EFFECT OF POTASSIUM ON THE GROWTH AND YIELD OF TOMATO (*Solanum lycopersicum L.*)

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This is to certify that thesis entitled, **"EFFECT OF POTASSIUM ON THE GROWTH AND YIELD OF TOMATO"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **SOIL SCIENCE,** embodies the result of a piece of Bona fide research work carried out by **Saikat Das,** Registration **No.11-04603** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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DEDICATED TO
MY
BELOVED PARENTS

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SAU, Dhaka **Saikat Das**

EFFECT OF POTASSIUM ON THE GROWTH AND YIELD OF TOMATO (*Solanum lycopersicum* L.)

ABSTRACT

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A field experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka, Bangladesh during October 2020 to April, 2021 to evaluate the effect of potassium on growth and yield of tomato. Selected variety of tomato was, viz., BARI Tomato-2, and six doses of potassium viz. T_0=0 kg/ha T_1= 20 kg/ha, T_2= 40 kg/ha, T_3= 60 kg/ha, T_4= 80 kg/ha and T_5= 100 kg/ha were used to conduct this experiment. The experiment was laid out in Randomized complete Block Design (RCBD) having single factor and replicated three times. Data were taken on growth,yield contributing characters, yield and the collected data were statistically analyzed for evaluation of the treatment effects.Plant height was recorded at 30, 40, 50 and 60 DAT (days after transplanting) and observed growth of BARI Tomato-2 which was significantly higher in early vegetative to successive days after planting up to 60 DAT where highest plant height (69.9 cm) was obtained in T_4treatment which performed better compared to other treatments. As like the plant height, branch development of BARI Tomato-2 was also better which indicating higher branch number. Number of fruits plant^{-1} of tomato varied significantly for different levels of potassium fertilizer. The highest number of fruits plant^{-1} (30.3) was recorded from BARI Tomato-2 variety with the treatment of T_4. The highest fruit weight (80.96 g) was recorded from treatment T_4 where 80 kg/ha potassium was applied.The maximum yield of fruits per plot was observed for T_4 as 62.57 kg per plot. The maximum straw yield per plot was resulted from the treatment of T_4 as 12.67 kg per plot. The maximum yield of fruits per hectare was resulted from the treatment of T_4 (66.74 t/ha). Based on the result of the present study it was found that application of T_4 80 kg/ ha treatment performed the highest yield (66.74 t/ha) of BARI Tomato-2. The treatment $T_4$with the application of 80 kg/ ha potassium is the appropriate practice for tomato production and considered as optimum potassium fertilizer dose for the maximum yield of BARI Tomato-2 (RATAN).

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LIST OF ABBREVIATION AND ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
FAO	=	Food and Agriculture Organization
N	=	Nitrogen
B	=	Boron
et al.	=	And others
TSP	=	Triple Super Phosphate
MOP	=	Murate of Potash
RCBD	=	Randomized Complete Block Design
DAT	=	Days after Transplanting
ha^{-1}	=	Per hectare
g	=	gram
kg	=	Kilogram
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources Development Institute
wt	=	Weight
LSD	=	Least Significant Difference
^{0}C	=	Degree Celsius
NS	=	Not significant
Max	=	Maximum
Min	=	Minimum
%	=	Percent
NPK	=	Nitrogen, Phosphorus and Potassium
CV%	=	Percentage of Coefficient of Variance

CHAPTER I

INTRODUCTION

Tomato (*Solanum lycopersicum* L., previously named *Lycopersicon esculentum* Mill.) is an important crop in several parts of the world, including Bangladesh. It is economically attractive and the area under tomato cultivation is increasing daily. Tomato is rich source of minerals and vitamins; its distinctive nutritional attributes play an important role in reducing risk of cardiovascular and associated diseases through their bioactivity in modulating disease process pathways. About 150 million tons of tomato are produced each year all over the world, of which 40 million as tomato products (tomato paste, peeled or unpeeled, whole or chopped tomatoes). As it is a relatively short duration crop and gives high yield, so it is economically attractive and the area under cultivation is increasing daily all over the world Moreover, it is an important source of lycopene, which is a powerful antioxidant that acts as an anticarcinogen. Tomato fruits are also an outstanding source of ascorbic acid, and are main source of vitamin C next to citrus. In Eritrea, tomato production has a long tradition among farmers. It is highly valuable and most popular cultivated vegetable crop grown throughout the country. It serves as source of the livelihood of many rural farmers both as food and cash. Farmers prefer to cultivate tomato because of its high demand in the market, good return and reasonably good yield. A positive correlation between the yields of tomato and high income to farmers when it is cultivated on large scale has also been reported. However, average yield of tomato in Eritrea has remained as low as 10.4 t/ha compared to average yield of 51, 41, 36 and 34 Mt/ha in America, Europe, Asia and the world respectively (FAOSTAT, 2018). This could be due to poor soil fertility and the imbalanced application of Nitrogen-Phosphorus-Potassium (NPK) fertilizers.

In Bangladesh, it is cultivated as winter vegetable, which occupied on area of 59000 acres of land, and the total production of tomatoes were 74 thousand metric tons in Bangladesh in the year of 2019-2020 (BBS, 2021). Thus, the Average yield of tomato is 14.35 tons/ha, while it was 41.81 t/ha in the world (FAO, 2018). Which is very low in comparison with that of other countries, namely India (15.67 t/ha), Japan (52.82 t/ha) and USA (63.66 t/ha). The yield of tomato in our country is not satisfactory enough in comparison to requirement (Aditya *et al.*, 1999). There are many reasons such as lack of appropriate time of sowing dates, lack of improved varieties, lack of proper cultural and management practices is the barrier to increase the tomato production in Bangladesh. Meanwhile, the scientists have developed some varieties to increase the growth and yield of tomato. In addition, several researchers are still working for improving the growth and yield of tomato both in winter and summer season with proper management practices.

In our country, the soils of most regions have less than 1.5%, some soils even have less than 1% organic matter (BARC, 2018). Organic manure has the largest effect on yield and quality of tomato. The increase in vegetative growth of tomato could be attributed to physiological role of organic manure and its involvement in the metabolism of protein, synthesis of pectin, maintaining the correct water relation within the plant, resynthesis of adenosine triphosphate (ATP) and translocation of sugar at development of the flowering and fruiting stages (Bose and Tripathi, 1996). The improvement in quality parameters of tomato fruit due to organic manure application could be the result of overall growth and development of the crop.

Potassium plays an important role in tomato fruit quality by involves in metabolic processes, such as the enzyme activation, synthesis of proteins, membrane transport processes and the generation of turgor pressure (Dorais *et al.*, 2001). Potassium (K) is a key nutrient for enhancing productivity of vegetable crops and its content in vegetables has significant positive relationship with quality attributes (Bidari and Hebsur, 2011). Potassium has significant contribution in photosynthesis, enzyme activation, cell turgor maintenance and ion homeostasis (Marschner 1995). Additionally, it is also involved in the enrichment of lycopene contents of tomato fruit through synthesis of pigments or carotenoids (Bedari and Hebsur, 2011). Inside plant, K is found in ionic form only; it is co-factor of many enzymes. Major role of K in plant is osmotic adjustment. Under K deficient conditions, the fruit will be small in size, lack in red color and at early stage. Red color of fruit and ripening disorders closely related with K content of fruit (Perkins-Veazie and Robert 2003). It is reported that the K application above the optimum level reduces the tomato fruit color disorders (Hartz *et al.* 1999). Fruit quality is directly affected by potassium supply (Windsor, 1979; Janse, 1985; Martin-Prével, 1989).

