ha^{-1}) was obtained from C_1 (Cob removal) and lower (21.63 t ha^{-1}) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 18. Effect of cob removal on biological yield of maize

4.17.2 Effect of variety

The biological yield was significantly influenced by the variety (Appendix VII and Table 15). The highest biological yield (24.41 t ha^{-1}) was obtained from V_5 (BARI hybrid bhutta 9), which was similar with V_1, V_3 and V_4. The BARI hybrid bhutta 9 produced the highest grain yield and straw yield which resulted in the highest biological yield. The lowest biological yield (20.61 t ha^{-1}) was found from V_2 (Khaibhutta), which was similar with V1, V3, V4 and V6. The 18.43% higher biological yield was obtained from hybrid variety V_5 than composite variety V_2.

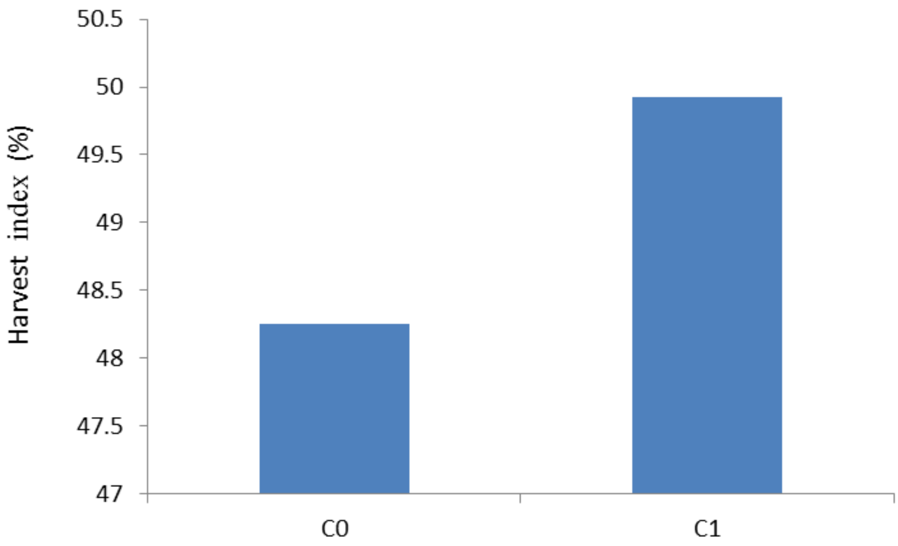
4.17.3 Interaction effect of variety and planting material

Interaction effect between cob removal and variety was significant in respect of biological yield (Appendix XII and Table 16). The highest biological yield (24.83 t ha^{-1}) was observed in C_1V_5 (Cob removal + BARI hybrid bhutta 9), which was statistically similar with C_0V_4 (No cob removal + BARI hybrid bhutta 7), C_0V_5, C_1V_6, C_1V_1 and C_1V_3. The lowest yield (17.81 t ha^{-1}) was observed in C_0V_6 (No cob removal + BARI sweet corn), which was similar with C_0V_1, C_0V_2 and C_1V_2. The highest biological yield of C_1V_5 was 39.41% higher than the lowest biological yield of C_0V_6.

4.18 Harvest index (%)

4.18.1 Effect of cob removal

The harvest index was not significantly influenced by cob removal (Appendix XII and Figure 19). Numerically higher harvest index (49.92 %) was obtained from C_1 (Cob removal) and lower (48.25 %) from C_0 (No cob removal).



C_0 = No cob removal C_1 = Cob removal

Figure 19. Effect of cob removal on harvest index of maize

4.18.2 Effect of variety

The harvest index was not significantly influenced by the variety (Appendix XII and Table 15). Numerically higher harvest index (49.60 %) was obtained from V_1 (Baby corn). The lower harvest index (48.38 %) was found from V_6 (BARI sweet corn).

4.18.3 Interaction effect of cob removal and variety

Interaction effect between cob removal and variety was significant in respect of harvest index (Appendix XII and Table 16). The highest harvest index (51.49%) was observed in C_1V_2 (cob removal + Khaibhutta), which was statistically similar with C_1V_6 (50.55 %), C_0V_1 (50.42 %), C_0V_5 (49.85 %) and C_1V_4 (49.89 %). The lowest harvest index (45.60 %) was observed in C_0V_2 (No cob removal +Khaibhutta), which was statistically similar with C_0V_6 (46.22 %), C_0V_3 (48.19 %), C_0V_4 (49.25 %), C_1V_1 (48.77 %), C_1V_3 (49.55 %) and C_1V_5 (49.32 %). The highest harvest index C_1V_2 was 12.92% higher than the C_0V_2. Reddy *et al.* (1987) reported the significant increase in yield attributes resulted in significant increase in harvest index (%).

