INFLUENCE OF POTASSIUM ON THE GROWTH AND YIELD OF HYBRID MAIZE (*Zea mays*) IN KHARIF I

KH. ABDUL BARI

DEPARTMENT OF AGRONOMY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

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INFLUENCE OF POTASSIUM ON THE GROWTH AND YIELD OF HYBRID MAIZE (*Zea mays*) IN KHARIF I

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KH. ABDUL BARI

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Approved by:

_____	_____
Prof. Dr. Md. Abdullahil Baque	**Prof. Dr. Mirza Hasanuzzaman**
Supervisor	**Co-Supervisor**

_____

Prof. Dr. Tuhin Suvra Roy

Chairman

Examination Committee

DEPARTMENT OF AGRONOMY
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar
Dhaka-1207

CERTIFICATE

*This is to certify that thesis entitled, "**INFLUENCE OF POTASSIUM ON THE GROWTH AND YIELD OF HYBRID MAIZE (Zea mays) IN KHARIF I**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (M.S.) in AGRONOMY**, embodies the result of a piece of bona-fide research work carried out by **KH. ABDUL BARI**, Registration no. **18-09198** under my supervision and guidance. No part of the th esis 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.

Date:

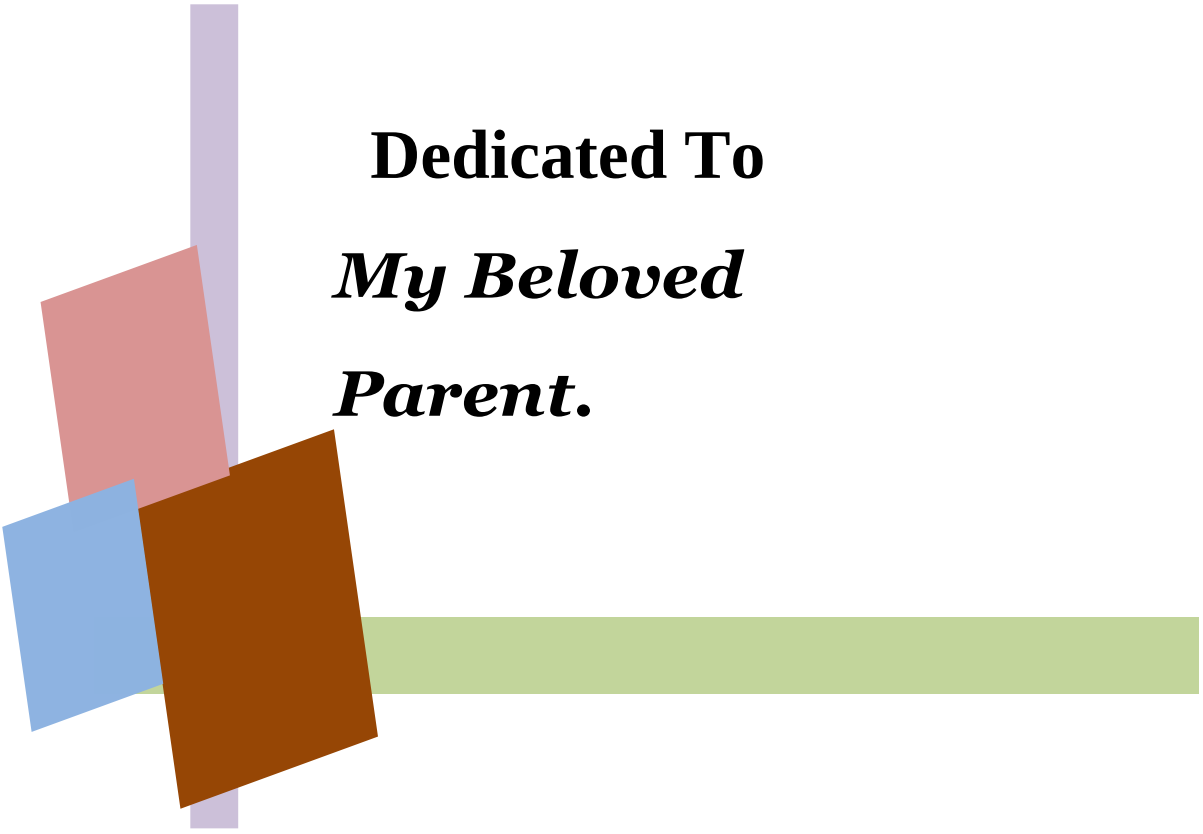
Place: Dhaka, Bangladesh

Prof. Dr. Md. Abdullahil Baque
Department of Agronomy
Sher-e-Bangla Agricultural
University,
Dhaka-1207

Dedicated To

My Beloved

Parent.



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ABSTRACT

An experiment was conducted at Sher-e-Bangla Agricultural University farm, Dhaka to study the influence of potassium on the growth and yield of hybrid maize during April to July, 2019. The experiment consisted of two factors. Factor A: Maize hybrid variety (2); V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2 and B: Potassium levels (6); K_0: Control, K_1: 60 kg K ha^{-1} + Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF. The experiment was laid out in Split Plot Design with three replications. Plant height, dry matter weight $plant^{-1}$, number of leaves $plant^{-1}$, leaf area $plant^{-1}$, dry matter weight $plant^{-1}$,growth rate $plant^{-1}$, cob length $plant^{-1}$, cob circumference $plant^{-1}$,number of grains row cob^{-1}, number of grains row^{-1}, number of grains cob^{-1}, unfilled area cob^{-1} (%), 1000 grain weight, husk weight cob^{-1}, shell weight cob^{-1}, grain weight cob^{-1}, cob weight $plant^{-1}$, grain yield, stover yield, biological yield and harvest index were compared for different treatments. Results of the investigation revealed that, variety and potassium levels had significant influence on most of the growth, yield contributing characters and yield of maize. The maximum grain yield (11.94 t ha^{-1}) was recorded at SAU hybrid Vhutta 2 (V_2) and the minimum grain yield (10.54 t ha^{-1}) was recorded at SAU hybrid Vhutta 1 (V_1). The maximum grain yield (13.61 t ha^{-1}) was observed from 180 kg K ha^{-1} + RF (K_5) treatment and minimum grain yield (7.18 t ha^{-1}) was observed from control (K_0) treatment. The maximum grain yield (13.92 t ha^{-1}) was observed where SAU hybrid Vhutta-2 cultivated alone with 180 kg K ha^{-1} + RF treatment combination (V_2K_5) were applied and minimum grain yield (6.697 t ha^{-1}) was observed where SAU hybrid Vhutta 1 cultivated along with control fertilizers treatment combination (V_0K_1) were applied. Treatment combination V_2K_5 produced 51.89 % more grain yield over V_1K_0 treatment combination. So it may be concluded that SAU hybrid Vhutta 2 along with 180 kg K ha^{-1} + Recommended Fertilizers could be a best production package to produce higher grain yield of maize.

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LIST OF ABBREVIATIONS

AEZ	Agro-Ecological Zone
Anon.	Anonymous
AIS	Agriculture Information Service
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BINA	Bangladesh Institute of Nuclear Agriculture
BNNC	Bangladesh National Nutrition Council
BARI	Bangladesh Agricultural Research Institute
CIMMYT	International Maize and Wheat Improvement Center
CV %	Percent of Coefficient of Variance
cv.	Cultivar (s)
HI	Harvest Index
DAS	Days After Sowing
eds.	Editors
et al.	et alii (and others)
etc.	et cetera (and other similar things)
FAO	Food and Agriculture Organization
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
IRRI	International Rice Research Institute
L.	Linnaeus
LSD	Least Significant Difference
i.e.	id est (that is)
MOP	Muriate of Potash
NPTs	New Plant Types
SAU	Sher-e-Bangla Agricultural University
SRDI	Soil Resources and Development Institute
TDM	Total Dry Matter
TSP	Triple Super Phosphate
UNDP	United Nations Development Programme
var.	Variety
viz.	Namely

CHAPTER I

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 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). This cereal crop belongs to the family Poaceae. It is a typical monoecious plant highly cross-pollinated (95%), self-pollination may reach up to 5% (Poehlman and Sleper, 1995). It has very high yield potential, there is no cereal on the earth, which has so immense potentiality and that is why it is called "Queen of cereals" (FAO, 2002). It ranks 1stin respect of yield per unit area, 2nd in respect total production and 3rd after wheat and rice in respect of acreage in cereal crops (Zamir *et al.*, 2013).

Maize is grown as a fodder, feed and food crop. It is also used as raw material for manufacturing pharmaceutical and industrial products. 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).Maize grain contains 70% carbohydrate, 10% protein, 4% oil, 10.4% albumin, 2.3% crude fiber, 1.4% ash (Nasim *et al*., 2012). Moreover, it contains 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamin and 0.1 mg riboflavin per 100 g grains (Chowdhury and Islam, 1993). Maize oil is used as the best quality edible oil.

Its world average yield is 27.80 q ha^{-1} maize ranks first among the cereals and is followed by rice, wheat, and millets, with average grain yield of 22.5, 16.3 and 6.6 q ha^{-1}, respectively (Nasim *et al*., 2012). Introduction of maize in Bangladesh as human food can be a viable alternative for sustaining food security as the productivity of maize much higher than rice and wheat (Ray *et al.*, 2013). It provides many of the B vitamins and essential minerals along with fibre, but lacks some other nutrients, such as vitamin $B_{12}$and vitamin C. Maize has been a recent introduction in Bangladesh. Rice maize cropping system has been expanded (Timsina *et al.*, 2010) rapidly in the northern districts of Bangladesh mainly in response to increasing demand for poultry feed (BBS, 2016). Maize production of Bangladesh increased from 3,000 tons in 1968 to 3.03 million tons in 2017growing at an average annual rate of 28.35 % (FAO, 2019).

There are two kinds of maize in respect of grain colour; yellow and white. Worldwide, the yellow maize is mainly used as fodder while the white ones are consumed as human food (FAO, 2002). The currently grown maize in this country is yellow type, which is mainly adapted importing genetic materials from CIMMYT. Again, although there are some indigenous local maize in the south east hills those have also not improved for having higher yields (Ullah *et al.,* 2016). Maize currently grown in Bangladesh is of yellow type and is used in the feed industry. Hybrid maize cultivation area has increased at the rate of about 20-25% per year since nineties. Now-a-days, there are many government and non government organizations are working for increasing maize production in Bangladesh. Bangladesh Agricultural Research Institute (BARI) has developed seven open pollinated and 11 hybrid varieties whose yield potentials are 5.50–7.00 t ha^{-1} and 7.40–12.00 t ha^{-1}, respectively, which are well above the world average of 3.19 t ha^{-1} (Nasim *et al*., 2012). Different varieties respond differently to input supply, cultivation practices and prevailing environment etc during the growing season 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. In general the yield productivity of any crop in this country is low which is generally attributed to the poor agronomic management (Ullah *et al.*, 2017).Higher yield up to 9-11 t ha^{-1} can be obtained using hybrid seeds, balanced fertilizers and better management practices (Mondal *et al.*, 2014).

Maize requires adequate supply of nutrients particularly nitrogen, phosphorus, potassium, calcium, sulphur, Zinc and boron for good growth and high yield. Potassium (K) plays a vital role as macronutrient in plant growth and sustainable crop production (Baligar *et al*., 2001). Potassium requirement of maize is high as it absorbs potassium in large quantities than any other element, except nitrogen. Percentage of potassium in earth is about 2.6 %. In plants potassium stimulates about 80 different types of enzymes (Kasana and Khan, 1976). It maintains turgor pressure of cell, which is necessary for cell expansion.It also stimulates in the stomatal functioning and helps plants to grow under drought conditions. (Hsiao, 1973). Potassium is not a constituent of organic structure but regulates enzymatic activities and translocation of photosynthates (Mengel and Kirkby, 1987). It enhances the root development due to which vegetative growth and production is increased (Yadav and Swami, 1988). Leon

(1999) concluded that yield components like 1000-grain weight and number of grains ear-^{1} remained unaffected like plant height, days taken to tasseling and silking, however, stalk yield and protein contents were significantly affected with the potassium and phosphorus application. Keeping these facts in view, investigation was conducted under following objectives:

i. To observe the varietal performance of two varieties of maize.
ii. To determine the optimum dose of potassium fertilizer on growth and yield of maize.
iii. To evaluate the interaction effect of variety and potassium level on growth and yield of maize varieties.

CHAPTER II

REVIEW OF LITERATURE

Variety is an important factor as it influences the plant population per unit area, availability of sunlight, nutrient competition, photosynthesis, respiration etc. It is well known that in general hybrids are more vigorous than conventional varieties. This means they are more able to compensate in the field under difficult growing conditions and thus increasing productivity of specific crops. Potassium plays a vital role as macronutrient in plant growth and sustainable crop production. Potassium is associated with the movement of water, nutrients and carbohydrates in plant tissue. It's involved with enzyme activation within the plant, which affects protein, starch and adenosine triphosphate (ATP) production. The production of ATP can regulate the rate of photosynthesis. Potassium also helps regulate the opening and closing of the stomata, which regulates the exchange of water vapor, oxygen and carbon dioxide. If Potassium is deficient or not supplied in adequate amounts, it stunts plant growth and reduces yield which ultimately influence the growth and development of the crops. An attempt was made in this section to collect and study relevant information available regarding the impact of potassium on the growth and yield of SAU Hybrid Vutta-1 and SAU Hybrid Vutta-2 to gather knowledge helpful in conducting the present piece of work.

2.1 Effect of hybrid varieties

2.1.1 Plant height (cm)

Belay (2019) reported that plant height was significantly ($p < 0.01$) affected due to the main effect of variety and year. Accordingly, significantly taller plants (239.0 cm) was obtained from the variety BH-661 than variety BH-QPY-545.

Hasan *et al.* (2018) conducted an experiment to investigate the effect of variety and plant spacing on yield attributes and yield of maize and reported that variety and plant spacing had significant effect on the studied crop characters and yield. The highest plant height was observed in BARI hybrid maize 7. On the other hand, the shortest plant was observed in Khoi bhutta.

An experiment was carried out by Asaduzzaman *et al*. (2014) to find out the suitable variety and N fertilizer rate for baby corn production at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during rabi season of 2008-09 and found that, variety Shuvra produced the tallest plant (179.1 cm) and BARI sweet corn^{-1} produced the shortest plant (149.3 cm).

An experiment was carried out by Enujeke (2013a) 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. The results obtained during the 8th week after sowing indicated that hybrid variety 9022-13 which had higher plant height of 170.0cm where as the Oba Super 2 gave the lowest plant height 156.3 cm.

Asafu-Agyei (1990) reported that, the highest plant height (223 cm) was recorded from Dobidi variety and the lowest one (170 cm) from Dorke variety.

2.1.2 Number of leaves plant-^{1} (no.)

Hasan *et al.* (2018) revealed that variety and plant spacing had significant effect on the studied crop characters and yield. The highest number of leaves plant^{-1} was observed in BARI hybrid maize 7. On the other hand, the lowest number of leaves plant^{-1} was observed in Khoi bhutta.

An experiment was carried out by Enujeke (2013a) 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. 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.

2.1.3 Leaf area plant^{-1} (cm^{2})

Asaduzzaman *et al*. (2014) reported that, Shuvra gave the highest LAI (5.50) and the lowest one (3.10) was noted for BARI sweet corn^{-1}.

An experiment was conducted by Enujeke (2013 a) indicated that the maximum leaf area 673.2cm^{2} was recorded from hybrid variety 9022-13 where as the lowest one 576.5 cm^{2} was recorded from Oba Super 2.

Shafi *et al.* (2012) showed that the highest leaf area index was recorded by Sarhad white and the lowest one was recorded from Pahari.

2.1.4 Dry matter content plant^{-1} (g)

Asaduzzaman *et al*. (2014) reported that, Hybrid baby corn-271 produced the highest (160.50 g) dry matter plant^{-1}.On the other hand Khoibhutta had the lowest dry matter plant-^{1}(122.13 g) accumulation.

2.1.5 Cob length Plant^{-1} (cm)

Belay (2019) reported that variations in ear length observed might be due to maize hybrids could have different varietal characteristics for this trait.

Hasan *et al.* (2018) revealed that variety and plant spacing had significant effect on the studied crop characters and yield. The longest cob plant-^{1} was observed in BARI hybrid maize 7. On the other hand, the shortest cob plant-^{1} observed in Khoi bhutta.

2.1.6 Cob circumference Plant^{-1} (cm)

Belay (2019) revealed that the effects of variety and year had significant ($p < 0.01$) effect on ear diameter, whereas other effects were non-significant where higher ear diameter (4.45 cm) was obtained from variety BH-661 than variety BH-QPY-545. The possible reason for observed thicker ear diameters for variety BH-661 might be due to large kernel size for variety BH-661 as compared to variety BH-QPY-545.

Akil *et al.* (2018) revealed that the hybrid maize varieties different significantly on cob diameter. Bima-4 significantly produced the highest cob diameter (5.11cm), but Nasa-29 produced the lowest cob diameter (4.74cm).

Hasan *et al.* (2018) reported that variety and plant spacing had significant effect on the studied crop characters and yield. The maximum diameter of cob was observed in BARI hybrid maize 7. On the other hand minimum diameter of cob was observed in Khoi bhutta.

2.1.7 Number of grains cob^{-1} (no.)

Hasan *et al.* (2018) reported that variety and plant spacing had significant effect on the studied crop characters and yield. The highest number of kernel cob^{-1} was observed in BARI hybrid maize 7. On the other hand lowest number of grains cob^{-1} was observed in Khoi bhutta

Enujeke (2013 b) indicated that the number of grains cob-^{1} of variety BR9922-DMRSF2 were highest (460.0) in 2008 and (467.7) in 2009 and the lowest number of grains cob-^{1} were recorded from variety AMATZBRC2WB (329.3) in 2008 and (334.13) in 2009.

Shafi *et al.* (2012) reported that among varieties, highest number of grains ear-^{1} was recorded for Sarhad white while minimum was recorded from Pahari.

2.1.8 1000 grains weight (g)

Hasan *et al.* (2018) reported that the highest plant height, highest number of leaves plant-1, longest cob, maximum diameter of cob, highest number of kernel cob-1, the highest 1000-grain weight, maximum grain yield and stover yield were observed in BARI hybrid maize 7. On the other hand, the shortest plant, lowest number of cob, diameter of cob, lowest number of grains cob^{-1}, 1000-grain weight, grain yield and stover yield were observed in Khoi bhutta.

Akil *et al.* (2018) revealed the heavier mean of the weight 1000 grains was Bima-4 (351.1 g followed by Nasa-29 (347.5g) and Bima-20 323.3g).

Hussain *et al.* (2007) showed that maximum (273 g) 1000-grains weight was observed for variety Azam, while variety Kissan-90 gave minimum (269 g) 1000-grains weight.

2.1.9 Cob weight plant^{-1}

Khan *et al.* (2017) was conducted a field experiment during kharif 2016 at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.) The experiment was laid out in Randomized Block Design. The result showed that growth yield attributes viz., cob weight with husk (325.27 g), cob weight without husk (250.30 g) were recorded maximum in ‘sweety’ as compared to ‘Sweet glory’ variety.

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

Hasan *et al.* (2018) conducted an experiment to investigate the effect of variety and plant spacing on yield attributes and yield of maize and observed that the highest grain yield was observed in BARI hybrid maize 7 (9.04 t ha^{-1}) and the lowest grain yield was observed in khoi bhutta (4.08 t ha^{-1})**.**

Ghimire *et al.* (2016) reported that the maximum grain yield ranging from (3.17 to 7.25 t/ha) and (1.60 to 6.32 t/ha) was produced by Rajkumar in improved practice and

farmers practice of cultivation respectively while minimum grain yield was found in Arun2 ranging from (0.95 to 4.43 t/ha) and (0.81 to 4.09 t/ha) in improved practice and farmers practice of cultivation respectively.

The experiment observed that the maximum ear yield with husk (12.80 t ha-^{1}) was recorded in Hybrid Baby Corn-271 and the minimum (9.70 t ha-^{1}) was recorded in Shuvra.

A study was carried out by Enujeke (2013 b) in the Teaching and Research Farm of Delta State University, Asaba Campus (Nigeria) from March to December in 2008 and replicated between March and December, 2009, to evaluate the effects of variety and spacing on yield indices of Open-pollinated maize. The results obtained from the study indicated that the grain yield of variety BR9922-DMRSF2 were highest (4.7 t ha-^{1}) in 2008 and (4.9 t ha-^{1}) in 2009 and the lowest grain yield were recorded from variety AMATZBRC2WB (3.5 t ha-^{1}) in 2008 and (3.7 t ha-^{1}) in 2009.

Shafi *et al.* (2012) reported that the data showed that maximum grain yield was produced by Sarhad white and minimum grain yield was gained by Pahari.

Asafu-Agyei (1990) reported that, the highest grain yield (6.0 t ha-^{1}) was recorded from Dobidi variety and the lowest grain yield (4.50 t ha-1) was recorded from Dorke variety.

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

Hasan *et al.* (2018) conducted an experiment to investigate the effect of variety and plant spacing on yield attributes and yield of maize. Result showed that the highest stover yield (12.38 t ha-^{1}) was obtained from C-1921 variety and the lowest stover yield (6.30t ha-^{1}) was produced by khoi bhutta.

Shafi *et al.* (2012) reported that, in case of varieties, maximum stover yield was produced by Sarhad white and the minimum stover yield was produced by Pahari.

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

Khan (2017) showed that the mean values of the data indicated that Genotypes PS-1 and PS-2 produced biological yield (12679 and 12189 kg ha-^{1}) and performed better as compared to genotypes PS-3 and Iqbal (check)

Shafi *et al.* (2012) reported that the data showed that maximum biological yield was produced by Sarhad white and minimum by Pahari.

2.1.13 Harvest index (%)

Khan (2017) showed that the mean values of the data indicated that Genotypes PS-1 and PS-2 produced higher harvest index of 43.3 and 43.2%, respectively and performed better as compared to genotypes PS-3 and Iqbal (check).

Shafi *et al.* (2012) that, maximum harvest index was recorded from Sarhad white when compared with other varieties.

2.2 Effect of potassium level

2.2.1 Plant height

Jasar *et al. (*2019) reported that long stature plants (215.25cm) were produced when potash was applied at the rate of 120kg ha^{-1} which was statistically similar to 90 kg ha^{-1}, followed by 60 kg ha^{-1} (198.37cm) whereas short stature plants (179.43 cm) were produced in plots where potash was not applied.

Akil *et al.* (2018) reported that potassium at rate 80 kg K_2O ha^{-1} for Nasa-29 had the tallest plants among all other potassium rate and maize varieties (210.9cm).

2.2.2 Leaf area $plant^{-1}$

Jasar *et al.* (2019) reported that potash applied at the rate of 120kg ha^{-1} had the largest leaf area (494.28 cm^2) which was statistically at par with 90 kg ha^{-1}, followed by 60 kg ha^{-1} (475.21 cm^2), whereas less leaf area (376.95cm^2) was obtained where potash was not applied.

Olowobko *et al.* (2017) reported that maize leaf area was significantly increased at 6 WAP with the application of all potassium rates with the exception of 30 kg K ha^{-1}. At 8 WAP maize leaf area was observed to increase with increasing potassium rates and significantly lower area was observed in the control. Highest leaf area was produced with K rate of 180 kg ha^{-1}.

2.2.3 Dry matter content plant^{-1} (g)

Olowobko *et al.* (2017) reported that that dry weight was significantly increased with potassium rate of 180 kg ha^{-1} relative to the control and K application rates below 90 kg ha^{-1}.

Swetha *et al*. (2017) observed that application of 60 kg K2O ha^{-1} (K3) recorded significantly the maximum dry weight of cob (32.0 g), whereas the lowest was observed with K_1 (control).

2.2.4 Cob length plant-^{1}

Swetha *et al.* (2017) observed that application of 60 kg K_2O ha^{-1} (K3) recorded significantly the higher cob length (18.61 cm whereas the lowest was observed with K1 (control).

2.2.5 Cob diameter plant^{-1}

Akil *et al.* (2018) revealed that the highest cob diameter (5.24cm) produced by Bima-4 at applied 100kg K_2O ha-^{1}. These cob diameter differences among the varieties in relation to the potassium fertilizer were attributed to genetic variability.

2.2.6 Number of grains cob^{-1}

Jasar *et al.* (2019) observed that application of potash at the rate of 120 kg ha^{-1} resulted in more number of grains ear^{-1} (547.37) however it was statistically at par with 90 kg K ha^{-1}, followed by 60 kg K ha^{-1} (515.31), while lower grains ear^{-1} (483.62) were recorded for the plots where potash was not applied.