Intensive research has been done to investigate the effects of K on yield quality of vegetables grown, showing the significance of K in the nutrition of the crop (Sonneveld and Voogt, 1985; Voogt, 1987; Bakker *et al.*, 1989; Kreij, 1996 and Kreij, 1999). However, a complication with increasing K supply is that enlargement of the total ion concentration (EC level). At the same time the osmotic pressure is increased, which in itself has a clear effect on yield and quality (Sonneveld and van den Burg, 1991). The effect of K nutrition should be studied by taking into consideration the total ion concentration (EC). Fruit cracking in sweet pepper was reduced by increasing K levels (Kreij *et al.*, 1999). Lin *et al.* (2004) found that increasing potassium levels significantly increased the concentration of total sugar, total soluble solids, glutamic acid, aspartic acid, alanine, and volatile acetate of muskmelon. In tomato, it has been reported that acid and reducing sugar contents, often correlated with K application, influence not only sweet and sour taste attributes, but also different flavor traits (Auerswald *et al.*, 1999; Chapagain and Wiesman, 2004; Petersen, *et al.*, 1998).

The present study is to undertake with following objectives:

1. To evaluate out the effect of different level of potassium (K) on growth and yield of BARI Tomato-2 (RATAN).

2. To find out the optimum doses of potassium (K) for higher yield of BARI Tomato-2 (RATAN).

CHAPTER II

REVIEW OF LITERATURE

Tomato is an important vegetable crop and received much attention of the researchers throughout the world to develop its suitable production technique. Establishment and growth of tomato plants largely depend on the fertilizer and variety. Large number of researchers have studied the effect of potassium and variety on the growth, yield and quality of tomato in different countries of the world, but their findings have little relevance to the agro-ecological situation of Bangladesh. Literature is available about the present research topic and reviewed here, which will contribute useful information to the present study.

Effect of potassium on growth and yield of tomato

Abd-El-Hamied and Abd El-Hady (2018) conducted two field experiments to study the effect of three phosphors rates (0, 14 and 28 kg P fed^{-1}); five foliar treatments (0, 0.3 and 0.6% of Ca and 0.5% and 1% of K) and their interactions on tomato growth and yield. Data showed that phosphorus treatment of 14 kg P fed^{-1} gave the best results of leaf area (cm^2), fresh weight of tomatoes leaves, potassium content (%) in leaves, fresh weight of four fruit, fruit diameter and tomatoes yield (Mg fed^{-1}). In addition, foliar application treatments at 0.3% Ca and 0.5% K recorded the highest results of plant height, leaf area (cm^2), fresh weight of tomato leaves, N, P contents in leaves, chlorophyll content of leaves, weight of four fruits, fruit diameter, tomato yields (Mg fed^{-1}). The highest tomato yields (Mg fed^{-1}) values were18 and 18.06 Mg fed-1 recorded with 14 kg P fed^{-1} and 0.3% calcium as a foliar application followed by 14 kg P fed^{-1} and 0.5% potassium which recorded 17.36 and 17.32 Mg fed^{-1}, respectively in both seasons. Generally, it is concluded that the interaction between the treatment of 14kg P fed^{-1} and 0.3% 5 calcium or 0.5% potassium as a foliar application enhanced tomato yield and nutrient uptake.

Samra *et al.* (2017) concluded that, the effect of different levels of potassium (0, 60, 120 and 180 kg/ha) applied on onion cv. Swat-1 and the results indicated that maximum leaf length (32.00 cm), plant height (48.16 cm), number of leaves per plant (7.50), bulb diameter (5.20 cm) and maximum yield (24.67 t ha^{-1}) with potassium at the rate of 120 kg/ha over control. Subba *et al.* (2017) conducted an experiment on carrot to evaluate the potassium fertilizer levels (0, 50, 75 and 100 kg/ha) with a uniform dose of nitrogen and phosphorus and reported the highest mean vegetative parameters such as plant height (36.75 cm), number of leaves per plant (9.45), fresh weight of leaves (35.12 g) and dry weight of leaves (8.78 g) with the treatment combination of 100 kg K20 and 15 kg B. The treatment 75 kg K/ha gave the maximum yield (31.83 t/ha).

Zhu *et al.* (2016) conducted a study to evaluate the effects of K rates on fruit yield and postharvest quality of tomato grown on a calcareous soil. Tomatoes were grown using six rates of K: 0, 60, 100, 160, 200, and 240 lb/acre of K_2O. Potassium fertilizer placement was divided into pre-plant dry fertilizer and fertigation. None of the fruit categories at the first harvest were significantly affected by K doses. For the second harvest, the response of total marketable yields was highest with critical rate of 200 lb/acre. Quadratic regression models predicted maximum extra-large fruit and total season marketable yields at 171 and 185 lb/acre, respectively.

Atanda and Olaniyi (2016) conducted a field experiment to evaluate the effect of potassium levels on onion and the results indicated that significantly highest plant height (36 cm), number of leaves (5.3), maximum average bulb weight (78.44 g), bulb diameter (5.20 cm) and yield (24.67 t ha^{-1}) was observed with potassium at the rate of 120 kg/ha. Fouzia *et al.* (2016) studied the influence of different potassium levels (30, 50, 70, 90, 110 K kg/ha) on carrot cv. New Kuroda and reported the highest shoot height (64.88 cm), maximum number of leaves (11.45), highest shoot weight per plant (88.67 kg), highest root length (14.01 cm), maximum root diameter (4.48

cm), fresh weight (0.130 kg) and highest root yield (30.50 t/ha) were recorded with 70 kg K/ha.

Afzal *et al.* (2015) conducted an experiment to investigate the specific contribution of potassium to yield and quality of tomato, a field experiment was conducted on two tomato cultivars, Nagina and Roma. Foliar application with varying levels (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0%) of potassium solutions was applied to the plants and compared with control (without K). Exogenous application of 0.6% K significantly improved plant height, lycopene content, potassium, fruit weight and diameter. Exogenous application of 0.5, 0.6 and 0.7% K maximally improved ascorbic acid contents of both tomato cultivars whereas 0.4 and 0.8% did not improve ascorbic acid contents. Due to positive correlation between K nutrition and fruit quality attributes, exogenous application of an appropriate K level can contribute to higher yield and better quality of tomato fruits. Among all potassium levels,0.5–0.7% K maximally improved performance of tomato plants of both cultivars.

A field experiment was conducted by Ahmad *et al.* (2015) to investigate the effect of potassium and its time of application on yield and quality of tomato variety, Nagina. Treatments included three potassium levels i.e. 60, 90 and 120 kg ha^{-1} and two application timings: at transplanting as single dose, and half at transplanting + half at 40 days after transplanting in two splits, were applied along with a control (0 kg ha^{-1} K). Potassium application @ 60 kg ha^{-1} either applied in single or in two splits, significantly increased the yield and improved the quality parameters of tomato over control while higher levels of K (90 and 120 kg ha^{-1}) did not show further significant increase in the yield and quality subsequently. Ascorbic acid remained unaffected. Results revealed that time of application/splitting of K did not affect the yield and quality. The highest yield (23.3 t ha^{-1}), firmness (8.32 kg), fruit weight (83.24 g $fruit^{-1}$), total invert sugars (4.11 %), dry matter (6.33 %) and mineral matter (1.95 %) were recorded with the application of 120 kg ha^{-1} potassium at transplanting while the highest values of acidity (0.81%), TSS (7.03 %) and ascorbic acid (30.33 mg 100 g^{-}

[1]) were observed in treatment where potassium was applied @ 60 kg ha -1 in two splits. Minimum yield (17.2 t ha^{-1}), firmness (6.35 kg), fruit weight (68.11 g/fruit), mineral matter (1.80 %), dry matter (5.26 %), acidity (0.61 %), ascorbic acid (21.79 mg $100g^{-1}$), TSS (6.60 %) and total invert sugars (3.85 %) were found in control.

