GROWTH AND YIELD OF WHITE MAIZE VARIETIES UNDER VARYING FERTILIZER DOSES

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CERTIFICATE

*This is to certify that the thesis entitled "**GROWTH AND YIELD OF WHITE MAIZE VARIETIES UNDER VARYING FERTILIZER DOSES**" 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 (MS)** in **AGRONOMY,** embodies the results of a piece of bona fide research work carried out by **MD. RAFIQUL ISLAM,** Registration No. **15-06888** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information as has been availed of during the course of this investigation has duly been acknowledged.

Dated:

Dhaka, Bangladesh

(Prof. Dr. Md. Jafar Ullah)

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GROWTH AND YIELD OF WHITE MAIZE VARIETIES UNDER VARIES FERTILIZER DOSES

ABSTRACT

An experiment was conducted at the experimental field of Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2015 to April, 2016 to study the growth and yield of white maize varieties under fertilizer doses. The experiment consisted of two factors. Factor A: Fertilizer doses (5 levels); F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = above 25% of recommended dose (125%) and F_5 = above 50% of recommended dose (150%) and factor B: Varieties (2 levels); V_1: KS-510 and V_2: PSC-121. The experiment was laid out in a split-plot design with three replications where doses of fertilizers were assigned in the main plot and varieties in the sub-plot. Results showed that plant height of both the varieties at maturity (around 200 cm) but fertilizer dose 50% above recommended had the highest plant height (220 cm).V_1 had significantly higher leaf area (3873.98 cm^2). Variety did not differed in dry matter production. F_4V_2 showed the highest biological yield (21.78 t ha^{-1}), grain yield (7.98 t ha^{-1}) which was at par with those of F_1V_1, F_4V_1, F_5V_1, F_1V_2 and F_5V_2. The highest seed yield F_4V_2 was attributed to either number of grains per cob (512) or 100 seed weight (41.0 g).

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LIST OF ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
LAI	=	Leaf area index
ppm	=	Parts per million
et al.	=	And others
N	=	Nitrogen
TSP	=	Triple Super Phosphate
MP	=	Muriate of Potash
RCBD	=	Randomized complete block design
DAS	=	Days after sowing
ha^{-1}	=	Per hectare
G	=	Gram (g)
Kg	=	Kilogram
µg	=	Micro gram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources and Development Institute
HI	=	Harvest Index
No.	=	Number
WUE	=	Water use efficiency
Wt.	=	Weight
LSD	=	Least Significant Difference
^{0}C	=	Degree Celsius
NS	=	Non significant
mm	=	Millimeter

Max	=	Maximum
Min	=	Minimum
%	=	Percent
cv.	=	Cultivar
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of coefficient of variance
Hr	=	Hour
T	=	Ton
viz.	=	Videlicet (namely)

CHAPTER 1

INTRODUCTION

Maize (*Zea mays* L.) is the world's widely grown highland cereal and primary staple food crop in many developing countries (Kandil, 2013). It is a typical monoecious plant highly cross-pollinated (95%), self pollination may reach up to 5% (Poehlman and Sleper, 1995). It was originated in America and first cultivated in the area of Mexico more than 7,000 years ago, and spread throughout North and South America (Hailare, 2000). In the world production, maize is ranked as the third major cereal crop after wheat and rice (Zamir *et al.,* 2013). World production of white maize is currently estimated to be around 65 to 70 million tons. Among the individual geographical regions of the developing countries, white maize production has a paramount importance in Bangladesh. The major producers are the United States, Brazil, France, India and Italy. The main white maize producers in Africa include Kenya, Tanzania, Zambia and Zimbabwe (Kidist, 2013).

Wheat, rice and maize are the most important cereal crops in the world but maize is the most popular due to its high yielding, easy of processing, readily digested and costs less than other cereals (Jaliya *et al*., 2008). Because of its variable use in agro-industries, it is recognized as a leading commercial crop of great agro-economic value. Maize as a major source of carbohydrate is used as human food in different forms, in the textile industry and also in the pharmaceutical industry. It is composed of approximately 76-88% of carbohydrate, 6-16% of protein, 4-5.7% fat and 1.3% of minerals. So that it is more balanced nutritionally and agriculturally small quantity grains are currently used for livestock as well as poultry feed and this is expected to increase with the development of the livestock and poultry production enterprise in the country.

However, in spite of the increase in land areas under maize production, yield is still low as compared to the average international productivity. The low productivity of maize is attributed to many factors like decline of soil fertility, poor agronomic practices, and limited use of input, insufficient technology generation, poor seed quality, disease, insect, pest and weeds.

Declining soil fertility and insufficient use of fertilizers resulting in severe nutrient depletion of soils causes low yield of maize (Buresh *et al*., 1997). It was generally observed that maize fail to produce good grain in plots without adequate nutrients (Adediran and Banjoko, 2003). Inorganic fertilizer exert strong influence on plant growth, development and yield (Stefano *et al*., 2004).The availability of sufficient growth nutrients from inorganic fertilizers lead to improved cell activities, enhanced cell multiplication and enlargement and luxuriant growth (Fashina *et al*., 2002). Luxuriant growth resulting from fertilizer application leads to larger dry matter production (Obi *et al*., 2005) owing better utilization of solar radiation and more nutrient (Saeed *et al*., 2001). Maize requires adequate supply of nutrients particularly nitrogen, phosphorus, potassium, calcium, sulphur, Zinc and boron for good growth and high yield.

Nitrogen exists in the soil system in many forms and changes (transforms) very easily from one form to another. Nitrogen is a vital plant nutrient and a major yield-determining factor required for good vegetative growth and grain development in maize production (Adediran, and Banjoko, 1995; Shanti, *et al*., 1997). The quantity required of these nutrients particularly nitrogen depends on the pre-clearing vegetation, organic matter content, tillage method and light intensity (Kang, 1981). It is very essential for plant growth and makes up 1 to 4 percent of dry matter of the plants (Anonymous, 2000). Nitrogen is a component of protein and nucleic acids and when nitrogen is sub-optimal, growth is reduced (Haque *et al*., 2001). Its availability in sufficient quantity throughout the growing season is essential for optimum maize growth. It is an integral component of many other compounds essential for plant growth processes including chlorophyll, many enzymes and alkaloid composition. Grain yield was increased significantly with different levels of nitrogen applications in maize plants (Manzoor *et al*., 2010). It also mediates the utilization of phosphorus, potassium and other elements in plants (Brady, 1984). The optimal amounts of these elements in the soil cannot be utilized efficiently if nitrogen is deficient in plants. Therefore, nitrogen deficiency or excess can result in reduces maize yields.

Phosphorus is another essential nutrient required to increase maize yield. The lack of phosphorus is as important as the lack of nitrogen in limiting maize performance. Phosphorus plays an important part in many physiological processes that occur within a developing and maturing plant. It is involved in enzymatic reactions in the plant. Phosphorus is essential for cell division because it is a constituent element of nucleoproteins which are involved in the cell reproduction processes. It is also a component of a chemical essential to the reactions of carbohydrate synthesis and degradation. It is important for seed formation and crop maturation. It helps to strengthen the skeletal structure of the plant thereby preventing lodging. It also affects the quality of the grains and it may increase the plant resistance to diseases.

Potassium (K), as a plant nutrient is becoming increasingly important in Bangladesh and a good crop response to K is being reported from many parts of the country. Crops showed yield benefits from potassium application. K also plays a vital role as macronutrient in plant growth and sustainable crop production (Baligar *et al*., 2001). It maintains turgor pressure of cell which is necessary for cell expansion. It helps in osmo-regulation of plant cell, assists in opening and closing of stomata. It plays a key role in activation of more than 60 enzymes (Tisdale *et al*., 1990; Bukhsh *et al*., 2011).

The use of agricultural gypsum can also favor the improvement of physical and chemical properties of soil. The efficiency of gypsum in the improvement of chemical properties of soil has been demonstrated in many studies. These improvements result from the increase in the concentration of calcium (Caires *et al*., 2003; Serafim, 2012;), and sulfur (Neis *et al*. 2010), the formation of less toxic species of Al ($AlSO_4^+$) (Caires *et al*., 2006; Soratto and Crusciol, 2008; Raij, 2008) and Al^{3+} precipitation (Zandoná *et al*., 2015), leading to better root development and increased water and nutrient uptake by plants (Serafim *et al*. 2012). This can be explained by the fact that calcium is the main component of root cell wall, which acts on cell elongation and proliferation (Silva *et al*., 2013). Gypsum can increase water infiltration rate and reduce surface runoff by reducing surface waterproofing and the formation of crust (Favaretto *et al*. 2006, Silveira *et al*. 2008). These effects would contribute to increase water retention capacity in soil, resulting in increased production. According to Silva, *et al*. (2013) the use of agricultural gypsum can favor the resilience of soil organic matter. Decomposed crop residues release low-molecular-weight organic acids capable of forming organic complexes with calcium and clay (Amaral *et al.*, 2004) increasing stabilization and the residence time of organic matter in the soil (Bronick and Lal, 2005).

Boron deficiency was already known to cause plants to stop growing. Lack of boron actually causes a problem in the meristems, or the stem cells of the plant. Boron is essential for formation of tassel and kernels. The inability to transport boron weakened the structure of pectin, which is a fiber that the plant needs to remain physically stable. When this happened, the growing points in the plant that contain meristems withered, which hurt the kernels and tassels. These causes a great reduction occurs during the production of maize.

Corn is more often deficient in zinc than in other micronutrients, and is responsive to zinc application when deficient. Zinc is an element used by crops in small quantities (usually less than 0.5 pounds per acre), yet is essential to normal plant growth and development. Zinc has several important functions in plants, including major roles in enzyme reactions, photosynthesis, DNA transcription and auxin activity.

Even though zinc is needed in small amounts, it has a huge impact on how a corn plant grows and ultimately how much yield is produced. In a study performed by the University of Nebraska on a low zinc testing soil showed a 53 bushel increase in yield by adding one pound of zinc to a starter. Zinc plays a critical role in the following systems of a corn plant. It acts as aids in the synthesis (production) of growth hormones and proteins. It is needed in the production of chlorophyll and carbohydrate metabolism. It is essential for the transportation of calcium throughout the corn plant. It is necessary for cell elongation, the increase in leaf and node size along with grain formation. Zinc deficiency leads to poor root development, stunted growth Small leaves shortened internodes, delayed silking and tasseling and chalky kernels which causes reductions in yield up to 40%. In Bangladesh maize has been incepted source and by doing research Bangladesh Agricultural Research Institute (BARI) has developed over ten varieties. However, those are yellow maize which are mostly used as feed for cattle, poultry and fishes. White maize is a traditional type of maize which is almost solely used by human worldwide and its use as human food is increasing worldwide. Moreover, it is speculated that Bangladesh along with the whole world may not cope with the ongoing population increase to supply required food after 2050 only from rice and wheat which are C_3 crops. Maize being a C_4 crop has highest yield productivity and so might be the only prospective crop to ensure food security in future. Almost no works were done in Bangladesh with white maize. Taking the above mentioned viewed the presented study was aimed with following objectives:

- To observe the growth and yield of white maize varieties.
- To determine the optimum level of fertilizer for proper growth and yield of white maize.
- To study the combined effect of variety and different level of fertilizers on the growth and yield of white maize.

CHAPTER 2

REVIEW OF LITERATURE

An attempt was made in this section to collect and study relevant information available in the country and abroad regarding the effect of different varieties and level of fertilizer management on the growth and yield of white maize to gather knowledge helpful in conducting the present research work and subsequently writing up the result and discussion.

2.1 Effect of different varieties

Plant height

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They reported that, Shuvra produced the tallest plant (179.1 cm) and BARI sweet corn-1 produced the shortest plant (149.3 cm).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate

(TSP). They reported that, maximum dry matter accumulation plant^{-1} (100.41 g) was recorded for C-79 and the lowest dry matter accumulation plant^{-1} (60.28 g) was found from C-20 variety.

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, both two hybrid varieties YH-1921 and YH-1898 showed non-significant result (220.56 cm and 213.00 cm, respectively) for plant height.

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (175.30 cm) and V_2 (Sultan) (174.93 cm) however did not differ significantly for plant height.

Msarmo and Mhango (2005) conducted an experiment at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer. The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, local maize had the highest plant height of (245.3 cm) as compared to Masika and DK8031 which had (165.4 cm) and (175.1 cm), respectively.

Number of leaves plant^{-1}

Enujeke (2013a) conducted an experiment in Teaching and Research Farm of Delta State University, Asaba Campus from March, 2008 to June, 2010 to evaluate the effects of variety and spacing on growth characters of hybrid maize. It was a factorial experiment carried out in a Randomized Complete Block Design (RCBD) with three replicates. Three hybrid maize varieties were evaluated under three different plant spacing for such growth characters as plant height, number of leaves, leaf area and stem diameter. The results obtained during the 8th week after sowing revealed that hybrid variety 9022-13 which gave highest number of leaves of 13.2 and the lowest number of leaves 12.2 was recorded from Oba Super 2.

Leaf area plant^{-1}

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They reported that, Shuvra gave the highest (5.12) LAI and the lowest one (2.91) was noted for BARI sweet corn-1.

Athar *et al.*. (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg/ha) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). The result of the study revealed that, maximum leaf area $plant^{-1}$ (5439 cm^2) was recorded for C-79 variety and the minimum leaf area $plant^{-1}$ (3642 cm^2) was found from C-20.

Dry matter $plant^{-1}$

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They reported that, Hybrid baby corn-271 produced the highest dry matter $plant^{-1}$ (172.15 g) where as the Khoibhutta had the lowest dry matter accumulation $plant^{-1}$ (112.56 g).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). They reported that, tallest plant height (175.89 cm) was recorded for C-79 variety and the lowest dry matter accumulation $plant^{-1}$ (98.44 cm) was found from C-20.

Number of rows ear^{-1}

A study was conducted by Asghar *et al.* (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (14.70) and V_2 (Sultan) (14.38) however did not differ significantly for number of grains row cob^{-1}.

Number of grains ear^{-1}

Enujeke (2013b) carried out a study in the Teaching and Research Farm of Delta state University, Asaba Campus from March 2008 to June, 2010 to evaluate the effects of variety, organic manure and inorganic fertilizer on number of grain cob^{-1} of maize. The experiment was carried out in a Randomized Complete Block Design (RCBD) replicated three times in a factorial layout. Four different rates of poultry manure, cattle dung and NPK 20:10:10 fertilizer were applied to three different maize varieties sown at 75cm x 15 cm and evaluated for number of grains cob^{-1}. The result of the study indicated that, with respect to varietal performance, hybrid variety 9022-13 had the highest number of grains/cob (517.8), followed by open-pollinated variety BR9922-DMRSRF$_2$ (474.0). Agbor local variety had the lowest number of grains/cob (386.6).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate

(TSP). The result of the study revealed that, maximum number of grains ear^{-1} (532.0) was recorded for C-79 variety and the minimum number of grains ear^{-1} (282.0) was found from C-20.

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, both two hybrid varieties YH-1921 and YH-1898 showed non-significant result (578.17a and 495.83, respectively) for number of grain ear^{-1}.

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (415.29) and V_2 (Sultan) (410.69) however did not differ significantly for number of grains cob^{-1}.

1000 grain weight

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, both two hybrid varieties YH-1921 and YH-1898 showed non-significant result (324.17 g and 378.44 g, respectively) for 1000 grain weight.

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (248.83 g) and V_2 (Sultan) (246.74 g) however did not show any difference in producing 1000-grain weight.

Msarmo and Mhango (2005) A study was conducted at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 $kgha^{-1}$ urea as top dressing (P_3). The result of the study revealed that, DK8031 had the highest 100 seed weight (41.45 g) as compared to local maize and Masika which had (35.17 g) and (34.60 g), respectively.

Grain yield

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, the maximum ear yield with husk (12.8 t ha^{-1}) was recorded in Hybrid Baby Corn-271 and the minimum (9.7 t ha^{-1}) was recorded in Shuvra.

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, both two hybrid varieties YH-

1921 and YH-1898 showed non-significant result (7.62 t ha^{-1} and 6.73 t ha^{-1}, respectively) for grain yield.

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (4.97 t ha^{-1}) and V_2 (Sultan) (4.88 t ha^{-1}) however did not show any difference in producing grain yield.

Msarmo and Mhango (2005) conducted a study at Bunda College during the 2003/04 crop season to assess the effect of fertiliudyzer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, variety DK8031 was the highest grain yielder (6313 kg ha^{-1}) followed by Masika (5467 kg ha^{-1}) and then local maize (4823 kg ha^{-1}).

Stover yield

Msarmo and Mhango (2005) conducted a study at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, variety DK8031 was the highest biomass yield (16131 kg ha^{-1}) followed by local maize (15114 kg ha^{-1}) and then Masika (12408 kg ha^{-1}).

Biological yield

Asghar *et al*. (2010) conducted a study by to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (14.46 t ha^{-1}) and V_2 (Sultan) (14.43 t ha^{-1}) however did not show any difference in producing biological yield.

Harvest index

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The varieties V_1 (Golden) (34.19 %) and V_2 (Sultan) (33.75 %) however did not show any difference for harvest index.

2.2 Effect of different levels of fertilizers

Plant height

A field nitrogen management trial was conducted by Woldesenbet and Haileyesus (2016) to know the maximum productivity of Maize response to high nitrogenous fertilization levels, from this perspective, using five N levels (0, 23, 46, 69 and 92 kg N ha^{-1}) with three replications. The study was conducted in 2015 in Decha District, Modyo Gombera Kebele of Kaffa Zone, SNNPR State. The experiment was laid out in RCBD. The result of this study indicated that there is an increase in plant height with an increase in nitrogen level. The tallest plant (360.66 cm) was recorded from the application of 92 kg N ha^{-1} and the shortest (347.33 cm) from no N application.

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They reported that, N-fertilizer had significant effect on plant height at all growth stages. The tallest plant (185.26 cm) was recorded at 200 kg N ha^{-1} and the shortest (113.58 cm) at 0 kg N ha^{-1}.