Swetha *et al*. (2017) reported that application of 60 kg K_2O ha-^{1} (K3) recorded significantly the higher number of grains per cob (250.41) whereas the lowest was observed with K1 (control).

Hussain *et al.* (2007) observed that the mean values of potassium levels showed that maximum (324) number of grains ear-^{1} was obtained at 90 kg K ha^{-1} while minimum (271) grains ear^{-1} with 30 kg K ha^{-1}, respectively.

2.2.7 1000 grain weight (g)

Jasar *et al.* (2019) reported that potash levels showed significant effect on 1000 grain weight of cob. Application of potash at the rate of 120kg h^{-1} produced heavier

thousand grains weight (414.87g), followed by 90kg ha^{-1} (391.68 d) then by 60kg ha^{-1} (378.12g), while no application of potash resulted in lighter thousand grains weight (354. 12g).

Hussain *et al.* (2007) observed that the mean values of potassium levels showed that In case of potassium levels, maximum (307 g) 1000-grains weight was found with 90 kg K ha-^{1}, while minimum (233 g) was obtained with 30 kg K ha^{-1}.

2.2.8 Cob Weight $plant^{-1}$

Hussain *et al*. (2007) reported that Pplots treated with 90 kg K ha^{-1} gave heavier ears of 101g as compared to 30 kg K ha^{-1} with 87 g weight ear^{-1}.

2.2.9 Grain Yield (t ha^{-1})

Jasar *et al. (*2019) was conducted an experiment during 2014 on spring maize hybrids and potash levels at Agriculture university Peshawar research form in Khyberpakhtunkhwa Pakistan. The mean values for potash (K) indicated that higher grain yield (4192kg h-^{1}) was obtained with 120kg K ha^{-1} which was statistically similar to 90kg K ha-1(4128kg h^{-1}), followed by 60kg K ha-^{1} (3515 kg ha^{-1}), while no application of potash resulted in lower grain yield (3151 kg ha^{-1}).

Sadiq *et al*. (2017) showed that mean values for K indicated that higher grain yield (4762 kg ha^{-1}) was recorded in those plots where K was applied at the rate of 120 kg ha^{-1} though statistically similar with 90 kg K ha^{-1} (4654) while minimum grain yield (3046 kg ha-^{1}) was recorded in control plots. The increase in grain yield might be due to maximum utilization of K by maize that increased grains ear^{-1}, grains weight and hence grain yield.

2.2.10 Stover Yield (t ha^{-1})

Sadiq *et al.* (2017) from the study result showed that among K levels increased stover yield (7660 kg ha^{-1}) was recorded where K was applied at the rate of 120 kg ha^{-1} though statistically at par with 90 kg ha^{-1} (7667 kg ha^{-1}), while minimum stover yield (6105 kg ha^{-1}) was observed in control plots. Enhancement in stover yield with the increased K level might be attributed to the increase in the height of maize plants.

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

Jasar *et al.* (2019) reported that application of potash at the rate of 90kg ha-^{1} resulted in higher biological yield (13580 kg ha^{-1}) however it was statistically at par with 120kg K ha^{-1} , followed by 60kg K ha^{-1} (11502kg ha^{-1}), while plots where potash was not applied resulted in lower biological yield (10496 kg ha^{-1})

Sadiq *et al*. (2017) reported that more biological yield was resulted when P and K were applied at the rate of 120 kg ha-^{1} each. It may be due to the increase of potash increased CO2 assimilation rate, enzyme activity, stomata closure and stabilized osmosis regulation which produced more carbohydrates which improved grain yield and biological yield.

2.2.12 Harvest index (%)

Sadiq *et al*. (2017) reported the increase in harvest index with the increase in potash level might be due to more partitioning of assimilates toward sink. More harvest index was noted with higher potash applied.

2.3 Interaction effect of varieties and potassium level

2.3.1 Plant Height

Jasar *et al. (*2019) reported that result exhibited that Potash (K) application and hybrids (H) as well as their interaction significantly affected various parameters of this experiment. From this experiment result revealed that different potash level and hybrid varieties and their interaction between K x H had significantly effect on plant height of white maize.

Jan *et al.* (2018) observed that hybrids and potassium levels significantly (P≤0.05) affected crop phenology (days to tasseling, silking, and maturity), growth (plant height) and yield traits (grains ear^{-1}, thousand grain weight), biological and grain yield. The study concludes that sowing of maize hybrid SB-92K97 with application of K at the rate of 120kg ha-^{1} gives higher maize return in terms of yield.

2.3.2 Leaf Area

Jasar *et al.* (2019) reported that potash (K) application and hybrids (H) as well as their interaction significantly affected various parameters of this experiment. From this experiment result revealed that different potash level and hybrid varieties and their interaction between K × H had significantly effect on plant leaf area of white maize.

Dulami and Hadethi (2015) observed that the triple interaction of IPA genotype with highest level of both fertilizers (200Kg K+1.5Kg B) ha^{-1} gave the highest average of leaf area , grains number per ear , grains yield (12.80 , 14.72) ton ha^{-1}, biological yield and harvest index (56.82 , 56.42)% in both seasons respectively.

2.3.3 Maize Cob Diameter

Akil *et al.* (2018) the application of potassium at the rate of 60 kg K2O ha^{-1} for Nasa-29 variety produced the highest grain yield (11.33 ha-^{1}) under field condition at the agro-ecological of Gowa, South Sulawesi.

2.3.4 Number of grains cob^{-1}

Jasar *et al.* (2019) revealed that plant height, Leaf area, number of grains cob^{-1},grain yield, biological yield had significantly effect on different potash level and hybrid varieties and with the interaction between K × H

Akil *et al.* (2018) reported that the interaction of different levels of potassium and hybrid maize varieties significantly affected to maize cob diameter, weight of 1000 grains, and grain yield. The application of potassium at the rate of 60 kg K_2O ha-^{1} for Nasa-29 variety produced the highest grain yield (11.33 ha^{-1}) under field condition at the agro-ecological of Gowa, South Sulawesi.

2.3.5 1000 Grains Weight

Akil *et al.* (2018) reported that the application of potassium at the rate of 60 kg K2O ha^{-1} for Nasa-29 variety produced the highest grain yield (11.33 ha^{-1}) under field condition at the agro-ecological of Gowa, South Sulawesi.

Jan *et al.* (2018) reported that hybrids and potassium levels significantly ($P \leq 0.05$) affected crop phenology (days to tasseling, silking, and maturity), growth (plant height) and yield traits (grains ear^{-1}, thousand grain weight), biological and grain

yield. The study concludes that sowing of maize hybrid SB-92K97 with application of K at the rate of 120kg ha^{-1} gives higher maize return in terms of yield.

2.3.6 Grain Yield

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2.3.7 Biological yield

Jasar *et al.* (2019) reported that plant height, Leaf area, number of grains cob^{-1},grain yield, biological yield had significantly effect on different potash level and hybrid varieties and with the interaction between K x H.

Jan *et al.* (2018) reported that hybrids and potassium levels significantly ($P \leq 0.05$) affected crop phenology (days to tasseling, silking, and maturity), growth (plant height) and yield traits (grains ear^{-1}, thousand grain weight), biological and grain yield.

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2.3.8 Harvest Index

Dulami and Hadethi (2015) reported that the triple interaction of IPA genotype with highest level of both fertilizers (200Kg K+1.5Kg B) ha^{-1} gave the highest average of leaf area , grains number per ear , grains yield (12.80 , 14.72) ton ha^{-1}, biological yield and harvest index (56.82 , 56.42) % in both seasons respectively.

CHAPTER III

MATERIALS AND METHODS

This section presents a brief description about the duration of the experimental period, site description, climatic condition of the area, crop or planting materials that are being used in the experiment, treatments, experimental design, crop growing procedure, intercultural operations, data collection and statistical analyses.

3.1 Experimental period

The experiment was conducted during the period from April to July, 2019 in Kharif-I season.

3.2 Experimental site description

3.2.1 Geographical location

The experiment was conducted at the Agronomy field of Sher-e-Bangla Agricultural University (SAU). Shere bangla nagar agargong Dhaka, Bangladesh. 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 (Anon., 2004).

3.2.2 Agro-Ecological Zone

The experimental field belongs to the Agro-ecological zone (AEZ) of "The Modhupur Tract", AEZ-28 (Anon., 1988 a). 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 (Anon., 1988 b). For better understanding about the experimental site has been shown in the Map of AEZ of Bangladesh in Appendix-I.

3.3 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 (Edris *et al.*, 1979). 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.

3.4 Soil

The soil of the experimental pots belongs to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon soil series. Soil pH ranges from 5.4–5.6 (Anon., 1989). The land was above flood level and sufficient sunshine was available during the experimental period. The morphological, physical and chemical characteristics of the experimental soil have been presented in Appendix-III.

3.5 Planting materials

In this research work, " SAU Hybrid Vutta 1 and SAU Hybrid Vutta 2" hybrid variety of maize seed were used as planting materials, which was collected from Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.

3.6 Description of the hybrid varieties

The SAU Hybrid Vutta 1 and SAU Hybrid Vutta 2" seeds were used as planting material for the present study. These variety was recommended for Rabi and kharif season. The feature of this variety was presented below:

SAU Hybrid Vutta-1

Name of Variety : SAU Hybrid Vutta 1
Type : Medium duration, Hybrid
Height : 180–240 cm
Crop duration : 100–110 days
Leaf colour at Maturity : Whitish green colour
Suitable area : All over Bangladesh
Number of cobs plant-^{1} : Mainly one
Grain colour : Yellow colour grains
Yield : 11-13.5 t ha^{-1}

SAU Hybrid Vutta-2

Name of Variety : SAU Hybrid Vutta 2

Type : Medium duration, Hybrid

Height : 180–240 cm

Crop duration : 100–110 days

Leaf colour at Maturity : Whitish green colour

Number of cobs plant-^{1} : Mainly one

Grain colour : Yellow colour grains

Yield : 12-14 t ha^{-1}

Source : Personal Communication: Prof. Dr. Md. Abdullahil Baque, Dept. Of Agronomy, SAU, Dhaka.

3.7 Major diseases and pest management

Insecticides Diazinon 60 EC @ 2 ml litre^{-1} water was sprayed to control Stem borer and Ripcord 10 EC @ 2 ml litre^{-1} water were sprayed to control earworm to protect the crop. Diseased or off type plants were uprooted as and when required.

Major diseases and Management

Diseases: Mainly leaf blight disease occurs at vegetative stage.

Management: Clean cultivation with timely sowing and balance fertilizer application. Seed treatment with vitavax-200 @ 2.5g kg^{-1} seed, spraying with Tilt or Folicure @ 0.5% and burning of crop residues.

Major insect/pest and Management

Insect pests: Cut worm and Stem borer attack at vegetative stage of maize as well as Earworm attack in cob at reproductive stage in maize.

Management

For cutworm: The larvae were killed after collecting from soil near the cut plants in morning. Dursban or Pyrifos 20 EC 5 ml liter^{-1} water sprayed especially at the base of plants to control cutworms.

For ear worm: The larvae are killed after collecting from the infested cobs. Cypermethrin (Ripcord 10 EC/Cymbush 10 EC) @ 2 ml litre^{-1} water sprayed to control this pest.

For stem borer: Marshall 20 EC or Diazinon 60 EC @ 2 ml litre^{-1} water sprayed properly to control the pest. Furadan 5 G or Carbofuran 5 G @ 20kg ha^{-1} applied on top of the plants in such a way so that the granules stay between the stem and leaf base. Such type of application of insecticides is known as whorl application.

3.8 Experimental details

Sowing Date: 9 April 2019

Silking Date: 24 may 2019

Harvesting Date: 17 July 2019

3.8.1 Experimental treatments

There were two sets of treatments in the experiment. The treatments were Maize Hybrid varieties and different potassium levels. Those are shown below:

Factor A: Maize Hybrid varieties (Two levels)

i. **SAU Hybrid Vutta 1**
ii. **SAU Hybrid Vutta 2**

Factor B: Different Levels of Potassium **(six levels)**

i. K_0: Control
ii K_1: 60 kg K ha^{-1}+ others Recommended Fertilizers (RF= urea: 550 kg ha^{-1}, TSP :250 kg ha^{-1} , MOP: 200kg ha^{-1}, Gypsum : 175 kg ha^{-1}, Boric acid : 6 kg ha^{-1} and cowdung : 100 ton ha^{-1})
iii. K_2: 90 kg K ha^{-1} + RF
iv. K_3: 120 kg K ha^{-1} + RF
v. K_4: 150 kg K ha^{-1} + RF and
vi. K_5: 180 kg K ha^{-1} + RF.

3.9 Experimental treatment & design

3.9.1 Treatment combinations

This two factor experiments were included 12 treatment combinations.

$V_1 K_0$, $V_1 K_1$, $V_1 K_2$, $V_1 K_3$, $V_1 K_4$ $V_1 K_5$, $V_2 K_0$, $V_2 K_1$, $V_2 K_2$, $V_2 K_3$, $V_2 K_4$, $V_2 K_5$

3.9.2 Experimental design

The experiment was laid out in the Split Plot design with three replications. In main plot there was hybrid maize varieties and in sub plot there was Different Levels of Potassium fertilizer treatment. The field was divided into 3 blocks to represent 3 replications. Total 36 unit plots was made for the experiment with 12 treatments. The size of each unit plot was 7 m^2 (3.50 m × 2 m). Distance maintained between replication and plots were 1.0 m and 0.75 m, respectively. Layout of the experimental field is presented in Appendix II.

3.10 Detail of experimental preparation

3.10.1 Preparation of experimental land

The land was opened with the help of a tractor drawn disc harrow on 4 April, 2019 and then ploughed with rotary plough twice followed by laddering to achieve a medium tilth required for the crop under consideration. All weeds and other plant residues of previous crop were removed from the field. Immediately after final land preparation, the field layout was made on 7 April 2019 according to experimental specification. A pre-sowing irrigation was given on 9 April 2019. Individual plots were cleaned and finally the plot were prepared.

3.10.2 Fertilizer application

Urea: 550 kg ha^{-1}, TSP :250 kg ha^{-1}, MOP: 200kg ha^{-1}, Gypsum : 175 kg ha^{-1}, Boric acid : 6 kg ha^{-1} and cowdung : 100 ton ha^{-1} were applied at final land preparation except urea fertilizer. In case of urea fertilizer its applied in 3 installment.1/3 at final land preparation stage,1/3 at vegetative stage and finally 1/3 at at flower initiation stage respectively following krishi projukti hatboi hybrid maize fertilizer dose (2019) recommendation. Potassium fertilizer (Murat of potash) was applied as per treatment variables.

3.10.3 Seed sowing

The white maize seeds were sown in lines maintaining row-to-row distance and plant to plant distance as per treatments having 2 seeds per hole under direct sowing in the well prepared plot on 9 April 2019. Maximum 99% seed was germinated.

3.11 Intercultural operations

After raising seedlings, various intercultural operations such as irrigation, weeding, gap filling and thinning, drainage, pest and disease control etc. were accomplished for better growth and development of the maize seedlings.

3.11.1 Gap filling and thinning

Gap filling and thinning was done on 29 April 2019, which was 20 days after sowing (DAS).

3.11.2 Weeding

The hand weeding was done as when necessary to keep the plot free from weeds. During plant growth period two weeding were done. The weeding was done on 29 April and 23 May 2019, which was 20 and 45 days after sowing, respectively.

3.11.3 Earthing up

Earthing up was done on 9 May 2019 which was 30 days after sowing. It was done to protect the plant from lodging and for better irrigation management
and nutrition uptake.

3.11.4 Application of irrigation water

Irrigation water was added to each plot, first irrigation was done as pre-sowing and other four were given at 20, 45, 65 and 85 days after sowing (DAS). First irrigation was given on 29 April 2019, which was 20 days after sowing. Second irrigation was given on 23 May 2019, which was 45 days after sowing. Third irrigation was given on 13 June 2019, which was 65 days after sowing, and fourth irrigation was given on, 3 July 2019, which was 85 days after sowing.

3.11.5 Drainage

There were heavy rainfalls during the experimental period. Drainage channels were properly prepared to easy and quick drained out of excess water.

3.11.6 Pest and disease control

As described in section 3.7.

3.11.7 General observations of the experimental site

Regular observations were made to see the growth stages of the crop. In general, the plot looked nice with normal green plants, which were vigorous and luxuriant.

3.12 Harvesting, threshing and cleaning

The mature cobs were harvested when the husk cover was completely dried and black coloration was found in the grain base (black band).The cobs of five randomly selected plants of each plot were separately harvested for recording yield attributes and other data. Harvesting was done on 23 February 2019

3.13 Drying

The harvested products were taken on the threshing floor and it was dried for about 4–5 days.

3.14 Crop sampling

During 30, 60, 90 Days and harvesting period 5 plants was cutting from the soil base which was selected for crop sampling for taking various parameters data of the plant.

A. Crop growth characters

1. Plant height (cm)
2. Number of leaves plant^{-1}
3. Leaf area plant^{-1} (cm^2)
4. Total dry matter plant^{-1} (g)
5. Growth rate plant^{-1}

B. Yield contributing characters

1. Cob length (cm)
2. Cob breadth (cm)
3. Number of rows cob^{-1} (no.)
4. Number of grains row^{-1} (no)
5. Total number of grains cob^{-1} (no)
6. Unfill area cob^{-1} (%)
7. 1000 grains weight cob^{-1} (g)
8. Husk weight plant^{-1} (g)

9. Shell weight plant^{-1} (g)

10. Grain weight cob^{-1} (g)

11. Total cob weight plant^{-1} (g)

12.Shelling Percentage (%)

C. Yield characters

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

2.Stover yield (t ha^{-1})

2. Biological (t ha^{-1})

3. Harvest index (%)

3.15 Procedure of recording data

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

3.15.1 Plant height (cm) at different DAS (45, 90 DAS and at harvest respectively)

At different stages of crop growth (45, 90 DAS and at harvest), the height of five randomly selected plants from the inner rows per plot was measured from ground level to the tip of the plant portion and the mean value of plant height was recorded in cm.

3.15.2 Number of leaves plant^{-1}

At different stages of crop growth (45, 90 DAS and at harvest), the number of leaves of five randomly selected plants from the inner rows per plot was measured by counting the number of leaves of the plant and the mean value of the number of leaves was recorded.

3.15.3 Leaf Area (cm^2) at 45, 90 DAS and at harvest

Leaf area was estimated manually by counting the total number of leaves plant^{-1} and measuring the length and average width of leaf and multiplying by a factor of 0.70 (Kluen and Wolf, 1986). It was done at 30, 60, 90 days after sowing and harvest.

Leaf area plant^{-1} =

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

3.15.4 Dry matter weight plant^{-1} at different DAS (45, 90 DAS and at harvest)

At 45, 90 DAS and at harvest 5 plants from each plot were uprooted randomly. Then the plant was cut into pieces. Then the various pieces of the plant were put into a paper packet ,in case of harvesting, cob was also put into a packet and placed in oven maintaining 70^0 C for 72 hours. Then the sample was transferred into desiccators and allowed to cool down at room temperature. Then the sample weight was taken and then calculate the total dry matter of a plant for each plot. It was performed at 45, 90 DAS and at harvest.

3.15.5 Crop growth rate (CGR)

The crop growth rate values at different growth stages were calculated using the following formula (Beadle, 1987).

$$CGR = 1/GA \times \frac{W2 - W1}{T2 - T1} \quad g\ m^{-2}d^{-1}$$

Where,

W1= Total dry matter production at previous sampling date

Surface area of leaf sample (m^2) x correction factor

Ground area from where the leaves are collected

W2= Total dry matter production at current sampling date

T1= Date of previous sampling

T2= Date of current sampling

GA= Ground area (m^2)

3.15.6 Cob length (cm)

Cob length was measured in centimeter. Cob length was measured from the base to the tip of the cob of the five selected plants in each plot with the help of a centimeter scale then average data were recorded.

3.15.7 Cob circumference (cm)

Five cobs were randomly selected per plot and the circumference was taken from each cob. Then average result was recorded in cm.

3.15.8 Number of grain rows cob^{-1}

Five cobs from each plot were selected randomly and the number of grain rows per cob was counted. Then the average result was recorded.

3.15. 9 Number of grain row^{-1}

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

3.15. 10 Number of grains cob^{-1}

The numbers of grains per cob was measured from the base to tip of the ear collected from five randomly selected cobs of each plot and finally average result was recorded.

3.15. 11 Unfilled area %cob^{-1}

Five cobs were randomly selected from each plot and unfill area %cob^{-1} was calculated by using the following formula–

$$\text{Unfilled grain \% cob}^{-1} = \frac{\text{Unfild grain length from tip}}{\text{Total length of the cob}} \times 100$$

3.15. 12 Weight of 1000 grains (g)

After removing the grain from each cob from each plot grains are stored in a specific grain stock or pot. From the seed stock of each plot 1000 seeds were calculated and the weight was measured by an electrical balance. It was recorded in gram.

3.15.13 Husk weight plant^{-1} (g)

Whole chaff without grains of five cobs were randomly taken from each plot and the weight was taken in an electrical balance. The average chaff weight was recorded in gram.

3.15.14 Shell weight plant^{-1} (g)

After removing the grain from cobs shell of five cobs were randomly taken from each plot and the weight was taken in an electrical balance. The average shell weight was recorded in gram.

3.15.15 Grain weight plant^{-1} (g)

Whole grains of five cobs were randomly taken from each plot and the weight was taken in an electrical balance. The average grain weight was recorded in gram.

3.15. 16 Total cob weight plant^{-1} (g)

Cob weight (Includes chaff ,shell and total grain weight of a cob) of five randomly selected cobs from the five selected plants in each plot was taken in an electrical balance and the average weight was recorded in gram.

3.15. 17 Shelling percentage cob^{-1}

Five cobs were randomly selected from each plot and shelling percentage was calculated by using the following formula(Ahmmed, 2018) :

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

3.15. 18 Grain yield (t ha^{-1})

After removing the grain from the cob grain yield was calculated. Grain yield was calculated from cleaned and well dried grains collected from 1m^2 area of each plot and expressed as t ha^{-1}. Finally grain yield was adjusted at 14% moisture. The grain yield t ha^{-1} was measured by the following formula (Khan *et al*., 2014):

$$\text{Grain yield (t ha}^{-1}) = \frac{\text{Grain yield per pot (kg)} \times 10000}{\text{Area of pot in square meter} \times 1000}$$

3.15. 19 Stover yield (t ha^{-1})

After removing the grains from the cob various parts of the plants without grain part was weighted and well dried stover were collected from each plot were taken and converted into hectare and were expressed in t ha^{-1} The straw yield t ha^{-1} was measured by the following formula (Khan *et al.*, 2014):

$$\text{Stover yield (t ha}^{-1}) = \frac{\text{Stover yield per plot (kg)} \times 10000}{\text{Area of pot in square meter} \times 1000}$$

3.15. 20 Biological yield (t ha^{-1})

Grain yield alone with stover yield was regarded as biological yield and calculated with the following formula (Khan *et al*., 2014):

Biological yield (t ha^{-1}) = grain yield (t ha^{-1}) + stover yield (t ha^{-1})

3.15. 21 Harvest index (%)

Harvest Index indicate the ratio of economic yield (grain yield) to biological yield and was calculated with the following formula (Khan *et al*., 2014):

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

3.16 Statistical analysis

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package program name Statistix 10 Data analysis software and the mean differences were adjusted by Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

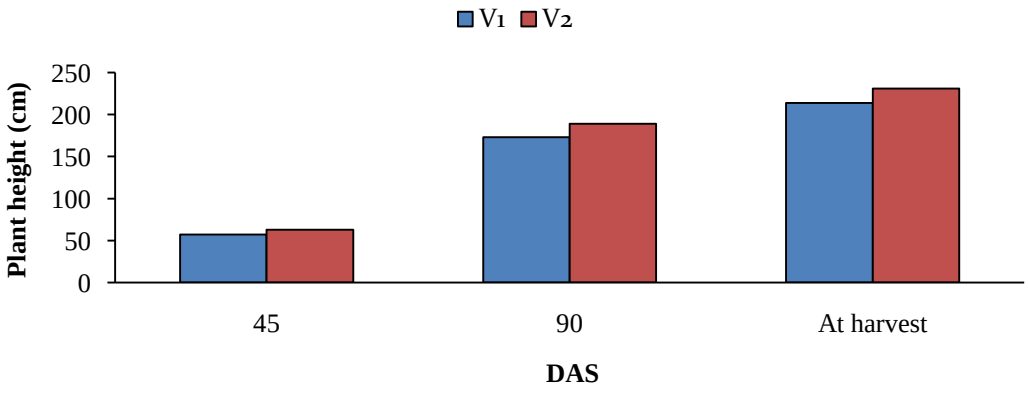
The data on different growth, yield contributing characters and yield were recorded to find out the appropriate variety and potassium fertilizers levels on white maize. The results have been presented and discussed and possible explanations have been given under the following headings:

4.1 Review on growth parameters

4.1.1 Plant height (cm)

4.1.1.1 Effect of variety

Plant height is an important morphological character that acts as a main indicator of availability of growth resources in its approach. Plant height of maize was greatly influenced by different treatments at different days after sowing (DAS) under the present study (Figure- 1) . Result revealed that the maximum plant height (63, 189.17, and 230.83 cm at 45 DAS, 90 DAS and harvest respectively) was observed from V_2 treatment. Whereas the minimum plant height (57.167, 172.83 and 213.68cm at 45 DAS, 90 DAS and harvest respectively) was observed from V_1 treatment. This result was in agreement with the previous findings of (Belay, 2019; Hasan *et al.*, 2018; Asaduzzaman *et al*., 2014; Enujeke, 2013a and Asafu-Agyei, 1990).