Javari *et al.* (2012) conducted a pot experiment to investigate effect of different rates of potassium fertilizer on chemical and sensory attributes of tomato during crop season of 2009. The pots were treated with K_2O @ 0, 75, 150, 225, 300, 375, 450 Kg K_2O ha^{-1} along with basal doses of N and P (100 Kg N and 80 Kg and P_2O_5 ha^{-1}, respectively). Treatments were arranged in complete randomized design. The result showed that total solids, sugars & titratible acidity increased significantly with increasing rates of potassium but contrary to above attributes the pH decreased. Similarly, lycopene, vitamin C and total soluble solids increased significantly with increased application of K_2O up to 375 kg but thereafter decreased when K_2O was applied @ 450 Kg K_2O ha^{-1}. Significant relationships were apparent between fertilizer rates and surface redness, tissue redness, firmness, crispness, mealinss, sweetness, sourness and flavor. Moreover, several masking effects were observed between taste active components and chemical components of tomato fruit. A positive linear correlation of flavor with sugar, total solids, titratible acidity; surface redness with lycopene & firmness with total solids while negative correlation between flavor and pH was observed. It was concluded that increasing K concentration resulted in improved quality parameters of tomato fruit and application of K_2O @ 375 Kg K_2O ha^{-1} along with recommended doses of N and P was found to be the best dose for high quality tomato fruit.

El-Nemr *et al.* (2012) conducted to study the effect of different concentrations of potassium (K) on the vegetative growth, yield and important quality traits of different tomato cultivars, including TSS, titratable acidity, vitamin C content and pH of fruit juice. Three K levels of 200, 300, and 350 ppm in the nutrient solution were used and two cultivars (Florid at and Super Strain B) were compared. Florid at cultivars showed 23% higher total soluble solids (TSS) than Super Strain B and also showed a total vitamin C content (4.65 $mg\cdot kg^{-1}$), markedly higher than Super Strain B. Increased K levels in the nutrient solution resulted in increased contents of TSS, Vitamin C contents, titratable acidity and juice pH in tomato fruits. Higher yield was recorded with Florid at cultivar and high level of K concentration (350 ppm).

Iqbal *et al.* (2011) were undertaken to study the effect of N and K doses (60, 90 and 120kg ha^{-1} N and 90kg, 110kg, 130kg ha^{-1} of K) on growth, economical yield and yield components of tomato under the agro-climatic conditions of Swat. The parameters selected under study i.e plant height at flowering stage, days to flowering, days to maturity, number of primary branches per plant, fruit length, fruit width, number of fruits per plant and total yield were significantly affected by the applications of N and K. The maximum days to flowering (52) in 00kg N and 110 kg of K, maximum days to maturity (85.67) were taken when was obtained with the application of 120kg N and 130kg ha^{-1} of K was applied. Maximum fruit length (5.96cm) was noted in 00kg of N and 130kg of K, while maximum fruit diameter (5.08cm) was noted when plants received 120kg N and 90kg K. in treatment (120kg N and 90kg ha^{-1} of K), Economical yield (19 ton ha^{-1}) was obtained with 60kgN and 130kg ha^{-1} of K.

Ehsan *et al.* (2010) conducted a field experiment to evaluate comparative effects of sulphate and muriate of potash (SOP and MOP) application on yield, chemical composition and quality of tomato (*Lycopersicon esculentum* M. cultivar Roma) at National Agricultural Research Centre Islamabad, Pakistan. Potassium from two sources i.e., MOP and SOP was applied @ 0, 100 and 200kg K ha^{-1} with constant dose of 200 kg N ha^{-1} and 65 kg P ha^{-1}. A significant increase in tomato yield with K application was observed. Potassium applied @100 kg K ha^{-1} as MOP produced significantly higher marketable tomatoes as compared to SOP and control. Vitamin C contents in tomato fruits increased with K application in the form of MOP. The K use as MOP significantly reduced incidence of leaf blight disease and insect pest attack in tomato plant as compared to SOP and control treatments.

Akhtar *et al.* (2010) conducted to evaluate comparative effects of sulphate and muriate of potash (SOP and MOP) application on yield, chemical composition and quality of tomato (*Lycopersicon esculentum* M. cultivar Roma) at National Agricultural Research Centre Islamabad, Pakistan. Potassium from two sources i.e., MOP and SOP was applied @ 0, 100 and 200 kg K ha^{-1} with constant dose of 200 kg N ha^{-1} and 65 kg P ha^{-1}. A significant increase in tomato yield with K application was observed. Potassium applied @ 100 kg K ha^{-1} as MOP produced significantly higher marketable tomatoes as compared to SOP and control. Levels and sources of potassium showed no effect on acidity of tomato fruits. Potash application decreased sugar content of tomato fruits as compared to control. This effect of K on reducing sugar content was more pronounced in K treated fruits as SOP than those of MOP. Vitamin C contents in tomato fruits increased with K application in the form of MOP. The K use as MOP significantly reduced incidence of leaf blight disease and insect pest attack in tomato plant as compared to SOP and control treatments.

Field experiments were conducted by Singh *et al.* (2004) on a Mollisol in Pantnagar, Uttaranchal, India, to determine the effects of integrated nutrient management on crop nutrient uptake and yield under okra-pea-tomato cropping sequence. In the sequence, treatments were given to okra crop, while in the succeeding crops (pea and tomato), only recommended dose of fertilizers were applied on the basis of soil test. The treatments consisted of NPK recommended dose of 80:30:30 kg/ha with biofertilizer. The treatments were applied in the first crop and their effect was observed on instant as well as succeeding crops. The integrated use of organic and inorganic sources of nutrients and biofertilizers increased the N, P and K concentrations in the plants including fruits of tomato. The integrated nutrient management also significantly increased shoot dry matter and fruit yields of tomato.

Gent (2004) determined if the yield of greenhouse tomato benefit from supplemental nitrogen (N) and potassium (K) supplied in amounts greater than that taken up by the plants, the yield and fruit and leaf tissue composition were compared for tomato plants grown in rock wool medium and supplied with sufficient N and K, or with N and/or K supply increased by approximately 30% over the control. In 1999, supplemental N in the form of NH_4NO_3 decreased yield, a trend that became more obvious as the season progressed. The K supply had no significant effect. In 2000, supplemental N in the form of $Mg(NO_3)_2$ increased early yield and fruit size. This effect disappeared later in the season. The different response to supplemental N in the two years may be due to the effect of the form of N supplied on vegetative tissue. NH_4NO_3 supplement increased N in leaf or petiole tissue more than the $Mg(NO_3)_2$ supplement. Supplemental N did not affect the composition of the fruit. Supplemental K increased N and K in leaf or petiole tissue. It did not affect K in fruit tissue but decrease Ca in fruit tissue in 1999.

Liu *et al.* (2004) conducted in a solar greenhouse using tomato cv. Zhongza 9 to investigate the light and temperature in the greenhouse, and the distribution of N, P and K in soil culture in winter-spring and autumn-winter crops. The distribution of total N, P and K was affected by light and temperature condition in the greenhouse. Both in winter-spring and autumn-winter crops, the distribution trend of total N, P and K was the same as that of dry material: mainly distributed in the stem and leaves before fruit formation stage, and in the fruits during fruit formation stage. In autumn-winter crop, because of the abominable light and temperature condition, the distributing proportion of N, P and K in early and middle stages of picking was higher than that in winter spring crop. The total proportion changed with different elements and growth stages.