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). They reported that, tallest plant height (182.31 cm) was recorded for 50 kg ha^{-1} urea application and the shortest plant (102.38 cm) was found from control treatment (0 kg ha^{-1}).

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-

1921) for growth and yield. Results showed that, maximum plant height (230.50 cm) was recorded in maize plants fertilized with NP @ 400-200 kg ha^{-1} followed by 350-175 kg ha^{-1} NP (230.0 cm) with non-significant difference, where as the minimum plant height (187.50 cm) was recorded in control plot (0-0 kg ha^{-1}).

A study was conducted by Asghar *et al.* (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. Among different treatments, F_3 (250-110-85 NPK kg ha^{-1}) gave maximum plant height (198.55 cm) against the minimum recorded (143.60 cm) in F_0 (control).

Onasanya *et al.* (2009) conducted an experiment to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. The results of the study showed that, the maximum plant height was recorded from at 8WAP (Week after transplanting) the tallest plant height (192.50 cm) was recorded from T_3 (120 kg N ha^{-1} + 0 kg P ha^{-1}) where as the shortest plant height (167.06 cm) was recorded from control treatment T_1.

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, plant height was increased with successive increment in fertilizer application rate up to 600 kg ha^{-1}. Maize plants were tallest (168.35 cm) that received 600 kg NPK ha^{-1} and the shortest plant (148.20 cm) was recorded that received no fertilizers.

Msarmo and Mhango (2005) conducted a study at Bunda College during the crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 $kgha^{-1}$ urea as top dressing (P_3). The result of the study revealed that, P_1 gave the highest plant height of 177.7 cm followed by P_2 (175 cm) and then P_3 (172.6 cm).

Number of leaves $plant^{-1}$

A field nitrogen management trial was conducted by Woldesenbet *et al.* (2016) to know the maximum productivity of Maize response to high nitrogenous fertilization levels, from this perspective, using five N levels (0, 23, 46, 69 and 92 kg N ha^{-1}) with three replications. The study was conducted in 2015 in Decha District, Modyo Gombera Kebele of Kaffa Zone, SNNPR State. The experiment was laid out in RCBD. The result of this study indicated that, there is an increase in number of leaves with an increase in N level. The data showed that the maximum numbers of leaves per plant (17.2) were obtained from the application of 69 and 92 kg N ha^{-1} and the minimum number of leaves per plant (15.8) were obtained from no N application.

Onasanya *et al.* (2009) conducted an experiment to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October,

2007. The results of the study revealed that, T_3 (120 kg N ha^{-1} + 0 kg P ha^{-1}) produced the maximum number of leaves $plant^{-1}$ (12.39) which differ significantly from all other treatments. T_1 (control) had the least number of leaves $plant^{-1}$ (10.51).

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, the highest number of leaf $plant^{-1}$ (32.10) was recorded from the maize plants that received 600 kg ha^{-1} and the lowest number of leaf $plant^{-1}$ (8.50) was recorded from the maize plants that received no fertilizers.

Leaf area $plant^{-1}$

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, plot treated with 200 kg ha^{-1} gave the highest LAI (5.23) where as the plot treated with 0 kg ha^{-1} had the lowest LAI (2.75).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg/ha) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). The result of the study revealed that, maximum leaf area $plant^{-1}$ (5700 cm^2) was recorded for 100 kg ha^{-1} urea application and the minimum leaf area $plant^{-1}$ (3854 cm^2) was found from control treatment (0 kg ha^{-1}).

Onasanya *et al.* (2009) conducted an experiment to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. They reported that, the highest leaf area $plant^{-1}$ (964.71 cm^2) was recorded in T_{10} (120 kg N ha^{-1} + 20 kg P ha^{-1}) at 8WAP. However, this was not significantly different from T_{11} (120 kg N ha^{-1} + 40 kg P ha^{-1}) and T_3 (120 kg N ha^{-1} + 0 kg P ha^{-1}). The control plot (T_1) gave the lowest value of leaf area $plant^{-1}$ (501.22 cm^2).

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, the highest leaf area $plant^{-1}$ (1600.00 cm^2) was recorded from the maize plants that received 600 kg ha^{-1} and the lowest leaf area $plant^{-1}$ (46.75 cm^2) was recorded from the maize plants that received no fertilizers.

Kumar *et al*. (2007) conducted a field experiment at Main Agricultural Research Station, Agriculture College, Dharwad, during 2002-03 to study the fertilizer requirement of sweet corn grown on Vertisols of zone-8 of Karnataka. The experiment was laid out in Randomized Block Design (RCBD) with three replications. Recommended disease of fertilizer (RDF) of grain maize was (150:75:37.5 kg ha^{-1} NPK, respectively). Treatment were consisting of varying levels of N, P and K, to study the effect of N, P and K levels on sweet corn. The nutrient levels were, three levels of N (100%, 75% and 50% RDN of grain maize), two P levels (100% and 75% RDP of grain maize) and three K levels (75%, 100% and125% RDK of grain maize) and totally 18 different treatment combinations were laid out. The growth parameters of sweet corn *viz*., leaf area index and total dry matter production were influenced favourably with increasing levels of NPK application. The yield and yield components of sweet corn were also influenced favourably with increasing levels of NPK application. They reported that, Irrespective of the growth stages, the treatments which received 75% RDN or more (T_1, T_2, T_4, T_7, T_{10}, T_{13}, T_{14} and T_{16}) recorded higher leaf area index than other treatments. The highest leaf area index was recorded in treatment T_{13}, which received 100% RDN + 100% RDP + 125% RDK (0.63, 3.35 and 3.05 at 30, 60 DAS and at harvest, respectively). The lowest leaf area index was recorded in treatment T_{12} which received 50% RDN + 75% RDP + 75% RDK (0.35, 2.67 and 2.50 at 30, 60 DAS and at harvest, respectively).

Dry matter plant^{-1}

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They reported that, plot treated with 200 kg ha^{-1} produced the highest dry matter $plant^{-1}$ (215.45 g) where as the plot treated with 0 kg ha^{-1} had the lowest dry matter accumulation $plant^{-1}$ (85.67 g).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six repli-cates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). They reported that, maximum dry matter accumulation $plant^{-1}$ (103.58 g) was recorded for 175 kg ha^{-1} urea application and the lowest dry matter accumulation $plant^{-1}$ (65.29 g) was found from control treatment (0 kg ha^{-1}).

Stem diameter

Seidel *et al*. (2016) conducted a study aimed to evaluate production components, yield of maize intercropped with jack bean and soil resistance to penetration using different doses of gypsum. The experimental design was a randomized complete block design in split plots with four replications and was carried out during season 2013/2014. The main plots were maize intercropped with jack beans and maize sown alone, and the subplots were six doses of gypsum (0, 1, 2, 3, 4, 5 t ha^{-1}).They reported that stem diameter did not significantly influenced by different rate of gypsum. The highest stem diameter was (2.89 cm) recorded from 5 t ha^{-1} gypsum and the lowest stem diameter (2.82 cm) was recorded from 0 t ha^{-1} gypsum.

Onasanya *et al.* (2009) conducted an experiment to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. They reported that, the highest stem girth was recorded in T_{10} (120 kg N ha^{-1} + 20 kg P ha^{-1}), while the lowest stem girth was recorded in the control. The stem girth ranged from 7.33cm in the control (T_1) to 8.44cm in T_{10} (120 kg N ha^{-1} + 20 kg P ha^{-1}), respectively.

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, stem girth was increased with successive increment in fertilizer application rate up to 600 kg ha^{-1} the maize plants that received 600 kg ha^{-1} had the greatest stem girth (7.67 cm) and the lowest stem girth (6.34 cm) was recorded that received no fertilizers.

Number of rows ear^{-1}

A field nitrogen management trial was conducted by Woldesenbet *et al*. (2016) to know the maximum productivity of Maize response to high nitrogenous fertilization levels, from this perspective, using five N levels (0, 23, 46, 69 and 92 kg N ha^{-1}) with three replications. The study was conducted in 2015 in Decha District, Modyo Gombera Kebele of Kaffa Zone, SNNPR State. The experiment was laid out in RCBD. The result of this study revealed that, the application of different levels of nitrogen (46 kg ha^{-1}, 69 kg ha^{-1} and 92 kg ha^{-1}) is non-significant on number of rows per plant. This result is similar to Arif *et al.* (2010) who found non-significant result by applying 80 kg N ha^{-1}, 120 kg N ha^{-1}and 160 kg N ha^{-1}. Moraditochaee *et al.* (2012) also showed that the application of N fertilizer was non-significant on number of rows per ear.

A study was conducted by Asghar *et al.* (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The maximum number of grain rows per cob (15.30) was produced by NPK application at the rate of 250-110-85 kg ha^{-1}, however, did not differ statistically when compared with treatment 175-80-60 kg ha^{-1}which gave 15.03 number of grain rows per cob. The treatment F_1 (100-50-35 NPK kg ha^{-1}) results 14.30 and seemed to be better than the control 13.53.

Number of grains ear^{-1}

A field nitrogen management trial was conducted by Woldesenbet *et al.* (2016) to know the maximum productivity of Maize response to high nitrogenous fertilization levels, from this perspective, using five N levels (0, 23, 46, 69 and 92 kg N ha^{-1}) with three replications. The study was conducted in 2015 in Decha District, Modyo Gombera Kebele of Kaffa Zone, SNNPR State. The experiment was laid out in RCBD. The result of this study revealed that maximum number of kernels (588.00) was produced when 92 kg N ha^{-1} was applied and the minimum number of grains (497.86) was recorded from no N application.

Jan *et al.* (2014) conducted field trials during summer 2011-2012 at New Developmental Farm of The University Agriculture, Peshawar, Pakistan to study the effects of soil amendments on yield and yield attributes of maize (*Zea mays* L.) under different irrigation schedule. The field experiments were laid out in randomized complete block design having three replications. Two separated filed experiments were maintained. Treatments were randomized in each field. One filed was specified for 6 irrigations while other had 3 irrigations. The treatments consisted of soil amendments (FYM (10 t ha^{-1}), crop residue (wheat straw 10 t ha^{-1}), gypsum (1000 kg ha^{-1}), qemisoyl (10 kg ha^{-1})

and humic acid (12 kg ha^{-1})) were used. The results of the study revealed that, plots treated with FYM at 10 t ha^{-1} produced more grains ear^{-1} (504), statistically at par when plots treated with humic acid, while minimum grains ear^{-1} (271) was observed in control plots.

Enujeke (2013a) carried out a study in the Teaching and Research Farm of Delta state University, Asaba Campus from March 2008 to June, 2010 to evaluate the effects of variety, organic manure and inorganic fertilizer on number of grain cob^{-1} of maize. The experiment was carried out in a Randomized Complete Block Design (RCBD) replicated three times in a factorial layout. Four different rates of poultry manure, cattle dung and NPK 20:10:10 fertilizer were applied to three different maize varieties sown at 75cm x 15 cm and evaluated for number of grains cob^{-1}. The result of the study indicated that, plants that received inorganic fertilizer NPK 20:10:10 had the highest number of grains/cob (506.0) followed by plants that received poultry manure (468.0). Plants that received cattle dung had the lowest number of grains/cob (458.0).

Athar *et al.* (2012) conducted a pot experiment in a wire netting green house at Bahauddin Zakariya University, Multan, Pakistan in order to assess the beneficial effect of urea on corn cultivars (C-20 and C-79) differing in yield production. Corn plants were grown in loam soil with alkaline in reaction. The pots were arranged in a complete randomized manner with six replicates. Two weeks old plants were subjected to different levels of urea (46% N). Five levels of urea (0, 50, 100, 175 and 225 kg ha^{-1}) with constant (150 kg ha^{-1}) TSP (46% P_2O_5) and SOP (50% K_2O) were applied in two steps half dose at the seedling stage and the remaining half was supplied at vegetative stage (6 weeks) at constant (100 kg ha^{-1}) sulfate of potash (SOP) and triple super phosphate (TSP). The result of the study revealed that, maximum number of grains ear^{-1} (552.0 g) was recorded for 175 kg ha^{-1} urea application and the minimum number of grains ear^{-1} (297.0 g) was found from control treatment (0 kg ha^{-1}).

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. Number of grains cob^{-1} is an important yield determining component of maize. The data regarding number of grains cob^{-1} showed that various NPK applications significantly affected number of grains cob^{-1}. Treatment F_3 (250-110-85 NPK kg ha^{-1}) produced more number of grains (425.13) per cob. Treatment F_3 was followed by treatment F_2 (175-80-60 NPK kg ha^{-1}) (421.28), F_1 (100-50-35 NPK kg ha^{-1}) (414.48) and F_0 (0-0-0 NPK kg ha^{-1}) produced the lowest number of grains (391.29) per cob. Response of maize crop to various NP levels was studied by Mukhtar *et al.* (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. Results revealed that, maize crop fertilized at 250-125 kg NP produced significantly maximum grains per ear (658.0) against minimum (217.0) in case of control plot.

Onasanya *et al.* (2009) conducted an experiment to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. The results of the study revealed that, application of 120 kg N ha^{-1} + 40 kg P ha^{-1} (T_{11}) produced the maximum number of grains per ear which was significantly different from all other treatments. The minimum number of grains per ear was obtained in the control (T_1). Grain number varied from 262.28 in the control to 497.30 in T_{11} (120 kg N ha^{-1} + 40 kg P ha^{-1}), respectively.

Kumar *et al*. (2007) conducted a field experiment at Main Agricultural Research Station, Agriculture College, Dharwad, during 2002-03 to study the fertilizer requirement of sweet corn grown on Vertisols of zone-8 of Karnataka. The experiment was laid out in Randomized Block Design (RCBD) with three replications. Recommended disease of fertilizer (RDF) of grain maize was (150:75:37.5 kg ha^{-1} NPK, respectively). Treatment were consisting of varying levels of N, P and K, to study the effect of N, P and K levels on sweet corn. The nutrient levels were, three levels of N (100%, 75% and 50% RDN of grain maize), two P levels (100% and 75% RDP of grain maize) and three K levels (75%, 100% and125% RDK of grain maize) and totally 18 different treatment combinations were laid out. They reported that, the treatment receiving 100% RDN irrespective of levels of P and K (T_1, T_4, T_7, T_{10}, T_{13} and T_{16}) recorded higher number of grains per cob and were on par with each other. The highest number of grains per cob was observed in T_{13} (583.00), which was significantly higher than T_{12} which received 50% RDN + 75% RDP + 75% RDK (420.66).

1000 grain weight

Seidel *et al*. (2016) conducted a study aimed to evaluate production components, yield of maize intercropped with jack bean and soil resistance to penetration using different doses of gypsum. The experimental design was a randomized complete block design in split plots with four replications and was carried out during season 2013/2014. The main plots were maize intercropped with jack beans and maize sown alone, and the subplots were six doses of gypsum (0, 1, 2, 3, 4, 5 t ha^{-1}).They reported that 1000 grain weight did not significantly influenced by different rate of gypsum. The highest 1000 grain weight (286.34 g) was recorded from 5 t ha^{-1} gypsum and the lowest 1000 grain weight (284.48 g) was recorded from 0 t ha^{-1} gypsum.

Field trials were conducted by Jan *et al.* (2014) during summer 2011-2012 at New Developmental Farm of The University Agriculture, Peshawar, Pakistan to study the effects of soil amendments on yield and yield attributes of maize (*Zea mays* L.) under different irrigation schedule. The field experiments were layout in randomized complete block design having three replications. Two separated filed experiments were maintained. Treatments were randomized in each field. One filed was specified for 6 irrigations while other had 3 irrigations. The treatments consisted of soil amendments (FYM (10 t ha^{-1}), crop residue (wheat straw 10 t ha^{-1}), gypsum (1000 kg ha^{-1}), qemisoyl (10 kg ha^{-1}) and humic acid (12 kg ha^{-1})) were used. The results of the study revealed that, plots treated with FYM at 10 t ha^{-1} produced heavier 1000 grains weight (287.4 g) and statistically at par when plots treated with humic acid, while minimum 1000 grains weight (164.1 g) were recorded in control plots.

Response of maize crop to various NP levels was studied by Mukhtar *et al.* (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. Results showed that, maximum 1000-grain weight (430.00 g) was obtained in 250- 125 kg NP level against minimum (141.8 g) in case of control plot (0-0 kg ha^{-1}).

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. The NPK application @ 250-110-85 kg ha^{-1} produced highest 1000-grain weight (255.92 g). Next to follow were treatment F_2 (175-80-60 NPK kg ha^{-1}) and F_1 (100-50-35 NPK kg ha^{-1}) resulted in 253.18 g and 245.13 g, respectively. The minimum 1000-grain weight (236.90 g) was recorded in treatment from plots receiving no fertilizer.

An experiment was carried out by Onasanya *et al.* (2009) to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. The results of the study revealed that, the treatment T_{11} (120 kg N ha^{-1} + 40 kg P ha^{-1}) produced the maximum 1000-grain weight (265.67 g) which was significantly different from the rest of all the treatments. T_8 (60 kg N ha^{-1} + 40 kg P ha^{-1}) also gave a higher 1000-grain weight over others. The minimum weight of 1000 grains (220.93 g) was obtained in T_1 (control).

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, the highest 100 grain weight (11.62 g) was recorded from the maize plants that received 400 kg ha^{-1} and the lowest 100 grain weight (9.43 g) was recorded from the maize plants that received no fertilizers.

A study was conducted by Msarmo and Mhango (2005) at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, P_2 gave the highest 100 seed weight of 39.35 g followed by P_1 (36.96 g) and then P_3 (34.92 g).

Grain yield

Seidel *et al*. (2016) conducted a study aimed to evaluate production components, yield of maize intercropped with jack bean and soil resistance to penetration using different doses of gypsum. The experimental design was a randomized complete block design in split plots with four replications and was carried out during season 2013/2014. The main plots were maize intercropped with jack beans and maize sown alone, and the subplots were six doses of gypsum (0, 1, 2, 3, 4, 5 t ha^{-1}).They reported that grain yield did not significantly influenced by different rate of gypsum. The highest grain yield (8.24 t ha^{-1}) was recorded from 5 t ha^{-1} gypsum and the lowest grain yield (7.86 t ha^{-1}) was recorded from 0 t ha^{-1} gypsum.