ECONOMIC RETURN

Table 17: Total return (Tk. ha^{-1}) from harvested cob

Treatments	**Return (Tk. ha^{-1})**		**Total return (Tk. ha^{-1})**
	Baby corn	Grain	
C_0V_1	-	344320	344320
C_0V_2	-	296000	296000
C_0V_3	-	345280	345280
C_0V_4	-	381120	381120
C_0V_5	-	382720	382720
C_0V_6	-	263040	263040
C_1V_1	164440	361920	526360
C_1V_2	157780	345600	503380
C_1V_3	160000	369920	529920
C_1V_4	153340	351360	504700
C_1V_5	162220	391680	553900
C_1V_6	160000	386880	546880

From above table, the treatment with no cob removal gave return only from grain; there was no return from baby corn. So, the total return from this treatment was less for all variety than that treatment with cob removal. The treatment with cob removal gave baby corn at early stage and grain at harvest. So, the total return was higher for all cob removal variety than those treatments without cob removal (Table 17).The interaction of C_1V_5 (cob removal + BARI hybrid bhutta 9) gave the maximum total return of Tk.553900 ha^{-1} whereas the combination of C_0V_6 (no cob removal + BARI sweet corn)gave the minimum total return(Tk. 263040 ha^{-1}).

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from November 2013 to March 2014 to study the influence of cob removal on yield of composite and hybrid maize. The experiment comprised as two factors, Factor A: No cob removal (C_0) and Cob removal (C_1) and factor B: Baby corn (V_1), Khaibhutta (V_2), BARI bhutta 6 (V_3), BARI hybrid bhutta 7 (V_4), BARI hybrid bhutta 9 (V_5) and BARI sweet corn (V_6). The experiment was laid out in split-plot design with three replications. Data on different growth parameters, yield attributes and yield were recorded and analyzed.

The data on crop growth characters like plant height (cm), leaf area index (LAI), dry matter production (leaf, stem and root) were recorded at different days after sowing (DAS) as well as the crop characters like cob diameter (cm), cob length (cm), number of cobs plant^{-1}, number of grain rows cob^{-1}, number of grains cob^{-1}, weight of 1000 grains, shelling percentage, grain yield (t ha^{-1}), stover yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (HI) were also recorded after harvest and the analysis were completed using the MSTATC computer package program. The mean differences among the treatments were compared by least significant difference test (LSD) at 5% level of significance.

Results of the experiment showed that variety had a significant influence on growth characters (plant height, leaf number, leaf area index, dry matter production of both shoot and root and their ratio). On the other hand, significant effects were observed on the yield contributing characters like number of cob plant^{-1}, cob breadth(cm), cob length (cm), number of grain rows cob^{-1},number of grain cob^{-1}, weight of 1000 grains, grain yield (t ha^{-1}), stover yield (t ha^{-1}) and biological yield (t ha^{-1}). But it had showed the insignificant influence on shelling percentage and harvest index (%).

At harvest, there was no significant variation observed on plant height and leaf area index for cob removal treatment but significant on leaf number where higher result was observed from no cob removal and lower from cob removal. In case of yield contributing characters like cob length (cm), number of cobs plant^{-1}, number of grain rows cob^{-1}, number of grains cob^{-1}, weight of 1000 grains, grain yield (t ha^{-1}), stover yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%) showed no significance differences by cob removal. But cob breadth and shelling percentage showed significant differences in cob removal treatment.

At harvest, the highest and lowest plant height was 231.4 and 190.8 cm by the BARI hybrid bhutta 9 and the composite variety BARI sweet corn respectively. The highest leaf number was recorded from composite variety. In case of leaf area index, the data were recorded at 25, 50, 75 and 100 DAS where the hybrid variety gave the highest leaf area index compared to the composite variety. The highest dry matter production of root was recorded from BARI hybrid bhutta 7 and no significant differences observed for of shoot weight. The hybrid variety gave the superior result in case of number of rows cob^{-1}, cob breadth, cob length, number of grains cob^{-1}, grain yield, stover yield and biological yield.