An experiment was conducted by Chapagain *et al.* (2003) to find out the effects of potassium chloride (KCl) as potassium (K) in fertilizer solution on growth, yield and quality of tomato (cv. Durinta) in a controlled greenhouses were compared with potassium nitrate (KNO_3), the conventional K source for vegetable fertilization. Ammoniurn nitrate (NH_4NO_3), calcium nitrate [$Ca(NO_3)_2$] and nitric acid (HNO_3) were used as nitrogen (N) sources in KCl treatments. Plant height, time to anthesis, time to harvest, and leaf nutrient content were monitored. No significant differences in yield components and plant growth were recorded among the treatments. It was concluded that KNO_3 can be replaced fully or partially (depending on water quality) by KCI in tomato production while improving the quality of fruits. Results are given of several studies in different regions by Johnston *et al.* (2003) in Iran on the effects of different rates of K fertilizer application on crop yield and water use efficiency. All the soils used in these experiments were calcareous soils. On farms growing wheat in the Karaj and Darab regions, different rates and sources of K were tested in 1999. In a tomato plantation in Marand region, muriate of potash at 2 rates (100 and 150 kg K20/ha) with 8000 m3/ha of irrigation water was tested in 1999 and found that 150 kg K_2O/ha superior than 100 kg K20/ha regarding yield and yield contributing characters. The study on the effect of organic and inorganic fertilizers on yield and quality of tomato (cv. Parhhani 'Yashashri") conducted in Parbhani, Maharashtra, India, by Mohd *et al.* (2002) to revealed that application of 50% recommended dose of farmyard manure (FYM) @ 12.5 t ha^{-1} along with reduced levels of recommended doses of fertilizers (50% of the recommended dose of fertilizers of 100:50:50 NPK kg ha^{-1}) resulted in the highest yield with high quality. The study also revealed that the readymade organic manures of commercial companies used in this study were inferior to traditional organic manures, viz. FYM and vermicompost.

Tomato cv. House Momotaro plants growing in perlite with a nutrient solution were supplemented with 10, 20, 30 or 40 mM KCI or NaCl on various dates after anthesis, to determine the optimum salt concentration and application time for the improvement of fruit quality in tomatoes by Rhee *et al.* (2001). The number of fruit binds was limited and planting density was increased to minimize yield loss. Fruit quality improved as the salt concentration increased and improved with earlier applications. However, the improvements were accompanied by proportional yield reductions. KCI at 20 mM and NaCl at 25 mM improved fruit quality without significantly reducing yield. Application at 20 days alter anthesis of the first truss flowers gave the best results.

Khalil *et al.* (2001) study was undertaken in Peshawar, Pakistan in the summer of 1995-96 to determine the appropriate nitrogen fertilizer for maximum 21 tomato (cv. Peshawar Local) yield and its effects on various agronomic characters of tomato. Treatments comprised: untreated control; 150 kg ammonium nitrate/ha; 150 kg ammonium nitrate/ha + 100 kg P/ha + 50 kg K/ha; 150 kg ammonium sulfate; 150 kg ammonium sulfate/ha + 100 kg P/ha + 50 kg K/ha; 150 kg urea/ha; 150 kg urea/ha + 100 kg P/ha + 50 kg K/ha. Generally, ammonium sulfate fertilizer was the most efficient source of nitrogen for tomato production, followed by urea and ammonium nitrate. The ammonium sulfate + P + K treatment was the best among all treatments with respect to days to flower initiation (57 days), days to first picking (94 days), weight of individual fruit (50.8 g), weight of total fruits per plant (1990 g) and yield (21865 kg/ha). The control resulted in the significantly lowest response with respect to different agronomic characters under study.

Sun-Hong Mei *et al.* (2001) to the effect of K deficiency on the incidence of brown blotches in ripening fruits of tomatoes was investigated. K deficiency was associated with the occurrence of brown blotches, with more blotches observed in plants experiencing longer periods of K deficiency. Yield was reduced in K-deficient plants. Ravinder *et al.* (2000) In experiments at Solan in 1996 and 1997, eight tomato hybrids (Meenakashi, Manisha, Menka, SolanSagun, FT-5XEC-174023, EC174023XEC-174041, Rachna and Naveen) were treated with four NPK combinations (100:75:55; 150:112.5:82.5; 200:150:110; 250:187.5:137.5 kg $N:P_2O_5: K_2O$ ha^{-1}). The number of marketable fruits per plant and yield per plant were highest in Menka followed by

Manisha. Of the fertilizer treatments, 200:150:110 kg N: P2O5:K2O ha^{-1} produced the highest yields.

A long-term field experiment was conducted by Wijewardena and Amarasiri (1997) at Bandarawela (Sri Lanka) on a Red Yellow Podzolic soil during the ten cropping seasons commencing Maha 1986/87. Four levels of potassium fertilizers at rates of 0. 25, 50 and 100 kg K_2O/ha were applied for each crop. Potato. cabbage. Tomato, pole bean, cabbage, potato, cabbage, tomato, pole bean and cabbage were cultivated in this sequence. Alier cultivation of low K removal crops such as potato and pole bean, soil exchangeable K increased when 100 kg K_2O/ha was applied. Soil K increased when potassium was continuously applied to soil at 100 kg K_2O/ha but the cropping sequence was an important factor to he considered. High yields of vegetables e.g. tomato could be obtained with 100 kg K_2O/ha per season without any accumulation of K in the soil.

A fertilizer trail was conducted by Pansare *et al.* (1994) to find out the effect of different N, P and K on yield and quality of tomato. They found that the maximum yield of high-quality tomatoes were obtained when straight fertilizers was added in the N, P, K ratio of 3:1:2 (150 kg N/ha, 50 kg P_2O_5/ha, 100 kg K_2O/ha). Cerne and Briski (2003) conducted field trials on the fertilizer and irrigation requirement of tomato cv. Rutgers plants where 250 kg N and 72 kg P_2O_5/ha plants 200 or 400 kg K_2O/ha in the first year, 0 or 200 kg K_2O/ha in the second year, 0 or 40 t; stable manure/ha were applied in all treatments. The combination of 400 kg K_2O/ha stable manure and irrigation gave the highest total yield in the 1st and 2nd years (1.03and 2.25 kg/plant respectively). Silva and Vizzotto (1990) conducted field trail with the cultivar Angela Gigante 1-5, 100, the plants received N:P_2O_5: K_2O at 30-180; 75-450:30-180 kg/ha plus poultry manure at 0, 10 or 20 t/ha. The largest fruits and the highest yields (53 t/ha) were obtained by applying N:P_2O_5: K_2O at 104:259:140 kg/ha plus poultry manure at 20 t/ha.

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials and methods that were used in carrying out the experiment. It includes a short description of location of the experimental plot, characteristics of soil, climate and materials used for the experiment. The details of the experiment are described below.

3.1 Location of the experiment field

The field experiment was conducted at the Sher-e-Bangla Agricultural University Farm, Dhaka, Bangladesh from October 2020 to April, 2021 to evaluate the effect of potassium on yield and quality of tomato.

3.2 Climate of the experimental area

The area is characterized by hot and humid climate. The average rainfall of the locality of the experimental area is 89.06 mm, the minimum and maximum temperature is 11.10 °C and 34.80 ºC respectively. The average relative humidity was 75.8 % during October 2020 to April, 2021 (Appendix IV).

3.3. Soil of the experimental field

Initial soil samples from 0-15 cm depth were collected from experimental field. The collected samples were analyzed at Soil Resources Development Institute (SRDI), Dhaka, Bangladesh. The physico-chemical properties of the soil are presented in Appendix II. The soil of the experimental plots belonged to the agro-ecological zone of Madhupur Tract (AEZ-28), which is shown in Appendix II.

3.4 Plant materials used

In this research work, the seeds of one tomato variety were used as planting materials. The tomato variety used in the experiments was BARI Tomato-2 (RATAN). BARI

Tomato-2 was collected from the Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) at Joydebpur, Gazipur, Dhaka.