A field nitrogen management trial was conducted by Woldesenbet *et al*. (2016) to know the maximum productivity of Maize response to high nitrogenous fertilization levels, from this perspective, using five N levels (0, 23, 46, 69 and 92 kg N ha^{-1}) with three replications. The study was conducted in 2015 in Decha District, Modyo Gombera Kebele of Kaffa Zone, SNNPR State. The experiment was laid out in RCBD. The result of this study showed that maximum grain yield (7.55 t ha^{-1}) was recorded from 69 kg N ha^{-1} and minimum grain yield was (7.10 t ha^{-1}) obtained from no N application.

Jan *et al*. (2014) conducted field trials during summer 2011-2012 at New Developmental Farm of The University Agriculture, Peshawar, Pakistan to study the effects of soil amendments on yield and yield attributes of maize (*Zea mays* L.) under different irrigation schedule. The field experiments were layout in randomized complete block design having three replications. Two separated filed experiments were maintained. Treatments were randomized in each field. One filed was specified for 6 irrigations while other had 3 irrigations. The treatments consisted of soil amendments (FYM (10 t ha^{-1}), crop residue (wheat straw 10 t ha^{-1}), gypsum (1000 kg ha^{-1}), qemisoyl (10 kg ha^{-1}) and humic acid (12 kg ha^{-1})) were used. The results of the study revealed that, soil amendments had significant effect on grain yield. Plots treated with FYM at 10 t ha^{-1} produced maximum grain yield (3896 kg ha^{-1}) and were statistically at par when plots treated with humic acid, while minimum grain yield (2413 kg ha^{-1}) was recorded in control plots.

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, the highest ear yield (14.6 t ha^{-1}) with husk was recorded at 200 kg N ha^{-1} which was significantly different from other rates and the lowest was found at 0 kg N ha^{-1} (5.7 t ha^{-1}).

Response of maize crop to various NP levels was studied by Mukhtar *et al.* (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. Results revealed that, Maximum grain yield (8.24 t ha^{-1}) was noted in case of NP application of 250-125 kg followed by 300-150 kg NP (7.77 t ha^{-1}). Control plot produced minimum (2.728 t ha^{-1}).

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. Among different treatment, treatment F_3 (250-110-85 NPK kg ha^{-1}) produced maximum grain yield 6.03 t ha^{-1}. However, yield of plots of treatment F_3 did not differ statistically when compared with the yield of treatment F_2 (175-80-60 NPK kg ha^{-1}) which was 5.90 t ha^{-1}. Next to follow was treatment F_1 (100-50-35 NPK kg ha^{-1}) yield (4.53 t ha^{-1}) and the plots without NPK application produced significantly the lowest grain yield (3.25 t ha^{-1}).

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, the highest grain yield (7.95 t ha^{-1}) was recorded from the maize plants that received 400 kg ha^{-1} and the lowest grain yield (3.52 t ha^{-1}) was recorded from the maize plants that received no fertilizers.

An experiment was carried out by Onasanya *et al.* (2009) to evaluate the effect of twelve different rates of nitrogen and phosphorus fertilizers on growth and yield of maize (*Zea mays* L.) in southern Nigeria between June and October, 2007. The results of the study revealed that, application of 120 kg N ha^{-1} +40 kg P ha^{-1} (T_{11}) gave the highest significant (P=0.05) grain yield. This was followed by T_8 (60 kg N ha^{-1} + 40 kg P ha^{-1}). The lowest yield was recorded in the control plot (T_1). The grain yield ranged from 3.08 t ha^{-1} in the control plot (T_1) to 7.13t ha^{-1} in T_{11} (120 kg N ha^{-1} + 40 kg P ha^{-1}).

Kumar *et al*. (2007) conducted a field experiment at Main Agricultural Research Station, Agriculture College, Dharwad, during 2002-03 to study the fertilizer requirement of sweet corn grown on Vertisols of zone-8 of Karnataka. The experiment was laid out in Randomized Block Design (RCBD) with three replications. Recommended disease of fertilizer (RDF) of grain maize was (150:75:37.5 kg ha^{-1} NPK, respectively). Treatment were consisting of varying levels of N, P and K, to study the effect of N, P and K levels on sweet corn. The nutrient levels were, three levels of N (100%, 75% and 50% RDN of grain maize), two P levels (100% and 75% RDP of grain maize) and three K levels (75%, 100% and125% RDK of grain maize) and totally 18 different treatment combinations were laid out. The results of fresh cob yield revealed that cob yield of sweet corn varied with varying fertilizer levels. The treatments which received 100% RDN, irrespective of P and K levels (T_1, T_4, T_7, T_{10}, T_{13} and T_{16}) recorded higher yields of fresh cob than other treatments, the highest cob yield was recorded in T_{13} which received 100% RDN + 100% RDP + 125% RDK (13.72 t ha^{-1}), on the other hand the lowest one was fond in T_{12} which received 50% RDN + 75% RDP + 75% RDK (9.48 t ha^{-1}).

Msarmo and Mhango (2005) conducted a field experiment at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, a combination of 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2 gave the highest grain yield of 6291 kg ha-^{1}. P_1 which was a combination of (100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing) was the second with 5422 kg ha^{-1} and lastly P_3 which was a combination of 100 kg ha^{-1} as basal and 150 ka ha^{-1} urea as top dressing gave the lowest grain yield (4891 kg ha^{-1}).

Stover yield

Law-ogbomoa and Law-ogbomo (2009) conducted field trials to estimate the effect of NPK 15:15:15 fertilizer on the growth and yield of maize which were conducted over a two year period. Field trials were carried at Teaching and Research Farms, Benson Idahosa University, Benin City (5004´ N and 5045´ E) between March and June in 2005 and 2006. The trials were laid down in a randomized complete block design. The treatments included four NPK fertilizer rates viz. 0 (0 kg + 0 kg P + 0 kg K), 200 (30 kg + 13.58 kg P + 24.90 kg K), 400 (60 kg + 27.16 kg P + 49.80 kg K) and 600 (90 kg + 40.70 kg P + 74.70 kg K) kg ha^{-1} of compound fertilizer. The results of the trials revealed that, the highest stover yield (10.36 t ha^{-1}) was recorded from the maize plants that received 600 kg ha^{-1} and the lowest stover yield (4.82 t ha^{-1}) was recorded from the maize plants that received no fertilizers.

Kumar *et al*. (2007) conducted a field experiment at Main Agricultural Research Station, Agriculture College, Dharwad, during 2002-03 to study the fertilizer requirement of sweet corn grown on Vertisols of zone-8 of Karnataka. The experiment was laid out in Randomized Block Design (RCBD) with three replications. Recommended disease of fertilizer (RDF) of grain maize was (150:75:37.5 kg ha^{-1} NPK, respectively). Treatment were consisting of varying levels of N, P and K, to study the effect of N, P and K levels on sweet corn. The nutrient levels were, three levels of N (100%, 75% and 50% RDN of grain maize), two P levels (100% and 75% RDP of grain maize) and three K levels (75%, 100% and125% RDK of grain maize) and totally 18 different treatment combinations were laid out. They reported that, The treatments which received 100% RDN (T_1, T_4, T_7, T_{10}, T_{13} and T_{16}) accounted for higher stover yield than other treatments, the highest being in case of T_{13} which received 100% RDN + 100% RDP + 125% RDK (12.70, 71.04 and 81.40 q ha^{-1} at 30, 60 DAS and at harvest, respectively). The treatment which received only 50% RDN + 75% RDP + 75% RDK recorded the lowest stover (10.22, 58.06 and 68.33 q ha^{-1} at 30, 60 DAS and at harvest, respectively).

Msarmo and Mhango (2005) conducted a study at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, a combination of 100 kg ha^{-1} urea as basal and 150 kg ha^{-1} urea as top dressing (P_3 gave the highest biomass yield of 16500 kg ha^{-1} and P_1 which was a combination of 100 kg ha^{-1} as basal and 100 ka ha^{-1} urea as top dressing gave the lowest biomass yield (12980 kg ha^{-1}).

Biological yield

A study was conducted by Asghar *et al.* (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. Among different NPK levels treatment F_3 (250-110-85 NPK kg ha^{-1}) gave more biological yield (16.83 t ha^{-1}) as compared to rest of the treatments. Treatment F_3 was however, statistically at par with treatment F_2 (175-80-60 NPK kg ha^{-1}) (16.23 t ha^{-1}). Next to follow was the treatment F_1 (100-50-35 NPK kg ha^{-1}) (13.69 t ha^{-1}) and minimum biological yield was produced in treatment F_0 (10.81 t ha^{-1}).

Harvest index

Jan *et al.* (2014) conducted field trials during summer 2011-2012 at New Developmental Farm of The University Agriculture, Peshawar, Pakistan to study the effects of soil amendments on yield and yield attributes of maize (*Zea mays* L.) under different irrigation schedule. The field experiments were layout in randomized complete block design having three replications. Two separated filed experiments were maintained. Treatments were randomized in each field. One filed was specified for 6 irrigations while other had 3 irrigations. The treatments consisted of soil amendments (FYM (10 t ha^{-1}), crop residue (wheat straw 10 t ha^{-1}), gypsum (1000 kg ha^{-1}), qemisoyl (10 kg ha^{-1}) and humic acid (12 kg ha^{-1})) were used. The results of the study revealed that, soil amendments had significant effect on harvest index. Plots treated with FYM at 10 t ha^{-1} had maximum harvest index (28.4 %) as compared with control (25.3 %).

A study was conducted by Asghar *et al*. (2010) to investigate the effect of different NPK rates on growth and yield of maize cultivars; Golden and Sultan. The experiment was laid out in a randomized complete block design (factorial) with three blocks. Among different treatments, treatment F_2 (175-80-60 NPK kg ha^{-1}) resulted in more harvest index (36.47%) but this treatment is statistically at par with treatment F_3 (250-110-85 NPK kg ha^{-1}) harvest index (35.96%), treatment F_3 is also statistically similar to treatment F_1(100-50-35 NPK kg ha^{-1}) harvest index (33.19%). Similarly, treatment F_1 is statistically at par with treatment F_0 results (30.25%).

2.3 Combined effect of different varieties and levels of fertilizer management

Plant height

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, the tallest plant (205.23 cm) was obtained from Shuvra at 200 kg N ha^{-1} and the shortest (98.75 cm) from BARI sweet corn-1 at 0 kg N ha^{-1}.

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, interaction of Hybrid x NP fertilizer was non-significant for plant height. The highest plant height (234.67 cm) was recorded from interaction of YH-1921 x 300-150 kg ha^{-1} NP and the lowest plant height (174.33 cm) was recorded from interaction of YH-1921 x 0-0 kg ha^{-1} NP.

Leaf area plant^{-1}

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, Shuvra gave the highest (6.05) LAI values with 200 kg N ha^{-1} and Khoibhutta gave the lowest (1.95) LAI values with 0 kg N ha^{-1}.

Dry matter plant^{-1}

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, hybrid baby corn-271 had the highest dry matter $plant^{-1}$ (250.59g)with 200 kg N ha^{-1} and the lowest dry matter $plant^{-1}$ (52.67 g) in Khoibhutta with 0 kg N ha^{-1}.

Number of grains ear^{-1}

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, interaction of Hybrid x NP fertilizer was significant number of grains ear^{-1}. The highest number of grains ear^{-1} (714.0) was recorded from interaction of YH-1921 x 250-125 kg ha^{-1} NP and the lowest number of grains ear^{-1} (227.0) was recorded from interaction of YH-1921 x 0-0 kg ha^{-1} NP.

1000 grain weight

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, interaction of Hybrid x NP fertilizer was significant for1000 grain weight. The highest 1000 grain weight (460.0 g) was recorded from interaction of YH-1898 x 250-125 kg ha^{-1} NP and the lowest 1000 grain weight (128.0 g) was recorded from interaction of YH-1921 x 0-0 kg ha^{-1} NP.

Grain yield

Four baby corn varieties viz. Hybrid baby corn-271, Shuvra, Khoibhutta and BARI sweet corn-1 were planted by Asaduzzaman *et al*. (2014) at five N fertilizer rates viz. 0 kg N ha^{-1} (N_0), 80 kg N ha^{-1} (N_1), 120 kg N ha^{-1} (N_2), 160 kg N ha^{-1} (N_3) and 200 kg N ha^{-1} (N_4) in the experiment to find out the suitable variety and N fertilizer rate for baby corn production. The experiment was carried out at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during *rabi* season of 2008-09. They observed that, the highest baby corn yield (18.04 t ha^{-1}) with husk was recorded in Hybrid baby corn-271 at 200 kg N ha^{-1} and the lowest (4.26 t ha^{-1}) in Shuvra at 0 kg N ha^{-1}.

Response of maize crop to various NP levels was studied by Mukhtar *et al*. (2011) at Maize and Millets Research Institute, Yusafwala, Sahiwal, Pakistan during kharif 2009. Six NP rates (0 - 0, 200-100, 250-125, 300-150, 350-175 and 400-200 kg ha^{-1}) were tried non two maize hybrids (YH-1898 and YH-1921) for growth and yield. They reported that, interaction of Hybrid x NP fertilizer was non-significant for grain yield. The highest grain yield (8.30 t ha^{-1}) was recorded from interaction of YH-1921 x 300-150 kg ha^{-1} NP and the lowest grain yield (2.64 t ha^{-1}) was recorded from interaction of YH-1921 x 0-0 kg ha^{-1} NP.

Harvest index

A study was conducted by Msarmo and Mhango (2005) at Bunda College during the 2003/04 crop season to assess the effect of fertilizer application practices on performance of maize with emphasis on improving the efficiency of using urea as a top dressing fertilizer The treatments were laid out as a split-plot in a randomized complete block design (RCBD) with maize varieties as main plots and fertilizer application practices as subplots. There were three maize varieties and three fertilizer application practices. The maize varieties included local maize, Masika (composite) and DK8031 (hybrid) and the fertilizer application practices were 100 kg ha^{-1} urea as basal and 100 kg ha^{-1} urea as top dressing (P_1), 100 kg ha^{-1} urea as basal and 75 kg ha^{-1} urea as top dressing (P_2) and 100 kg ha^{-1} as basal and 150 kgha^{-1} urea as top dressing (P_3). The result of the study revealed that, P_2 gave the highest harvest index in Masika and DK8031 of 0.49 and 0.50, respectively. This is so because the plants were able to take up the nitrogen from the urea fertilizer which was applied at an early stage and used it for grain formation. However, P_1 and P_2 gave the same harvest index of 0.40 in local maize. P_3 gave the lowest harvest indices in all the maize varieties.

CHAPTER III

MATERIALS AND METHODS

The experiment was undertaken during November, 2015 to April, 2016 to study the effect of variety and fertilizer doses on the growth and yield of 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 Agronomy field of Sher-e-Bangla Agricultural University (SAU). The experimental site is geographically situated at 23°77′ N latitude and 90°33′ E longitude at an altitude of 8.6 meter above sea level. The experimental field belongs to the Agro-ecological zone (AEZ) of “The Modhupur Tract”, AEZ-28. This was a region of complex relief and soils developed over the Modhupur clay, where floodplain sediments buried the dissected edges of the Modhupur Tract leaving small hillocks of red soils as ‘islands’ surrounded by floodplain. For better understanding about the experimental site has been shown in the Map of AEZ of Bangladesh in Appendix-I.

3.2 Climate

The climate of the experimental site was subtropical, characterized by the winter season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October. Meteorological data related to the temperature, relative humidity and rainfall during the experiment period of was collected from Bangladesh Meteorological Department (Climate division), Sher-e-Bangla Nagar, Dhaka and has been presented in Appendix- III.

3.3 Soil

The soil of the experimental field belongs to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon soil series. Soil pH ranges from 5.4-5.6. The land was above flood level and sufficient sunshine was available during the experimental period. Soil samples from 0-15 cm depths were collected from the experimental field. The soil analyses were done at Soil Resource and Development Institute (SRDI), Dhaka. The physicochemical properties of the soil are presented in Appendix II.

3.4 Treatments

The experiment consisted of two factors as mentioned below:

Factor A: Fertilizer doses (5 levels) in the main plot

- F_1 = Recommended dose (100%)*
- F_2 = Below 25% of recommended dose (75%)
- F_3 = Below 50% of recommended dose (50%)
- F_4 = Above 25% of recommended dose (125%) and
- F_5 = Above 50% of recommended dose (150%)

*The recommended dose: The field was fertilized with nitrogen, phosphate, potash, sulphur, zinc and boron at the rate of 500-250-200-250-15-5 kg ha^{-1} of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid respectively (BARI, 2011).

Factor B:

Varieties (V) two levels in the sub plot

- V_1 = KS-510
- V_2 = PSC-121

The treatment combinations are as follows:

F_1V_1, F_1V_2, F_2V_1, F_2V_2, F_3V_1, F_3V_2, F_4V_1, F_4V_2, F_5V_1 and F_5V_2

3.5 Plant materials

Maize cv. KS-510 and PSC-121 were used as plant materials for the present study. These varieties are recommended for Robi season.

The description of the variety is given below:

KS-510

- Identifying character: Double cross hybrid, bold grain quality, stays green at maturity, good crop standibility and drought tolerant.
- Developed by: Proline seed company, India.
- Crop duration: Medium, Maturity period 90-100 Days
- Yield : 7-7.5 t ha^{-1}
- Sowing time: Ideal for kharif season
- Harvesting time: After attaining physiological maturity.

PSC-121

- Identifying character: Double cross hybrid, bold grain quality, stays green at maturity, good crop standibility and drought tolerant.
- Developed by: Proline seed company, India.
- Crop duration: Medium, Maturity period 90-100 Days
- Yield : 7-7.5 t ha^{-1}
- Sowing time: Ideal for kharif season
- Harvesting time: After attaining physiological maturity.

3.6 Layout of the experiment

The experiment was laid out in split-plot design with fertilizer treatment in the main plot and variety in the subplot having 3 replications. The field was divided into 3 blocks to represent 3 replications. There were 30 unit plots altogether in the experiment. The size of each unit plot was 4m × 3m. Row to row and plat to plant distances were 60 cm and 25 cm, respectively. Distance maintained between replication and plots were 1.0m and 0.75m. The treatments were assigned in plot at random. Details layout of the experimental plot has been presented below.