Interaction effect of cob removal and variety was found significant for all the studied parameters. The highest plant height (240.7 cm) at harvest was found in C_1V_5 that was similar to C_1V_4, C_0V_5, C_0V_2 and C_0V_3. The highest leaf number (14.93) at harvest was recorded from C_0V_1 and the lowest from C_0V_6 (11.40). At 100 DAS, the highest leaf area index (9.42) was observed in C_1V_4 which was similar with C_1V_5, where the lowest from C_1V_6 (5.18).The ratio of shoot and root at harvest, the highest value (6.69) was recorded from C_1V_6 and the lowest (2.57) was recorded from C_1V_1.In case of number of cobs plant^{-1}, number of grain rows cob^{-1}, number of grains cob^{-1}, cob length (cm) and cob breadth (cm) ,the highest value (1.93,17.33, 602.0, 35.33 cm and 21.23 cm respectively) was observed from C_0V_1, $C_1V_{4,}$ C_1V_5 and C_0V_4 respectively, whereas the lowest value (1.06, 14.00, 424.7, 23.47 cm and 16.12 cm) was recorded from C_0V_4, C_0V_6, C_1V_6, C_1V_1 and

C_1V_2 respectively. Yield parameters like 1000-grains weight, shelling percentage, grain yield, stover yield, biological yield and harvest index gave the highest value (226.7 g, 71.99 %, 12.24 t ha^{-1}, 12.59 t ha^{-1}, 24.83 t ha^{-1} and 51.49 %) was recorded from C_0V_2, $C_0V_{6,}$ C_0V_5, C_1V_2 respectively and the lowest value (165.3, 49.09, 8.22, 9. 59, 17.81 and 45.60) was observed from C_0V_5, C_0V_6 and C_0V_2 respectively. The maximum total return was given by C_1V_5.

No significant variation was observed between no cob removal and cob removal treatments. The growth behavior and yield of the six studied varieties were different with varietal difference. BARI hybrid bhutta 9 in combination with cob removal gave the highest grain yield (12.24 t ha^{-1}), which was 48.90% higher than the treatment combination of BARI sweet corn with no cob removal. As a result, if the cob removal practices were adapted by the farmers, they can get additional income from selling out baby corn with the cob removal at early stage and grain yield at harvest.

Considering the results of the present experiment, further studies in the following areas are suggested:

1. Studies of similar nature could be carried out in different agro-ecological zones (AEZ) of Bangladesh for the evaluation of zonal adaptability.
2. In this study, four composite and two hybrid of maize were tested. It is necessary to carry out experiment with more composite and hybrid varieties.