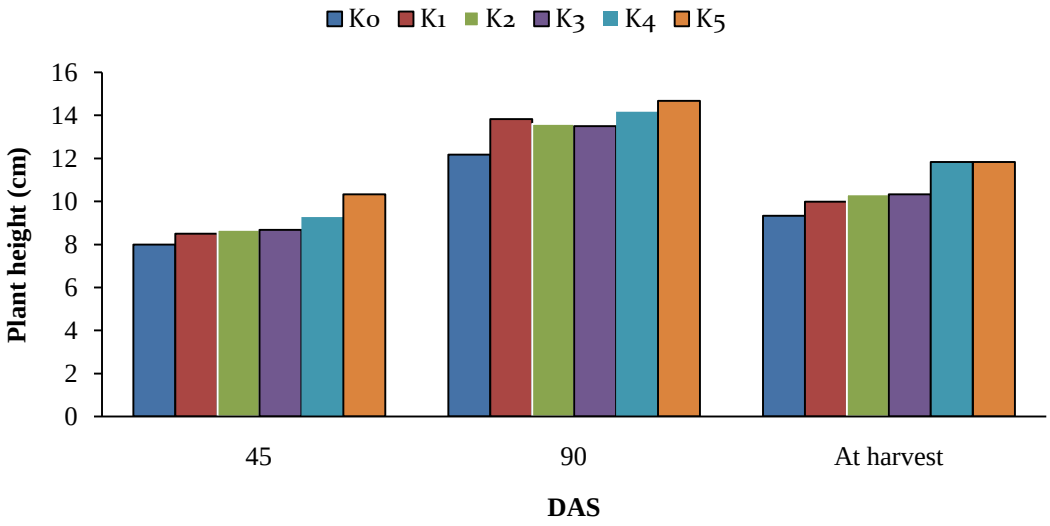


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 1 : Effect of variety on plant height of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 5.09, 15.79 and 12.42 at 45 DAS, 90 DAS and harvest, respectively).

4.1.1.2 Effect of potassium level

Different potassium level showed significant effect on plant height of maize (Figure- 2). Result revealed that the highest plant height (63.5, 192, and 236.67 cm at 45 DAS, 90 DAS and harvest respectively) was observed from K_5 treatment. Statistically similar result was also found with K_4 treatment followed by K_3 treatment at 45 DAS, 90 DAS and harvest respectively and K_2 treatment at 45 DAS, 90 DAS. Whereas the lowest plant height (54.50, 163.50, and 197.50cm at 45 DAS, 90 DAS and harvest respectively) was observed from K_0 treatment which was statistically similar with K_1 treatment at 45 DAS, 90 DAS and harvest respectively. Jasar *et al.* (2019) reported that long stature plants (215.25cm) were produced when potash was applied at the rate of 120kg ha^{-1} which was statistically similar to 90 kg ha^{-1}, followed by 60kg ha^{-1} (198.37cm) whereas short stature plants (179.43cm) were produced in plots where potash was not applied. Similar results with the present study also found by (Akil *et al.*, 2018 and Olowobko *et al*,. 2017).



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF..

Figure 2 : Effect of potassium level on plant height of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 3.58, 10.86 and 10.19 at 45 DAS, 90 DAS and at harvest, respectively).

4.1.1.3 Interaction effect variety and potassium level on plant height

Interaction effect of different variety and potassium level showed significant effect on plant height of maize (Table 1). Result revealed that the highest plant height (65, 194, and 238.33cm at 45 DAS, 90DAS and harvest respectively) was observed from the treatment combination of V_2K_5. Statistically similar result was also observed with all others treatment combination excepts V_1K_0 and V_1K_1 at 45 DAS, 90DAS and harvest respectively and with V_1K_2, V_1K_3, and V_2K_0 at harvest. Whereas the minimum plant height (49, 147 and 182 cm at 45DAS, 90DAS, harvest respectively) was observed from the treatment combination of V_1K_0 which was statistically similar with the treatment combination of V_1K_2 at 30, 90DAS and harvest respectively. This result was in agreement with the previous findings of (Jasar *et al,*. 2019 and Jan *et al.,* 2018).

Table 1: Interaction effect of variety and potassium level on plant height of maize at different days after sowing (DAS) and at harvest

Treatment Interaction	Plant height (cm)		
	45 DAS	90 DAS	At harvest
V_1K_0	49.00 b	147.00 b	182.00 d
V_1K_1	51.00 b	155.00 b	195.00 d
V_1K_2	59.50 a	178.00 a	218.33 bc
V_1K_3	59.50 a	179.00 a	218.33bc
V_1K_4	62.00 a	188.00 a	233.40 ab
V_1K_5	62.00 a	190.00 a	235.00 a
V_2K_0	60.00 a	180.00 a	213.00 c
V_2K_1	62.00 a	188.00 a	229.00 ab
V_2K_2	62.00 a	188.00 a	233.67 ab
V_2K_3	64.00 a	191.00 a	234.67 ab
V_2K_4	65.00 a	194.00 a	236.33 a
V_2K_5	65.00 a	194.00 a	238.33 a
$LSD_{(0.05)}$	5.06	15.36	14.42
CV(%)	4.95	4.98	3.81

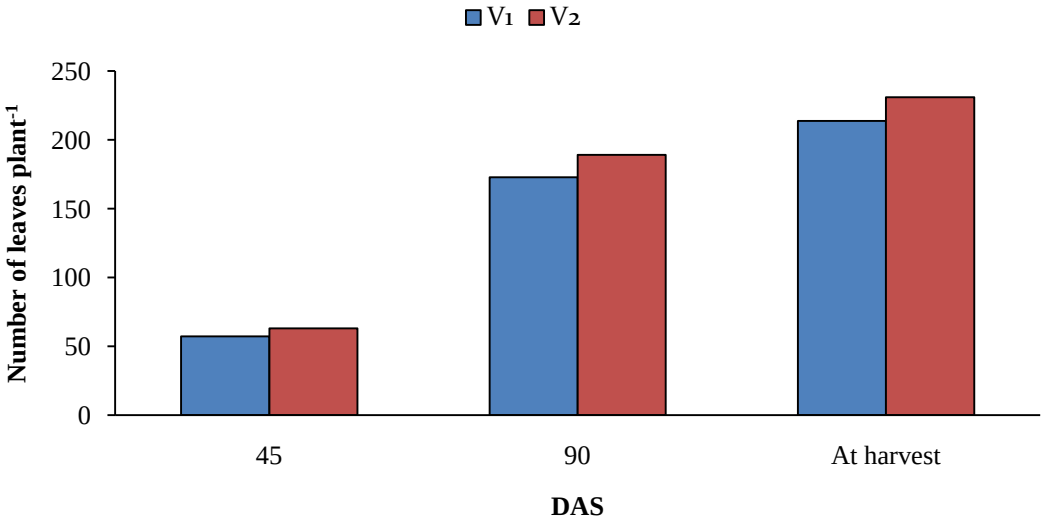
In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.1.2 Number of leaves $plant^{-1}$

4.1.2.1 Effect of variety

Number of leaves $plant^{-1}$ of maize was greatly influenced by different variety at 45DAS and 90DAS after sowing (DAS) under the present study (Figure 3). Result revealed that the maximum number of leaves (9.7583, 14.277 and 10.773 at 45 DAS, 90 DAS and harvest respectively) was observed from V_2 treatment. Whereas the minimum number of leaves (8.0533, 13.035, 10.442 at 45 DAS, 90 DAS and harvest respectively) was observed from V_1 treatment. Hasan *et al.* (2018) suggested 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, which supported the present study.

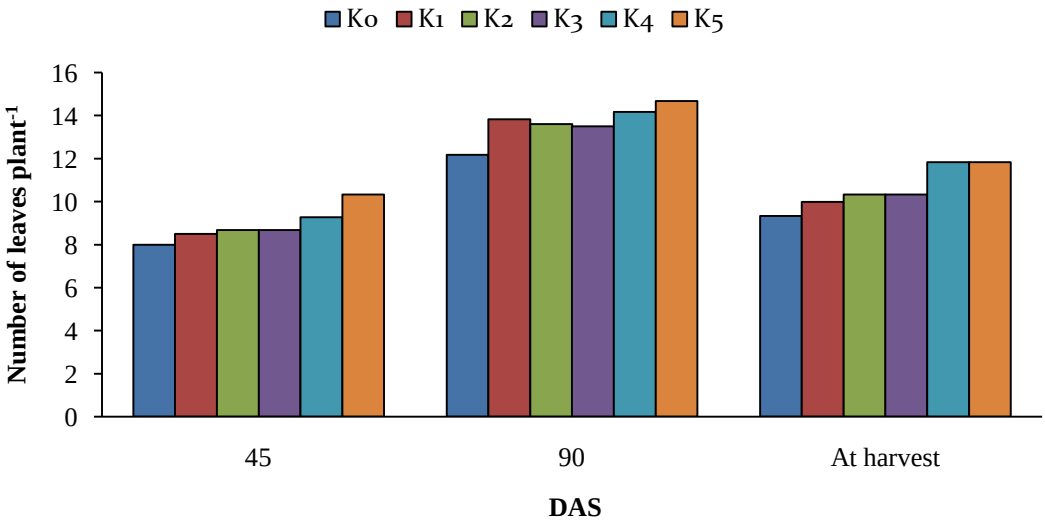


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 3: Effect of variety on plant number of leaves at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 0.72, 1.09 and NS at 45 DAS, 90 DAS and at harvest, respectively).

4.1.2.2 Effect of potassium level

Number of leaves plant^{-1} of maize was greatly influenced by different potassium level at different days after sowing (DAS) under the present study (Figure 4). Result revealed that the maximum number of leaves 10.330, 14.665 and 11.830 at 45 DAS, 90 DAS and harvest respectively) was observed from K_5 treatment. which was statistically similar with K_4 treatment at 90 DAS and harvest respectively. Whereas the minimum number of leaves (8, 12.165 and 9.33 at 45 DAS, 90 DAS and harvest respectively) was observed from K_0 treatment. Jasar *et al. (*2019) and Olowobko *et al.* (2017) also found similar results with the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 4 : Effect of potassium level on number of leaves of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 0.49, 0.78 and 0.49 at 45 DAS, 90 DAS and at harvest, respectively).

4.1.2.2 Interaction effect variety and potassium level on number of leaves $plant^{-1}$

Interaction effect of different variety and potassium level showed significant effect on number of leaves per plant of maize (Table 2). Result revealed that the maximum number of leaves per plant (12.33, 16 and 12.33 at 45 DAS, 90 DAS and harvest respectively) was observed from the treatment combination of V_2K_5. Statistically similar result was also observed with V_2K_4 at 90 DAS, harvest respectively. Whereas the minimum number of leaves (7.0, 12.0 and 9.0 at 45 DAS, 90 DAS, harvest respectively) was observed from the treatment combination of V_1K_0 which was statistically similar with the treatment combination of V_2K_0 at 90 DAS and harvest respectively and treatment combination V_1K_3 at 90 DAS.

Table 2: Interaction effect of variety and potassium levels on number of leaves plant^{-1} of maize at different days after sowing (DAS) and at harvest

Treatment Interaction	Number of leaves plant^{-1}		
	45DAS	90 DAS	At harvest
V_1K_0	7.00 e	12.00 e	9.00 d
V_1K_1	8.00 d	13.33 cd	10.33 c
V_1K_2	8.33 cd	13.22 cd	10.33 c
V_1K_3	8.33 cd	13.00 c-e	10.33 c
V_1K_4	8.33 cd	13.33 cd	11.33 b
V_1K_5	8.33 cd	13.33 cd	11.33 b
V_2K_0	9.00 c	12.33 de	9.66 cd
V_2K_1	9.00 c	14.33 bc	9.66 cd
V_2K_2	9.00 c	14.00 bc	10.33 c
V_2K_3	9.00 c	14.00 bc	10.33 c
V_2K_4	10.22 b	15.00 ab	12.33 a
V_2K_5	12.33 a	16.00 a	12.33 a
$LSD_{(0.05)}$	0.69	1.09	0.6953
CV(%)	4.58	4.73	3.85

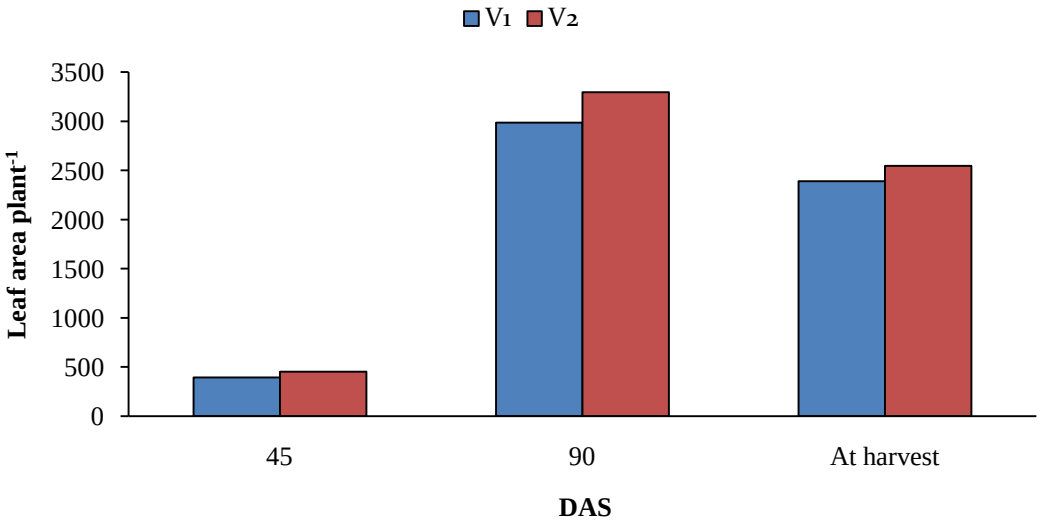
In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.1.3 Leaf area plant^{-1}

4.1.3.1 Effect of variety

Leaf area plant^{-1} of maize was greatly influenced by different variety at 45DAS and 90DAS after sowing (DAS) under the present study (Figure 5). Result revealed that the maximum leaf area (452.63, 3295.0 and 2546.2 cm^2 at 45 DAS, 90 DAS and harvest respectively) was observed from V_2 treatment which was statistically similar with V_1 treatment at harvest . Whereas the minimum leaf area (394.77, 2985.5, 2388.3 cm^2 at 45 DAS, 90 DAS and harvest respectively) was observed from V_1 treatment. Enujeke (2013 a) reported that maximum leaf area 673.2cm^2 was recorded from

hybrid variety 9022-13 where as the lowest one 576.5 cm^2 was recorded from Oba Super 2, which supported the present study.

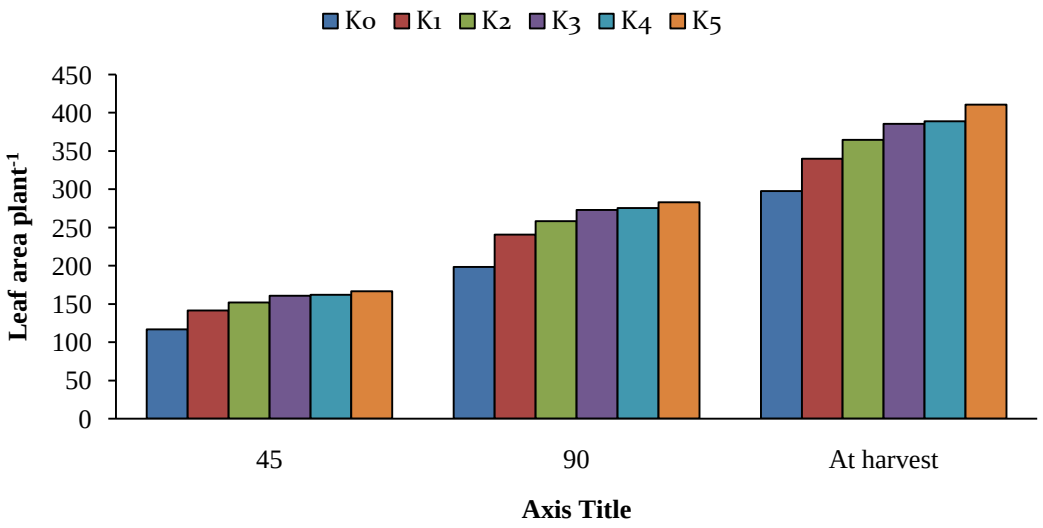


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 5 : Effect of variety on leaf area $plant^{-1}$ of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 28.98, 245.08 and NS at 45 DAS, 90 DAS and at harvest, respectively).

4.1.3.2 Effect of potassium level

Leaf area $plant^{-1}$ of maize was greatly influenced by different potassium level at different after sowing (DAS) under the present study (Figure 6). Result revealed that the maximum leaf area (543.25,4308.5 2959.5 cm^2 at 45 DAS, 90 DAS and harvest respectively) was observed from K_5 treatment. Whereas the minimum leaf area (312.15, 2301.5 and2103.0 cm^2 at 45 DAS, 90 DAS and harvest respectively) was observed from K_0 treatment, which was statistically similar with K_1 treatment during harvest.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 6 : Effect of potassium level on leaf area plant^{-1} of maize at different days after sowing (DAS) and at harvest ($LSD_{(0.05)}$= 20.27, 169.75 and 155.48 at 45 DAS, 90 DAS and at harvest, respectively).

4.1.3.3 Interaction effect variety and potassium level on leaf area plant^{-1}

Interaction effect of different variety and potassium level showed significant effect on leaf area plant^{-1} of maize (Table 3). Result revealed that the maximum number of leaf area per plant (595.70, 4666.0 and 3057 cm^2 at 45 DAS, 90DAS and harvest respectively) was observed from the treatment combination of V_2K_5. Whereas the minimum leaf area plant^{-1} (298.60, 2084.0, 2044 cm^2 at 45 DAS, 90 DAS, harvest respectively) was observed from the treatment combination of V_1K_0 which was statistically similar with the treatment combination of V_2K_0 and V_1K_1 at 45 DAS; with treatment combination V_2K_0 followed by V_2K_1, V_1K_1 and V_1K_2 at harvest. Jasar *et al.* (2019) and Dulami and Hadethi (2015) also found similar results with the present study.

Table 3: Interaction effect of variety and potassium level on leaf area plant^{-1} of maize at different days after sowing (DAS) and at harvest

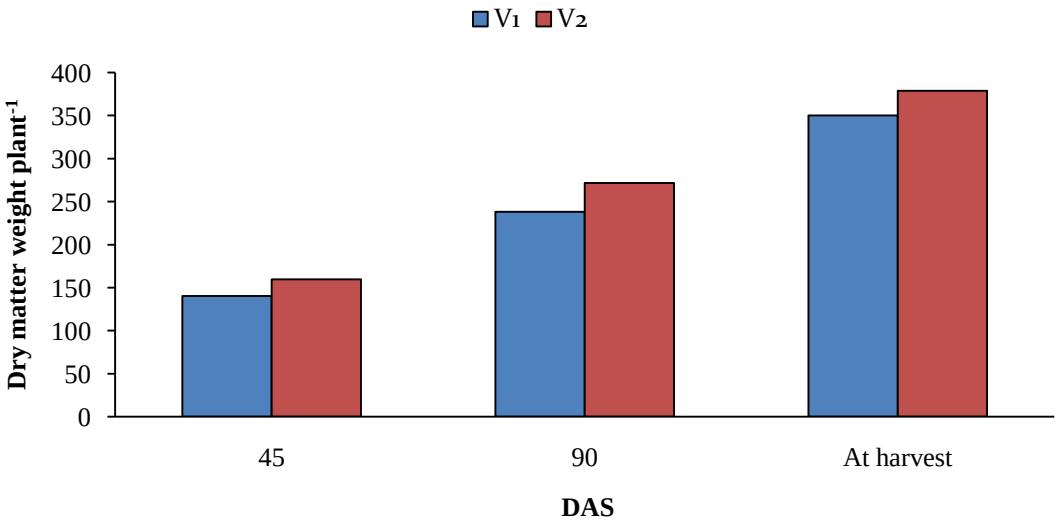
Treatment Interaction	Leaf area of maize plant^{-1}(cm^2)		
	45DAS	90DAS	At harvest
V_1K_0	298.60 f	2084.0 e	2044.0 e
V_1K_1	326.00 ef	2516.0 d	2240.0 de
V_1K_2	377.40 d	2730.0 d	2240.0 de
V_1K_3	425.20 c	3315.0 c	2380.0 cd
V_1K_4	450.60 c	3317.0 c	2564.0 c
V_1K_5	490.80 b	3951.0b	2862.0 ab
V_2K_0	325.70 ef	2519.0 d	2162.0 de
V_2K_1	342.60 de	2578.0 d	2180.0 de
V_2K_2	425.20 c	2735.0 d	2564.0 c
V_2K_3	450.60 c	3317.0 c	2657.0 bc
V_2K_4	576.00 a	3955.0 b	2657.0 bc
V_2K_5	595.70 a	4666.0 a	3057.0 a
$LSD_{(0.05)}$	28.67	240.06	219.88
CV(%)	3.97	4.49	5.23

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.1.4 Dry matter weight plant^{-1}

4.1.4.1 Effect of variety

Dry matter weight plant^{-1} of maize was greatly influenced by different variety at different days after sowing (DAS) under the present study (Figure 7). Result revealed that the maximum Dry matter weight plant^{-1} (159.68, 271.46 and 378.90 g at 45 DAS, 90 DAS and harvest respectively) was observed from V_2 treatment. Whereas the minimum Dry matter weight plant^{-1} (140.15, 238.20 and 350.02 g at 45 DAS, 90 DAS and harvest respectively) was observed from V_1 treatment. Asaduzzaman *et al.* (2014) found similar results with the present study.

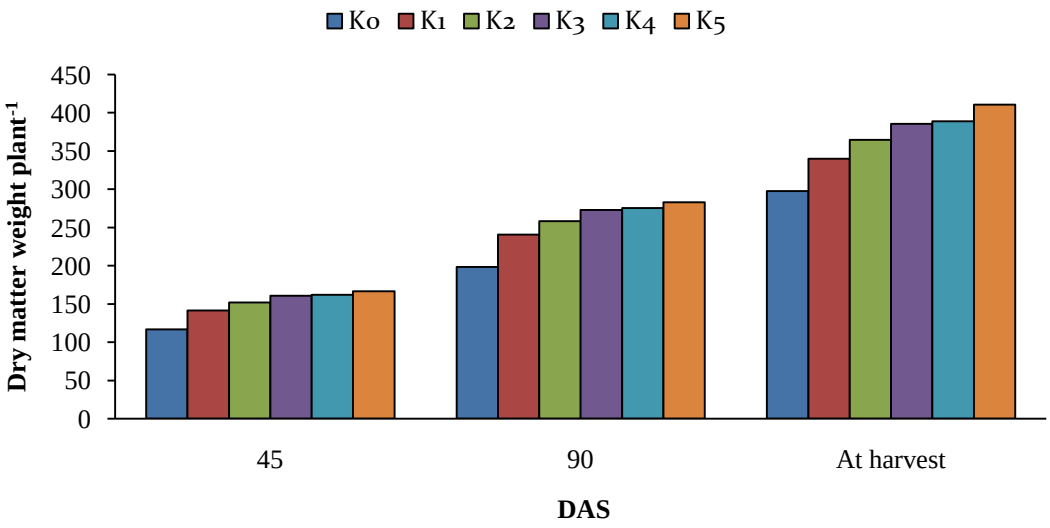


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 7 : Effect of variety on dry matter weight plant^{-1} of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 14.93, 25.05 and 27.39 at 45 DAS, 90 DAS and at harvest, respectively).