3.7 Crop Management

3.7.1 Seed Collection

Healthy seeds of KS-510 and PSC-121 were collected from a private organization.

3.7.2 Land preparation

The plot selected for the experiment was opened in the last week of November, 2015 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.

3.7.3 Fertilizer application

The recommended doses of fertilizer were 500-250-200-250-15-5 kg ha^{-1} urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid following BARI (2011). The field was fertilized with above mentioned fertilizer as per treatment. The whole amount of all the fertilizers except urea were applied at the time of final land preparation and thoroughly incorporated with soil with the help of a spade. Urea was side dressed in three equal splits on 30, 60 and 90 DAS.

3.7.4 Seed sowing

Seeds of the variety KS-510 and PSC-121 were sown on 30 November, 2015 in lines maintaining a line to line distance of 60 cm and plant to plant distance of 25 cm having 2 seeds $hole^{-1}$ in the well prepared plot.

3.7.5 Intercultural operations

3.7.5.1 Irrigation

First irrigation was given on 14 December, 2015 which was 15 days after sowing. Second irrigation was given on 29 December, 2015 which was 30 days after sowing. Third irrigation was given on 28 January, 2016 which was 60 days after sowing and fourth irrigation was given on 27 February, 2016 which was 90 days after sowing.

3.7.5.2 Gap filling, thinning, and weeding

Gap filling was done on 9 December, 2015 which was 10 days after sowing. During plant growth period one thinning and two weeding were done, thinning was done on 13 December, 2015 which was 14 days after sowing and the weeding was done on 28 December, 2015 and 27 January, 2016 which was 29 and 60 days after sowing, respectively.

3.7.5.3 Earthing up

Earthing up was done on 5 january, 2015 which was 35 days after sowing. It was done to protect the plant from lodging and for better nutrition uptake.

3.7.5.4 Plant protection measures

Insecticides Diazinon 60 EC @ 2 ml litre^{-1} water was sprayed to control Stem borer on 14 February, 22 February and 2 March, 2016 and Ripcord 10 EC @ 2 ml litre^{-1} water were sprayed to control earthworm on 20 and 27 March, 2016 to protect the crop.

3.7.6 Harvesting

The crops 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. Harvesting was done on 25 April, 2016.

3.7.7 Drying

The harvested products were taken on the threshing floor and it was dried for about 3-4 days.

3.8 Collection of data

Data were collected on the following parameters-

A. Crop growth characters

1. Plant height (cm) at 30, 60, 90 days after sowing (DAS) and at harvest
2. No. of leaves plant^{-1} at 30, 60, 90 DAS and at harvest
3. Leaf Area (cm^2) at 30, 60, 90 DAS and at harvest
4. Base diameter (cm) at 60, 90 DAS and at harvest
5. Dry matter weight plant^{-1} (g) at 60, 90 DAS and at harvest

B. Yield contributing characters and yield data

1. Grain rows cob^{-1} (no.)
2. Grains cob^{-1} (no.)
3. Weight of 100 grains (g)
4. Grain yield (t ha^{-1})
5. Stover yield (t ha^{-1})
6. Biological yield (t ha^{-1})
7. Harvest index (%)

3.9 Procedure of recording data

A brief outline on data recording procedure followed during the study is given below:

3.9.1 Plant height at different DAS (30, 60, 90 DAS and at harvest)

At different stages of crop growth (30, 60, 90 DAS and at harvest), the height of five randomly selected plants from the inner rows plot^{-1} was measured from ground level to the tip of the plant portion and the mean value of plant height was recorded in cm.

3.9.2 Number of leaves plant^{-1} at different DAS (30, 60, 90 DAS and at harvest)

At different stages of crop growth (30, 60, 90 DAS and at harvest), the total number of collar leaf of five randomly selected plants from the inner rows plot^{-1} was counted and the mean value of the number of collar leaf was recorded in cm. Dried leaves at the harvesting was not counted while monitoring the leaf number. Only the coller leaves were counted.

3.9.3 Leaf Area at different DAS (30, 60, 90 DAS and at harvest)

Leaf area was estimated manually by counting the total number of leaves per plant and measuring the length and average width of leaf and multiplying by a factor of 0.70 (Keulen and Wolf, 1986). It was done at 30, 60, 90 days after sowing (DAS) and at harvest. Dried leaves at the harvesting was not included while monitoring the leaf area.

$$\text{Leaf area plant}^{-1} = \frac{\text{Surface area of leaf sample } (\text{cm}^2) \times \text{No.of leaves/ plant} \times \text{correction factor}}{\text{No.of leaves sampled}}$$

3.9.4 Base diameter at different DAS (60, 90 DAS and at harvest)

From each plot 3 plants were uprooted randomly. Then the diameter was taken from the base portion of each plant. Then average result was recorded in cm.

3.9.5 Dry matter weight plant^{-1} at different DAS (60, 90 DAS and at harvest)

From each plot 3 plants were uprooted randomly. Then the stem, leaves and roots were separated. The shoot sample (stem and leaves) was sliced into very thin pieces and put into envelop and placed in oven maintaining 70^0 C for 72 hours. Then the shoot sample was transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. It was performed at 60, 90 DAS and at harvest.

3.9.6 Number of grain rows cob^{-1}

Ten cobs from each plot were selected randomly and the number of rows was counted and then the average result was recorded.

3.9.7 Number of grains cob^{-1}

Ten cobs from each plot were selected randomly and the number of grains was counted and then the average result was recorded.

3.9.8 Weight of 100 grains

From the seed stock of each plot 100 seeds were counted and the weight was measured by an electrical balance. It was recorded in gram.

3.9.9 Grain yield (t ha^{-1})

Grain yield was calculated from cleaned and well dried grains collected from the central 1.5 m^2 area of all 2 inner rows of the each plot (leaving two boarder rows) and expressed as t ha^{-1} on 12% moisture basis. Grain moisture content was measured by using a digital moisture tester.

3.9.10 Stover yield (t ha^{-1})

Stover yield was determined from the central 1.5m length of all 2 inner rows of the each plot. After threshing, the sub sample was oven dried to a constant weight and finally converted to t ha^{-1}.

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

It was the total yield including both the economic and stover yield.

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

3.9.12 Harvest index (HI)

Harvest index is the ratio of economic (grain) yield and biological yield. It was calculated by dividing the economic yield grain from the harvested area by the biological yield of the same area and multiplying by 100.

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (t/ ha)}}{\text{Biological yield (t/ ha)}} \times 100$$

3.10 Statistical analysis

The obtained data for different characters were statistically analyzed with the computer based software MSTAT-C to find out feasibility of replacing chemical fertilizer by using organic fertilizer on the performance of maize and the mean values of all characters were evaluated and analysis of variances were performed by the F-test. The significance of the difference among treatment means were estimated by the Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER 4

RESULTS AND DISCUSSION

The experiment was conducted to study the effect on growth and yield of white maize using varies fertilizer doses. Data on different growth, yield contributing characters and yield of maize were recorded. The analyses of variance (ANOVA) of the data on different parameters are presented in Appendix IV-X. The results have been presented and discussed and possible interpretations have been given under the following headings.

4.1 Plant height

4.1.1 Effect of fertilizer doses

Effect of fertilizer doses showed a non-significant variation on plant height for all growth stages of maize except 60 DAS and at harvest (Figure 1). At 60 DAS, F_1 showed the tallest plant (90.72 cm) which was statistically similar with F_4 and F_5; whereas F_3 showed the shortest plant (68.39 cm). At harvest, F_1 showed the tallest plant (184.10 cm); whereas F_2 showed the shortest plant (168.50 cm) which was statistically similar F_4. The increase in plant height with different nitrogen sources can be attributed to the fact that nitrogen promotes plant growth, increases the number and length of the internodes which results in progressive increase in plant height. Similar results were reported by Sharma (1973), Turkhede and Rajendra (1978), Koul (1997), Saigusa *et al.* (1999) and Gasim (2001). However, the remarkable increase in plant height was attained by recommended dose of fertilizer. This result also is in agreement with the finding of Sahid *et al.* (1990), Omara (1989), Bindra and Kharwara (1994), Elmar (2001) and Gader (2007).

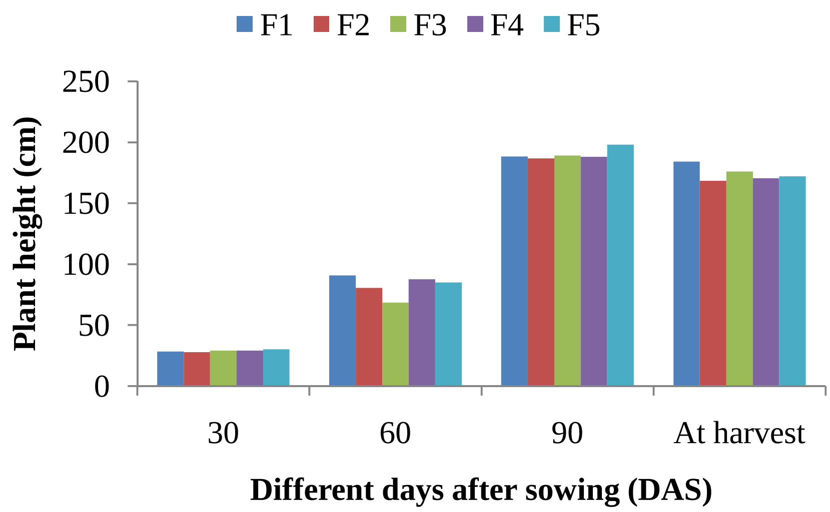

Figure 1. Effect of fertilizer management on the plant height of maize at different days after sowing (LSD $_{(0.05)}$ = NS, 9.39, NS and 3.12 at 30, 60, 90 DAS and at harvest, respectively)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.1.2 Effect of variety

Non-significant difference was observed on the plant height at different growth stages of maize due to variety (Figure 2). Among the varieties, PSC-121 (V_2) showed the tallest plant (29.65 and 83.38 cm at 30 and 60 DAS, respectively) and the shortest plant (187.43 and 172.56 cm at 90 DAS and harvest, respectively); whereas KS-510 (V_1) showed the shortest plant (28.18 and 81.52 cm at 30 and 60 DAS, respectively) and the tallest plant (192.75 and 175.93 cm at 90 DAS and harvest, respectively).

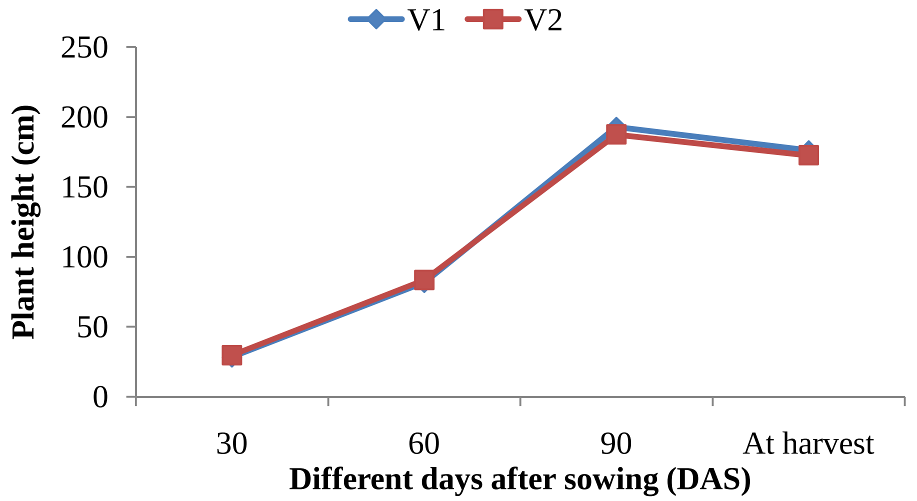

Figure 2. Effect of variety on the plant height of maize at different days after sowing (LSD $_{(0.05)}$ = NS, NS, NS and NS at 30, 60, 90 DAS and at harvest, respectively)

V_1: KS-510 and V_2: PSC-121

4.1.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed an increasing trend with advances of growth period in respect of plant height (Table 1). The rate of increase was much higher in the early stages of growth 30 DAS to 90 DAS. At 30 DAS, V_2F_5 combination showed the tallest plant (32.29 cm) which was statistically similar with F_1V_1, F_4V_1, F_2V_2, F_3V_2 and F_4V_2; whereas F_2V_1combination showed the shortest plant (25.50 cm) which was statistically similar with F_3V_1, F_5V_1, F_1V_2 and F_4V_2. At 60 DAS, F_4V_1 combination showed the tallest plant (94.44 cm) which was statistically similar with F_1V_1, F_5V_1, F_1V_2, F_2V_2 and F_5V_2; whereas F_3V_1 combination showed the shortest plant (64.33 cm) which was statistically similar with F_2V_1 and F_3V_2. At 90 DAS, F_5V_1 combination showed the tallest plant (206.70 cm) which was statistically similar with all other combinations except F_2V_1 and F_4V_2; whereas F_2V_1 combination showed the shortest plant (179.70 cm) which was statistically similar with all other combinations except F_5V_1. At harvest, F_1V_1 combination showed the tallest plant (186.00 cm) which was statistically similar with F_1V_2; whereas F_5V_2 combination showed the shortest plant (164.70 cm) which was statistically similar with F_2V_1. The result was corroborated with Kgasago (2006) who reported significant variation among the varieties of baby corn in terms of plant height. Plant height differed significantly at all growth stages for N-levels. Usually N-fertilizer enhances the growth of a crop plant synthesizing more protein and chlorophyll. This helps to increase the plant height and other growth parameters. Plant height increased significantly with the increase of N-levels was also observed by Singh (2001), Thakur and Sharma (1999) and Thakur *et al.* (1997).

Table 1. Combined effect of variety and fertilizer doses on plant height of maize at different days after sowing

Treatment combinations	Days after sowing (DAS)			
	30	**60**	**90**	**At Harvest**
F_1V_1	29.47 ab	89.43 ab	191.4 ab	186.0 a
F_1V_2	27.12 bc	92.00 ab	185.3 ab	182.3 ab
F_2V_1	25.50 c	71.15 cd	179.7 b	165.1 e
F_2V_2	30.21 ab	89.89 ab	193.9 ab	172.0 d
F_3V_1	28.35 bc	64.33 d	191.9 ab	178.0 bc
F_3V_2	29.78 ab	72.44 cd	186.4 ab	173.9 cd
F_4V_1	29.51 ab	94.44 a	194.0 ab	171.1 d
F_4V_2	28.82 abc	80.78 bc	182.0 b	169.8 d
F_5V_1	28.06 bc	88.22 ab	206.7 a	179.6 b
F_5V_2	32.29 a	81.78 abc	189.5 ab	164.7 e
LSD $_{(0.05)}$	**3.75**	**13.28**	**23.2**	**4.41**
CV (%)	**7.49**	**9.31**	**7.05**	**4.54**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%) V_1: KS-510 and V_2: PSC-121;

4.2 No. of Leaves plant^{-1}

4.2.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation on no. of leaves plant^{-1} of maize at 60 DAS and 90 DAS (Figure 3). At 60 DAS, F_2 showed the highest number of leaves plant^{-1} (5.11) which was statistically similar with F_1, F_4 and F_5; whereas F_3 showed the lowest number of leaves plant^{-1} (4.56). At 90 DAS, F_5 showed the highest number of leaves plant^{-1} (16.17) which was statistically similar with F_4; whereas F_2 showed the lowest number of leaves plant^{-1} (14.44) which was statistically similar with F_1, F_3 and F_4. This is similar to the findings of Woldesenbet *et al*. (2016) who indicated that, there is an increase in number of leaves with an increase in fertilizer level. The increase in the number of leaves per plant could possibly be ascribed to the fact that nitrogen often increases plant growth and plant height and this resulted in more nodes and internodes and subsequently more production of leaves. In this respect, Okajina *et al*. (1983), Sawi (1993) and Jhones *et al*. (1995) found that nitrogen fertilization, significantly increased the number of leaves and they suggested that the increasing in number of leaves may be as a result of increasing number of nodes.

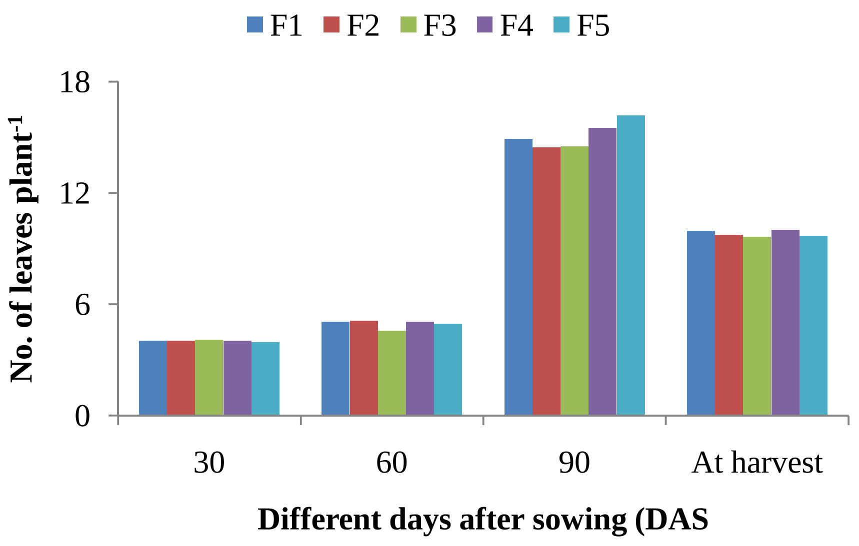

Figure 3. Effect of fertilizer management on the no. of leaves plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = NS, 0.34, 1.08 and NS at 30, 60, 90 DAS and at harvest, respectively)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.2.2 Effect of variety

Non-significant difference was observed on no. of leaves plant^{-1} at different growth stages (Figure 4). Among the varieties, KS-510 (V_1) showed the highest number of leaves plant^{-1} (4.11, 4.98, 15.71 and 9.80 at 30, 60, 90 DAS and at harvest, respectively) and PSC-121 (V_2) showed the lowest number of leaves plant^{-1} (3.92, 4.91, 14.49 and 9.78 at 30, 60, 90 DAS and at harvest, respectively).