3.5. Raising of seedlings

Tomato seedlings were raised in two seedbeds of 3 m x 2 m size. A distance of 50 cm was maintained between the rows. The soil was well prepared and converted into loose friable and dried mass by spading. All weeds and stubbles were removed and 10 kg well rotten cow dung was mixed with the soil. Four gram of seeds was sown on each seedbed. The seeds were sown in the seedbeds 1 October, 2020. Sevin 85 SP was applied around each seedbed as precautionary measure against ants, worm and other harmful insects. The emergence of the seedlings took place with 6 to 8 days after sowing. Shading by polythene with bamboo structure was provided over the seedbed to protect the young seedlings from the scorching sunshine or rain. After 10 days emergence, the seedlings were transferred into a second bed to obtain healthy and vigorous seedlings. Diathane M-45 was sprayed in the seedbeds @ 2 g/l, to protect the seedlings from damping off and other diseases. Weeding, Mulching and Irrigation were done as and when required.

3.6 Treatments and layout of the experiment

Along with the Nitrogen 90 kg/ha, Phosphorus 40 kg/ha, Sulphur 20kg/ha and Zn 2kg/ha. The experiment consisted of six (6) different level of potassium:

level of Potassium fertilizer (MoP)

a) T_0=0 kg/ha (0 g MoP/plot)
b) T_1= 20 kg/ha (31.25g MoP/plot)
c) T_2= 40 kg/ha (62.5g MoP/plot)
d) T_3= 60 kg/ha (93.75g MoP/plot)
e) T_4= 80 kg/ha (125g MoP/plot)
f) T_5= 100 kg/ha (156.25g MoP/plot)

3.7 Design and layout of the experiment

The experiment was laid out in Randomized complete Block Design (RCBD) having single factor and replicated three times. An area was divided into three equal blocks. Each block was consisting of 6 plots where 6 treatments were allotted randomly. These there were 18-unit plots altogether in the experiment. The size of each plot was 3.75m × 2.5m. The distance between two rows and two seedlings were kept 75cm and 60 cm respectively (Appendix VII).

3.8 Cultivation procedure

3.8.1. Land preparation

The land for growing the crop was first opened with a tractor. Later on, the land was ploughed three times followed by laddering to obtain desirable tilth. The corners of the land were spaded and larger clods were broken into smaller pieces. After ploughing and laddering, all the stubbles and uprooted weeds were removed and then the land was ready. Finally, the unit plots were prepared as 15 cm raised beds. Ten pits were made in each plot in two rows maintaining a recommended spacing of row-to-row distance was 60 cm and plant to plant distance was 40 cm (BARI, 1996). The field layout and design or the experiment was followed immediately after land preparation.

3.8.2. Manure and fertilizers and its methods of application

Manure and fertilizers were applied in the experimental field as per the following doses in accordance with the Fertilizer recommendation guide 2018.

The fertilizer and manure received by all the plots at the rate of Cow dung 10 t/ha, Nitrogen 90 kg/ha, Phosphorus 40 kg/ha, Sulphur 20 kg/ha, Zinc 2 kg/ha.

3.8.3 Transplanting of seedlings

Healthy and uniform 30 days old seedlings were uprooted separately from the seed bed and were transplanted in the experimental plots in the afternoon of 30 October 2020 planting. The seedbed was watered before uprooting the seedlings from the seedbed so as to minimize damage to the roots. The seedlings were watered after transplanting. Shading was provided using polythene with bamboo structure from seed sowing to harvesting to protect the tomato seedlings from the adverse weather conditions in summer season. Seedlings were also planted around the border area of the experimental plots for gap filling.

3.8.4 Intercultural operations

After transplanting the seedlings, various kinds of intercultural operations were accomplished for better growth and development of the plants, which are as follows,

a) Shading

Shading was provided by using polythene with bamboo structure from seed sowing to harvesting of tomato plants thus create a favorable environment for the growth, development and yield of tomato during summer season.

b) Gap filling

When the seedlings were well established, the soil around the base of each seedling was pulverized. A few gaps filling was done by healthy seedlings of the same stock where initial planted seedling failed to survive.

c) Weeding and Mulching

Weeding and Mulching were accomplished as and whenever necessary to keep the crop free from weeds, for better soil aeration and to break the crust. It also helped in soil moisture conservation.

d) Staking and Pruning

When the plants were well established, staking was given to each plant by Dhaincha (Sesbania sp.) and bamboo sticks to keep them erect. Within a few days of staking, as the plants grew up, the plants were given a uniform moderate pruning.

e) Irrigation

Light irrigation was provided immediately after transplanting the seedlings and it was continued till the seedlings established in the field. Thereafter irrigation was provided.

f) Plant protection

Insect pests: Malathion 57 EC was applied & 2 ml 1-1 against the insect pests like cut worm, leaf hopper, fruit borer and others. The insecticide application was made fortnightly for a week after transplanting to a week before first harvesting. Furadan 10 G was also applied during final land preparation as soil insecticide. Diseases: During foggy weather precautionary measured against disease infection of summer tomato was taken by spraying Diathane M-45 fortnightly & 2 g l-1, at the early vegetative stage. Ridomil gold was also applied @ 2 g 1-1 against Early blight disease of tomato.

3.9 Harvesting

Fruits were harvested at 5-day intervals during early ripe stage when they attained slightly red color. Harvesting was started from 16 January, 2021 and was continued up to 10 April 2021.

3.10 Data collection

Ten plants were selected randomly from each plot for data collection in such a way that the border effect could be avoided for the highest precision. Data on the following parameters were recorded from the sample plants during the course of experiment.

3.10.1 Plant height (cm)

Plant height at final harvest was measured from sample plants in centimeter from the ground level to the tip of the longest stem and mean value was calculated. Plant height was also recorded at 10 days interval starting from 30 days of planting up to 60 days to observe the growth rate of plants.

3.10.2 Number of branches per plant

The total number of branches per plant was counted from plant of each unit pot. Data was recorded at 10 days interval starting from 30 days to 60 DAT.

3.10.3 Length of branches

The length of branch was measured with a measuring tape from the stem of the branch to the top of 10 randomly selected branches from each plot and their average was taken in centimeter (cm) as the length branch.

3.10.4 Number of leaf per plant

The total number of leaves per plant was counted from plant of each unit pot. Data was recorded at 10 days interval starting from 40 days to 60 DAT.

3.10.5. Number of fruits per plant

The number of fruits per plant was counted from plant of each unit plot and the average number of fruits per plant was recorded.

3.10.6 Fruit weight (g)

Among the total number of fruits during the period from first to final harvest the fruits, except the first and final harvest, was considered for determining the individual fruit weight by the following formula:

Weight of individual fruit (g) = $\frac{Total\ weight\ of\ fruit\ per\ plant}{Total\ number\ of\ fruit\ per\ plant}$

3.10.7 Yield of fruits per plot (kg)

A per scale balance was used to take the weight of fruits per plot. It was measured by total the fruit yield of each unit plot separately during the period from fruit to final harvest and was recorded in kilogram (kg).

3.10.8 Straw yield per plot (kg)

A per scale balance was used to take the weight of plant without fruits per plot.

3.10.9 Yield of fruits per hectare (t/ha)

It was measured by the following formula Fruit yield per hectare (t/ha)

3.11 Statistical analysis

The recorded data on various parameters were statistically analyzed by using MSTAT-C statistical package programmed. The mean for all the treatments was calculated and analysis of variance for all the characters was performed by F-test. Difference between treatment means were determined by Duncan`s new Multiple Range Test (DMRT) according to Gomez and Gomes, (1984).

Plate 01: Photograph showing field preparation and data collection.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter comprises the presentation and discussion of the results from the experiment. The experiment was conducted to determine the effects of potassium on growth and yield of BARI tomato-2 (RATAN). Some of the data have been presented and expressed in table (s) and others in figures for ease of discussion, comparison and understanding. A summary of all the parameters have been shown in possible interpretation wherever necessary have given under the following headings.