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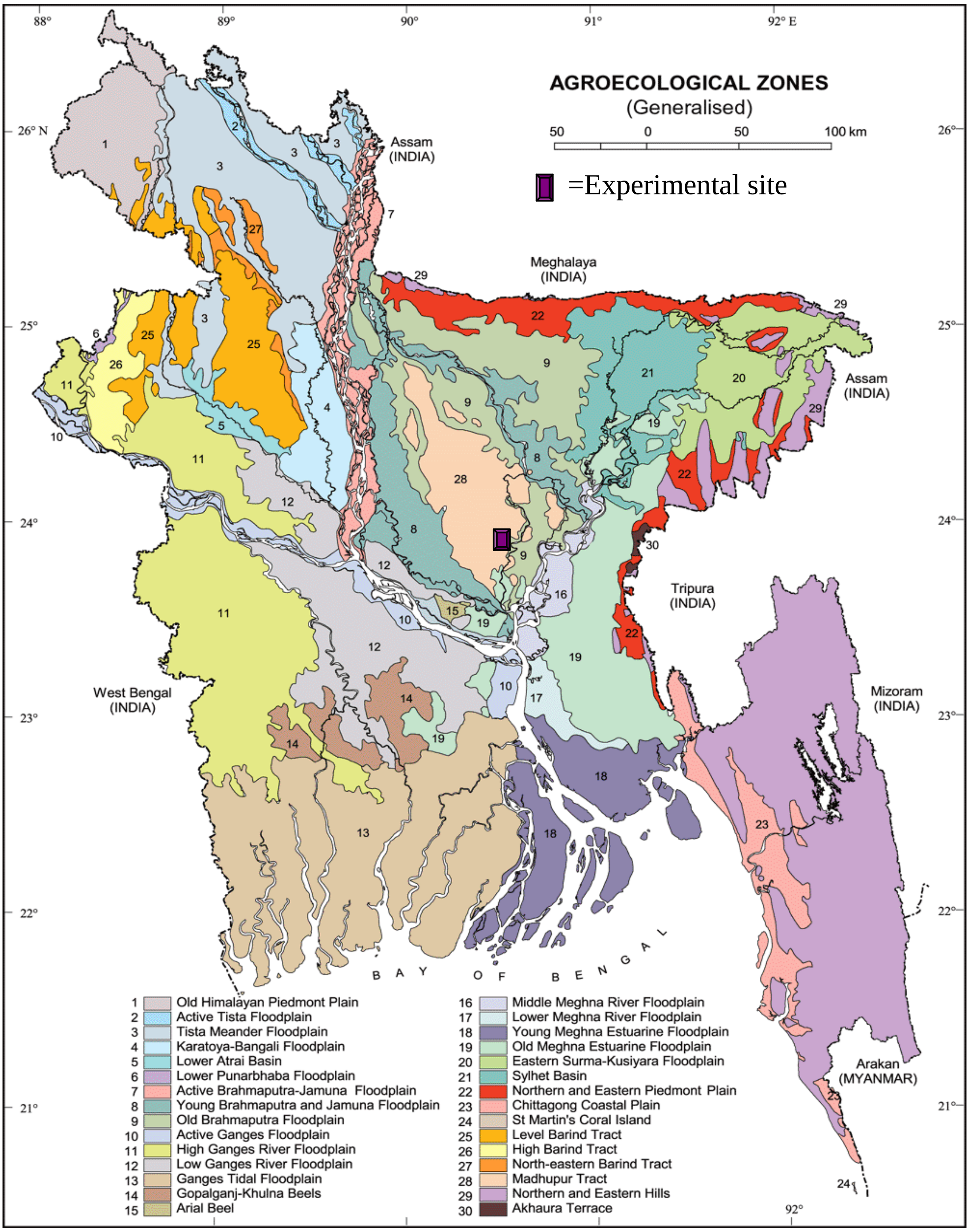
APPENDICES

Appendix I. Experimental location on the map of Agro-ecological Zones of Bangladesh



Appendix II. The physical and chemical characteristics of soil of the experimental site as observed prior to experimentation (0-15 cm depth)

Constituents	**Percent**
Sand	26
Silt	45
Clay	29
Textural class	Silty clay

Chemical composition:

Soil characters	**Value**
Organic carbon (%)	0.45
Organic matter (%)	0.54
Total nitrogen (%)	0.027
Phosphorus	6.3 µg/g soil
Sulphur	8.42 µg/g soil
Magnesium	1.17 meq/100 g soil
Boron	0.88 µg/g soil
Copper	1.64 µg/g soil
Zinc	1.54 µg/g soil
Potassium	0.10 meg/100g soil

Source: Soil Resources Development Institute (SRDI), Khamarbari, Dhaka

Appendix III. Monthly average air temperature, rainfall and relative humidity of the experimental site during the period from November 2013 to April 2014

Months	Air temperature (^0C)		Relative humidity (%)	Total rainfall (mm)
	Maximum	Minimum		
November, 2013	25.82	16.04	78	00
December, 2013	22.40	13.50	74	00
January, 2014	24.50	12.40	68	00
February, 2014	27.10	16.70	67	30
March, 2014	31.40	19.60	54	11
April, 2014	33.5	22.6	61	160.4

Source: Bangladesh Meteorological Department (Climate and Weather Division), Agargoan, Dhaka- 1207

Appendix IV. Mean square values for plant height of maize at different days after sowing

Sources of variation	Degrees of freedom	Mean square values for plant height at different days after sowing				
		25 DAS	50 DAS	75 DAS	100 DAS	At harvest
Replication	2	21.310	363.608	200.736	173.230	422.358
Cob removal	1	5.290 NS	54.760NS	65.880 NS	16.268NS	0.810 NS
Error (a)	2	3.986	539.463	609.169	3.689	197.841
Variety	5	46.442*	1011.044*	1200.29*	722.302*	1359.0*
Cob removal × Variety	5	4.053*	117.168*	166.746*	223.419*	253.992*
Error (b)	20	4.967	356.330	340.555	133.141	208.564

* Significant at 5% level NS = Non significant

Appendix V. Mean square values for leaf number of maize at different days after sowing