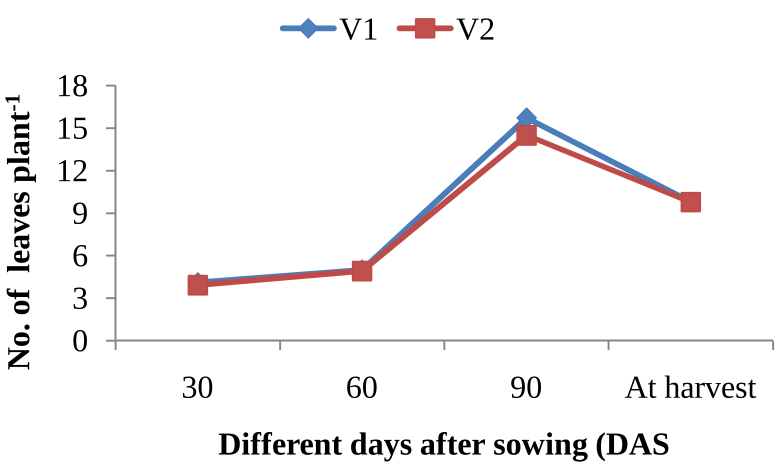

Figure 4. Effect of variety on the no. of leaves plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = NS, NS, NS and NS at 30, 60, 90 DAS and at harvest, respectively)

V_1: KS-510 and V_2: PSC-121

4.2.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed an increasing trend with advances of growth period in respect of no. of leaves plant^{-1} (Table 2). The rate of increase was much higher in the early stages of growth 60 DAS to 90 DAS. After that the rate was decreasing up to harvest. At 30 DAS, the highest number of leaves plant^{-1} (4.37) was observed in F_3V_1 which was statistically similar with all other combinations except F_3V_2 and F_5V_2; whereas the lowest number of leaves plant^{-1} (3.77) was observed in F_5V_2 which was statistically similar with all other combinations except F_3V_1. At 60 DAS, the highest number of leaves plant^{-1} (5.22) was observed in F_1V_1 and F_2 V_2which was statistically similar with all other combinations except F_3V_1 and F_3V_2; whereas the lowest number of leaves plant^{-1} (4.56) was observed in F_3V_1 and F_3V_2which was statistically similar with all other combinations except F_1V_1, F_4V_1 and F_2V_2. At 90 DAS, the highest number of leaves plant^{-1} (17.22) was observed in F_5V_1 which was statistically similar with $F_1V_1$and F_4V_1; whereas the lowest number of leaves plant^{-1} (13.67) was observed in F_1V_2 which was statistically similar with all other combinations except F_1V_1, F_3V_1, F_4V_1 and F_5V_1. At harvest, the highest number of leaves plant^{-1} (10.44) was observed in F_1V_1 which was statistically similar with all other combinations except F_2V_1, F_5V_1, F_1V_2 and F_3V_2; whereas the lowest number of leaves plant^{-1} (9.44) was observed in F_2V_1 which was statistically similar with all other combinations except F_1V_1.

Table 2. Combined effect of variety and fertilizer doses on no. of leaves plant^{-1} of maize at different days after sowing

Treatment combinations	Days after sowing (DAS)			
	30	60	90	At Harvest
F_1V_1	4.20 ab	5.22 a	16.11 ab	10.44 a
F_1V_2	3.83 ab	4.89 ab	13.67 d	9.45 b
F_2V_1	3.83 ab	5.00 ab	13.89 cd	9.44 b
F_2V_2	4.20 ab	5.22 a	15.00 b-d	10.00 ab
F_3V_1	4.37 a	4.56 b	15.22 bc	9.78 ab
F_3V_2	3.80 b	4.56 b	13.78 cd	9.45 b
F_4V_1	4.033 ab	5.11 a	16.11 ab	9.78 ab
F_4V_2	4.00 ab	5.00 ab	14.89 b-d	10.22 ab
F_5V_1	4.10 ab	5.00 ab	17.22 a	9.56 b
F_5V_2	3.77 b	4.89 ab	15.11 b-d	9.78 ab
LSD $_{(0.05)}$	**0.55**	**0.48**	**1.52**	**0.85**
CV (%)	**7.84**	**5.59**	**5.83**	**5.01**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

4.3 Leaf Area Plant^{-1} (cm^2)

4.3.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation on leaf area plant^{-1}of maize (Figure 5). At 30 DAS, F_4 showed the maximum leaf area plant^{-1} (252.5 cm^2) which was statistically similar with F_5; whereas F_2 showed the minimum leaf area plant^{-1} (180.4 cm^2) which was statistically similar with F_1. At 60 DAS, F_1 showed the maximum leaf area plant^{-1} (635.8 cm^2) which was statistically similar with F_4 and F_5; whereas F_3 showed the minimum leaf area plant^{-1} (326.8 cm^2). At 90 DAS, F_5 showed the maximum leaf area plant^{-1} (3593 cm^2) which was statistically similar with F_1 and F_4; whereas F_3 showed the minimum leaf area plant^{-1} (2701 cm^2) which was statistically similar with F_2. At harvest, F_1 showed the maximum leaf area plant^{-1} (2857 cm^2); whereas F_4 showed the minimum leaf area plant^{-1} (2311 cm^2) which was statistically similar with all other treatment except F_1. This is similar to the findings of Asaduzzaman *et al*. (2014), Athar *et al.* (2012), Onasanya *et al.* (2009) and Kumar *et al*. (2007) who found that the leaf area of maize were also influenced favorably with increasing levels of NPK application.

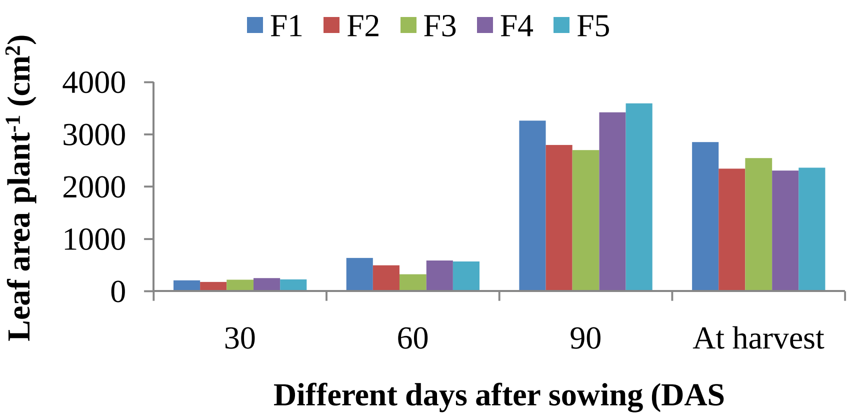

Figure 5. Effect of fertilizer management on the leaf area plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = 26.35, 69.2, 417.2 and 303 at 30, 60, 90 DAS and at harvest, respectively)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.3.2 Effect of variety

Maize variety exhibited significant difference on leaf area plant^{-1} at 90 DAS (Figure 6). At 90 DAS, V_1 and V_2 showed the highest (3873.98 cm^2) and lowest (2439.69 cm^2) leaf area plant^{-1}, respectively. This is similar to the findings of Asaduzzaman *et al*. (2014), Enujeke (2013a) and Shafi *et al.* (2012). The differences observed in leaf area of the varieties of maize sown could be attributed to the differences in leaf arrangement, photosynthetic activities of leaves, differences in chlorophyll content and activity of photosynthetic enzymes. This is similar to the findings of Gwizdek (1989) who attributed the differences between the leaf area and other growth characters of maize genotypes to differences in photosynthetic activity of leaves, leaf arrangement, chlorophyll content, stomatal conductance value and activity of photosynthetic enzymes. The differences observed in leaf area is also similar to the findings of Akinfoesoye *et al*., (1997); Odeleye and Odeleye (2001) who suggested that since maize varieties differ in leaf area, other growth characters as well as in yield and its components, breeders must select most promising combiners in their breeding programs.

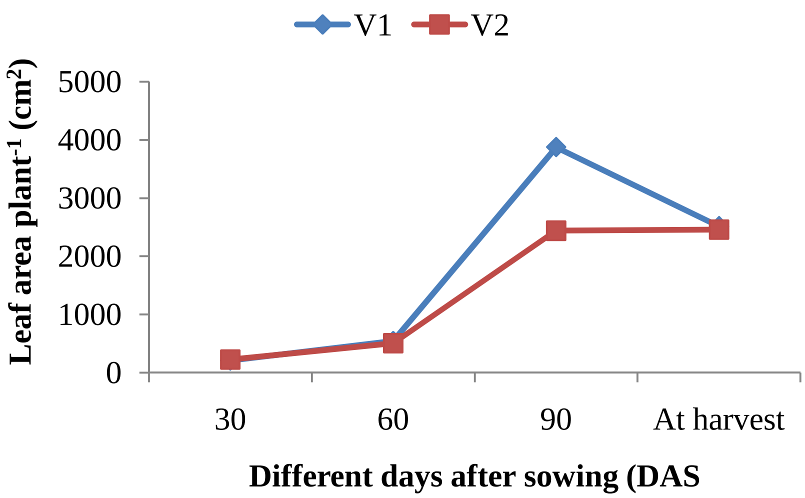

Figure 6. Effect of variety on the leaf area plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = NS, NS, 297.29 and NS at 30, 60, 90 DAS and at harvest, respectively)

V_1: KS-510 and V_2: PSC-121

4.3.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation with advances of growth period in respect of leaf area plant^{-1} (Table 3). At 30 DAS, the maximum leaf area plant^{-1} (255.0 cm^2) was observed in F_4V_1 which was statistically similar with F_5V_1, F_3V_2, F_4V_2 and F_5V_2; whereas the minimum leaf area plant^{-1} (155.3 cm^2) was observed in F_2V_1. At 60 DAS, the maximum leaf area plant^{-1} (754.6 cm^2) was observed in F_4V_1 which was statistically similar with F_1V_1; whereas the minimum leaf area plant^{-1} (297.6 cm^2) was observed in F_3V_1 which was statistically similar with F_2V_1 and F_3V_2. At 90 DAS, the maximum leaf area (4668 cm^2) was observed in F_5V_1 and the minimum leaf area plant^{-1} (2086 cm^2) was observed in F_3V_2 which was statistically similar with F_1V_2, F_2V_2 and F_5V_2. At harvest, the maximum leaf area plant^{-1} (3057 cm^2) was observed in F_1V_1 which was statistically similar with F_3V_1, F_1V_2 and F_2V_2; whereas the minimum leaf area plant^{-1} (2044 cm^2) was observed in F_2 V_1which was statistically similar with F_4V_1, F_5V_1, F_3 $V_2$and F_4V_2. Thakur *et al*. (1997) studied the response of baby corn to different levels of nitrogen and found that growth parameters viz., plant height, leaf area and dry matter accumulation were increased with increasing levels of nitrogen application.

Table 3. Combined effect of variety and fertilizer doses on leaf area plant^{-1} of maize at different days after sowing

Treatment combinations	Days after sowing (DAS)			
	30	60	90	At Harvest
F_1V_1	202.9 b	695.7 ab	3950 b	3057 a
F_1V_2	208.2 b	576.0 c	2577 de	2657 a-c
F_2V_1	155.3 c	377.4 de	3318 c	2044 e
F_2V_2	205.6 b	615.8 bc	2284 de	2653 a-c
F_3V_1	210.0 b	297.6 e	3316 c	2862 ab
F_3V_2	234.1 ab	356.0 de	2086 e	2240 c-e
F_4V_1	255.0 a	754.6 a	4118 ab	2443 b-e
F_4V_2	250.1 a	425.2 d	2734 cd	2180 de
F_5V_1	228.2 ab	590.8 c	4668 a	2163 de
F_5V_2	230.0 ab	550.6 c	2518 de	2564 b-d
LSD $_{(0.05)}$	**37.27**	**97.86**	**590**	**428.5**
CV (%)	**9.88**	**10.79**	**10.8**	**9.96**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

4.4 Base diameter (cm)

4.4.1 Effect of fertilizer doses

Fertilizer doses showed a non-significant variation on base diameter except 60 DAS (Figure 7). At 60 DAS, F_1 showed the highest base diameter (5.50 cm) which was statistically similar with all other treatments except F_3; whereas F_3 showed the lowest base diameter (4.24 cm) which was statistically different from others.

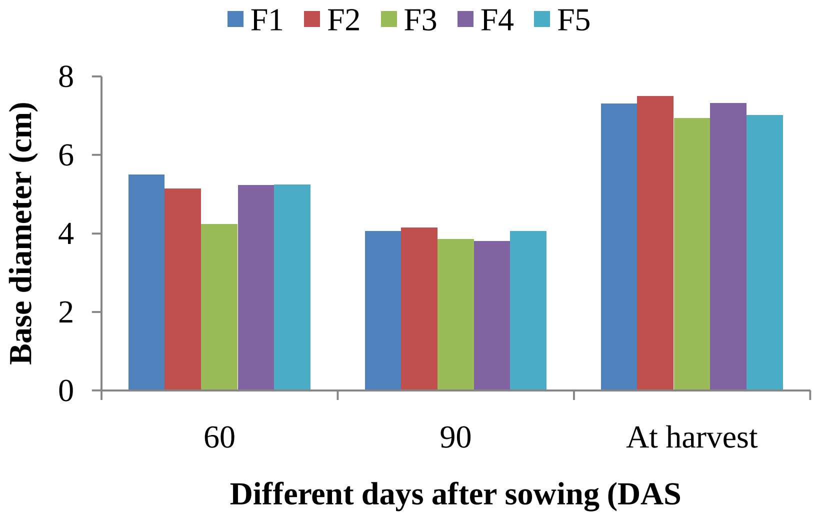

Figure 7. Effect of fertilizer management on the base diameter of maize at different days after sowing (LSD $_{(0.05)}$ = 0.49, NS and NS at 60, 90 DAS and at harvest)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.4.2 Effect of variety

Significant difference was observed on base diameter of maize at 90 DAS (Figure 8). Among the varieties, KS-510 (V_1) showed the highest base diameter (4.17 cm at 90 DAS) and lowest base diameter (3.80 cm at 90 DAS) was observed from PSC-121 (V_2). At 60 DAS and at harvest, non-significant difference was observed on base diameter of maize. This is similar to the findings of Enujeke (2013a), Obi (1999) and Udoh (2005) who reported that some maize varieties have yield advantage because they possess such special qualities as high yield, disease resistance, and early maturity, uniformity in flowering and ear placement, and ease of harvesting using combined harvester.

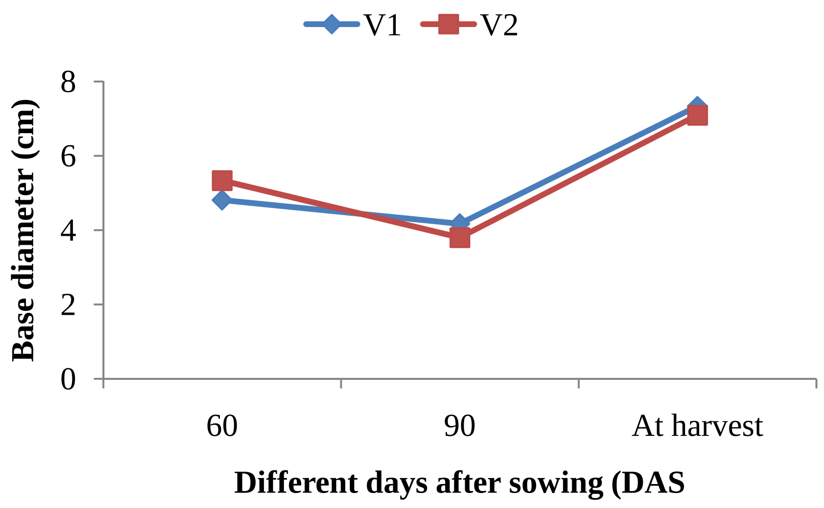

Figure 8. Effect of variety on the base diameter of maize at different days after sowing (LSD $_{(0.05)}$ = NS, 0.31 and NS at 60, 90 DAS and at harvest)

V_1: KS-510 and V_2: PSC-121

4.4.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation with advances of growth period in respect of base diameter (Table 4). At 60 DAS, the maximum base diameter (5.96 cm) was observed in F_2V_2 which was statistically similar with F_4V_1, F_1V_2 and F_5V_2; whereas the minimum base diameter (4.09 cm) was observed in F_3V_1 which was statistically similar with F_2V_1 and F_3V_2. At 90 DAS, the maximum base diameter (4.73 cm) was observed in V_1F_5 which was statistically similar with F_1V_1, F_2V_1 and F_2V_2; whereas the minimum base diameter (3.38 cm) was observed in F_5V_2 which was statistically similar with all other combinations except F_1V_1, F_2V_1 and F_5V_1. At harvest, the maximum base diameter (7.63 cm) was observed in F_2V_1which was statistically similar with all other combinations except F_3V_2 and F_5V_2; whereas the minimum base diameter (6.49 cm) was observed in F_5V_2 which was statistically similar with F_1V_1, F_3V_1, F_4V_1, F_3V_2 and F_4V_2. The increase in stem diameter of maize varieties due to application of nitrogen can be explained by the fact that nitrogen promotes plants growth. On the other hand the increase in stem diameter due to the application of NPK can be ascribed to the presence of sulfur as reported by Elmar (2001). The increase of stem diameter as a result of NPK applications may be due to the fact that, this nitrogen source was composed of many nutrients (N, P and K).