4.1 Plant height (cm)

Plant height is one of the most important growth parameters that indicates vegetative growth trend of plants. Different level of Potassium applied to determine the effect on the vegetative growth of the selected variety BARI Tomato-2 (RATAN). Plant height was recorded at different days after transplanting (30, 40, 50 and 60 DAT) has been shown in Table 4.1. Plant height was recorded at 30, 40, 50 and 60 DAT (days after transplanting) and observed growth of BARI Tomato-2 which was significantly higher in early vegetative to successive days after planting with a similar trend for 30 and 40 DAT where higher plant height (39.6 and 51.9cm) was obtained in T_5 treatment. But final plant height indicated its potential ability to grow over the growth stages up to 60 DAT where T_4 gives the higher (69.9 cm) plant height compared with others level of potassium. Plant height is one of the important parameters, which is positively correlated with the yield of tomato (Taleb, 1994).

Table 4.1. Effects of potassium on plant height (cm) was recorded at 30, 40, 50 and 60 DAT (days after transplanting).

Treatments	DAT (days after transplanting)			
	30	**40**	**50**	**60**
T_0	31.5 e	37.93 e	51.87 f	60.2 e
T_1	34.03 d	40.37 d	55.13 e	61.56 d
T_2	35.13 c	46.43 c	56.30 d	61.97 d
T_3	37.57 b	49.87 b	58.10 c	62.90 c
T_4	38.77 a	52.70 a	61.67 a	69.90 a
T_5	39.63 a	51.93 a	60.97 b	69.13 b
LSD	0.91	0.76	0.48	0.71
CV%	10.39	8.91	7.46	9.60

[In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.]

[T_0=0 kg/ha, T_1= 20 kg/ha, T_2= 40 kg/ha, T_3= 60 kg/ha, T_4= 80 kg/ha and T_5= 100 kg/ha.

4.2 Number of branches per plant

The different potassium treatments were influenced the number of branches per plant at 30, 40, 50 and 60 DAT. At 30 DAT (Table 4.2). It was found that relative development of branch system of BARI Tomato-2 varied significantly as influenced by the level of potassium fertilizer. As like the plant height, branch development of BARI Tomato-2 was also better which indicating higher branch number. Different levels of potassium influenced significantly the number of branches plant^{-1} of tomato for at 30, 40, 50 and 60 days after transplanting (DAT) under the present trial. Table 4.2 shows the effect of different level of potassium as for 30 and 40 DAT where T_4 results the highest no. of branch (7.3 and 8.6) and final number of branches per plant indicated its potential ability to grow new branches over the growth stages up to 60 DAT where T_4 gave the highest number of branches per plant.

Table 4.2. Effect of potassium on number of branches per plant was recorded at 30, 40, 50 and 60 DAT (days after transplanting).

Treatments	DAT (days after transplanting)			
	30	**40**	**50**	**60**
T_0	3.33 d	4.66 d	4.66 c	8.67 b
T_1	4.67 c	6.67 c	6.67 b	9.00 b
T_2	5.67 bc	7.33 bc	7.00 b	9.67 ab
T_3	6.33 ab	8.33 ab	8.66 a	10.00 ab
T_4	7.33 a	8.67 a	9.33 a	11.66 a
T_5	6.33 ab	7.66 abc	9.00 a	10.67 ab
LSD	1.18	1.03	1.62	2.07
CV%	11.58	7.86	11.76	11.42

[In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.] [T_0=0 kg/ha (0 g MoP/plot), T_1= 20 kg/ha (31.25g MoP/plot), T_2= 40 kg/ha (62.5g MoP/plot), T_3= 60 kg/ha (93.75g MoP/plot), T_4= 80 kg/ha (125g MoP/plot) and T_5= 100 kg/ha (156.25g MoP/plot)]

4.3 Length of branches

Length of branch was influenced by different level of potassium fertilizer at 30, 40, 50 and 60 DAT (Table 4.3). For all 30, 40, 50 and 60 DAT, highest length of branches (15.4, 20.3, 23.4 and 29.13 cm) was found in T_4 treatment.

Table 4.3. Effects of potassium on length of branches was recorded at 30, 40, 50 and 60 DAT (days after transplanting).

Treatments	DAT (days after transplanting)			
	30	**40**	**50**	**60**
T_0	9.03 e	13.37 d	15.93 e	23.70 e
T_1	9.90 d	15.36 c	18.64 d	24.97 d
T_2	11.00 c	17.60 b	19.23 c	27.30 c
T_3	13.93 b	17.30 b	21.37 b	28.26 b
T_4	15.40 a	20.30 a	23.40 a	29.13 a
T_5	15.10 a	19.40 a	23.00 a	28.13 b
LSD	0.42	1.01	0.61	0.46
CV%	10.86	9.25	10.66	8.94

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications. [T_0=0 kg/ha T_1= 20 kg/ha, T_2= 40 kg/ha, T_3= 60 kg/ha, T_4= 80 kg/ha and T_5= 100 kg/ha.]

4.4 Number of leaf per plant

Statistically significant variation was recorded for number of leaves plant^{-1} of tomato due to different levels of potassium fertilizer at 40, 50 and 60 DAT under the present trial.

The number of leaves per plant was different at 40, 50 and 60 DAT (Table 4.4). For 40 DAT T_4 (BARI Tomato-2) shows the highest number of leaves per plant as (31.3) and for 60 DAT (48.7).

Table 4.4. Effects of potassium on number of leaves per plant was recorded at 40, 50 and 60 DAT (days after transplanting).

Treatments	DAT (days after transplanting)		
	40	50	60
T_0	21.67 c	28.67 c	35.33 e
T_1	23.67 c	31.33 bc	39.00 d
T_2	27.33 b	32.00 b	41.00 c
T_3	30.00 ab	34.00 b	45.67 b
T_4	31.33 a	39.00 a	48.67 a
T_5	30.00 ab	38.66 a	48.33 a
LSD	3.37	3.05	1.79
CV%	6.78	4.95	8.23

In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications. [T_0=0 kg/ha, T_1= 20 kg/ha, T_2= 40 kg/ha, T_3= 60 kg/ha, T_4= 80 kg/ha and T_5= 100 kg/ha.]

4.5 Number of fruits per plant

There was a significant difference among the treatments in the number of fruits per plant. Number of fruits plant^{-1} of tomato varied significantly for different levels of potassium fertilizer (Table 4.5). The highest number of fruits plant^{-1} (30.3) was recorded from BARI Tomato-2 variety with the treatment of T_4 where 80 kg/ha potassium was applied (Figure 1)

4.6 Fruit weight (g)

Individual fruit weight directly altered with the application of different level of potassium and varied significantly for different levels of potassium fertilizer. The highest fruit weight (80.96 g) was recorded from the treatment of T_4 where 80 kg/ha potassium was applied (Table 4.5)

Table 4.5. Effects of potassium on number of fruits per plant and fruit weight.

Treatments	Number of fruits per plant	Fruit weight (g)
T_0	18.33 c	69.23 e
T_1	19.67 bc	70.57 d
T_2	22.33 b	78.00 c
T_3	27.33 a	80.00 ab
T_4	30.33 a	80.96 a
T_5	29.00 a	79.87 b
LSD	3.82	1.03
CV%	8.56	7.74

[In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.]