4.1.4.2 Effect of potassium level

Different potassium level at different after sowing (DAS) showed significant effect on maize (Figure 8). Result revealed that the maximum Dry matter weight plant^{-1} (166.46, 282.98 and 410.50 g at 45 DAS, 90 DAS and harvest respectively) was observed from K_5 treatment which was statistically similar with K_5 followed by K_5 treatment. Whereas the minimum Dry matter weight plant^{-1} (116.88, 198.52 and 297.50 g at 45 DAS, 90 DAS and harvest respectively) was observed from K_0 treatment. Olowobko *et al.* (2017) reported that dry weight was significantly increased with potassium rate of 180 kg ha^{-1} relative to the control and K application rates below 90 kg ha^{-1}. Swetha *et al*. (2017) also suggested that application of 60 kg K_2O ha^{-1} (K_3) recorded significantly the maximum dry weight of cob (32.0 g), whereas the lowest was observed with K_0 (control).



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 8 : Effect of potassium level on dry matter weight plant^{-1} of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 10.99, 20.83 and 19.44 at 45 DAS, 90 DAS and at harvest, respectively).

4.1.4.3 Interaction effect variety and potassium level on dry matter weight plant^{-1}

Interaction effect variety and potassium level on dry matter weight per plant showed significant effect on maize at different after sowing (DAS) (Table 4). Result revealed that the maximum dry matter weight plant^{-1} (174.58, 296.79 and 419.00 g at 45 DAS, 90 DAS and harvest respectively) was observed from V_2K_5 treatment combination which was statistically similar with V_2K_4 followed by V_2K_3, V_2K_2, V_1K_5 and V_1 K_4 treatment combination at 45 DAS ; with V_2K_4 followed by V_2K_3, V_2K_2, V_1K_5, V_1 K_4 and V_1 K_3 treatment combination at 90 DAS with V_1K_5 followed by V_2K_4, and V_2K_3 treatment combination at harvest. Whereas the minimum dry matter weight plant^{-1} (93.75, 159.04 and 285 g at 45 DAS, 90 DAS and harvest respectively) was observed from V_1K_0 treatment combination which was statistically similar with V_2K_0 treatment combination at harvest.

Table 4: Interaction effect of variety and potassium level on plant dry matter weight of maize at different days after sowing and harvest

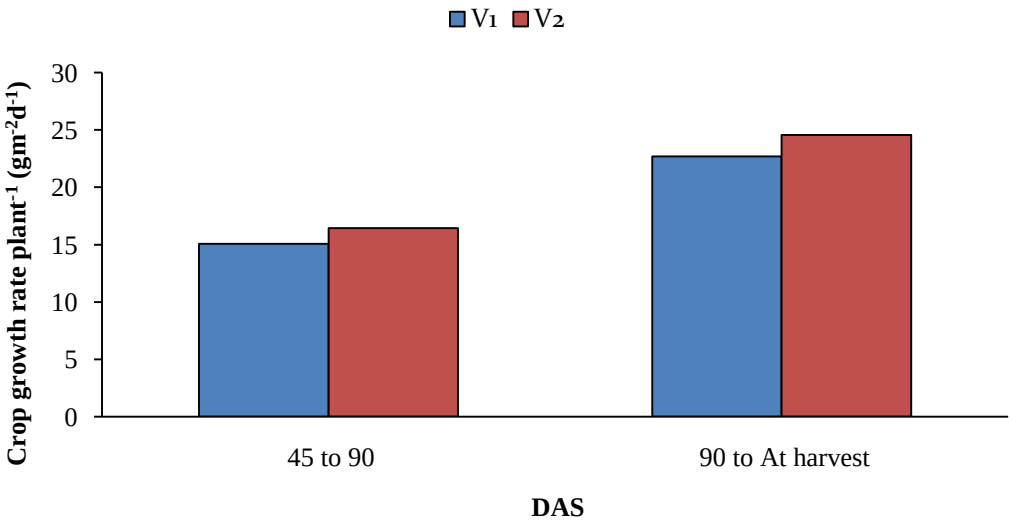
Treatment Interaction	Plant dry matter weight (gm)		
	45 DAS	90 DAS	At harvest
V_1K_0	93.75 f	159.04 f	285.00 h
V_1K_1	133.33 e	226.67 e	320.00 fg
V_1K_2	144.58 c-e	245.79 c-e	347.00 ef
V_1K_3	154.40 b-d	262.47 a-d	370.55 c-e
V_1K_4	156.50 a-d	266.05 a-d	375.60 b-d
V_1K_5	158.33 a-d	269.17 a-d	402.00 ab
V_2K_0	140.00 de	238.00 de	310.00 gh
V_2K_1	150.00 c-e	255.00 b-e	360.00 de
V_2K_2	159.17 a-c	270.58 a-c	382.00 b-d
V_2K_3	166.83 ab	283.62 ab	400.40 a-c
V_2K_4	167.50 ab	284.75 a	402.00 a-c
V_2K_5	174.58 a	296.79 a	419.00 a
$LSD_{(0.05)}$	15.55	29.45	27.48
CV(%)	6.09	6.79	4.43

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.1.5 Growth rate plant^{-1} (g $m^{-2}d^{-1}$)

4.1.5.1 Effect of variety

Maize variety significantly affect growth rate of maize (Figure 9). From the experiment result revealed that the maximum growth rate plant^{-1} (16.428 , 24.558 gm-^{2}d-^{1} at 90 DAS and harvest respectively) was observed from V_2 treatment. Whereas the minimum growth rate plant^{-1} (15.069 and 22.687 $gm^{-2}d^{-1}$ at 90 DAS and harvest respectively) was observed from V_1 treatment.

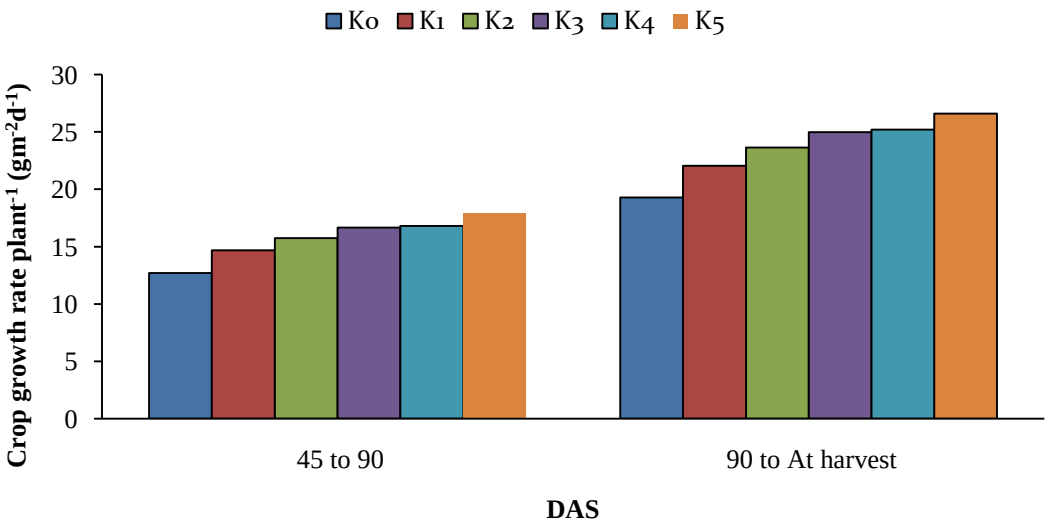


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 9 : Effect of variety on growth rate plant^{-1} of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 1.33 and 1.84 at 90 DAS and at harvest, respectively)

4.1.5.2 Effect of potassium level

Different potassium level showed significant affect on growth rate of maize (Figure 10). From the experiment result revealed that the maximum growth rate plant^{-1} (17.904 and 26.606 gm-^{2}d-^{1} at 90 DAS and harvest respectively) was observed from K_5 treatment which was statistically similar with K_4 treatment at harvest. Whereas the minimum growth rate plant^{-1} (12.688 and 19.282 gm^{-2}d^{-1} at 90 DAS and harvest respectively) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 10 : Effect of potassium level on growth rate plant^{-1} of maize at different days after sowing (DAS) and at harvest ($LSD_{(.05)}$= 1.08 and 1.42 at 90 DAS and at harvest respectively).

4.1.5.3 Interaction effect variety and potassium level on growth rate plant^{-1} of maize

Interaction effect of variety and Potassium level on growth rate per plant showed significant effect on maize at different after sowing (DAS) (Table 5). Result revealed that the maximum growth rate plant^{-1} (18.438 and 27.157 gm^{-2}d^{-1} at 90 DAS and at harvest, respectively) was observed from V_2K_5 treatment combination which was statistically similar with V_2K_4 followed by V_1K_5 and V_2K_3 treatment combination at 90 DAS and harvest respectively. Whereas the minimum growth rate plant^{-1} (11.981 and 18.472 gm-^{2}d-^{1} at 45 DAS to 90 DAS and 90 DAS to harvest respectively) was observed from V_1K_0 treatment combination which was statistically similar with V_2K_0 treatment combination at harvest.

Table 5: Interaction effect of variety and potassium level on growth stage of maize at 45 DAS to 90 DAS and 90 DAS to At harvest

Treatment Interaction	45 DAS to 90 DAS	90 DAS to At harvest
V_1K_0	11.98 f	18.47 f
V_1K_1	13.83 de	20.74 e
V_1K_2	14.99 c-e	22.49 de
V_1K_3	16.01 bc	24.02 cd
V_1K_4	16.23 bc	24.34 b-d
V_1K_5	17.37 ab	26.06 ab
V_2K_0	13.39 ef	20.09 ef
V_2K_1	15.55 b-d	23.33 d
V_2K_2	16.51 bc	24.75 b-d
V_2K_3	17.30 ab	25.95 a-c
V_2K_4	17.37 ab	26.05 a-c
V_2K_5	18.44 a	27.16 a
$LSD_{(0.05)}$	1.53	2.0056
CV(%)	5.70	4.98

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

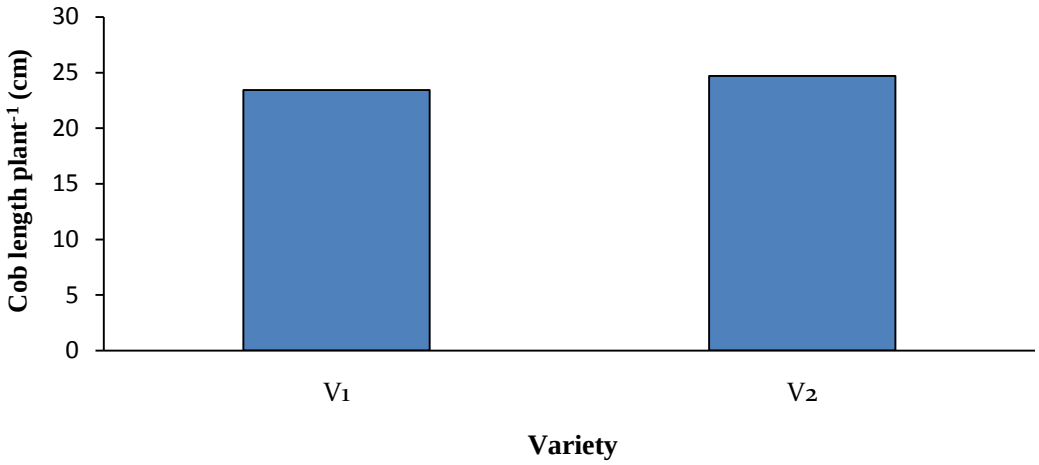
4.2 Yield contributing characters

4.2.1 Cob length (cm)

4.2.1.1 Effect of variety

Maize variety significantly affect on cob length $plant^{-1}$ (Figure 11). From the experiment result revealed that the maximum cob length $plant^{-1}$ (24.695 cm) was observed from V_2 treatment. Whereas the minimum cob length $plant^{-1}$ (23.442 cm) was observed from V_1 treatment. Belay (2019) reported that varieties had a significant ($p< 0.01$) effect on ear length while the other effects were not significant. Accordingly, higher ear length (16.71 cm) was produced from variety BH-661 while

shorter ear length (14.77 cm) was produced from BH-QPY-545. Variations in ear length observed might be due to maize hybrids could have different varietal characteristics for this trait. Hasan *et al.* (2018) also suggested that the longest cob plant-^{1} was observed in BARI hybrid maize 7. On the other hand, the shortest cob plant-^{1} observed in Khoi bhutta which supported the present study.

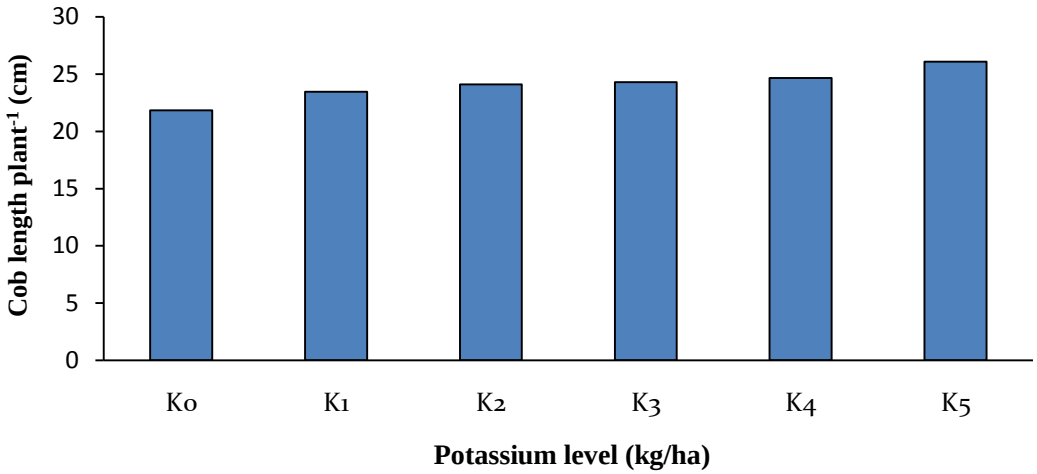


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 11 : Effect of variety on cob length plant^{-1} of maize (LSD$_{(0.05)}$= 1.24)

4.2.1.2 Effect of potassium level

Different potassium level also showed significant effect on cob length plant^{-1} (Figure 12). From the experiment all result, it was revealed that the maximum cob length plant^{-1} (26.080 cm) was observed from K_5 treatment which was statistically similar with K_4 treatment. Whereas the minimum cob length plant^{-1} (21.830 cm) was observed from K_0 treatment. Swetha *et al.* (2017) reported that application of 60 kg K_2O ha^{-1} (K_3) recorded significantly the higher cob length (18.61 cm whereas the lowest was observed with K_0 (control).



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 12 : Effect of potassium level on cob length cob^{-1} (LSD$_{(0.05)}$= 1.48)

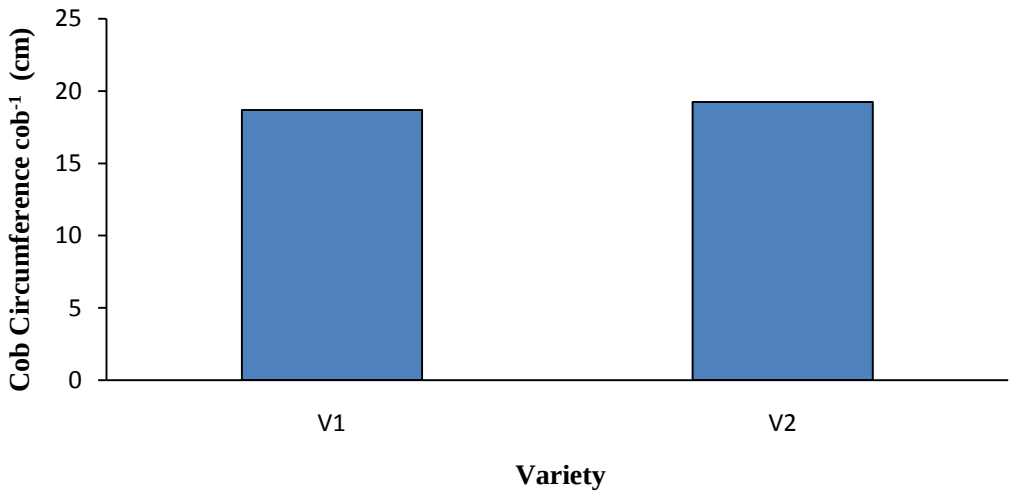
4.2.1.3 Interaction effect of variety and potassium level on cob length plant^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on cob length plant^{-1} of maize (Table 6). From the experiment result expressed that maximum cob length plant^{-1} (26.83cm) was observed from the treatment combination of V_2K_5 which was statistically similar with V_2K_4 followed by V_1K_5 treatment combination .Whereas the minimum cob length plant^{-1} (20.83 cm) was observed from V_1K_0 treatment combination which was statistically similar with V_1K_1 treatment combination.

4.2.2 Cob circumference (cm)

4.2.2.1 Effect of variety

Maize variety showed non significant affect on cob circumference plant^{-1} (Figure 13). From the experiment result revealed that the maximum cob circumference plant^{-1} (19.234 cm) was observed from V_2 treatment. Whereas the minimum cob circumference plant^{-1} (18.692 cm) was observed from V_1 treatment.

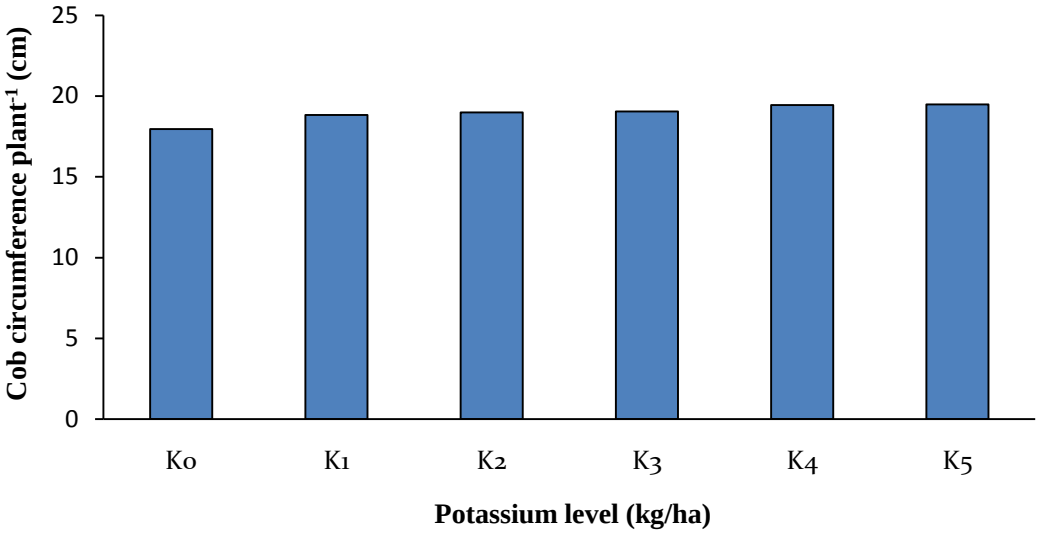


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 13 : Effect of variety on cob circumference plant^{-1} of maize ($LSD_{(0.05)}$= 1.67)

4.2.2.2 Effect of potassium level

Different potassium level also showed significant effect on cob circumference plant^{-1} (Figure 14). From the experiment result revealed that the maximum cob circumference plant^{-1} (19.495 cm) was observed from K_5 treatment which was statistically similar with all others treatment excepts K_0 treatment. Whereas the minimum cob circumference plant^{-1} (17.965 cm) was observed from K_0 treatment. Akil *et al.* (2018) found similar results with the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 14: Effect of potassium level on cob circumference plant^{-1}
$LSD_{(0.05)}$= (1.27)

4.2.2.3 Interaction effect of variety and potassium level on cob circumference plant^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on cob circumference plant^{-1} of maize (Table 6). From the experiment result expressed that maximum cob circumference plant^{-1} (19.830 cm) was observed from the treatment combination of V_2K_5 which was statistically similar with all others treatment excepts V_1K_0 treatment combination .Whereas the minimum cob circumference plant^{-1} (20.83 cm) was observed from V_1K_0 treatment combination . Akil *et al.* (2018) reported that the application of potassium at the rate of 60 kg K_2O ha-^{1} for Nasa-29 variety produced the highest grain yield (11.33 ha-^{1}) under field condition at the agro-ecological of Gowa, South Sulawesi.

Table 6: Interaction effect of variety and potassium level on cob length and cob circumference plant^{-1} of maize

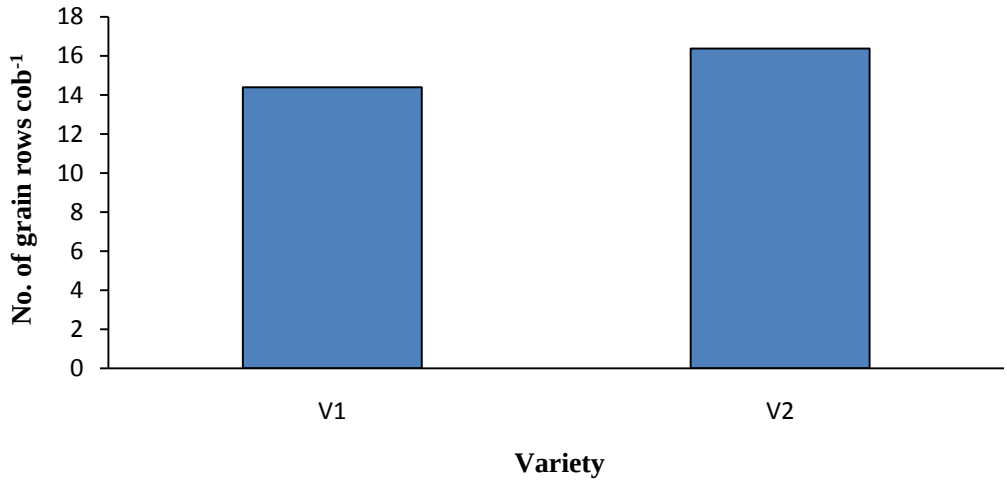
Treatment Interaction	Cob length (cm)	Cob Circumference (cm)
V_1K_0	20.83 d	17.60 b
V_1K_1	22.73 cd	18.83 ab
V_1K_2	23.83 bc	18.83 ab
V_1K_3	23.93 bc	18.83 ab
V_1K_4	24.00 bc	18.90 ab
V_1K_5	25.33 ab	19.16 ab
V_2K_0	22.83 cd	18.33 ab
V_2K_1	24.16 bc	18.83 ab
V_2K_2	24.36 bc	19.16 ab
V_2K_3	24.66 bc	19.26 ab
V_2K_4	25.33 ab	19.99 a
V_2K_5	26.83 a	19.83 a
$LSD_{(0.05)}$	2.09	1.79
CV(%)	3.60	5.56

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.2.3 Number of grain rows cob^{-1}

4.2.3.1 Effect of variety

Maize variety showed significant affect on grain rows cob^{-1} (Figure 15). From the experiment result, revealed that the maximum grain rows cob^{-1} (16.39) was observed from V_2 treatment. Whereas the minimum grain rows cob^{-1} (14.39) was observed from V_1 treatment. Hasan *et al.* (2018), Enujeke (2013 b) and Shafi *et al.* (2012) also found similar result which supported the present finding.