Table 4. Combined effect of variety and fertilizer doses on base diameter of maize at different days after sowing

Treatment combinations	Days after sowing (DAS)		
	60	**90**	**At Harvest**
F_1V_1	5.13 b	4.30 ab	7.06 a-c
F_1V_2	5.87 a	3.81 bc	7.55 ab
F_2V_1	4.31 d	4.24 ab	7.63 a
F_2V_2	5.96 a	4.04 a-c	7.38 ab
F_3V_1	4.09 d	3.70 bc	7.12 a-c
F_3V_2	4.39 cd	4.02 bc	6.76 bc
F_4V_1	5.41 ab	3.86 bc	7.36 a-c
F_4V_2	5.06 bc	3.73 bc	7.28 a-c
F_5V_1	5.0 b	4.73 a	7.53 ab
F_5V_2	5.40 ab	3.38 c	6.49 c
LSD $_{(0.05)}$	**0.70**	**0.71**	**0.87**
CV (%)	**7.93**	**10.25**	**6.94**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

4.5 Dry matter weight plant^{-1} (g)

4.5.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of dry matter weight plant^{-1} through the growth periods (Figure 9). At 30 DAS, F_4 showed the highest dry matter weight plant^{-1} (10.67 g) which was statistically similar with F_1; whereas F_2 showed the lowest dry matter weight plant^{-1} (8.50 g). At 60 DAS, F_1 showed the highest dry matter weight plant^{-1} (57.17 g) which was statistically similar with F_4 and F_5; whereas F_3 showed the lowest dry matter weight plant^{-1} (34.33 g) which was statistically similar with F_2. At 90 DAS, F_4 showed the highest dry matter weight plant^{-1} (139.80 g) which was statistically similar with F_2; whereas F_3 showed the lowest dry matter weight plant^{-1} (113.20 g) which was statistically similar with F_5. At harvest, F_4 showed the highest dry matter weight plant^{-1} (319.30 g) which was statistically similar with F_1 and F_5; whereas F_3 showed the lowest dry matter weight plant^{-1} (272.30 g) which was statistically similar with F_2.

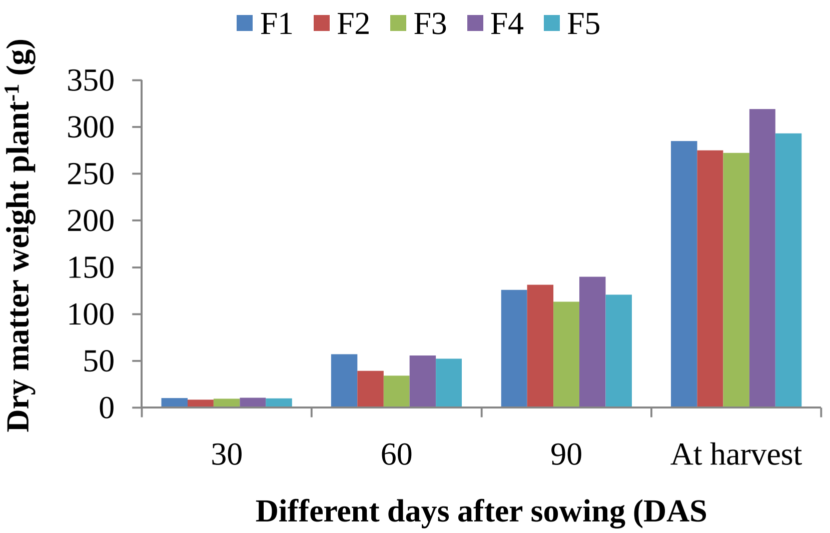

Figure 9. Effect of fertilizer management on the dry matter weight plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = 0.82, 5.32, 10.28 and 34.80 at 30, 60, 90 DAS and at harvest, respectively)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.5.2 Effect of variety

Maize variety exhibited significant difference on dry matter weight plant^{-1} except at harvest (Figure 10). Among the varieties, PSC-121 (V_2) showed the highest dry matter weight plant^{-1} (10.13, 52.20 and 133.27 g at 30, 60 and 90 DAS, respectively) and KS-510 (V_1) showed the lowest dry matter weight plant^{-1} (9.33, 43.47 and 119.27 g at 30, 60 and 90 DAS, respectively). This is similar to the findings of Asaduzzaman *et al*. (2014) who reported that hybrid maize varieties produced the higher dry matter than others.

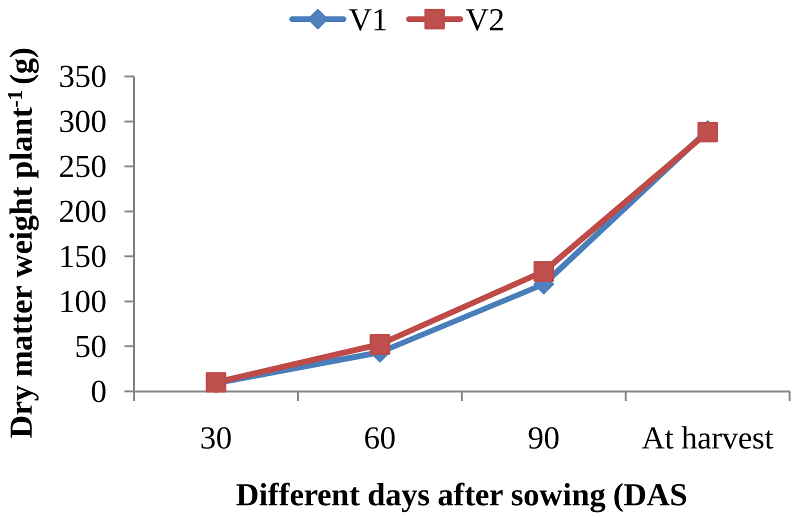

Figure 10. Effect of variety on the dry matter weight plant^{-1} of maize at different days after sowing (LSD $_{(0.05)}$ = 0.66, 2.55, 8.00 and NS at 30, 60, 90 DAS and at harvest, respectively)

V_1: KS-510 and V_2: PSC-121

4.5.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation with advances of growth period in respect of dry matter weight plant^{-1} all the growth stages (Table 5). At 30 DAS, the highest dry matter weight plant^{-1} (10.67 g) was observed in F_4V_2 which was statistically similar with all other combinations except F_2V_1 and F_3V_1; whereas the lowest dry matter weight plant^{-1} (7.33 g) was observed in F_2V_1. At 60 DAS, the highest dry matter weight plant^{-1} (64.33 g) was observed in F_1V_2 which was statistically similar with F_4V_2; whereas the lowest dry matter weight plant^{-1} (28.33 g) was observed in F_3V_1 which was statistically similar with F_2V_1. At 90 DAS, the highest dry matter weight plant^{-1} (145 g) was observed in F_4V_2 which was statistically similar with F_4V_1, F_1V_2 and F_2V_2; whereas the lowest dry matter weight plant^{-1} (100.7 g) was observed in F_3V_1 which was statistically similar with F_1V_1. At harvest, the highest dry matter weight plant^{-1} (342.70 g) was observed in F_4V_2 which was statistically similar with F_1V_1, F_4V_1 and F_5V_2; whereas the lowest dry matter weight plant^{-1} (263.30 g) was observed in F_3V_2 which was statistically at par with all other treatment combination except F_4V_2. This is similar to the findings of Asaduzzaman *et al*. (2014) who reported that hybrid maize varieties with higher fertilizer dose produced the higher dry matter than others.

Table 5. Combined effect of variety and fertilizer doses on dry matter weight plant^{-1} of maize at different days after sowing

Treatment combinations	Days after sowing (DAS)			
	30	**60**	**90**	**At Harvest**
F_1V_1	10.33 a	50.00 bc	111.0 de	307.3 ab
F_1V_2	10.00 a	64.33 a	141.0 a	262.7 b
F_2V_1	7.33 c	30.33 e	125.3 b-d	285.7 b
F_2V_2	9.67 ab	48.33 c	137.7 ab	264.7 b
F_3V_1	8.67 b	28.33 e	100.7 e	281.3 b
F_3V_2	10.33 a	40.33 d	125.7 bc	263.3 b
F_4V_1	10.67 a	54.67 bc	134.7 ab	296.0 ab
F_4V_2	10.67 a	57.00 ab	145.0 a	342.7 a
F_5V_1	9.67 ab	54.00 bc	124.7 b-d	278.7 b
F_5V_2	10.00 a	51.00 bc	117.0 cd	307.7 ab
LSD $_{(0.05)}$	**1.17**	**7.52**	**14.54**	**49.21**
CV (%)	**6.92**	**9.08**	**6.65**	**9.84**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%);F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

4.6 Number of row cob^{-1}

4.6.1 Effect of fertilizer doses

Fertilizer doses showed a non-significant variation in respect of the no. of row cob^{-1} (Figure 11). Among the fertilizer doses, F_2 showed the maximum no. of row cob^{-1} (14.33) and F_4 showed the minimum no. of row cob^{-1} (13.89).

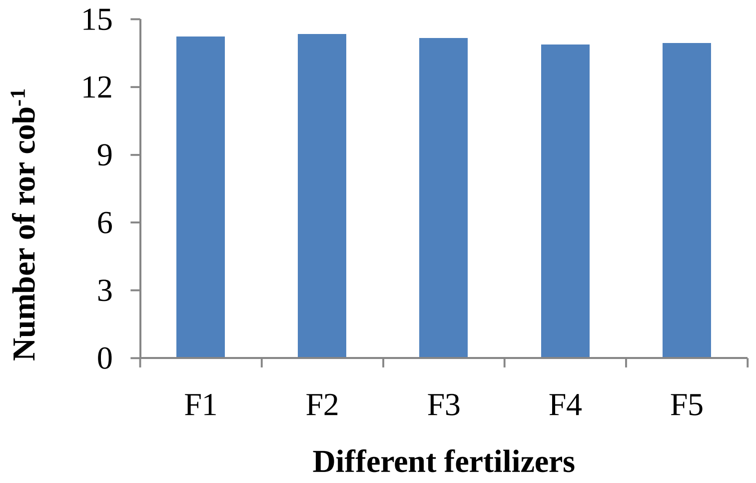

Figure 11. Effect of fertilizer management on the number of row cob^{-1} of maize (LSD $_{(0.05)}$ = NS)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.6.2 Effect of variety

Maize variety exhibited non-significant difference in respect of the no. of row cob^{-1} (Figure 12). Among the varieties, KS-510 (V_1) and PSC-121 (V_2) both showed the similar no. of row cob^{-1} (14.11). This is similar to the findings of Asghar *et al*. (2010) who found that the varieties did not differ significantly for number of row cob^{-1}.

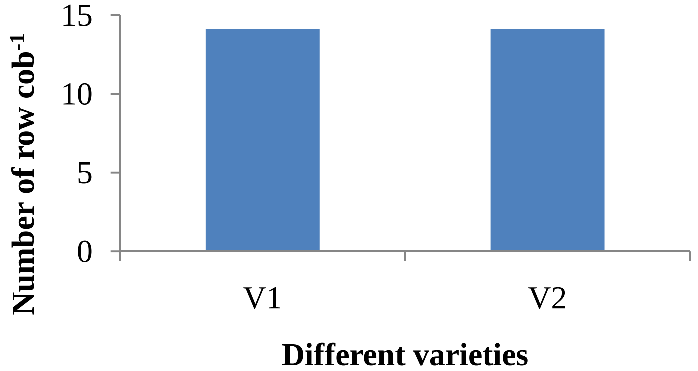

Figure 12. Effect of variety on the number of row cob^{-1} of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.6.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of the no. of row cob^{-1} (Table 6). The maximum no. of row cob^{-1} (15.11) was observed in F_2V_1which was statistically similar with F_1V_1, F_4V_1 F_5V_1, F_1V_2 and F_3V_2; whereas the minimum no. of row cob^{-1} (13.44) was observed in F_3V_1 which was statistically similar with all other combinations except F_2V_1 and F_3V_2.

4.7 Number of grain cob^{-1}

4.7.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of the no. of grain cob^{-1} (Figure 13). Among the fertilizer doses, F_4 showed the maximum no. of grain cob^{-1} (504.30) which was statistically similar with F_1; whereas F_3 showed the minimum no. of grain cob^{-1} (377.50).

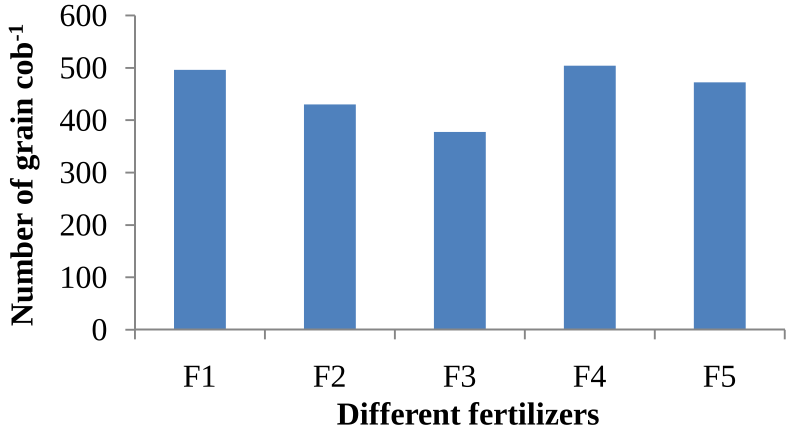

Figure 13. Effect of fertilizer management on the number of grain cob^{-1} of maize (LSD $_{(0.05)}$ = 29.31)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.7.2 Effect of variety

Maize variety exhibited non-significant difference in respect of the no. of grain cob^{-1} (Figure 14). Among the varieties, KS-510 (V_1) showed the minimum no.

of grain cob^{-1} (450.13) and PSC-121 (V_2) showed the maximum no. of grain cob^{-1} (462). This finding was similar to the findings of Mukhtar *et al*. (2011) and Asghar *et al*. (2010). They found that the varieties did not differ significantly for number of grains cob^{-1}. But Enujeke (2013b) and Athar *et al.* (2012) found the different findings who found that the maize variety exhibited significant difference in respect of the no. of grain cob^{-1}.

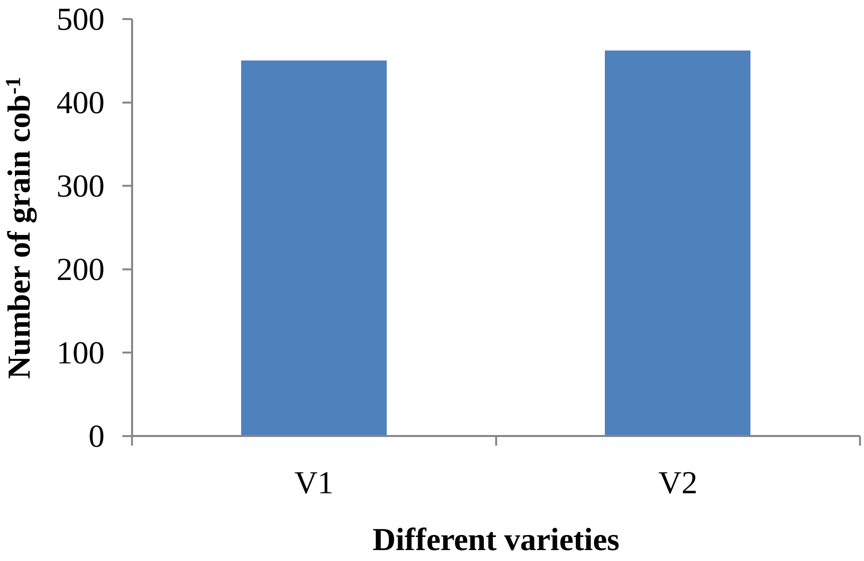

Figure 14. Effect of variety on the grains cob^{-1} of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.7.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of the no. of grains cob^{-1} (Table 6). The maximum no. of grain cob^{-1} (512.0) was observed in F_4V_2 which was statistically similar with all other combinations except F_2V_1, F_3V_1, F_5V_1, F_2V_2 and F_3V_2; whereas the minimum no. of grains cob^{-1} (370.0) was observed in F_3V_1 which was statistically similar with F_3V_2. This is similar to the findings of Mukhtar *et al*. (2011) who found that the maximum no. of grain cob^{-1} from the interaction of Hybrid and higher dose of NP fertilizer.

4.8 100 grain weight (g)

4.8.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of 100 grain weight (Figure 15). Among the fertilizer doses, F_4 showed the maximum 100 grain weight (39.93 g) which was statistically similar with F_1 and F_5; whereas F_3 showed the minimum 100 grain weight (28.83 g). This is similar to the findings of Seidel *et al.* (2016), Jan *et al.* (2014), Mukhtar *et al.* (2011), Asghar *et al.* (2010) and Onasanya *et al.* (2009) who found that the increasing level of fertilizer increases the 100 grain weight of maize.

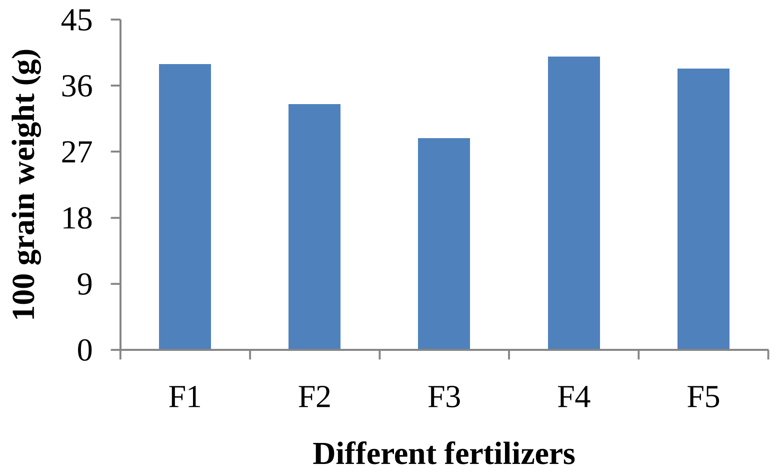

Figure 15. Effect of fertilizer management on the 100 grain weight of maize (LSD $_{(0.05)}$ = 2.25)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.8.2 Effect of variety

Maize variety exhibited a significant difference in respect of 100 grain weight (Figure 16). Among the varieties, PSC-121 (V_2) showed the maximum 100 grain weight (36.78 g) and KS-510 (V_1) showed the minimum 100 grain weight (35.04 g). Mukhtar *et al.* (2011) and Asghar *et al.* (2010) found the different findings as they found that the varieties did not show any difference in producing 100-grain weight.