Sources of variation	Degrees of freedom	Mean square values for leaf number at different days after sowing				
		25 DAS	50 DAS	75 DAS	100 DAS	At harvest
Replication	2	0.209	0.614	0.214	0.095	0.285
Cob removal	1	0.111 NS	0.028 NS	0.302 NS	0.234 NS	2.200*
Error (a)	2	0.022	0.608	1.506	0.022	0.045
Variety	5	0.594*	2.078*	2.439*	10.819*	7.264*
Cob removal× Variety	5	0.053*	0.622*	0.244*	1.204*	0.283*
Error (b)	20	0.216	0.571	0.936	0.993	0.757

* Significant at 5% level NS = Non significant

Appendix VI. Mean square values for leaf area index of maize at different days after sowing

Sources of variation	Degrees of freedom	Mean square values for leaf area index at different days after sowing			
		25 DAS	50 DAS	75 DAS	100DAS
Replication	2	82.174	1358.653	27314.966	24373.274
Cob removal	1	27.214 NS	15375.999 NS	26.523 NS	89067.423 NS
Error (a)	2	3.181	2794.504	23901.821	5314.846
Variety	5	98.702*	30611.155*	72364.93*	91068.951*
Cob removal × Variety	5	59.820*	7518.488*	9112.39*	24260.935*
Error (b)	20	17.931	8199.366	11427.44	32855.060

* Significant at 5% level NS = Non significant

Appendix VII. Mean square values for dry matter production of maize at different days after sowing

Sources of variation	Degrees of freedom	Mean square values for dry matter production at different days after sowing			
		Shoot		Root	
		50 DAS	At harvest	50 DAS	At harvest
Replication	2	48.471	204.374	32.018	1.275
Cob removal	1	11.834 NS	109.551*	3.074 NS	0.694 NS
Error (a)	2	3.452	39.768	5.117	31.117
Variety	5	33.633*	103.740 NS	7.551 NS	66.666*
Cob removal× Variety	5	9.219*	89.974*	1.883 NS	14.065*
Error (b)	20	23.454	149.506	7.719	37.037

* Significant at 5% level NS = Non significant

Appendix VIII. Mean square values for shoot and root ratio of maize at different days after sowing

Sources of variation	Degrees of freedom	Mean square values for shoot and root ratio at different days after sowing	
		50 DAS	At harvest
Replication	2	6.848	2.380
Cob removal	1	3.914 NS	0.483 NS
Error (a)	2	0.686	0.974
Variety	5	1.345 NS	6.849*
Cob removal× Variety	5	0.372 *	3.332 *
Error (b)	20	1.417	2.801

* Significant at 5% level NS = Non significant

Appendix IX. Mean square values for baby corn number and yield

Sources of variation	Degrees of freedom	Mean square values for baby corn number and yield	
		Baby corn number	Baby corn yield
Replication	2	617284.915	0.068
Variety	5	10987659.336 *	1.727 *
Error	10	8765414.545	0.224

* Significant at 5% level

Appendix X. Mean square values for yield contributing characters of maize

Sources of variation	Degrees of freedom	Mean square			
		No. of cobs $plant^{-1}$	No. of rows cob^{-1}	Cob length	Cob breadth
Replication	2	0.074	0.333	4.810	5.277
Cob removal	1	0.004 NS	0.444 NS	10.563 NS	0.227 *
Error (a)	2	0.028	0.778	5.076	3.349
Variety	5	0.546*	3.733*	58.696*	16.537*
Cob removal× Variety	5	0.063*	1.244*	16.255*	1.430*
Error (b)	20	0.076	1.222	9.405	1.479

* Significant at 5% level NS = Non significant

Appendix XI. Mean square values for yield contributing characters of maize

Sources of variation	Degrees of freedom	Mean square		
		No. of grains cob^{-1}	1000 grains weight	Shelling percentage
Replication	2	9435.444	277.000	113.051
Cob removal	1	6346.778 NS	235.111 NS	575.840*
Error (a)	2	8612.111	1834.778	12.784
Variety	5	17427.578 *	2056.667 *	101.171 NS
Cob removal× Variety	5	9883.044 *	1350.244 *	124.065*
Error (b)	20	7815.244	712.989	102.151

* Significant at 5% level NS = Non significant

Appendix XII. Mean square values for yield and other crop characters of maize

Sources of variation	Degrees of freedom	Mean square			
		Grain yield	Stover yield	Biological yield	Harvest index
Replication	2	1.504	0.162	1.994	7.340
Cob removal	1	9.292 NS	1.554 NS	18.447 NS	25.200 NS
Error (a)	2	3.191	4.047	14.248	0.818
Variety	5	3.720*	2.491*	12.255*	1.889 NS
Cob removal× Variety	5	3.902*	2.484*	10.762*	12.548*
Error (b)	20	1.619	1.802	5.809	6.013