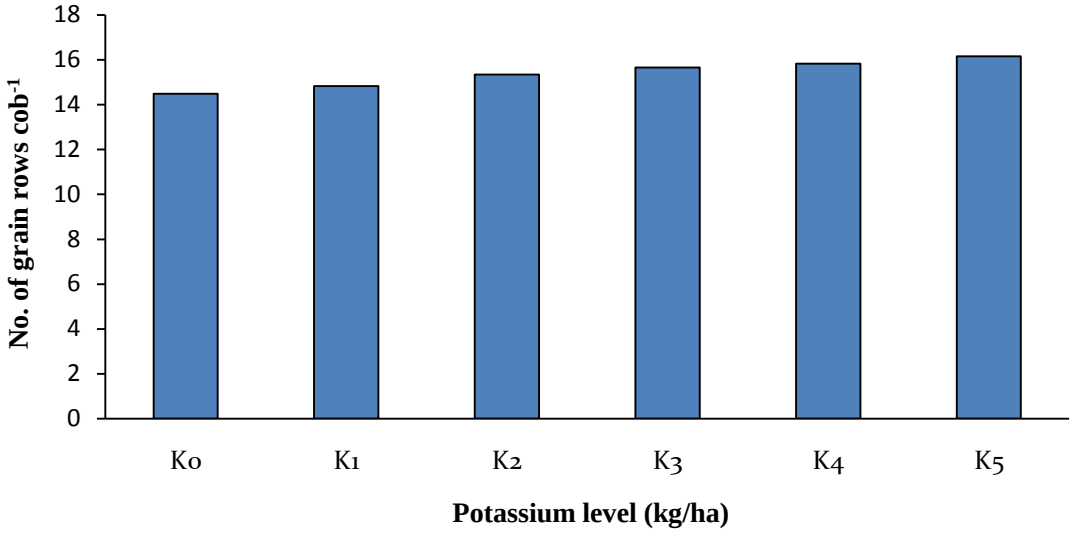


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 15 : Effect of variety on number of grain rows cob^{-1} of maize ($LSD_{(0.05)}$= 1.43)

4.2.3.2 Effect of potassium level

Different potassium level also showed significant affect on grain rows cob^{-1} (Figure 16). From the experiment result revealed that the maximum grain rows cob^{-1} (16.16) was observed from K_5 treatment which was statistically similar with K_4 treatment followed by K_3 treatment and K_2 treatment. Whereas the minimum grain rows cob^{-1} (14.49) was observed from K_0 treatment which was statistically similar with K_1 treatment. Jasar *et al.* (2019) and Swetha *et al.* (2017) also found similar result, which supported the present finding.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 16 : Effect of potassium level on number of grain rows cob^{-1} of maize ($LSD_{(0.05)}$= 0.98).

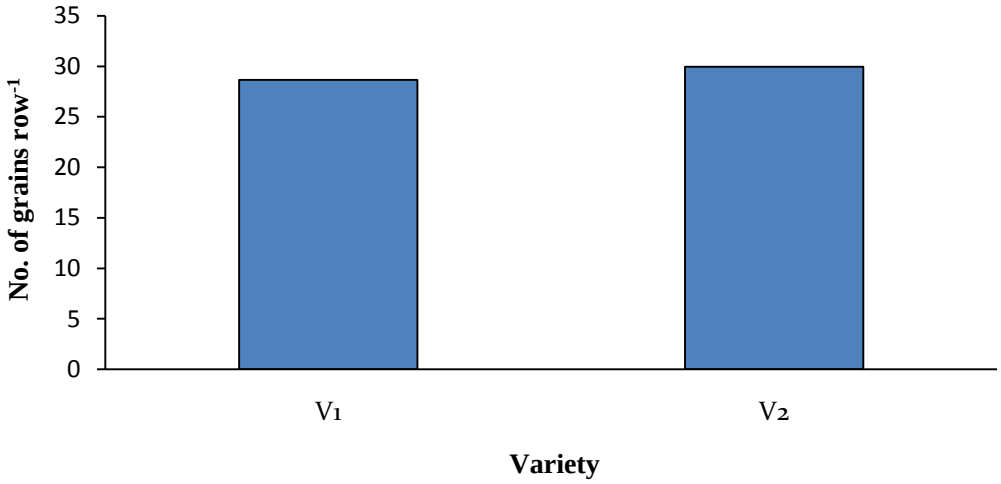
4.2.3.3 Interaction effect of variety and potassium level on grain rows cob-^{1} of maize

Interaction effect of different variety and potassium level showed significant effect on grain rows cob^{-1} of maize (Table 7). From the experiment result expressed that maximum grain rows cob^{-1} (16.66) was observed from the treatment combination of V_2K_5 which was statistically similar with all others treatment excepts V_1K_0, V_1K_1 and V_1K_2 treatment combination. Whereas minimum grain rows cob^{-1} (12.66) was observed from V_1K_0 treatment combination which was statistically similar with V_1K_1 treatment combination.

4.2.4 Number of grains row^{-1}

4.2.4.1 Effect of variety

Maize variety showed non significant affect on number of grains row^{-1} (Figure 17). From the experiment result revealed that the maximum number of grains row^{-1} (29.965) was observed from V_2 treatment. Whereas the minimum number of grains row-^{1} (28.665) was observed from V_1 treatment.

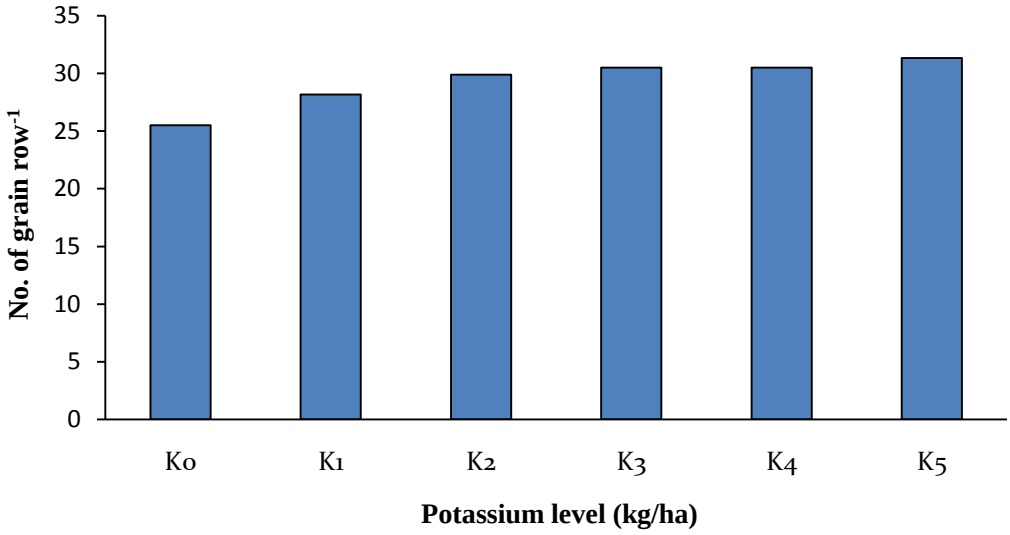


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 17 : Effect of variety on number of grains row^{-1} (LSD$_{(0.05)}$= NS).

4.2.4.2 Effect of potassium level

Different potassium level also showed significant affect on number of grains row^{-1} (Figure 18). From the experiment result revealed that the maximum number of grains row^{-1} (31.33) was observed from K_5 treatment which was statistically similar all other treatments except K_0 and K_1. Whereas the minimum number of grains row-^{1} (25.5) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 18 : Effect of potassium level on number of grains row^{-1} ($LSD_{(0.05)}$= 1.47).

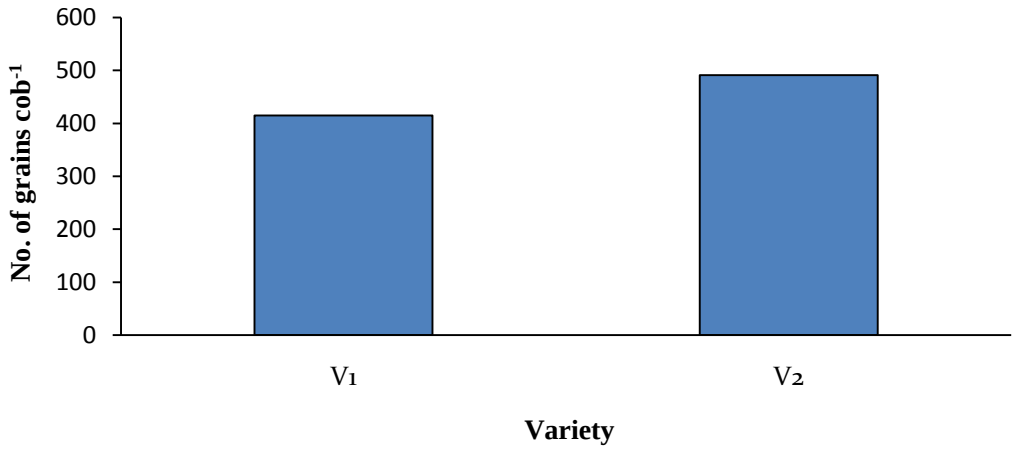
4.2.4.3 Interaction effect of variety and potassium level on grains row^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on number of grains row^{-1} of maize (Table 7). From the experiment result expressed that maximum number of grains row^{-1} (31.33) was observed from the treatment combination of V_2K_5 which was statistically similar with all others treatment excepts V_1K_0, V_1K_1 treatment combination .Whereas minimum number of grains row-^{1} (23) was observed from V_1K_0 treatment combination.

4.2.5 Number of grains cob^{-1}

4.2.5.1 Effect of variety

Maize variety showed significant affect on number of grains cob^{-1} (Figure 19). From the experiment result revealed that the maximum number of grains cob^{-1} (491.05) was observed from V_2 treatment. Whereas the minimum number of grains cob^{-1} (415.2) was observed from V_1 treatment.

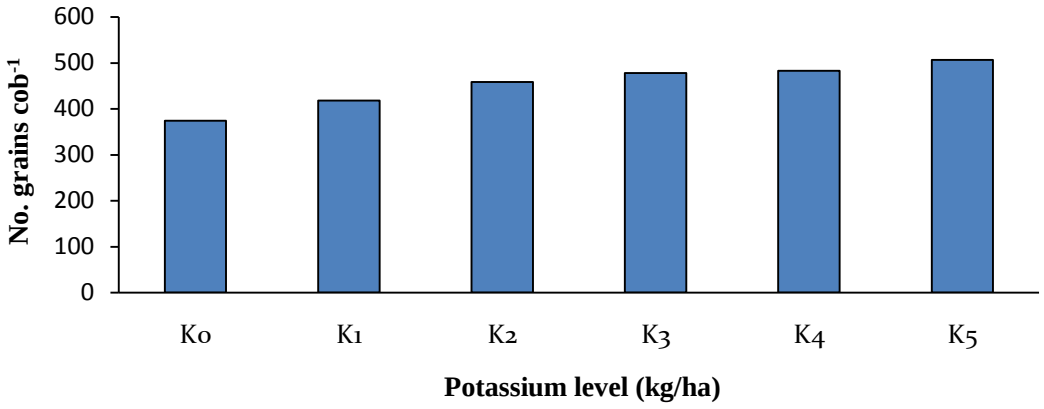


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 19 : Effect of variety on number of grains cob^{-1} (LSD$_{(0.05)}$= 43.03).

4.2.5.2 Effect of potassium level

Different potassium level also showed significant affect on number of grains cob^{-1} (Figure 20). From the experiment result revealed that the maximum number of grains cob^{-1} (506.29) was observed from K_5 treatment which was statistically similar with K_4 and K_3 treatment. Whereas the minimum number of grains cob^{-1} (374.21) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 20 : Effect of potassium level on number of grains cob^{-1} (LSD$_{(0.05)}$= 29.50).

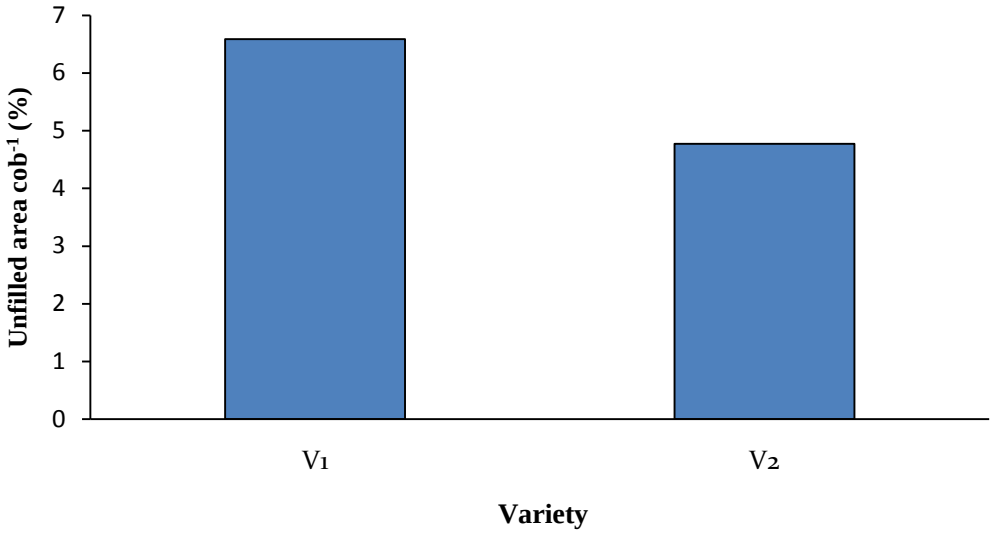
4.2.5.3 Interaction effect of variety and potassium level on number of grains cob^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on number of grains cob^{-1} of maize (Table 7). From the experiment result expressed that maximum number of grains cob^{-1} (521.96) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_2K_4, V_2K_3, V_1K_5 and V_2K_2 treatment combination .Whereas minimum number of grains cob^{-1} (291.18) was observed from V_1K_0 treatment combination. Jasar *et al. (*2019) and Akil *et al.* (2018) also found similar results with the present study.

4.2.6 Unfilled area cob^{-1} (%)

4.2.6.1 Effect of variety

Maize variety showed significant affect on unfilled area cob^{-1} (%) (Figure 21). From the experiment result revealed that the maximum unfilled area cob^{-1} (%) (6.59) was observed from V_1 treatment. Whereas the minimum unfilled area cob^{-1} (%) (4.775) was observed from V_2 treatment.

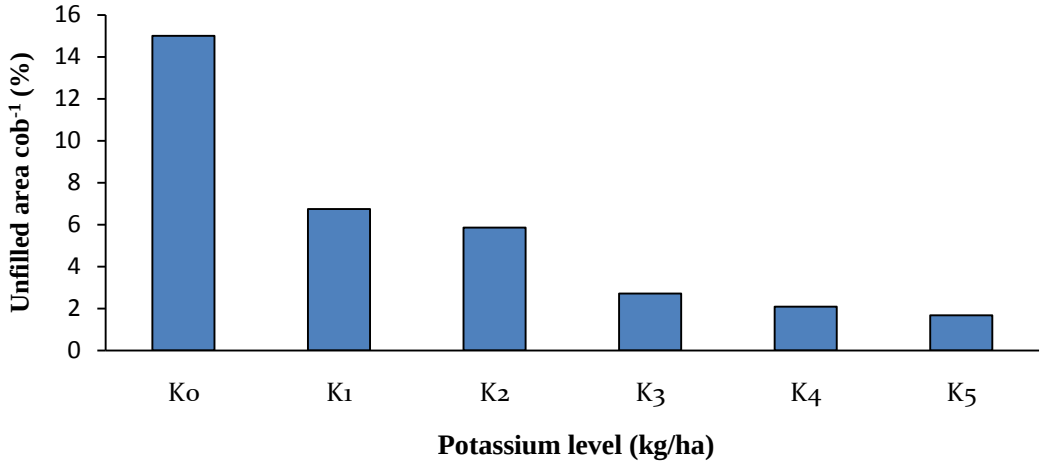


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 21: Effect of variety on unfilled area cob^{-1} (%) (LSD$_{(0.05)}$= 0.49).

4.2.6.2 Effect of potassium level

Different potassium level also showed significant affect on unfilled area cob^{-1} (%) (Figure 22). From the experiment result revealed that the maximum unfilled area cob^{-1} (%) (15.01 %) was observed from K_0 treatment. Whereas the minimum unfilled area cob^{-1} % (1.675 %) was observed from K_5 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 22: Effect of potassium level on unfilled area cob^{-1} (%) ($LSD_{(0.05)}$= 0.39).

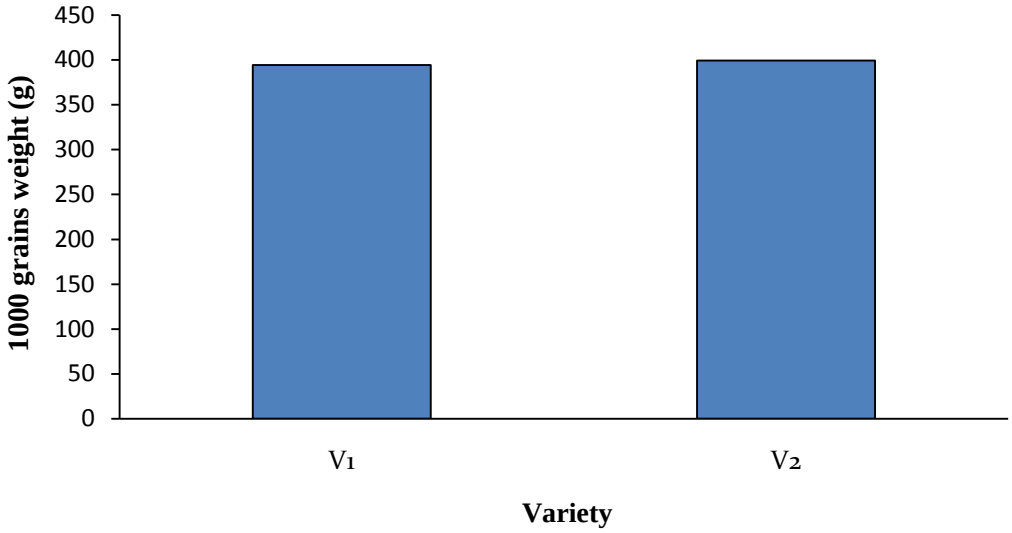
4.2.6.3 Interaction effect of variety and potassium level on unfilled area cob^{-1} (%) of maize

Interaction effect of different variety and potassium level showed significant effect on unfilled area cob^{-1} (%) of maize (Table 7). From the experiment result expressed that highest unfilled area cob^{-1} (%) (16.510 %) was observed from the treatment combination of V_1K_0.Whereas minimum unfilled area cob^{-1} (%) (1.550 %) was observed from V_2K_5 treatment combination which was statistically similar with the treatment combination of V_1K_5, followed by V_2K_4 and V_2K_3 treatment combination.

4.2.7 1000 grains weight (g)

4.2.7.1 Effect of variety

Maize variety showed non significant affect on 1000 grain weight (g) (Figure 23). From the experiment result revealed that the maximum 1000 grain weight (399.33 g) was observed from V_2 treatment. Whereas the 1000 grain weight cob^{-1} (394.50 g) was observed from V_1 treatment. Hasan *et al.* (2018), Akil *et al.* (2018), Hussain *et al.* (2007) also found similar result which supported the present finding.



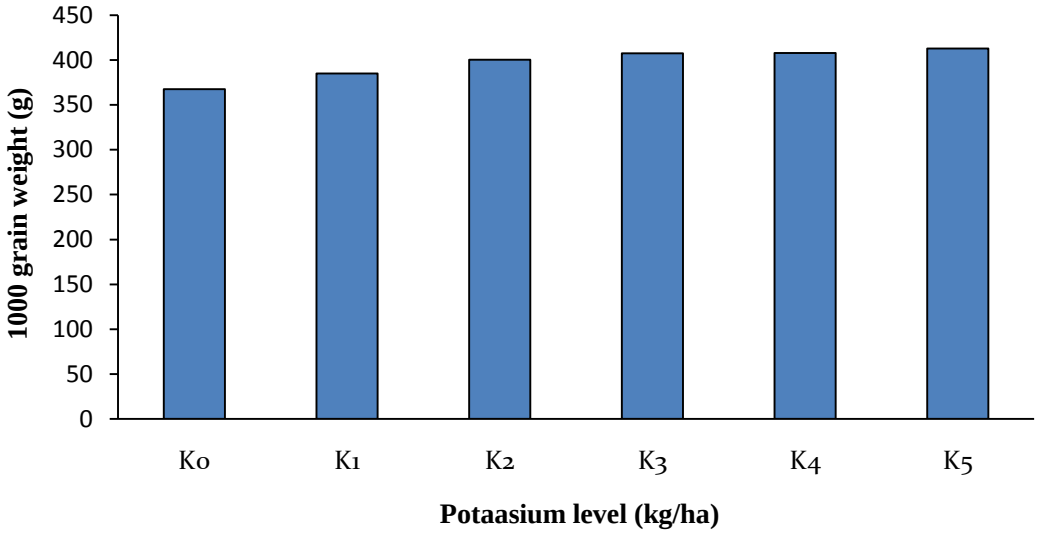
V_1: SAU Hybrid Vutta-1 and V_2: SAU Hybrid Vutta-2

Figure 23 : Effect of variety on 1000 grains weight (g) of maize ($LSD_{(0.05)}$= 32.34).

4.2.7.2 Effect of potassium level

Different potassium level showed significant affect on 1000 grain weight cob^{-1} (Figure 24). From the experiment result revealed that the maximum 1000 grain weight (413.0 g) was observed from K_5 treatment which was statistically similar with all others treatment except K_0 and K_1 treatment. Whereas the minimum 1000 grain weight (367.50 g) was observed from K_0 treatment which was statistically similar with K_1 treatment. Jasar *et al. (*2019) reported that application of potash at the rate of 120kg h-1 produced heavier thousand grains weight (414.87g), followed by 90kg ha^{-1} (391.68 d) then by 60kg ha^{-1} (378.12g), while no application of potash resulted in lighter thousand grains weight (354. 12g). Hussain *et al.* (2007) also reported that in

case of potassium levels, maximum (307 g) 1000-grains weight was found with 90 kg K ha^{-1}, while minimum (233 g) was obtained with 30 kg K ha^{-1}.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 24 : Effect of potassium level on 1000 grains weight (g) of maize ($LSD_{(0.05)}$= 22.26).

4.2.7.3 Interaction effect of variety and potassium level on 1000 grain weight cob^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on 1000 grain weight $cob^{-1}$of maize (Table 7). From the experiment result expressed that highest 1000 grains weight of (420.0 g) was observed from the treatment combination of V_2K_5 which was statistically similar with all other treatment except V_1K_0, V_2K_0, and V_2K_1, treatment combination .Whereas minimum 1000 grain weight (365.0 g) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_2K_0, followed by V_2K_1 treatment combination . similar results also found by Akil *et al.* (2018) and Jan *et al.* (2018) with the present study.

Table 7: Interaction effect of variety and level of potassium on number of row in a cob, number of grain in a row, number of grain cob^{-1} and unfilled area cob^{-1} (%) of maize at harvest

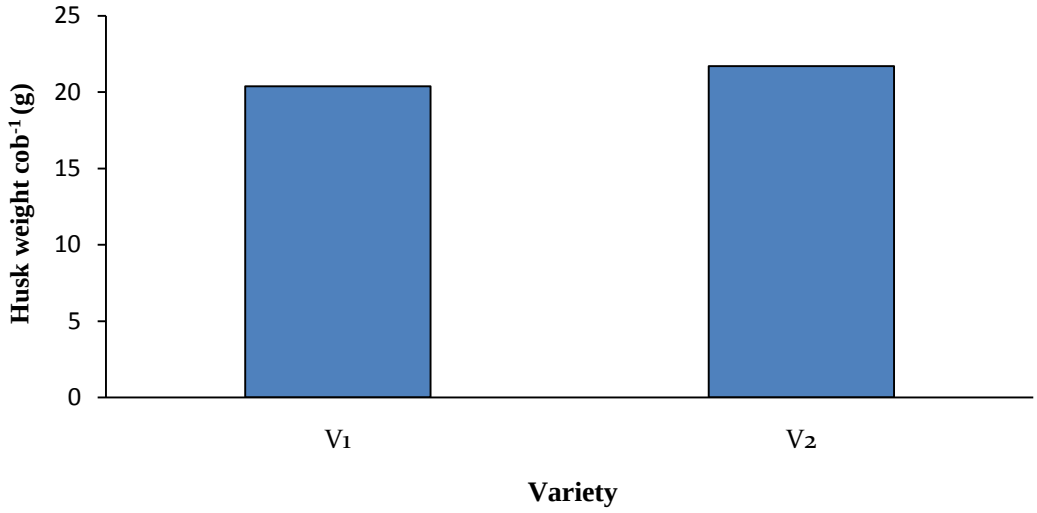
Treatment Interaction	Row cob^{-1}	Grains row^{-1}	Grains cob^{-1}	Unfilled area cob^{-1} (%)	1000 grains weight (g)
V_1K_0	12.66 d	23.00 d	291.18 f	16.51 a	365.00 d
V_1K_1	13.33 cd	27.66 c	368.71 e	8.03 c	390.00 a-d
V_1K_2	14.36 bc	30.00 ab	430.80 d	7.41 d	395.00 a-d
V_1K_3	15.00 ab	30.00 ab	450.00 cd	3.43 g	405.00 a-c
V_1K_4	15.33 ab	30.00 ab	459.90 bd	2.36 h	406.00 a-c
V_1K_5	15.66 ab	31.33 a	490.63 a-c	1.80 i	406.00 a-c
V_2K_0	16.33 a	28.00 bc	457.24 cd	13.51 b	370.00 cd
V_2K_1	16.33 a	28.66 a-c	468.02 b-d	5.46 e	380.00 b-d
V_2K_2	16.33 a	29.80 a-c	486.63 a-c	4.30 f	406.00 a-c
V_2K_3	16.33 a	31.00 a	506.23 ab	2.00 hi	410.00 ab
V_2K_4	16.33 a	31.00 a	506.23 ab	1.83 hi	410.00 ab
V_2K_5	16.66 a	31.33 a	521.96 a	1.55 i	420.00 a
$LSD_{(0.05)}$	1.3906	2.0860	41.719	0.5497	31.482
CV(%)	5.31	4.18	5.41	5.68	4.66

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.2.8 Husk weight cob^{-1}

4.2.8.1 Effect of variety

Maize variety showed non significant affect on husk weight cob-^{1} (Figure 25). From the experiment result revealed that the maximum husk weight cob-^{1} (21.697g) was observed from V_2 treatment. Whereas the minimum husk weight cob-^{1} (20.39 g) was observed from V_1 treatment.