[T_0=0 kg/ha, T_1= 20 kg/ha, T_2= 40 kg/ha, T_3= 60 kg/ha, T_4= 80 kg/ha and T_5= 100 kg/ha]

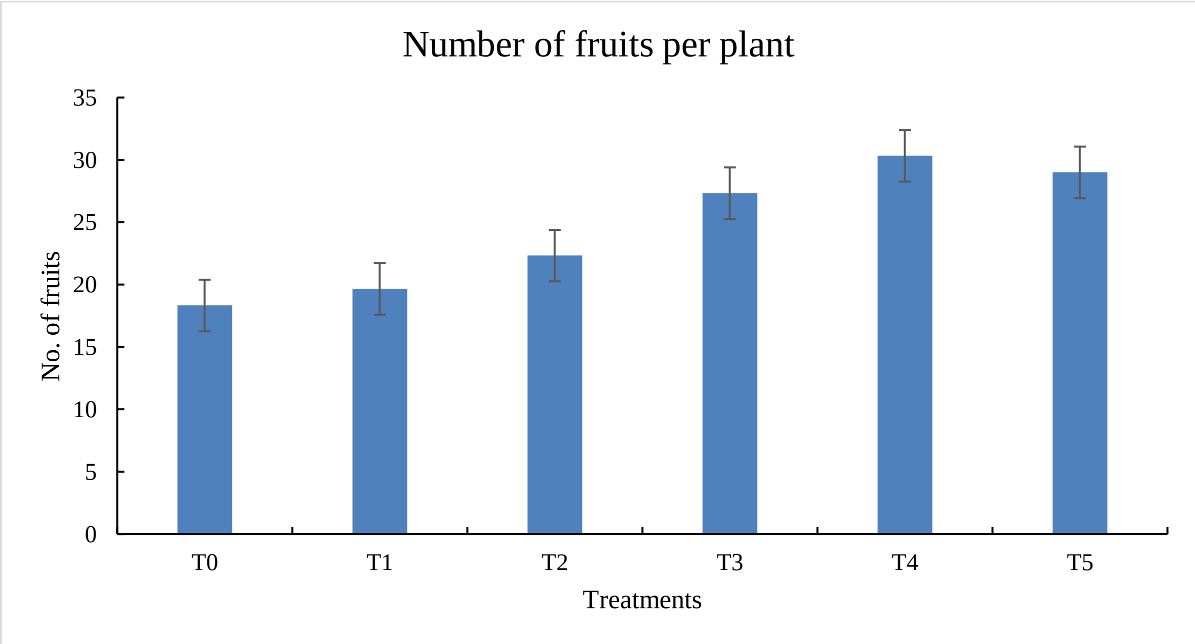

Figure 1: Effects of potassium on number of fruits per plant.

4.7 Yield of fruits (kg) per plot

The different level of potassium effect BARI tomato-2 significantly the yield of fruits per plot. The maximum yield of fruits per plot was observed for T_4 (62.57 kg/plot) and minimum yield was resulted from control treatment T_0 (41.3 kg/plot) (Fig. 2).

4.8 Straw yield (kg) per plot

The different levels of potassium influenced significantly the straw yield per plot. The maximum straw yield per plot was resulted from the treatment of T_4 (12.6 kg per plot) which was statistically similar with T_2, T_3, T_4 and T_5 treatments (Fig. 2).

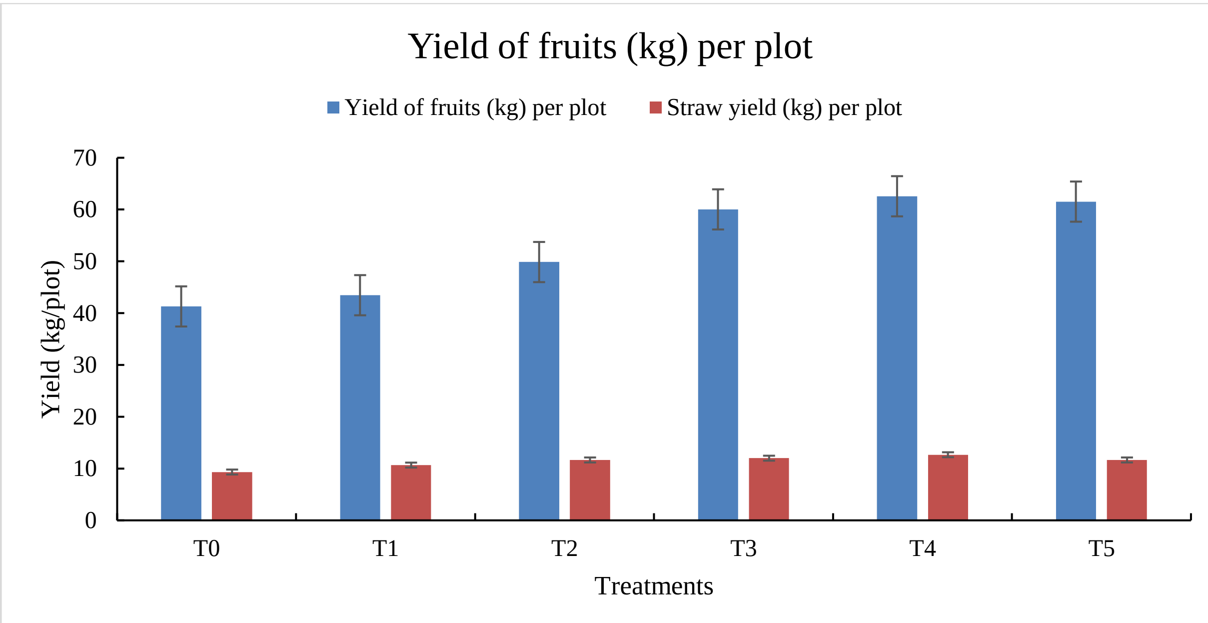

Figure 2: Effects of potassium on Yield of fruits (kg) per plot and Straw yield (kg) per plot.

4.9 Total fruit yield per hectare (t/ha)

The yield of tomato per plot was converted into per hectare, and has been expressed in metric tons. The different doses of potassium had significant effect on the yield of fruits per hectare (Table 4.6). The maximum yield of fruits per hectare was resulted from the treatment of T_4 as 66.74 (ton/ha.) and lowest yield observed from Control treatment T_0 (44.05 ton/ha.).

Table 4.6. Effects of potassium on Yield of fruits (kg) per plot, Straw yield (kg) per plot and Total fruit yield per hectare (t/ha).

Treatments	Yield of fruits (kg) per plot	Straw yield (kg) per plot	Total fruit yield per hectare (t/ha)
T_0	41.30 f	9.33 c	44.05 f
T_1	43.47 e	10.67 b	46.36 e
T_2	49.87 d	11.66 ab	53.19 d
T_3	60.03 c	12.00 a	64.07 c
T_4	62.57 a	12.67 a	66.74 a
T_5	61.53 b	11.66 ab	65.64 b
LSD	0.85	1.15	0.91
CV%	10.92	5.58	7.88

[In column, means containing same letter indicate significantly similar under DMRT at 5% level of significance. Values are the means of three replications.]

[T_0=0 kg/ha, T_1= 20 kg/ha, T_2= 40 kg/ha , T_3= 60 kg/ha , T_4= 80 kg/ha and T_5= 100 kg/ha]

CHAPTER V

SUMMARY AND CONCLUSION

The growth, yield contributing characters and yield of tomato largely depend on soil and climatic conditions and also on variety. Among these, proper doses of potassium play a vital role. The field experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka, Bangladesh during October 2020 to April, 2021 to evaluate the effect of potassium on yield and quality of tomato. Selected variety of tomato was, viz., BARI Tomato-2, and six doses of potassium viz. T_0=0 kg/ha (0 g MoP/plot), T_1= 20 kg/ha (31.25g MoP/plot), T_2= 40 kg/ha (62.5g MoP/plot), T_3= 60 kg/ha (93.75g MoP/plot), T_4= 80 kg/ha (125g MoP/plot) and T_5= 100 kg/ha (156.25g MoP/plot) were used to conduct this experiment. The experiment was laid out in Randomized complete Block Design (RCBD) having two factors and replicated three times. Data were taken on growth, yield contributing characters, yield and the collected data were statistically analyzed for evaluation of the treatment effects. The summary of the results has been described in this chapter.