* Significant at 5% level NS = Non significant

LIST OF PLATES

Plate 1. Field view of the experiment

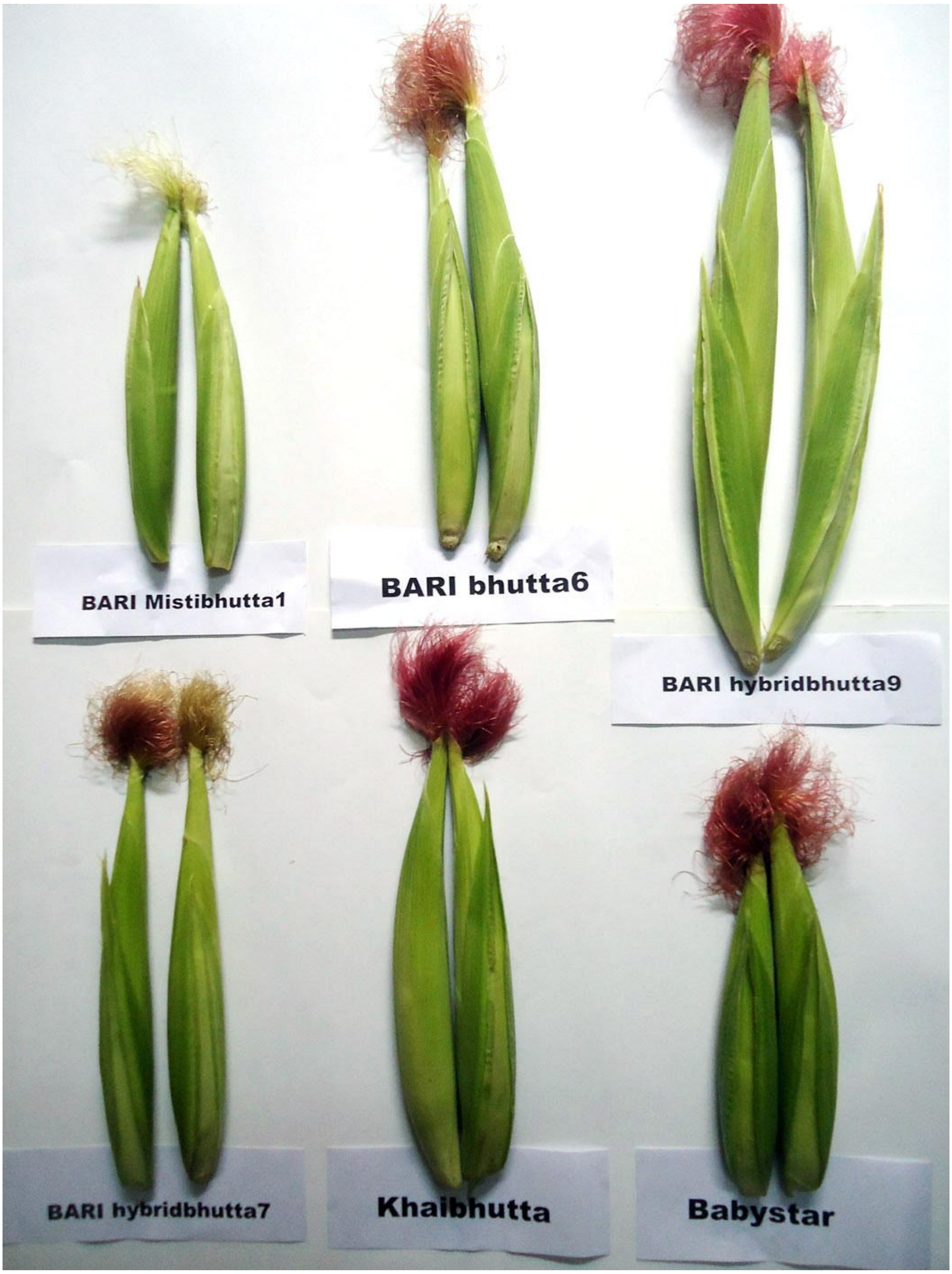


Plate 2. Immature cob of six maize varieties

Plate 3. Immature dehusked cob of six maize varieties