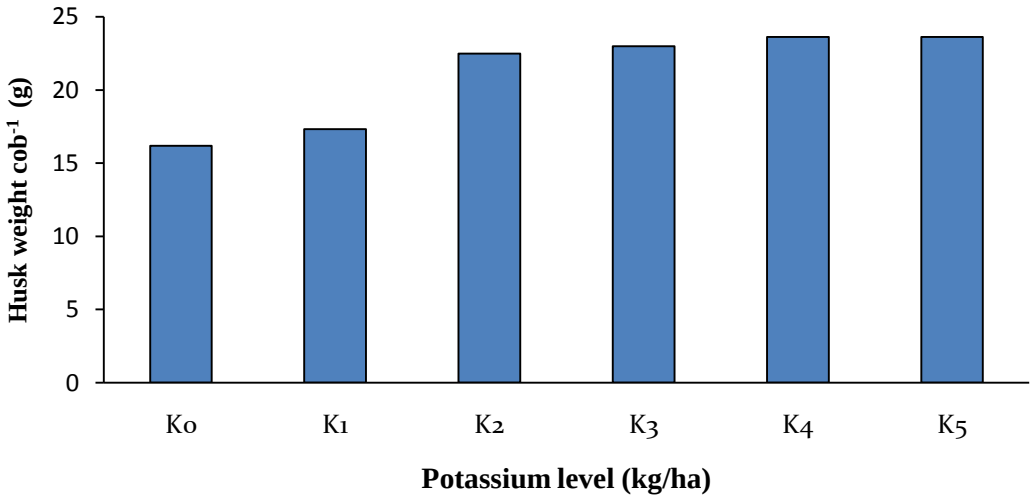


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 25 : Effect of variety on husk weight weight cob^{-1} (g) ($LSD_{(0.05)}$= 2.15).

4.2.8.2 Effect of potassium level

Different potassium level also showed significant affect on husk weight cob-^{1}(Figure 26). From the experiment result revealed that the maximum husk weight cob-^{1} (23.63 g) was observed from K_5 treatment which was similar with K_4 treatment followed by K_3 and K_2 treatment. Whereas the minimum husk weight cob-^{1} (16.18 g) was observed from K_0 treatment which was statistically similar with K_1 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 26: Effect of potassium level on husk weight weight cob^{-1} (g) LSD$_{(0.05)}$= 1.48).

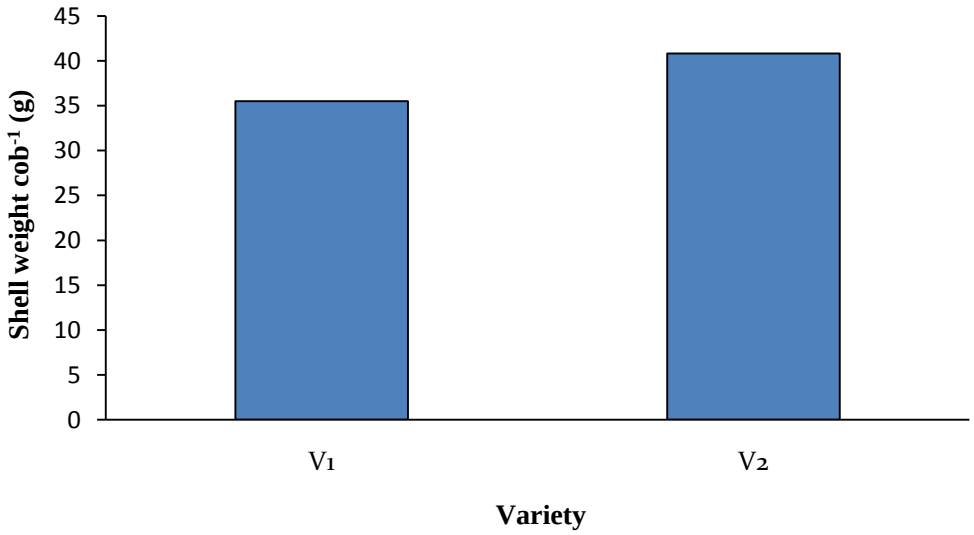
4.2.8.3 Interaction effect of variety and potassium level on husk weight cob^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on husk weight cob^{-1} of maize (Table 8). From the experiment result expressed that maximum husk weigh cob^{-1} (23.600 g) was observed from the treatment combination of V_2K_5 which was statistically similar with all others treatment combination except V_1K_0, V_1K_1, V_2K_0 and V_2K_1 treatment combination. Whereas minimum husk weight cob-^{1} (14.36) was observed from V_1K_1 treatment combination which was statistically similar with the treatment combination of V_1K_1 treatment combination.

4.2.9 Shell weight cob^{-1} (g)

4.2.9.1 Effect of variety

Maize variety showed significant affect on shell weight cob^{-1} (Figure 27). From the experiment result revealed that the maximum shell weight cob^{-1} (40.818 g) was observed from V_2 treatment. Whereas the minimum shell weight cob^{-1} (35.497 g) was observed from V_1 treatment.

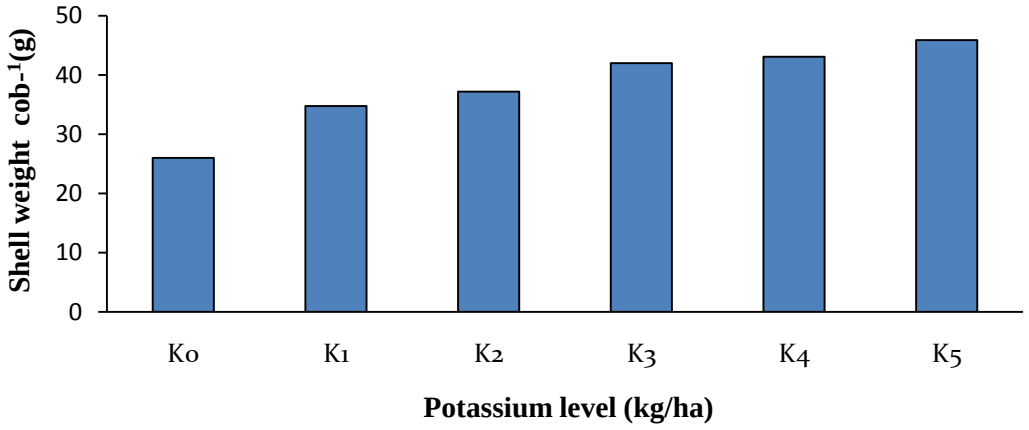


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 27 : Effect of variety on shell weight cob^{-1} (g) (LSD$_{(0.05)}$= 3.68).

4.2.9.2 Effect of potassium level

Different potassium level also showed significant affect on shell weight cob^{-1} (Figure 28). From the experiment result revealed that the maximum shell weight cob^{-1} (45.915 g) was observed from K_5 treatment. Whereas the minimum shell weight cob^{-1} (25.995 g) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 28: Effect of potassium level on shell weight cob^{-1} (g) ($LSD_{(0.05)}$= 2.65).

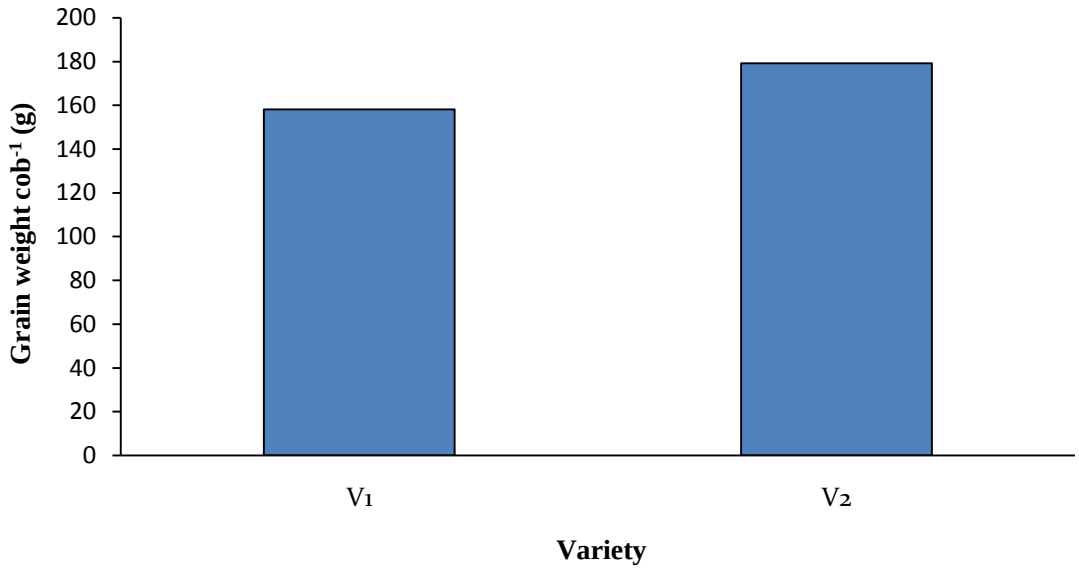
4.2.9.3 Interaction effect of variety and potassium level on shell weight cob^{-1} maize

Interaction effect of different variety and potassium level showed significant effect on shell weight cob^{-1} of maize (Table 8). From the experiment result expressed that maximum shell weight cob^{-1} (47.33 g) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_2K_4 .Whereas minimum shell weight cob^{-1} (23.66 g) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_2K_0 treatment combination.

4.2.10 Grain weight cob^{-1} (g)

4.2.10.1 Effect of variety

Maize variety showed significant affect on grain weight cob^{-1} (Figure 29). From the experiment result revealed that the maximum grain weight cob^{-1} (179.17 g) was observed from V_2 treatment. Whereas the minimum grain weight cob^{-1} (158.10 g) was observed from V_1 treatment.

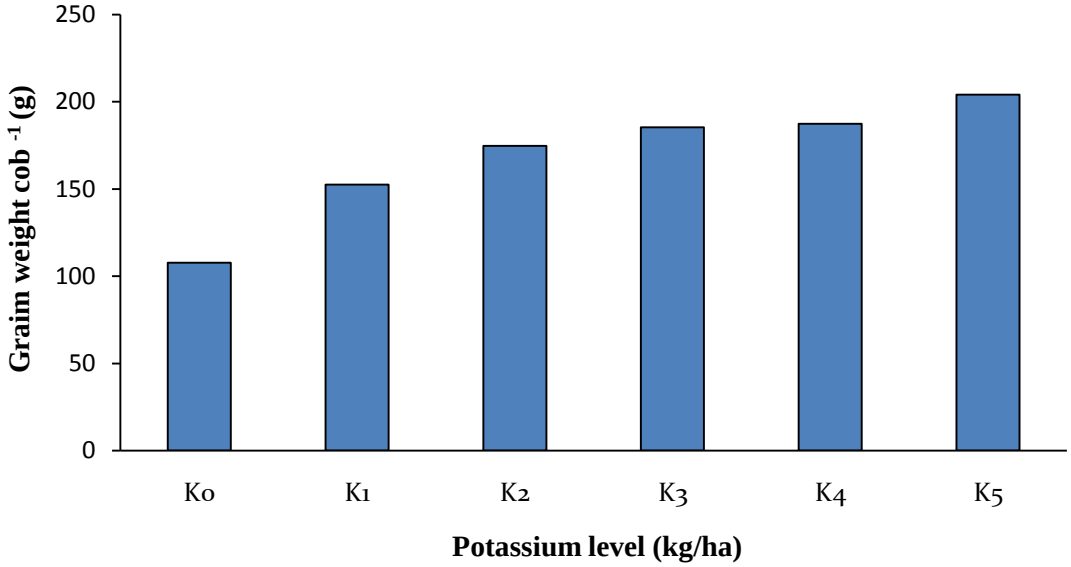


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 29 : Effect of variety on grain weight cob^{-1} (g) (LSD$_{(0.05)}$= 16.43).

4.2.10.2 Effect of potassium level

Different potassium level also showed significant affect on grain weight cob-^{1} (Figure 30). From the experiment result revealed that the maximum grain weight cob-^{1} (204.08 g) was observed from K_5 treatment. Whereas the minimum grain weight cob-^{1} (107.75 g) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 30 : Effect of potassium level on grain weight cob^{-1} (g) ($LSD_{(0.05)}$= 14.65).

4.2.10.3 Interaction effect of variety and potassium level on grain weight cob^{-1} maize

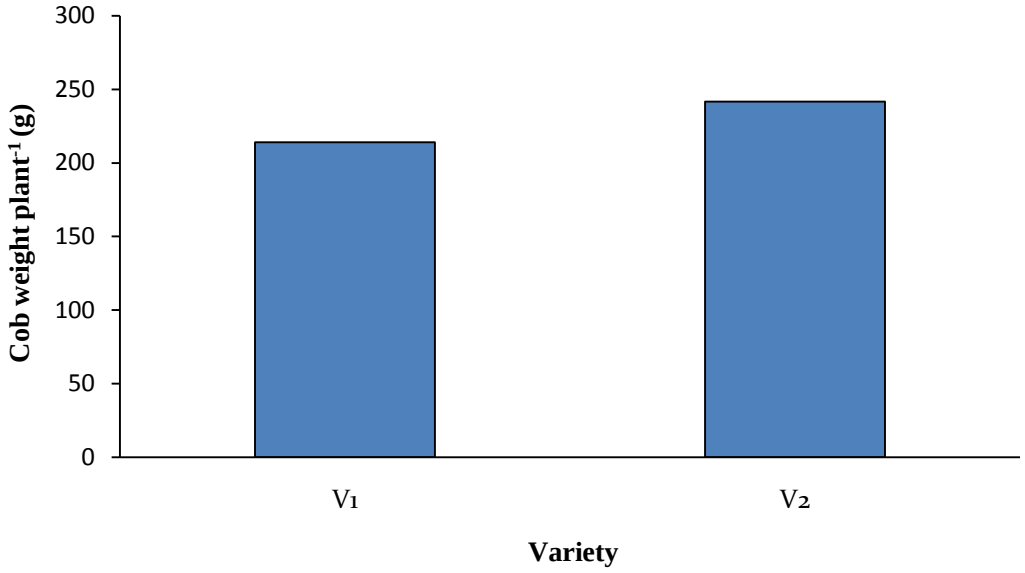
Interaction effect of different variety and potassium level showed significant effect on grain weight cob-^{1} of maize (Table 8). From the experiment result expressed that maximum grain weight cob-^{1} (208.78 g) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_1K_5 followed by V_2K_4 and V_2K_3 .Whereas minimum grain weight cob-^{1} (100.46 g) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_2K_0 treatment combination.

4.2.11 Cob weight plant^{-1} (g)

4.2.11.1 Effect of variety

Maize variety showed significant affect on cob weight plant^{-1} (g) (Figure 31). From the experiment result revealed that the maximum cob weight plant^{-1} (241.68 g) was observed from V_2 treatment. Whereas the minimum cob weight plant^{-1} (213.98 g) was observed from V_1 treatment. Khan *et al.* (2017) reported that growth yield attributes

viz., cob weight with husk (325.27 g), cob weight without husk (250.30 g) were recorded maximum in ‘sweety’ as compared to ‘Sweet glory’ variety.

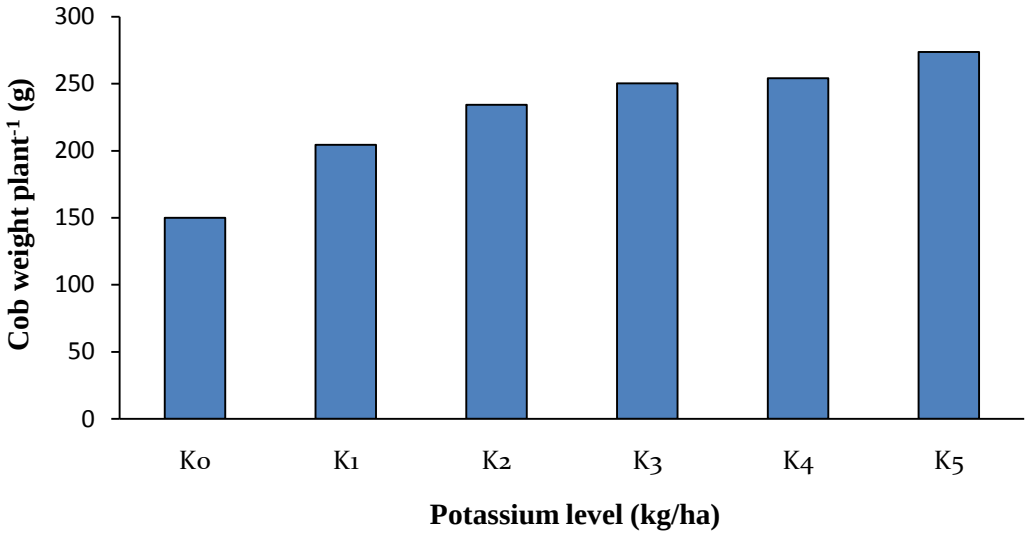


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 31 : Effect of variety on cob weight plant^{-1} (g) (LSD$_{(0.05)}$= 21.91).

4.2.11.2 Effect of potassium level

Different potassium level also showed significant affect on cob weight plant^{-1} (Figure 32) . From the experiment result revealed that the maximum cob weight plant^{-1} (273.63 g) was observed from K_5 treatment. Whereas the minimum cob weight plant^{-1} (149.92 g) was observed from K_0 treatment. Hussain *et al*. (2007) found similar result which supported the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 32: Effect of variety on cob weight plant^{-1} (g) ($LSD_{(0.05)}$= 15.55).

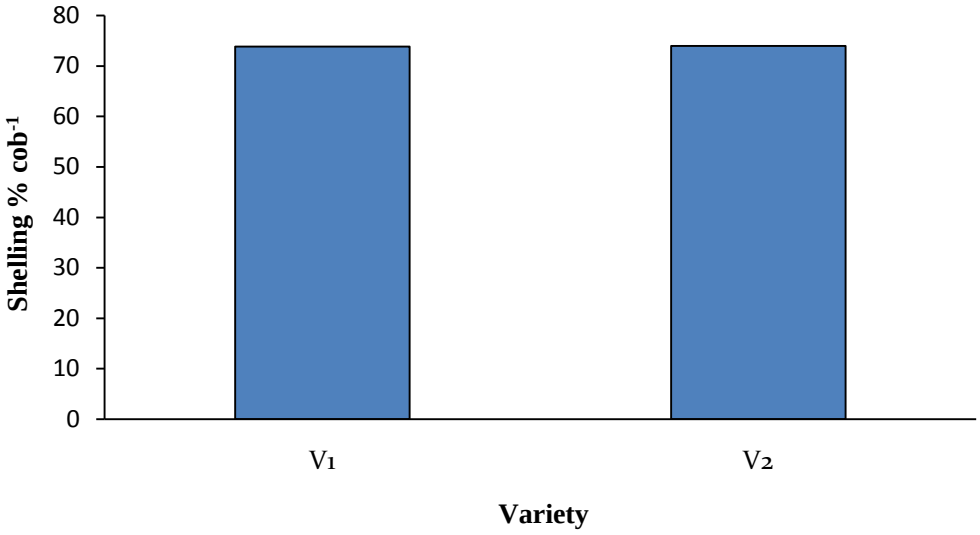
4.2.11.3 Interaction effect of variety and Potassium level on cob weight plant^{-1} maize

Interaction effect of different variety and potassium level showed significant effect cob weight plant^{-1} of maize (Table 8). From the experiment result expressed that maximum cob weight plant^{-1} (279.71 g) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_1K_5 followed by V_2K_4 and V_2K_3 .Whereas minimum cob weight plant^{-1} (100.46 g) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_2K_0 treatment combination .

4.2.12 Shelling %

4.2.12.1 Effect of variety

Maize variety showed non significant affect on shelling percentage (Figure 33). From the experiment result revealed that the maximum shelling percentage (73.952 %) was observed from V_2 treatment. Whereas the minimum shelling percentage (73.821 %) was observed from V_1 treatment.

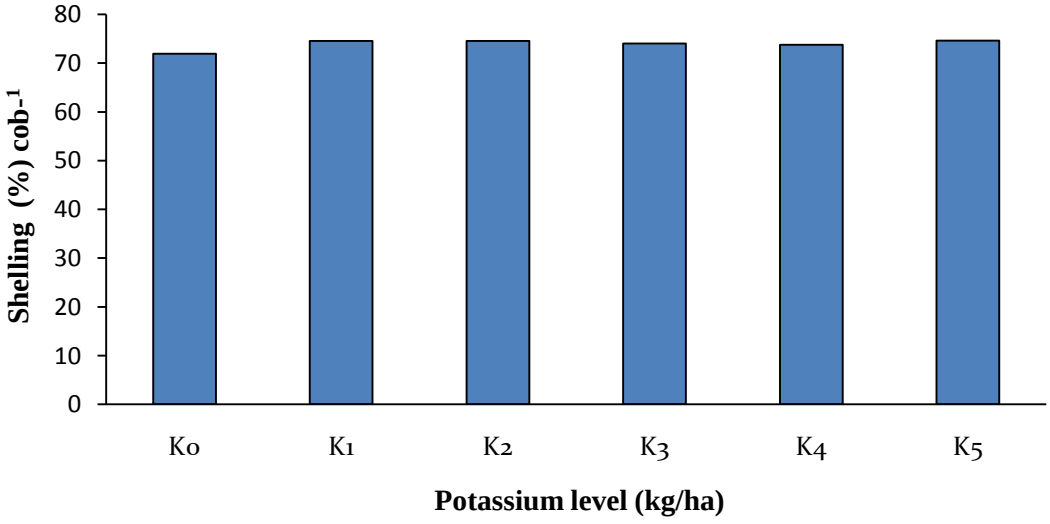


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 33 : Effect of variety on shelling % cob^{-1} (LSD$_{(0.05)}$= 7.36).

4.2.13.2 4.1.2.2 Effect of potassium level

Different potassium level showed non significant affect on shelling percentage (Figure 34). From the experiment result revealed that the maximum shelling percentage (74.583 %) was observed from K_5 treatment. Whereas the minimum shelling percentage (71.916 %) was observed from K_0 treatment.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 34 : Effect of potassium level on shelling % cob^{-1} (LSD$_{(0.05)}$= 5.30).

4.2.13.3 Interaction effect of variety and potassium level on shelling % cob^{-1}of maize

Interaction effect of different variety and potassium level showed non significant effect on shelling percentage of maize (Table 8). From the experiment result expressed that maximum shelling percentage (74.642 %) was observed from the treatment combination of V_2K_5 .Whereas minimum shelling percentage (72.544 %) was observed from V_1K_0 treatment combination .