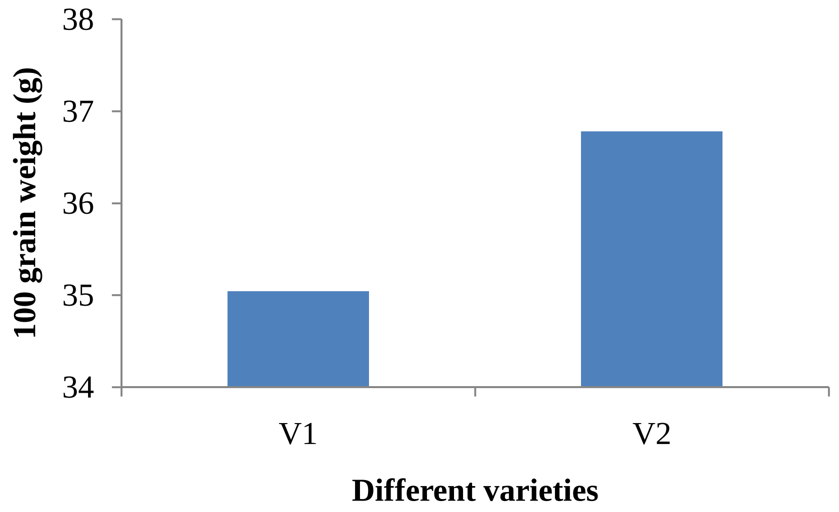

Figure 16. Effect of variety on the 100 grain weight of maize (LSD $_{(0.05)}$ = 1.64)

V_1: KS-510 and V_2: PSC-121

4.8.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of 100 grain weight (Table 6). The maximum 100 grain weight (41.00 g) was observed in F_4V_2 which was statistically similar with F_1V_1, F_4V_1, F_1V_2 and F_5V_2; whereas the minimum 100 grain weight (28.67 g) was observed in F_3V_1 which was statistically similar with F_3V_2. This is similar to the findings of Mukhtar *et al.* (2011) who found that the maximum 100 grain weight from the interaction of Hybrid and higher dose of NP fertilizer.

Table 6. Combined effect of variety and fertilizer doses on row cob^{-1}, grain cob^{-1} and 100 grain weight of maize

Treatment combinations	Row cob^{-1}	Grain cob^{-1}	100 grain weight (g)
F_1V_1	14.00 a-c	483.7 ab	38.00 ab
F_1V_2	14.45 a-c	508.7 ab	39.92 ab
F_2V_1	15.11 a	432.3 c	32.67 d
F_2V_2	13.55 c	427.7 c	34.33 cd
F_3V_1	13.44 c	370.0 d	28.67 e
F_3V_2	14.89 ab	385.0 d	29.00 e
F_4V_1	14.00 a-c	496.7 ab	38.87 ab
F_4V_2	13.78 bc	512.0 a	41.00 a
F_5V_1	14.00 a-c	468.0 bc	37.00 bc
F_5V_2	13.89 bc	476.7 ab	39.67 ab
LSD $_{(0.05)}$	**1.15**	**41.45**	**3.19**
CV (%)	**4.7**	**5.25**	**5.13**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

4.9 Grain yield (t ha^{-1})

4.9.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of grain yield (Figure 17). Among the fertilizer doses, F_4 showed the highest grain yield (7.79 t ha^{-1}) which was statistically similar with F_1 and F_5; whereas F_3 showed the lowest grain yield (4.44 t ha^{-1}). This is similar to the findings of Woldesenbet *et al*. (2016), Jan *et al.* (2014), Asaduzzaman *et al*. (2014), Mukhtar *et al.* (2011), Asghar *et al*. (2010), Onasanya *et al*. (2009) and Kumar *et al*. (2007) who found that the increasing level of fertilizer increases the grain yield due to vegetative and reproductive growth of the crop.

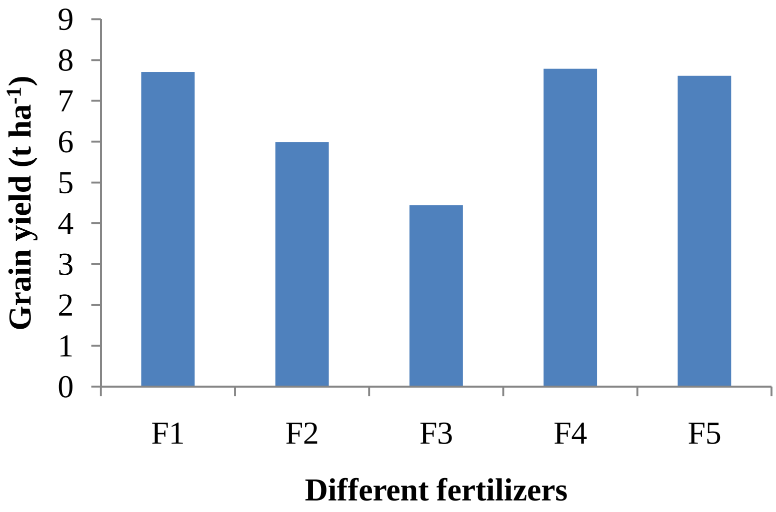

Figure 17. Effect of fertilizer management on the grain yield of maize (LSD $_{(0.05)}$ = 0.51)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.9.2 Effect of variety

Maize variety exhibited non-significant difference in respect of grain yield (Figure 18). Among the varieties, KS-510 (V_1) showed the lowest grain yield (6.56 t ha^{-1}) and PSC-121 (V_2) showed the highest grain yield (6.85 t ha^{-1}).

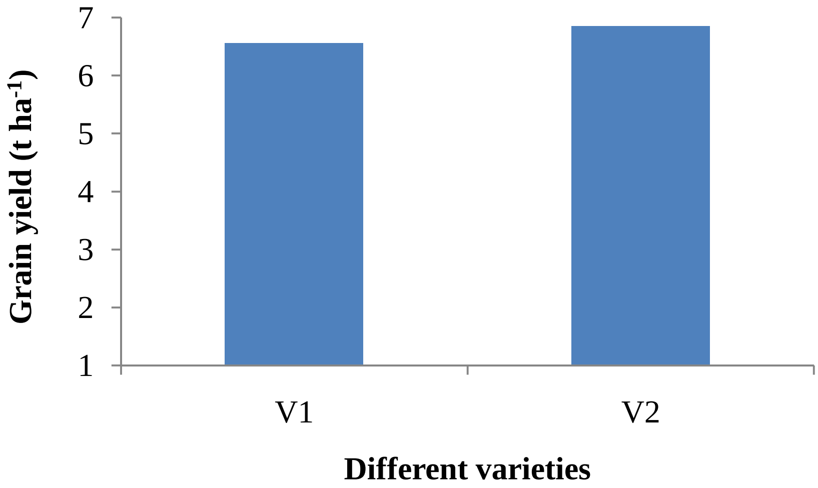

Figure 18. Effect of variety on the grain yield of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.9.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of grain yield (Table 7). The highest grain yield (7.98 t ha^{-1}) was observed in F_4V_2 which was statistically similar with F_1V_1, F_4V_1, F_5V_1, F_1V_2 and F_5V_2; whereas the lowest grain yield (4.40 t ha^{-1}) was observed in F_3V_1 which was statistically similar with F_3V_2. The higher grain yield produced with application of higher nitrogen could be ascribed to its profound influence on vegetative and reproductive growth of the crop. The results of the present investigation are in accordance with findings of Raja (2001), Thakur and Sharma (1999) and Kumar (2009). Thakur *et al*. (1997) studied the response of baby corn to different levels of nitrogen and found that nitrogen fertilization had noticeable influence on crop growth and yield of baby corn.

4.10 Stover yield (t ha^{-1})

4.10.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of stover yield (Figure 19). Among the fertilizer doses, F_4 showed the highest stover yield (13.99 t ha^{-1}) which was statistically similar with F_1 and F_5; whereas F_3 showed the lowest stover yield (7.52 t ha^{-1}) which was statistically distinct from other treatments. This is similar to the findings of Kumar *et al*. (2007) who found that the increasing level of fertilizer increases the stover yield due to vegetative growth of the crop.

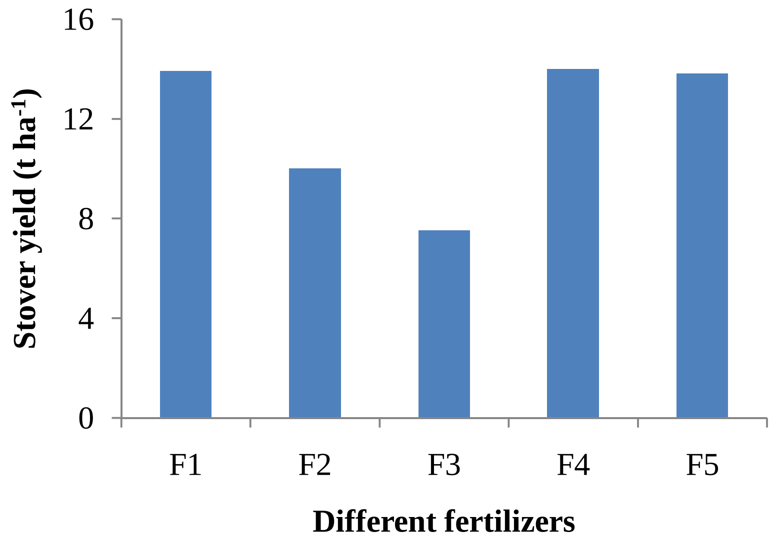

Figure 19. Effect of fertilizer management on the stover yield of maize (LSD $_{(0.05)}$ = 0.99)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.10.2 Effect of variety

Maize variety exhibited non-significant difference in respect of stover yield (Figure 20). Among the varieties, PSC-121 (V_2) showed the highest stover yield (12.06 t ha^{-1}) and KS-510 (V_1) showed the lowest stover yield (11.64 t ha^{-1}).

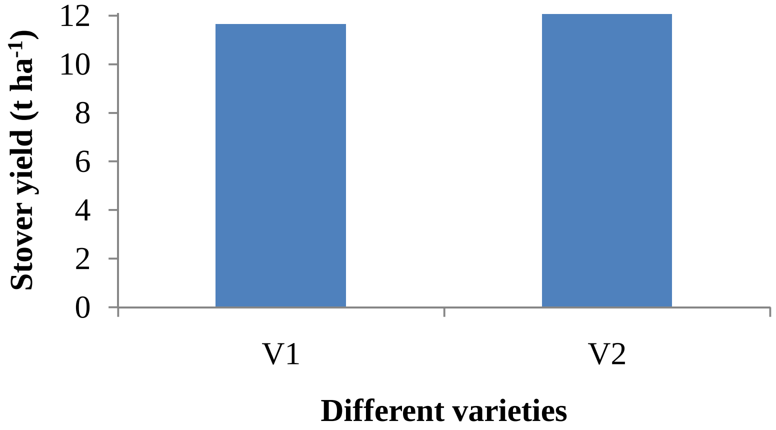

Figure 20. Effect of variety on the stover yield of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.10.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of stover yield (Table 7). The highest stover yield (14.40 t ha^{-1}) was observed in F_4V_2 which was statistically similar with all other combinations except F_2V_1, F_3V_1, F_2V_2 and F_3V_2; whereas the lowest stover yield (7.50 t ha^{-1}) was observed in F_3V_1 which was statistically similar with F_3V_2.

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

4.11.1 Effect of fertilizer doses

Fertilizer doses showed a significant variation in respect of biological yield (Figure 21). Among the fertilizer doses, F_4 showed the highest biological yield (21.78 t ha^{-1}) which was statistically similar with F_1 and F_5; whereas F_3 showed the lowest biological yield (11.96 t ha^{-1}) which was statistically different from others. This is similar to the findings of Asghar *et al.* (2010) who found that the increasing level of fertilizer increases the biological yield.

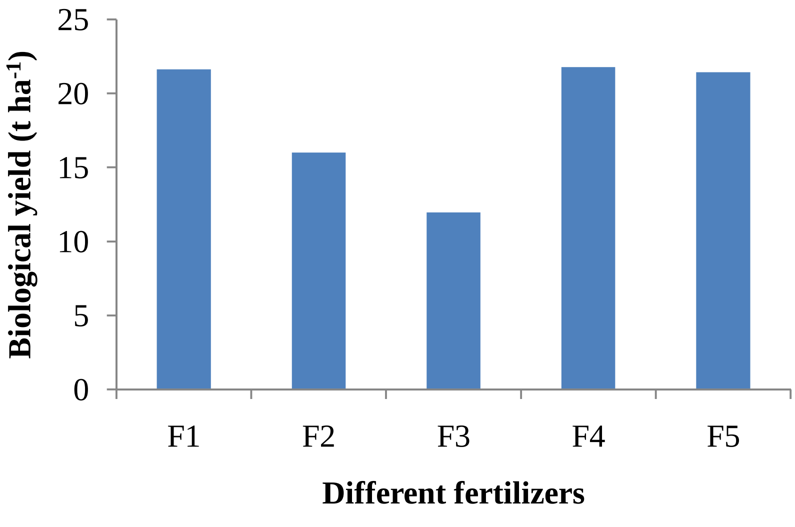

Figure 21. Effect of fertilizer management on the biological yield of maize (LSD $_{(0.05)}$ = 1.05)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.11.2 Effect of variety

Maize variety exhibited significant difference in respect of biological yield (Figure 22). Among the varieties, PSC-121 (V_2) showed the highest biological yield (18.92 t ha^{-1}) and KS-510 (V_1) showed the lowest biological yield (18.20 t ha^{-1}). Asghar *et al*. (2010) found the different findings as the varieties did not show any difference in producing biological yield.

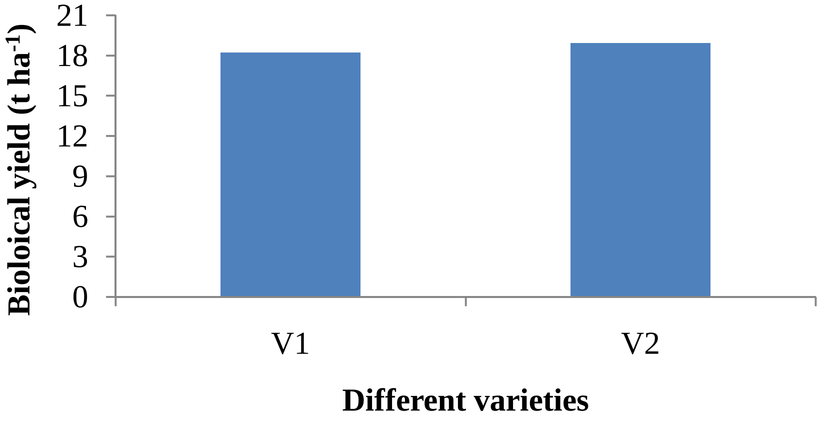

Figure 22. Effect of variety on the biological yield of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.11.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed significant variation in respect of biological yield (Table 7). The highest biological yield (22.38 t ha^{-1}) was observed in F_4V_2 which was statistically similar with all other combinations except F_2V_1, F_3V_1, F_2V_2 and F_3V_2; whereas the lowest biological yield (11.90 t ha^{-1}) was observed in F_3V_1 which was statistically similar with F_3V_2.

4.12 Harvest index (%)

4.12.1 Effect of fertilizer doses

Fertilizer doses showed a non-significant variation in respect of harvest index (Figure 23). Among the fertilizer doses, F_2 showed the highest harvest index (37.52%) and F_5 showed the lowest harvest index (35.55%).

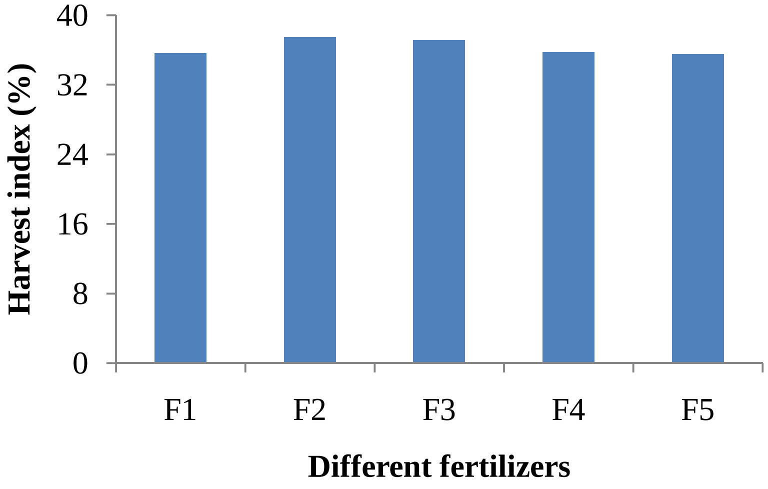

Figure 23. Effect of fertilizer management on the harvest index of maize (LSD $_{(0.05)}$ = NS)

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%)

4.12.2 Effect of variety

Maize variety exhibited non-significant difference in respect of harvest index (Figure 24). Among the varieties, KS-510 (V_1) showed the lowest harvest index (36.26%) and PSC-121 (V_2) showed the highest harvest index (36.41%). This is similar to the findings of Asghar *et al*. (2010) who found that the varieties did not show any difference in producing harvest index.