Table 8: Interaction effect of variety and potassium level on husk weight cob^{-1}, shell weight cob^{-1}, grain weight cob^{-1}, cob weight plant^{-1}, and shelling percentages

Treatment Interaction	Husk weight cob^{-1} (g)	Shell weight cob^{-1} (g)	Grain weight cob^{-1} (g)	Cob weight plant^{-1} (g)	Shelling percentage (%)
V_1K_0	14.36 c	23.66 e	100.46 g	138.48 h	72.54
V_1K_1	16.00 bc	30.16 d	136.42 f	182.58 g	74.72
V_1K_2	22.33 a	32.66 d	161.55 e	216.54 f	74.61
V_1K_3	22.33 a	40.50 bc	173.25 de	236.08d ef	73.39
V_1K_4	23.66 a	41.50 bc	177.52 c-e	242.68 c-e	73.15
V_1K_5	23.66 a	44.50 ab	199.38 ab	267.54 ab	74.52
V_2K_0	18.00 b	28.33 de	115.03 fg	161.36 gh	71.29
V_2K_1	18.66 b	39.33 c	168.49 de	226.48 ef	74.39
V_2K_2	22.66 a	41.76 bc	187.84 b-d	252.26 b-d	74.46
V_2K_3	23.66 a	43.50 b	197.43 a-c	264.59 a-c	74.62
V_2K_4	23.60 a	44.66 ab	197.43 a-c	265.69 a-c	74.31
V_2K_5	23.60 a	47.33 a	208.78 a	279.71 a	74.64
$LSD_{(0.05)}$	2.09	3.74	20.714	21.99	Ns
CV(%)	5.82	5.76	7.21	5.67	5.95

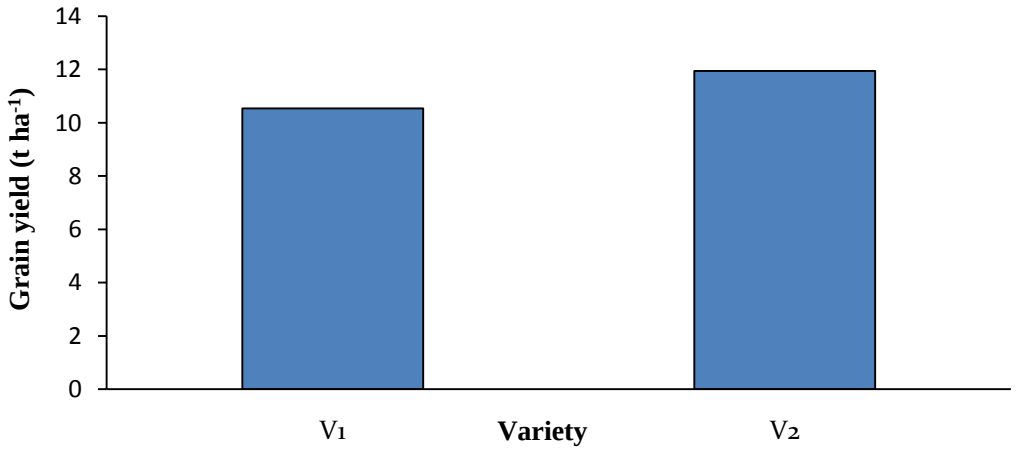
In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

4.3 Yield characters

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

4.3.1.1 Effect of variety

Maize variety showed significant affect on grain yield (t ha^{-1}) (Figure 35) . From the experiment result revealed that the maximum grain yield (11.94 t ha^{-1}) was observed from V_2 treatment. Whereas the minimum grain yield (10.54 t ha^{-1}) was observed from V_1 treatment. Hasan *et al.* (2018), Ghimire *et al.* (2016), Asaduzzaman *et al.* (2014), Enujeke (2013 b), Shafi *et al.* (2012) and Asafu-Agyei (1990) found similar result which supported the present study.

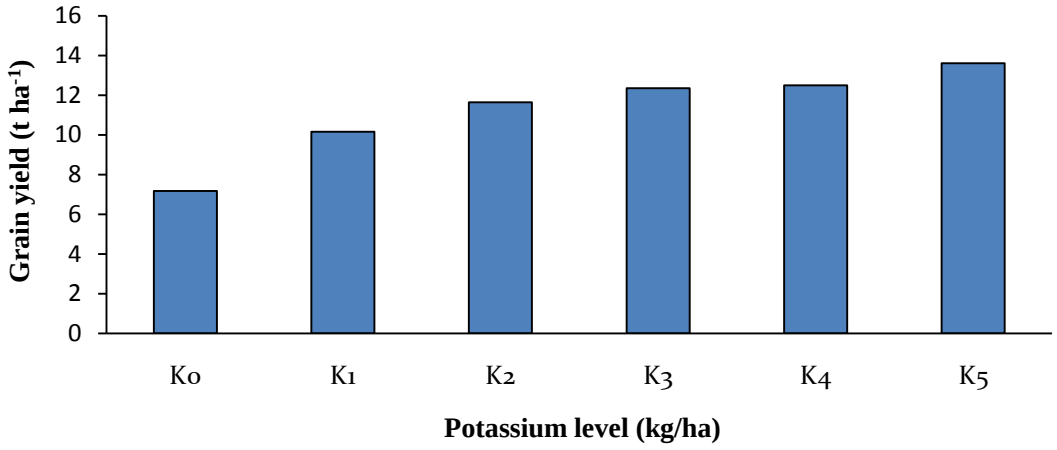


V_1: SAU Hybrid Vutta-1 and V_2: SAU Hybrid Vutta-1

Figure 35 : Effect of variety on grain yield (t ha^{-1}) of maize (LSD$_{(0.05)}$= 1.09).

4.3.1.2 Effect of potassium level

Different potassium level showed significant affect on grain yield (t ha^{-1}) of maize (Figure 36). From the experiment result revealed that the maximum grain yield (13.61 t ha^{-1}) was observed from K_5 treatment. Whereas the minimum grain yield (7.18 t ha^{-1}) was observed from K_0 treatment. Jasar *et al. (*2019) and Sadiq *et al.* (2017) also found similar results with the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 36: Effect of potassium level on grain yield (t ha^{-1}) of maize ($LSD_{(0.05)}$= 0.78).

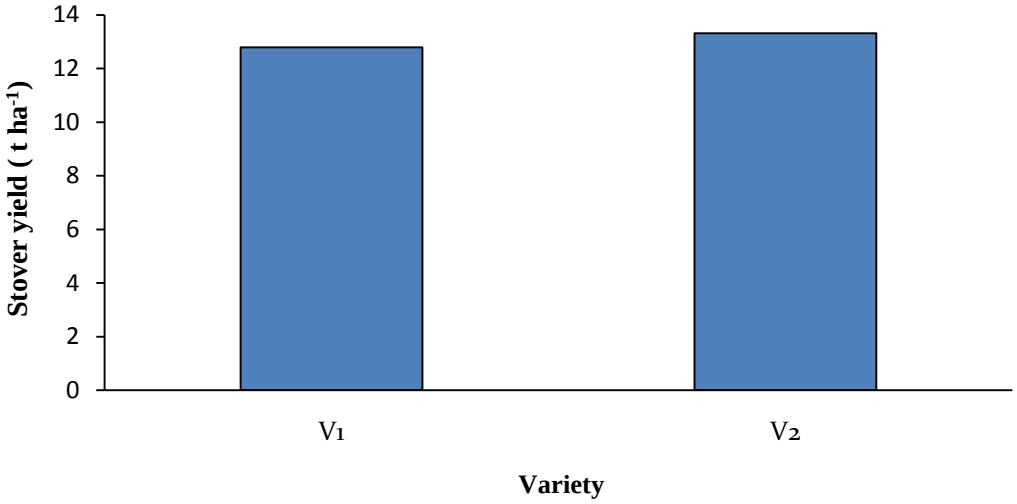
4.3.1.3 Interaction effect of variety and potassium level on grain yield of maize

Interaction effect of different variety and potassium level showed significant effect on grain yield (t ha-^{1}) of maize (Table 9). From the experiment result expressed that maximum grain yield (13.92 t ha-^{1}) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_1K_5 followed by V_2K_4 and V_2K_3 treatment combination .Whereas minimum grain yield (6.70 t ha^{-1}) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_1K_0. Jasar *et al. (*2019), Akil *et al*. (2018), and Jan *et al.* (2018) found similar result which supported the present study. The result obtained from the present study was similar with the findings of Jasar *et al. (*2019) , Jan *et al.* (2018) and Dulami and Hadethi (2015).

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

4.3.2.1 Effect of variety

Maize variety showed non significant affect on stover yield (t ha^{-1}) (Figure 37). From the experiment result revealed that the maximum stover yield (13.32 t ha^{-1}) was observed from V_2 treatment. Whereas the minimum stover yield (12.80 t ha^{-1}) was observed from V_1 treatment. Hasan *et al.* (2018) and Shafi *et al.* (2012) found similar result which supported the present study.

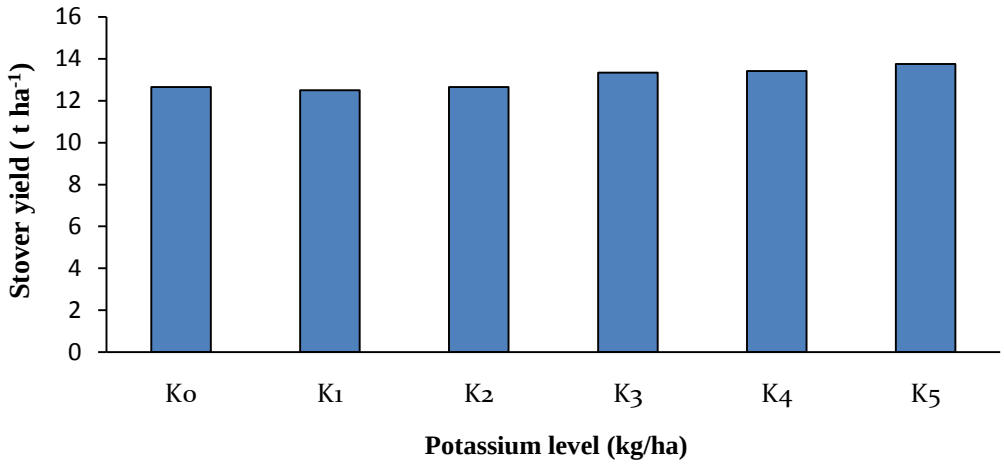


V_1: SAU Hybrid Vutta-1 and V_2: SAU Hybrid Vutta-2

Figure 37: Effect of variety on stover yield (t ha^{-1}) of maize (LSD$_{(0.05)}$= 0.69).

4.3.2.2 Effect of potassium level

Different potassium level showed significant affect on stover yield (t ha-^{1}) of maize(Figure 38). From the experiment result revealed that the maximum stover yield (13.76 t ha-^{1}) was observed from K_5 treatment which was statistically similar with K_4 and K_3 treatment. Whereas the minimum stover yield (12.50 t ha-^{1}) was observed from K_1 treatment which was statistically similar with K_0 and K_2 treatment . Sadiq *et al*. (2017) also found similar results with the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 38: Effect of variety on stover yield (t ha^{-1}) of maize ($LSD_{(0.05)}$= 0.59).

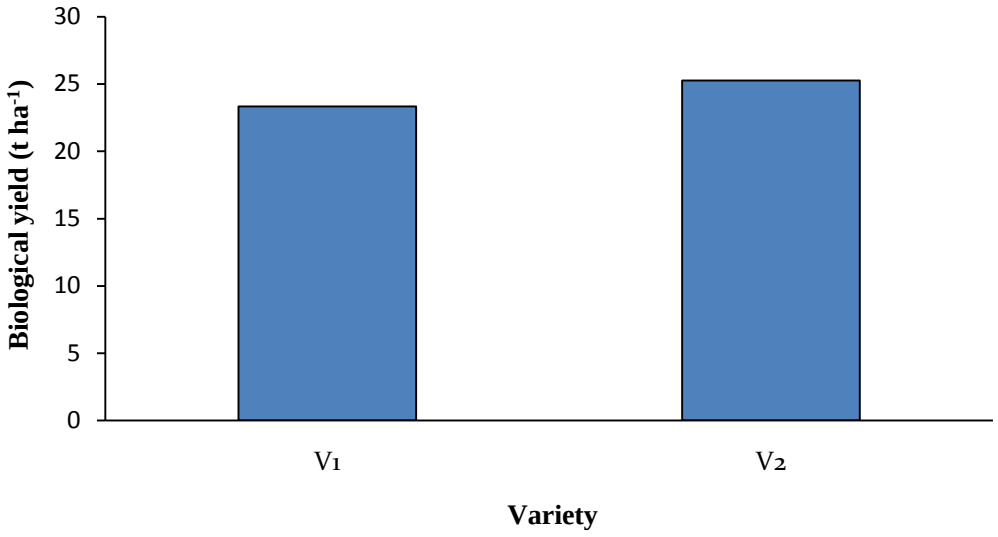
4.3.2.3 Interaction effect of variety and potassium level on stover yield of maize

Interaction effect of different variety and potassium level showed significant effect on stover yield (t ha^{-1}) of maize (Table 9). From the experiment result expressed that maximum stover yield (14.01 t ha^{-1}) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_2K_4 followed by V_2K_3, V_1K_5, V_1K_4 and V_1K_3 treatment combination .Whereas minimum stover yield (12.30 t ha^{-1}) was observed from V_1K_0 treatment combination which was statistically similar with the treatment combination of V_1K_0 followed by V_1K_1, V_1K_2, V_2K_1, V_2K_2 and V_2K_0 treatment combination.

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

4.3.3.1 Effect of variety

Maize variety showed significant affect on biological yield (t ha^{-1}) (Figure 39). From the experiment result revealed that the maximum biological yield (25.26 t ha^{-1}) was observed from V_2 treatment. Whereas the minimum biological yield (23.34 t ha^{-1}) was observed from V_1 treatment. Khan (2017) reported that Genotypes PS-1 and PS-2 produced biological yield (12679 and 12189 kg ha^{-1}) and performed better as compared to genotypes PS-3 and Iqbal (check). Shafi *et al.* (2012) also reported that the data showed that maximum biological yield was produced by Sarhad white and minimum by Pahari.

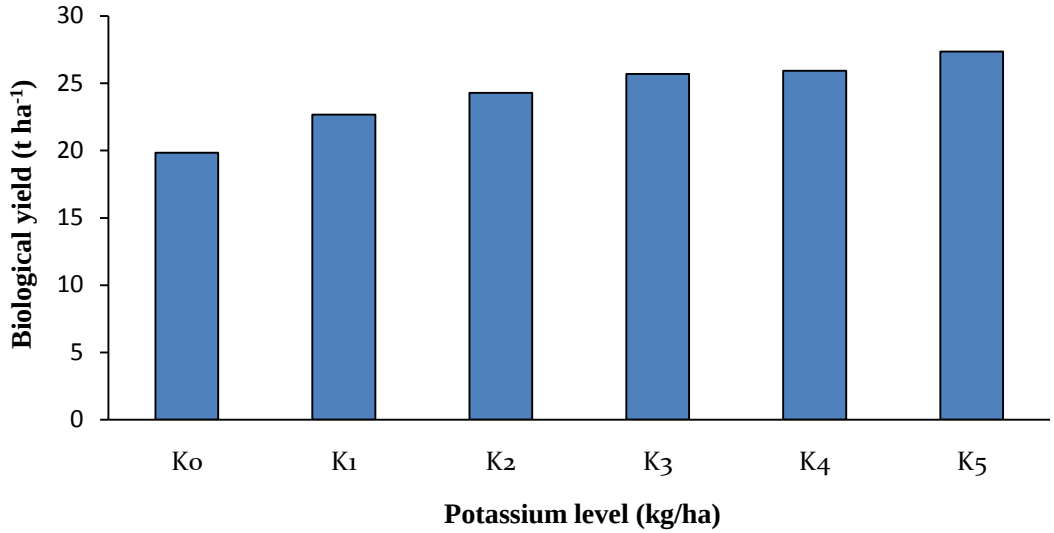


V1: SAU Hybrid Vutta 1 and V2: SAU Hybrid Vutta 2

Figure 39: Effect of variety on biological yield (t ha^{-1}) of maize ($LSD_{(0.05)}$= 1.92).

4.3.3.2 Effect of potassium level

Different potassium level showed significant affect on biological yield (t ha^{-1}) of maize (Figure 40). From the experiment result revealed that the maximum biological yield (27.367 t ha^{-1}) was observed from K_5 treatment which was statistically similar with K_4 treatment. Whereas the minimum biological yield (19.833 t ha^{-1}) was observed from K_0 treatment. Jasar *et al.* (2019) reported that the application of potash at the rate of 90 kg ha^{-1} resulted in higher biological yield (13580 kg ha^{-1}) however it was statistically at par with 120kg K ha^{-1}, followed by 60 kg K ha^{-1} (11502 kg ha^{-1}), while plots where potash was not applied resulted in lower biological yield (10496 kg ha^{-1}). Sadiq *et al*. (2017) also found similar result, which supported the present study.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 40: Effect of potassium level on biological yield (t ha^{-1}) of maize ($LSD_{(0.05)}$= 1.59).

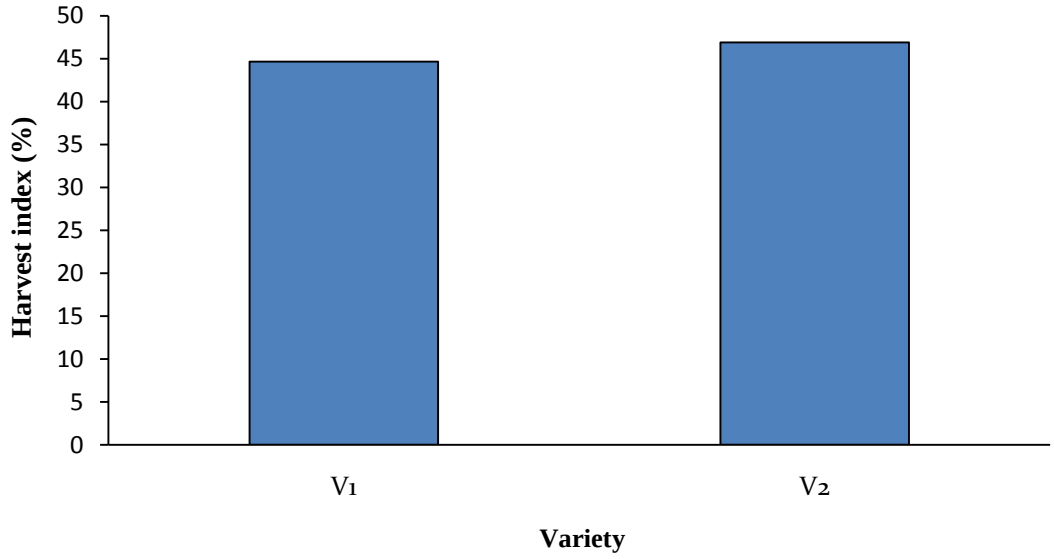
4.3.3.3 Interaction effect of variety and potassium level on biological yield of maize

Interaction effect of different variety and potassium level showed significant effect on biological yield (t ha-^{1}) of maize (Table 9). From the experiment result expressed that maximum biological yield (27.93 t ha^{-1}) was observed from the treatment combination of V_2K_5 which was statistically similar with the treatment combination of V_2K_4 followed by V_1K_5 and V_2K_5 treatment combination .Whereas minimum biological yield (19.00 t ha^{-1}) was observed from V_1K_0 treatment combination, which was statistically similar with the treatment combination of V_1K_0.

4.3.4 Harvest index (%)

4.3.4.1 Effect of variety

Maize variety showed non significant affect on harvest index (%) (Figure 41). From the experiment result revealed that the maximum harvest index (46.89 %) was observed from V_2 treatment. Whereas the minimum harvest index (44.68 %) was observed from V_1 treatment. Khan (2017) and Shafi *et al.* (2012) also found similar result which supported the present study.

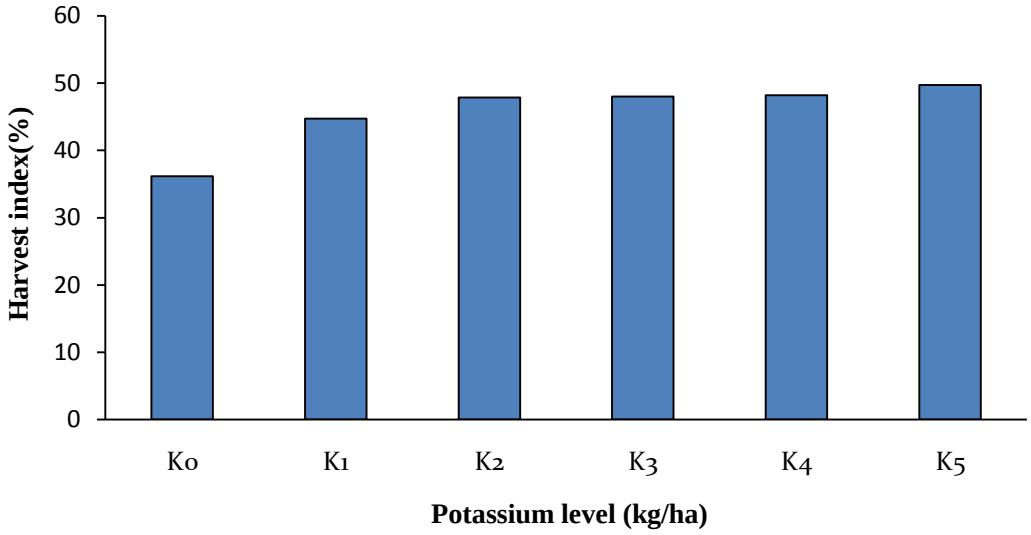


V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2

Figure 41: Effect of variety on harvest index (%) of maize ($LSD_{(0.05)}$= 3.58).

4.3.4.2 Effect of potassium level

Different potassium level showed significant affect on harvest index (%) of maize (Figure 42). From the experiment result revealed that the maximum harvest index (49.71 %) was observed from K_5 treatment, which was statistically similar with K_4 treatment followed by K_4, K_3, and K_2 treatment. Whereas the minimum harvest index (36.178 %) was observed from K_0 treatment. Sadiq *et al*. (2017) reported that that increase in harvest index (38.2 %) was recorded in those experimental units where potash was applied at the rate of 120 kg ha^{-1} were statistically at par with those plots where potash was applied at the rate of 90 kg ha-1 (37.6 %) and 60 kg ha^{-1} (37.4 %) whereas minimum harvest index (33.1 %) was recorded in control experimental units. The increase in harvest index with the increase in potash level might be due to more partitioning of assimilates toward sink. More harvest index was noted with higher potash applied.



K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Figure 42: Effect of potassium level on harvest index (%) of maize ($LSD_{(0.05)}$= 2.46).

4.3.4.3 Interaction effect of variety and potassium level on harvest index cob^{-1} of maize

Interaction effect of different variety and potassium level showed significant effect on harvest index (t ha^{-1}) of maize (Table 9). From the experiment result expressed that maximum harvest index (49.83 %) was observed from the treatment combination of V_2K_5 which was statistically similar with the all others treatment combination except of V_1K_0 and V_1K_1 treatment combination. Whereas minimum harvest index (35.25 %) was observed from V_1K_0 treatment combination. The result obtained from the present study was similar with the findings of Dulami and Hadethi (2015).

Table 9 : Interaction effect of variety and potassium level on grain yield t ha^{-1}, stover yield t ha^{-1}, biological yield t ha^{-1}and harvest index at harvest

Treatments Combination	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index %
V_1K_0	6.70 g	12.30 e	19.00 e	35.25 c
V_1K_1	9.10 f	12.23 e	21.33 d	42.63 b
V_1K_2	10.77 e	12.36 de	23.13 cd	46.56 ab
V_1K_3	11.55 de	13.15 a-d	24.70 bc	46.76 ab
V_1K_4	11.84 c-e	13.21 a-c	25.04 bc	47.26 a
V_1K_5	13.29 ab	13.51 a-c	26.80 ab	49.60 a
V_2K_0	7.67 g	13.00 b-e	20.67 de	37.11 c
V_2K_1	11.23 e	12.77 c-e	24.00 c	46.80 ab
V_2K_2	12.52 b-d	12.94 b-e	25.46 bc	49.17 a
V_2K_3	13.16 a-c	13.53 a-c	26.69 ab	49.31 a
V_2K_4	13.16 abc	13.64 ab	26.80 ab	49.11 a
V_2K_5	13.92 a	14.01 a	27.93 a	49.83 a
$LSD_{(0.05)}$	1.09	0.84	2.25	3.48
CV(%)	5.74	3.77	5.44	4.46

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 level of probability. Here, V_1: SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: Control, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

CHAPTER V

SUMMARY AND CONCLUSION

The present piece of work was carried out at the Research Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during April to July, 2019 in kharif-I season to investigate the effect of Hybrid variety and different levels of potassium on the growth and yield of maize. 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, Deep Red Brown Terrace Soils under Tejgaon soil series. The experiment consisted of two factors split plot design. Factor A: Maize hybrid variety (2); V_1: V1: SAU Hybrid Vutta 1 and V2: SAU Hybrid Vutta 2 and B: Potassium levels (6); K_0: No fertilizers, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF. There were 12 treatment combinations. The total numbers of unit plots were 36. The size of unit plot was 7.00 m^2 (3.5 m × 2 m). urea: 550 kg ha^{-1}, TSP :250 kg ha^{-1} , MOP: 200kg ha^{-1}, Gypsum : 175 kg ha^{-1}, Boric acid : 6 kg ha^{-1} and cowdung : 100 ton ha^{-1} were applied at final land preparation except urea fertilizer in case of urea fertilizer its applied in 3 installment.1/3 at final land preparation stage,1/3 at vegetative stage and finally 1/3 at at flower initiation stage respectively following krishi projukti hatboi (2019) recommendation. Data on different yield contributing characters and yield were recorded to find out the suitable hybrid variety and optimum rate of potassium for the highest yield of maize.

Different growth yield and yield contributing parameters were significantly influenced by different hybrid variety. Maximum plant height $plant^{-1}$ (63, 189.17, and 230.83 cm at 45 DAS, 90 DAS and harvest respectively), number of leaves $plant^{-1}$ (9.7583, 14.277 and 10.773 at 45 DAS, 90 DAS and harvest respectively), leaf area $plant^{-1}$ (452.63, 3295.0 and 2546.2 cm^2 at 45 DAS, 90 DAS and harvest respectively), dry matter weight $plant^{-1}$ (159.68, 271.46 and 378.90 g at 45 DAS, 90 DAS and harvest respectively), growth rate $plant^{-1}$ (17.904 and 26.61 $gm^{-2}d^{-1}$ at 45 to 90 DAS and 95 DAS to harvest respectively), cob length $plant^{-1}$ (24.70 cm), cob circumference $plant^{-1}$ (19.23 cm), grain rows cob^{-1} (16.39), grains row^{-1} (29.97), grains cob^{-1} (491.05), and 1000 grain weight cob^{-1} (399.33) were observed from V_2

treatment. Maximum unfilled area cob^{-1} (%) (6.59) was observed from V_1 treatment. Maximum husk weight cob^{-1} (21.70g), shell weight cob^{-1} (40.82 g) , grain weight cob-^{1} (179.17 g), cob weight plant^{-1} (241.68 g), were observed from V_2 treatment. Maximum shelling percentage (73.95 %), grain yield (11.94 t ha^{-1}), stover yield (13.32 t ha^{-1}), biological yield (25.26 t ha^{-1}) and harvest index (46.89 %) were observed from V_2 treatment. Whereas minimum plant height (57.167, 172.83 and 213.68cm at 45 DAS, 90 DAS and harvest respectively), number of leaves plant^{-1} (8.0533, 13.035, 10.442 at 45 DAS, 90 DAS and harvest respectively), leaf area plant^{-1} (394.77, 2985.5, 2388.3 cm^2 at 45 DAS, 90 DAS and harvest respectively), dry matter weight plant^{-1} (140.15, 238.20 and 350.02 g at 45 DAS, 90 DAS and harvest respectively), growth rate plant^{-1} (15.07 and 22.69 gm^{-2}d^{-1} at 45 to 90 DAS and 90 DAS to harvest respectively), minimum cob length plant^{-1} (23.442 cm), cob length plant^{-1} (23.442 cm), cob circumference plant^{-1} (18.692 cm), grain rows cob^{-1} (14.390), grains row^{-1} (28.665), grains cob^{-1} (415.2), and 1000 grain weight cob^{-1} (394.50 g) were observed from V_1 treatment. Minimum unfilled area cob^{-1} (%) (4.78) was observed from V_2 treatment. minimum husk weight cob^{-1} (20.39 g), shell weight cob^{-1} (35.49 g), grain weight cob^{-1} (158.10 g), cob weight plant^{-1} (213.98 g) were observed from V_1 treatment. minimum shell ratio (158.10 g) was observed from V_2 treatment. Minimum grain yield (10.54 t ha^{-1}), stover yield (12.80 t ha^{-1}), biological yield (23.34 t ha^{-1}) and harvest index (44.68 %) were observed from V_1 treatment.

Different growth, yield and yield contributing parameters were significantly influenced by different potassium level. From the experiment result revealed that highest plant height (63.5, 192, and 236.67 cm at 45 DAS, 90 DAS and at harvest respectively), number of leaves plant^{-1} (10.33, 14.665 and 11.83 at 45 DAS, 90 DAS and at harvest respectively), leaf area plant^{-1} (543.25,4308.5 2959.5 cm^2 at 45 DAS, 90 DAS and at harvest respectively), dry matter weight plant^{-1} (166.46, 282.98 and 410.50 g at 45 DAS, 90 DAS and at harvest respectively), growth rate plant^{-1} (17.904 and 26.606 gm^{-2}d^{-1} at 45 to 90 DAS and 90 DAS to harvest respectively), cob length plant^{-1} (26.080 cm) , cob circumference plant^{-1} (19.50 cm), grain rows cob^{-1} (16.16), number of grains row^{-1} (31.33), grains cob^{-1} (31.33) and 1000 grain weight (413.0 g) were observed from K_5 treatment. Maximum unfilled area cob^{-1} (%) (15.01 %) was observed from K_0 treatment. Maximum husk weight cob^{-1} (23.63 g), shell weight cob^{-1} (45.92 g), grain weight cob^{-1} (204.08 g), cob weight plant^{-1} (273.63 g) were

observed from K_5 treatment. Maximum shelling percentage (74.583 %), grain yield (11.944 t ha^{-1}), maximum stover yield (13.76 t ha^{-1}) , biological yield (27.37 t ha^{-1}) and harvest index (49.713 %) was observed from K_5 treatment. Whereas lowest plant height (54.50, 163.50, and 197.50 cm at 45 DAS, 90 DAS and harvest respectively), number of leaves $plant^{-1}$ (8, 12.165 and 9.33 at 45 DAS, 90 DAS and at harvest respectively), minimum leaf area $plant^{-1}$ (312.15, 2301.5 and 2103.0 cm^2 at 45 DAS, 90 DAS and at harvest respectively), dry matter weight $plant^{-1}$ (116.88, 198.52 and 297.50 g at 45 DAS, 90 DAS and harvest respectively), minimum growth rate $plant^{-1}$ (12.688 and 19.282 $gm^{-2}d^{-1}$ at 45 to 90 DAS and 90 DAS, at harvest respectively), cob length $plant^{-1}$ (21.83 cm), cob circumference $plant^{-1}$ (17.97 cm), grain rows cob^{-1} (14.50), grains row^{-1} (25.5), grains cob^{-1} (415.2) and 1000 grain weight (367.50 g) were observed from K_0 treatment. Minimum unfilled area cob^{-1} (%) (1.675 %) was observed from K_5 treatment. Minimum husk weight cob^{-1} (16.18 g), shell weight cob^{-1} (25.995 g), grain weight cob^{-1} (107.75 g), cob weight $plant^{-1}$ (149.92 g), shelling percentage (71.916 %), grain yield (7.183 t ha^{-1}), stover yield (12.50 t ha^{-1}), biological yield (19.83 t ha^{-1}) and harvest index (36.18 %) was observed from K_0 treatment.

Different growth, yield and yield contributing parameters were significantly influenced by the combined application of variety and different potassium fertilizer level. From the experiment result revealed that highest plant height (65, 194, and 238.33 cm at 45 DAS, 90DAS and harvest respectively), number of leaves $plant^{-1}$ (12.33, 16 and 12.33 at 45 DAS, 90 DAS and at harvest respectively), number of leaf area $plant^{-1}$ (595.70, 4666.0 and 3057 cm^2 at 45 DAS, 90 DAS and at harvest respectively), Dry matter weight $plant^{-1}$ (174.58, 296.79 and 419.00 g at 45 DAS, 90 DAS and at harvest respectively), growth rate $plant^{-1}$ (18.438 and 27.157 $gm^{-2}d^{-1}$ at 45 to 90 DAS, 90 DAS and at harvest respectively), cob length $plant^{-1}$ (26.83 cm), cob circumference $plant^{-1}$ (19.830 cm), grain rows cob^{-1} (16.66), grains row^{-1} (31.33), grains cob^{-1} (521.96) and 1000 grain weight (420 g) were observed from the treatment combination of V_2K_5. Highest unfilled area cob^{-1} (%) (16.510 %) was observed from the treatment combination of V_1K_0. Maximum husk weigh cob^{-1} (23.600 g), shell weight cob^{-1} (47.33 g), grain weight cob^{-1} (208.78 g), cob weight $plant^{-1}$ (279.71 g) were observed from the treatment combination of V_2K_5. Maximum shelling percentage (74.64 %), grain yield (13.92 t ha^{-1}), stover yield (14.01 t ha^{-1}), biological yield (27.93 t ha^{-1}) and harvest index (49.83 %) were observed from the treatment

combination V_2K_5. Whereas minimum plant height (49, 147 and 182cm at 45 DAS, 90 DAS, harvest respectively), number of leaves plant^{-1} (7.0, 12.0 and 9.0 at 45 DAS, 90 DAS and at harvest respectively), leaf area plant^{-1} (298.60, 2084.0, 2044 cm^2 at 45 DAS, 90 DAS and at harvest respectively), dry matter weight plant^{-1} (93.75, 159.04 and 285 g at 45 DAS, 90 DAS and harvest respectively), growth rate plant^{-1} (11.98 and 8.47 gm^{-2}d^{-1} at 45 to 90 DAS and 90 DAS and at harvest respectively), cob length plant^{-1} (20.83 cm), cob circumference plant^{-1} (20.83 cm), number of grain rows cob^{-1} (12.66), number of grains row^{-1} (23), number of grains cob^{-1} (291.18) and 1000 grain weight (365 g) were observed from the treatment combination of V_1K_0. minimum unfilled area cob^{-1} (%) (1.550 %) was observed from V_2K_5 treatment combination. Minimum husk weight cob^{-1} (14.36), shell weight cob^{-1} (23.66 g), grain weight cob^{-1} (100.46 g), cob weight plant^{-1} (100.46 g) were observed from the treatment combination of V_1K_0. Minimum shelling percentage (72.54 %), grain yield (6.697 t ha^{-1}), stover yield (12.30 t ha^{-1}), biological yield (19.000 t ha^{-1}) and finally minimum harvest index (35.25 %) was observed from V_1K_0 treatment combination.

Conclusion

The results in this present piece of work indicated that the plants performed better in respect of seed yield in V_2K_5 treatment combination than the control treatment combination(V_1K_0). It can be therefore, concluded from the above investigation that the combined application of SAU Hybrid vhutta 2 along with K_5 treatment (180 kg K ha^{-1} + RF) was found to be most suitable combination treatment for the highest grain yield of maize in AEZ 28 soils of Bangladesh which was due to that maximum cob length plant^{-1} (26.83 cm), cob circumference plant^{-1} (19.830 cm), grain rows cob^{-1} (16.66), grains row^{-1} (31.33), grains cob^{-1} (521.96) ,1000 grain weight (420 g), grain weight cob-^{1} (208.78 g), cob weight plant^{-1} (279.71 g) and lowest unfilled area cob^{-1} (1.55 %) were observed in V_2K_5 treatment combination which influences grain yield (13.919 t ha-^{1}) thus V_2K_5 treatment combination is best for maize production.

Recommendations

The present experiment was conducted only one season even in a single location. Therefore, it is difficult to recommend this finding without further study. By considering the results of the present experiment, further studies in the following areas are suggested below:

1. Studies of similar nature could be carried out in different Agro Ecological Zones (AEZ) in different seasons of Bangladesh for the evaluation of zonal adaptability.

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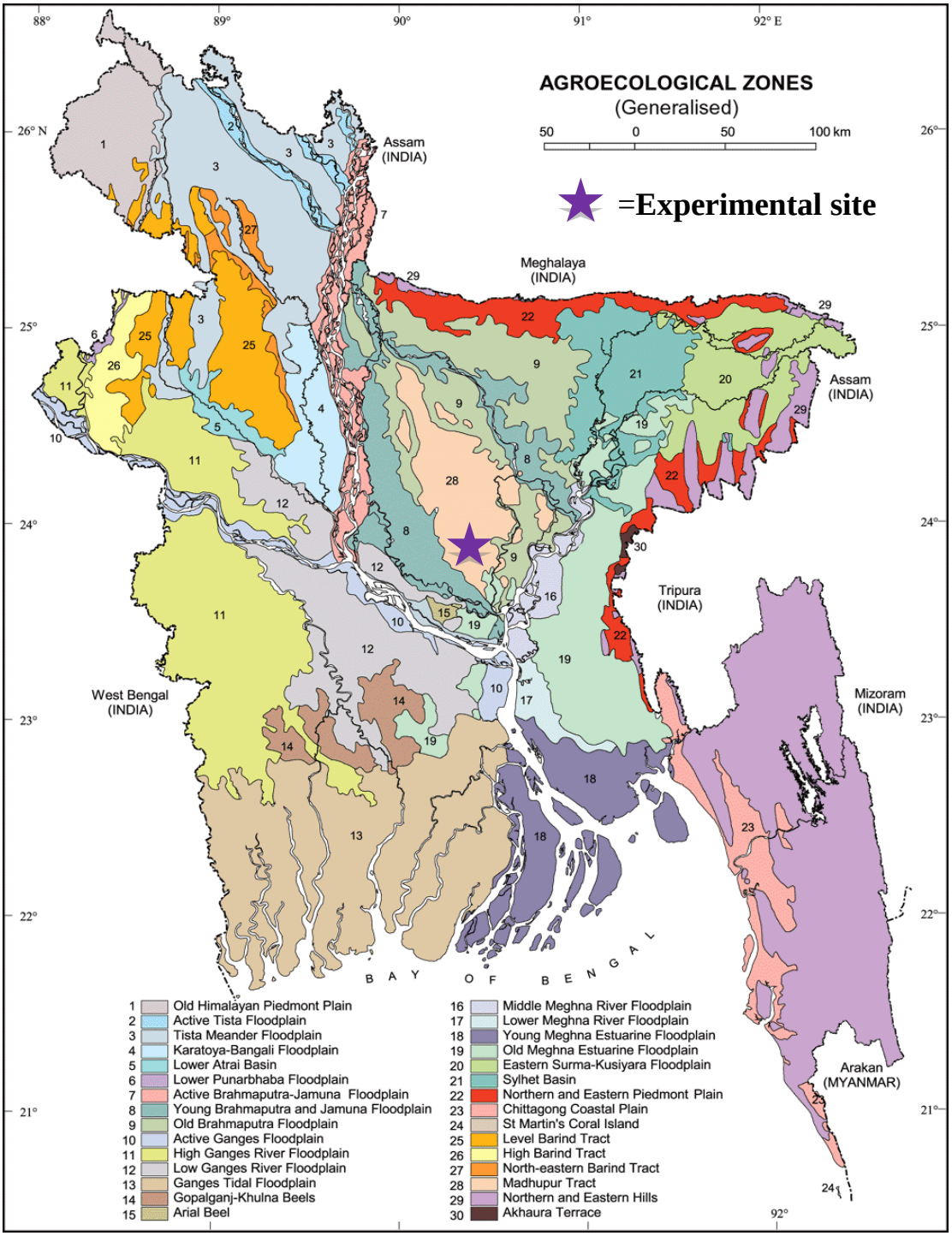
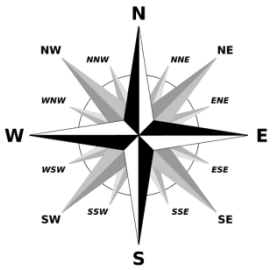
APPENDICES

Appendix I. Map showing the experimental location under study





Appendix II: Layout of the experimental field

R_1	R_2	R_3
V_1K_0	V_2K_4	V_1K_1
V_1K_1	V_2K_5	V_1K_3
V_1K_2	V_2K_0	V_1K_4
V_1K_3	V_2K_1	V_1K_5
V_1K_4	V_2K_2	V_1K_0
V_1K_5	V_2K_3	V_1K_1
V_2K_3	V_1K_1	V_2K_2
V_2K_4	V_1K_2	V_2K_0
V_2K_5	V_1K_3	V_2K_1
V_2K_0	V_1K_4	V_2K_5
2m V_2K_1	V_1K_5	V_2K_3
V_2K_2	V_1K_0	V_2K_4

1m 1m

3.5 m

Legend

SAU Hybrid Vutta 1 and V_2: SAU Hybrid Vutta 2; K_0: No fertilizers, K_1: 60 kg K ha^{-1}+ Recommended Fertilizers (RF), K_2: 90 kg K ha^{-1} + RF, K_3: 120 kg K ha^{-1} + RF, K_4: 150 kg K ha^{-1} + RF and K_5: 180 kg K ha^{-1} + RF.

Appendix III. Characteristics of soil of experimental field

A. Morphological characteristics of the experimental field

Morphological features	**Characteristics**
Location	Sher-e-Bangla Agricultural University Agronomy research field, Dhaka
AEZ	AEZ-28, Madhupur Tract
General Soil Type	Shallow 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 characteristics	**Value**
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total nitrogen (%)	0.03
Available P (ppm)	20.54
Exchangeable K (mg/100 g soil)	0.10

Appendix IV: Monthly average temperature, relative humidity and total rainfall of the experimental site during the period from April, 2019 to July, 2019

Year	Month	Air Temperature (°C)			Relative Humidity (%)	Total Rainfall (mm)	Sunshine (Hour)
		Max	Min	Mean			
2019	April	37	28	33	54	225.1	294
	May	39	29	35	61	259.3	294.5
	June	36	29	33	67	273.6	226.5
	July	34	28	31	74	380.6	194

Source: Bangladesh Metrological Department (Climate and weather division) Agargaon, Dhaka.

Appendix V. Analysis of variance of the data on plant height of maize as influenced by variety and potassium level

		Mean square of plant height at		
Source	**DF**	**45 DAS**	**90 DAS**	**At harvest**
Replication (A)	2	5.083	41.33	108.33
Variety (V)	1	306.250*	2401.00*	2649.16*
Error	2	12.583	121.33	75.00
Fertilize	5	84.700*	765.00*	1340.02*
V×F	5	24.700*	262.00*	261.86*
Error	20	8.833	81.33	71.67
Total	35			

* : Significant at 0.05 level of probability
NS: Non Significant

Appendix VI. Analysis of variance of the data on number of leaves plant^{-1} of maize as influenced by variety and potassium level

		Mean square of number of leaves plant^{-1} at		
Source	**DF**	**45 DAS**	**90 DAS**	**At harvest**
Replication (A)	2	0.0833	0.2500	0.08333
Variety (V)	1	26.1632*	13.8756*	0.99003^{NS}
Error	2	0.2500	0.5833	0.25000
Fertilize	5	3.9189*	4.2684*	6.18023*
V×F	5	2.4083*	1.0154*	0.66735*
Error	20	0.1667	0.4167	0.16667
Total	35			

* : Significant at 0.05 level of probability
^{NS}: Non Significant

Appendix VII. Analysis of variance of the data on number of leaves area plant^{-1} of maize as influenced by variety and potassium level

		Mean square of number of leaf area plant^{-1} at		
Source	**DF**	**45 DAS**	**90 DAS**	**At harvest**
Replication (A)	2	158.3	10533	10000
Variety (V)	1	30137.0*	862112*	224202^{NS}
Error	2	408.3	29200	23333
Fertilize	5	52151.4*	3435806*	562284*
V×F	5	3173.4*	160988*	28930*
Error	20	283.3	19867	16667
Total	35			

* : Significant at 0.05 level of probability
^{NS}: Non Significant

Appendix VIII. Analysis of variance of the data on dry matter weight plant^{-1} of maize as influenced by variety and potassium level

		Mean square of dry matter weight plant^{-1} at		
Source	**DF**	**45 DAS**	**90 DAS**	**At harvest**
Replication (A)	2	58.33	305.03	156.25
Variety (V)	1	3433.23*	9955.26*	7503.89*
Error	2	108.33	305.03	364.58
Fertilize	5	2037.27*	5910.22*	9882.82*
V×F	5	264.13*	772.46*	97.32*
Error	20	83.33	299.03	260.42
Total	35			

* : Significant at 0.05 level of probability
^{NS}: Non Significant

Appendix IX. Analysis of variance of the data on growth rate plant^{-1} of maize as influenced by variety and potassium level

		Mean square of growth rate plant^{-1} at	
Source	**DF**	**90 DAS**	**At harvest**
Replication (A)	2	0.7500	1.1200
Variety (V)	1	16.6169*	31.5235*
Error	2	0.8611	1.6533
Fertilize	5	20.4719*	41.5173*
V×F	5	0.0900*	0.4088*
Error	20	0.8056	1.3867
Total	35		

* : Significant at 0.05 level of probability
NS: Non Significant

Appendix X. Analysis of variance of the data on cob length (cm), cob circumference (cm), row cob^{-1}, grain row^{-1}, grain cob^{-1} of maize as influenced by variety and potassium level

		Mean square of				
Source	**DF**	**Cob length**	**Cob Circumference**	**Row cob^{-1}**	**Grain row^{-1}**	**Grain cob^{-1}**
Replication (A)	2	2.2500	0.86111	0.3333	0.7500	300.0
Variety (V)	1	14.1376*	2.64604*	35.820*	15.210^{NS}	51777.6*
Error	2	0.7500	1.36111	1.0000	2.250	900.0
Fertilize	5	11.8243*	1.84608*	2.375*	27.719*	14178.0*
V×F	5	0.4358*	0.21208*	1.872*	5.370*	3698.2*
Error	20	1.5000	1.11111	0.6667	1.5000	600.0
Total	35					

* : Significant at 0.05 level of probability
NS: Non Significant

Appendix XI. Analysis of variance of the data on unfilled area cob^{-1} %, 1000 grain weight, husk weight cob^{-1} (g) , shell weight cob-^{1} (g), grain weight cob-^{1} (g) of maize as influenced by variety and potassium level

		Mean square of				
Source	**DF**	**Unfilled area cob^{-1} (%)**	**1000 grain weight**	**Husk weight cob^{-1}**	**Shell weight cob^{-1}**	**Grain weight cob^{-1}**
Replication (A)	2	0.063	175.00	0.7500	3.083	164.58
Variety (V)	1	29.648*	210.25*	15.3664^{NS}	254.881*	3995.56*
Error	2	0.146	508.33	2.2500	6.583	131.25
Fertilize	5	151.077*	1816.45*	68.0867*	311.573*	7075.96*
V×F	5	2.370*	102.85*	3.5898*	13.734*	101.25*
Error	20	0.104	341.67	1.5000	4.833	147.92
Total	35					

* : Significant at 0.05 level of probability
^{NS}: Non Significant

Appendix XII. Analysis of variance of the data on cob weight plant^{-1} (g) and shelling percentage (%), as influenced by variety and potassium level

		Mean square of	
Source	**DF**	**Cob weight plant^{-1}**	**Shelling percentage**
Replication (A)	2	100.0	12.33
Variety (V)	1	6904.9*	0.15^{NS}
Error	2	233.3	26.33
Fertilize	5	11945.4*	6.327^{NS}
V×F	5	184.1*	1.34*
Error	20	166.7	19.33
Total	35		

* : Significant at 0.05 level of probability
^{NS}: Non Significant

Appendix XIII. Analysis of variance of the data on grain yield (t ha^{-1}), stover yield (t ha^{-1}), biological yield, (t ha^{-1}) and harvest index % of maize as influenced by variety and potassium level

		Mean square of			
Source	**DF**	**Grain yield**	**Stover yield**	**Biological yield**	**Harvest index**
Replication (A)	2	0.2500	0.23241	1.7627	2.083
Variety (V)	1	17.7581*	2.43662^{NS}	33.3506*	44.086*
Error	2	0.5833	0.23241	1.7877	6.250
Fertilize	5	31.4487*	1.61418*	43.9236*	148.814*
V×F	5	0.4500*	0.01868*	0.4325*	2.488*
Error	20	0.4167	0.24261	1.7452	4.167
Total	35				

* : Significant at 0.05 level of probability
^{NS}: Non Significant