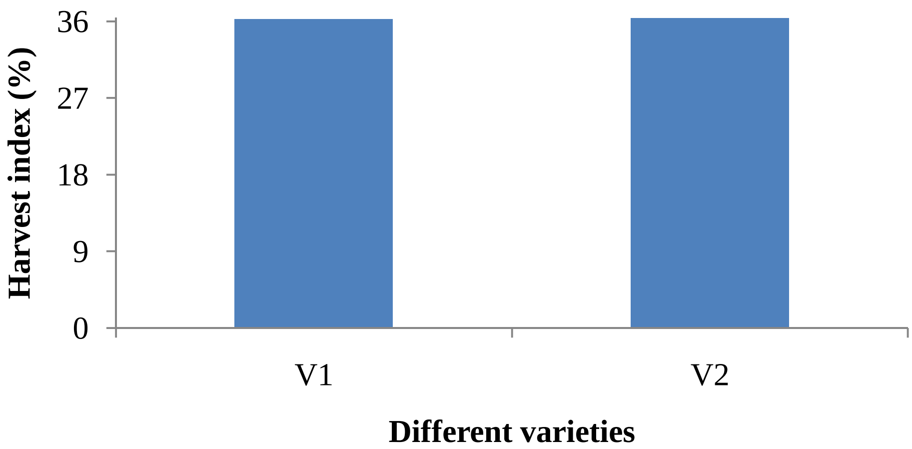

Figure 24. Effect of variety on the harvest index of maize (LSD $_{(0.05)}$ = NS)

V_1: KS-510 and V_2: PSC-121

4.12.3 Combined effect of variety and fertilizer doses

Combined effect of variety and fertilizer doses showed non-significant variation in respect of harvest index (Table 7). The highest harvest index (37.61%) was observed in F_2V_1 and the lowest harvest index (34.73%) was observed in F_5V_1.

Table 7. Combined effect of variety and fertilizer doses on grain yield, stover yield, biological yield and harvest index of maize

Treatment combinations	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
F_1V_1	7.57 a	13.47 a	21.04 a	35.96
F_1V_2	7.85 a	14.36 a	22.21 a	35.35
F_2V_1	5.83 b	9.69 b	15.52 b	37.61
F_2V_2	6.15 b	10.32 b	16.47 b	37.43
F_3V_1	4.40 c	7.50 c	11.90 c	37.09
F_3V_2	4.48 c	7.550 c	12.03 c	37.21
F_4V_1	7.60 a	13.58 a	21.18 a	35.89
F_4V_2	7.98 a	14.40 a	22.38 a	35.66
F_5V_1	7.42 a	13.95 a	21.36 a	34.73
F_5V_2	7.82 a	13.68 a	21.49 a	36.38
LSD $_{(0.05)}$	**0.72**	**1.40**	**1.48**	**NS**
CV (%)	**6.16**	**6.81**	**4.61**	**7.11**

F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%); V_1: KS-510 and V_2: PSC-121

CHAPTER V

SUMMARY AND CONCLUSION

The present research work was conducted at the experimental field of Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2015 to April, 2016 to study the growth and yield of white maize varieties under varing fertilizer doses. The experimental field belongs to the Agro-ecological zone (AEZ) of "The Modhupur Tract", AEZ-28. The soil of the experimental field belongs to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon soil series. The experiment consisted of two factors. Factor A: Fertilizer doses (5 levels); F_1 = Recommended dose (100%); F_2 = Below 25% of recommended dose (75%); F_3 = Below 50% of recommended dose (50%); F_4 = Above 25% of recommended dose (125%) and F_5 = Above 50% of recommended dose (150%) and factor B: Varieties (2 levels); V_1: KS-510 and V_2: PSC-121. The experiment was laid out in split-plot design with three replications where doses of fertilizers were assigned in the main plot and varieties in the sub-plot. There were 10 treatment combinations. The total numbers of unit plots were 30. The size of unit plot was 12 m^2 (4 m × 3 m). The field was fertilized with nitrogen, phosphate, potash, sulphur, zinc and boron at the rate of 500-250-200-250-15-5 kg ha^{-1} of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid respectively.

The collected data were statistically analyzed for evaluation of the treatment effect. Among the varieties, KS-510 (V_1) showed the tallest plant 175.93 cm and highest base diameter 7.34 cm at harvest and PSC-121 (V_2) showed the shortest plant 172.56 cm and lowest base diameter 7.09 cm at harvest. At 90 DAS, V_1 and V_2 showed the highest (15.71) and lowest (14.49) number of leaves $plant^{-1}$; highest (3873.98 cm^2) and lowest (2439.69 cm^2) leaf area $plant^{-1}$, respectively. At harvest, V_1 showed the highest dry matter weight $plant^{-1}$ (289.8 g) and V_2 showed the lowest dry matter weight $plant^{-1}$ (288.2 g). Among the varieties, KS-510 (V_1) and PSC-121 (V_2) both showed the similar no. of row cob^{-1} (14.11). Among the varieties, KS-510 (V_1) showed the minimum no. of grain cob^{-1} (450.13), minimum 100 grain weight (35.04 g), lowest grain yield (6.56 t ha^{-1}), lowest stover yield (11.64 t ha^{-1}), lowest biological yield (18.20 t ha^{-1}) and lowest harvest index (36.26%); whereas PSC-121 (V_2) showed the maximum no. of grain cob^{-1} (462.0), maximum 100 grain weight (36.78 g), highest grain yield (6.85 t ha^{-1}), highest stover yield (12.06 t ha^{-1}), highest biological yield (18.92 t ha^{-1}) and highest harvest index (36.41%).

Among the fertilizer doses, F_1 showed the tallest plant (184.10 cm at harvest) and F_2 showed the shortest plant (168.50 cm at harvest). At 90 DAS, F_5 and F_2 showed the highest (16.17) and lowest (14.44) number of leaves $plant^{-1}$, respectively. At 90 DAS, F_5 showed the maximum leaf area $plant^{-1}$ (3593 cm^2) and F_3 showed the minimum leaf area $plant^{-1}$ (2701 cm^2). At harvest, F_2 showed the highest base diameter (7.51 cm) and F_3 showed the lowest base diameter (6.94 cm). At harvest, F_4 showed the highest dry matter weight $plant^{-1}$ (319.30 g) and F_3 showed the lowest dry matter weight $plant^{-1}$ (272.30 g). Among the fertilizer doses, F_2 showed the maximum no. of row cob^{-1} (14.33) and F_3 showed the minimum no. of grain cob^{-1} (377.50); whereas F_4 showed the minimum no. of row cob^{-1} (13.89) and maximum no. of grain cob^{-1} (504.30). Among the fertilizer doses, F_4 showed the maximum 100 grain weight (39.93 g), highest grain yield (7.79 t ha^{-1}) and highest stover yield (13.99 t ha^{-1}); whereas F_3 showed the minimum 100 grain weight (28.83 g), lowest grain yield (4.44 t ha^{-1}) and lowest stover yield (7.52 t ha^{-1}). Among the fertilizer doses, F_2 showed the highest harvest index (37.52%) and F_5 showed the lowest harvest index (35.55%).

Among the combination of variety and fertilizer doses, F_1V_1 showed the tallest plant (186.00 cm at harvest) and F_5V_2 showed the shortest plant (164.70 cm at harvest). At 90 DAS, the highest number of leaves $plant^{-1}$ (17.22) was observed in F_5V_1 and the lowest number of leaves $plant^{-1}$ (13.67) was observed in F_1V_2. At 90 DAS, the maximum leaf area $plant^{-1}$ (4668 cm^2) was observed in F_5V_1;

whereas the minimum leaf area plant^{-1} (2086 cm^2) was observed in F_3V_2. At harvest, the highest base diameter (7.63 cm) was observed in F_2V_1 and the lowest base diameter (6.49 cm) was observed in F_5V_2. At harvest, the highest dry matter weight plant^{-1} (342.52 g) was observed in F_4V_2 and the lowest dry matter weight plant^{-1} (262.7 g) was observed in F_1V_2. The maximum no. of row cob^{-1} (15.11) was observed in F_2V_1 and the minimum no. of row cob^{-1} (13.44) was observed in F_3V_1. The maximum no. of grain cob^{-1} (512.0) was observed in F_4V_2 and the minimum no. of grain cob^{-1} (370.0) was observed in F_3V_1. The maximum 100 grain weight (41.00 g) was observed in F_4V_2 and the minimum 100 grain weight (28.67 g) was observed in F_3V_1. The highest grain yield (7.98 t ha^{-1}), highest stover yield (14.40 t ha^{-1}) and highest biological yield (22.38 t ha^{-1}) was observed in F_4V_2; whereas the lowest grain yield (4.40 t ha^{-1}), lowest stover yield (7.50 t ha^{-1}) and lowest biological yield (11.90 t ha^{-1}) was observed in F_3V_1. The highest harvest index (37.61%) was observed in F_2V_1 and the lowest harvest index (34.73%) was observed in F_5V_1.

The results in this study indicated that the plants performed better in respect of grain yield in F_4V_2 which statistically showed similarity with F_1V_2. It can be therefore, concluded from the above study that the treatment combination of PSC-121 or KS-510 variety along with recommended fertilizer dose was found to be the most suitable combination for the highest yield of white maize.

To reach a specific conclusion and recommendation, more research work on white maize should be done in different Agro-ecological zones of Bangladesh with this treatment variable.

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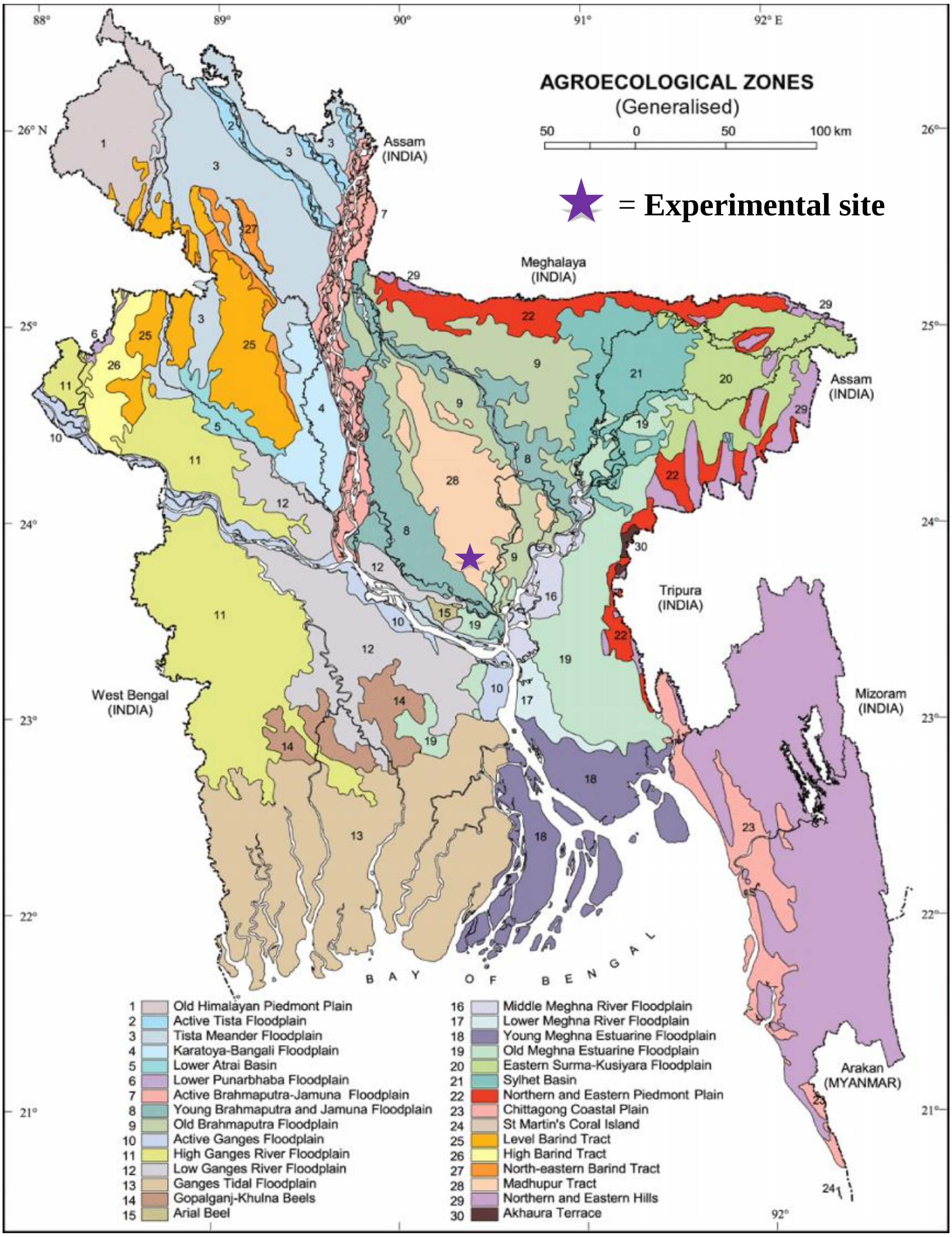
APPENDICES

Appendix I. Map showing the experimental site under study



Appendix II. Characteristics of soil of experimental field

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Sher-e-Bangla Agricultural University Research Farm, Dhaka
AEZ	AEZ-28, Modhupur Tract
General Soil Type	Deep Red Brown Terrace Soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled

B. The initial physical and chemical characteristics of soil of the experimental site (0 - 15 cm depth)

Physical characteristics	
Constituents	**Percent**
Sand	26
Silt	45
Clay	29
Textural class	Silty clay
Chemical characteristics	
Soil characters	**Value**
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total nitrogen (%)	0.03
Available P (ppm)	20.54
Exchangeable K (me/100 g soil)	0.10

Source: Soil Resource and Development Institute (SRDI), Farmgate, Dhaka

Appendix III. Monthly meteorological information during the period from November, 2015 to April, 2016

Year	Month	Air temperature (^0C)		Relative humidity (%)	Total rainfall (mm)
		Maximum	Minimum		
2015	November	28.10	11.83	58.18	47
	December	25.00	9.46	69.53	0
2016	January	25.20	12.80	69	00
	February	27.30	16.90	66	39
	March	31.70	19.20	57	23
	April				

Source: Metrological Centre, Agargaon, Dhaka (Climate Division)

Appendix IV. Analysis of variance of the data on plant height of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square of plant height at different days after sowing			
		30	60	90	At harvest
Replication	2	24.57	2.41	550.22	630.20
Fertilizer doses (A)	1	16.15^{NS}	25.98*	211.90^{NS}	85.18*
Error	2	8.69	42.97	203.76	126.63
Variety (B)	4	4.77^{NS}	454.39^{NS}	124.64^{NS}	228.52^{NS}
Fertilizer doses (A) X Variety (B)	4	14.05*	238.01*	212.25*	91.18*
Error	16	4.69	58.90	179.71	62.50

*Significant at 5% level of significance

^{NS} Non significant

Appendix V. Analysis of variance of the data on no. of leaves plant^{-1}of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square of no. of leaves plant^{-1} at different days after sowing			
		30	60	90	At harvest
Replication	2	0.01	0.40	0.90	0.77
Fertilizer doses (A)	1	0.26^{NS}	0.04*	11.20*	0.004^{NS}
Error	2	0.15	0.18	1.77	0.63
Variety (B)	4	0.02^{NS}	0.30^{NS}	3.19^{NS}	0.18^{NS}
Fertilizer doses (A) X Variety (B)	4	0.20*	0.06*	2.91*	0.62*
Error	16	0.10	0.08	0.77	0.24

*Significant at 5% level of significance

^{NS} Non significant

Appendix VI. Analysis of variance of the data on leaf area plant^{-1}of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square of leaf area plant^{-1} at different days after sowing			
		30	60	90	At harvest
Replication	2	986.14	4355.13	91112.34	11393.39
Fertilizer doses (A)	1	1758.74*	11094.94*	15428966.27*	22606.71*
Error	2	692.14	1147.31	35799.69	126275.59
Variety (B)	4	4344.45^{NS}	88004.17^{NS}	912051.80*	308988.34^{NS}
Fertilizer doses (A) X Variety (B)	4	747.06*	66485.10*	270078.97*	424859.99*
Error	16	463.53	3196.45	116188.63	61278.74

*Significant at 5% level of significance

^{NS} Non significant

Appendix VII. Analysis of variance of the data on base diameter of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square of base diameter at different days after sowing		
		60	90	At harvest
Replication	2	0.47	0.08	1.10
Fertilizer doses (A)	1	2.08*	1.03^{NS}	0.46^{NS}
Error	2	0.31	0.04	0.96
Variety (B)	4	1.41^{NS}	0.13*	0.33^{NS}
Fertilizer doses (A) X Variety (B)	4	0.81*	0.58*	0.46*
Error	16	0.16	0.17	0.25

*Significant at 5% level of significance

^{NS} Non significant

Appendix VIII. Analysis of variance of the data on dry matter weight plant^{-1} of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square of dry matter weight plant^{-1} at different days after sowing			
		30	60	90	At harvest
Replication	2	1.11	6.43	103.23	1703.10
Fertilizer doses (A)	1	4.80*	572.03*	1470.00*	19.20*
Error	2	0.18	2.63	25.90	2155.30
Variety (B)	4	3.97*	641.08*	618.97*	2133.92^{NS}
Fertilizer doses (A) X Variety (B)	4	1.97*	114.95*	323.50*	2162.28*
Error	16	0.45	18.87	70.61	808.33

*Significant at 5% level of significance

^{NS} Non significant

Appendix IX. Analysis of variance of the data on row cob^{-1}, grain cob^{-1}, 100 grain weight and grain yield of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square value			
		Row cob^{-1}	Grain cob^{-1}	100 grain weight	Grain yield
Replication	2	12.75	1303.03	0.21	0.31
Fertilizer doses (A)	1	0.001^{NS}	1056.13*	22.79*	0.63*
Error	2	0.21	1475.43	1.09	0.08
Variety (B)	4	0.21^{NS}	16581.72^{NS}	130.86*	12.99^{NS}
Fertilizer doses (A) X Variety (B)	4	1.79*	179.22*	1.14*	0.03*
Error	16	0.44	572.57	3.39	0.17

*Significant at 5% level of significance

^{NS} Non significant

Appendix X. Analysis of variance of the data on stover yield, biological yield and harvest index of white maize as influenced by combined effect of fertilizer doses and variety

Source of variation	df	Mean square value		
		Stover yield	Biological yield	Harvest index
Replication	2	0.28	0.33	4.93
Fertilizer doses (A)	1	1.36*	3.85*	0.17^{NS}
Error	2	0.15	0.42	0.40
Variety (B)	4	52.24^{NS}	117.13^{NS}	5.18^{NS}
Fertilizer doses (A) X Variety (B)	4	0.39*	0.44*	1.16^{NS}

Error	16	0.65	0.73	6.68

*Significant at 5% level of significance

^{NS} Non significant