Plant height was recorded at 30, 40, 50 and 60 DAT (days after transplanting) and observed growth of BARI Tomato-2 which was significantly higher in early vegetative to successive days after planting with a similar trend for 30 and 40 DAT where T_5 gave the highest plant height (39.6 and 51.9 cm). But final plant height indicated its potential ability to grow over the growth stages up to 60 DAT where T_4 gives the higher (69.9 cm) plant height compared with other levels of potassium. As like the plant height, branch development of BARI Tomato-2 was also better which indicating higher branch number. Different levels of potassium influenced significantly in terms of number of branch plant^{-1} of tomato for at 30, 40, 50 and 60 days after transplanting (DAT) under the present trial, where T_4 treatment produced the highest no. of branches (7.3 and 8.6) and final no. of branches per plant indicated its potential ability to grow new branches over the growth stages up to 60 DAT where T_4 gave the higher (11.6).

Length of branch was influenced by different level of potassium fertilizer at 30, 40, 50 and 60 DAT. For all 30, 40, 50 and 60 DAT T_4 produced the highest length of branches (15.4, 20.3, 23.4 and 29.13 cm). Number of fruits plant^{-1} of tomato varied significantly for different levels of potassium fertilizer. The highest number of fruits plant^{-1} (30.3) was recorded from BARI Tomato-2 variety with the treatment of T_4. The highest fruit weight (80.96 g) was recorded from BARI Tomato-2 variety with the treatment of T_4.

The maximum yield of fruits per plot was observed for T_4 (62.57 kg/plot) and minimum yield was resulted from control treatment T_0 (41.3 kg/plot). The maximum straw yield per plot was resulted from the treatment of T_4 as 12.6 kg per plot. The different doses of potassium had significant effect on the yield of fruits per hectare. The maximum yield of fruits per hectare was resulted from the treatment of T_4 as 66.74 (ton/ha.) and lowest yield observed from Control treatment T_0 (44.05 ton/ha.).

Conclusion

Based on the result of the present study it was found that application of 80 kg/ ha. (T_4) treatment performed the highest yield (66.74 t/ha) of BARI Tomato-2 and therefore could be recommended for profitable tomato production.

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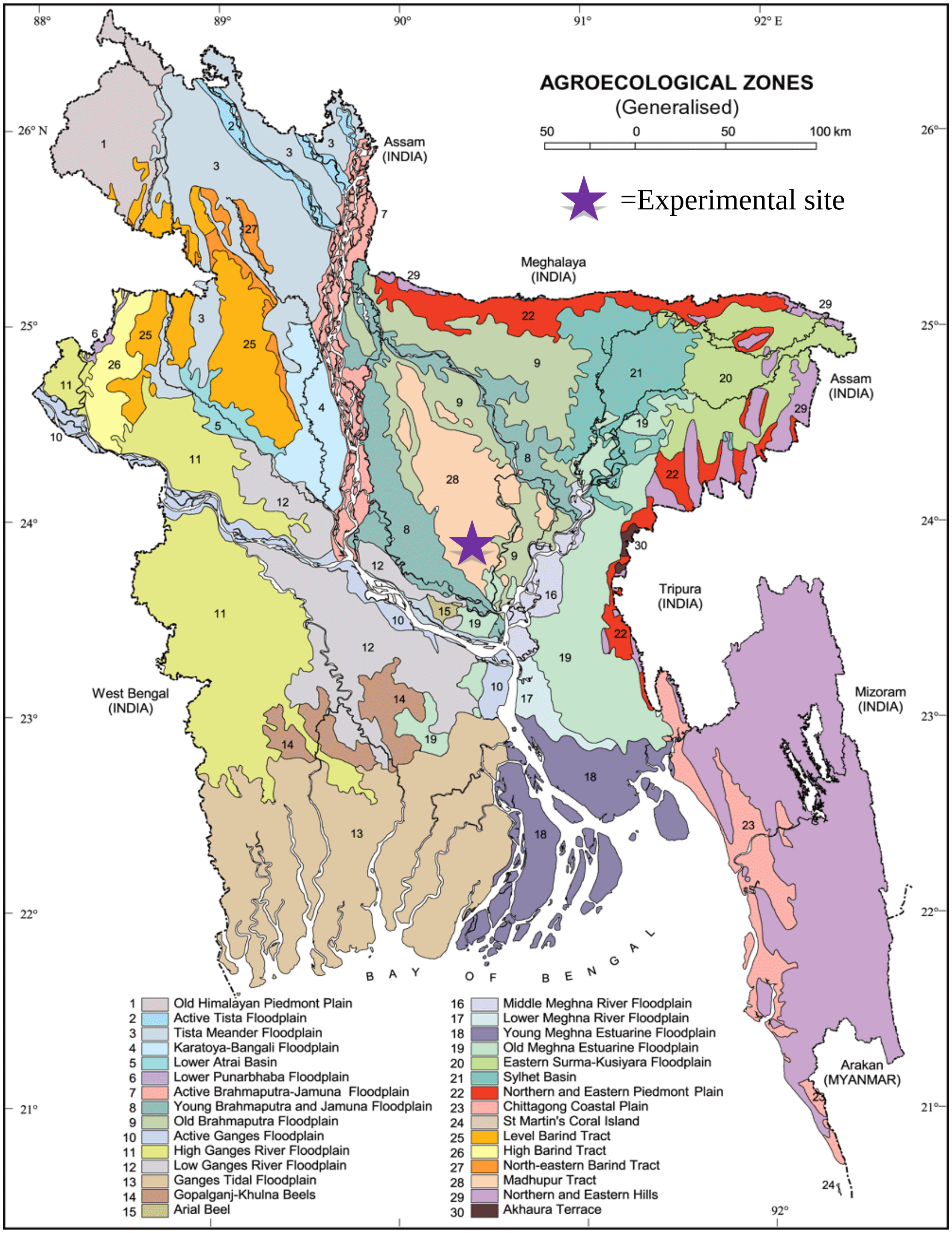
Appendices

Appendix I. Map showing the experimental site under study



Appendix II. Morphological characteristics of the experimental field

Morphological features	**Characteristics**
Location	Sher-e-Bangla Agricultural University Agronomy research field, Dhaka
AEZ	AEZ-28, Modhupur Tract
General Soil Type	Shallow Red Brown Terrace Soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled

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

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

Appendix IV. Monthly meteorological information during the period from October, 2020 to April, 2021

Year	Month	Air temperature (^{0}C)		Relative humidity (%)	Total rainfall (mm)
		Maximum	Minimum		
2020	October	29.50	12.3	59.8	34
	November	28.10	11.83	58.18	47
	December	25.00	9.46	69.53	00
2021	January	25.2	12.8	69	00
	February	27.3	16.9	66	39
	March	31.7	19.2	57	23
	April	32.4	21.1	63	31

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

Appendix V: Analysis of variance (mean square) of the data for Plant height.

Source of variation	df	Plant height			
		30 DAT	40 DAT	50 DAT	60 DAT
Replication	2	0.0039	0.344	0.1206	0.3072
Treatment	5	28.86	114.178	41.0152	51.8422
Error	10	0.25	0.179	0.0706	0.1506

Appendix VI: Analysis of variance (mean square) of the data for Number of branches.

Source of variation	df	No. of branches			
		30 DAT	40 DAT	50 DAT	60 DAT
Replication	2	2.889	2.388	3.889	2.889
Treatment	5	6.055	6.222	9.556	3.656
Error	10	0.422	0.322	0.789	1.289

Appendix VII: Analysis of variance (mean square) of the data for no. of fruit, yield (kg/plot), Straw Yield (kg/plot), Biological yield (t/ha).

Source of variation	df	No. of fruit	Yield (kg/plot)	Straw yield (kg/plot)	Yield (t/ha.)
Replication	2	4.667	0.014	0.667	0.016
Treatment	5	77.033	270.781	4.133	308.155
Error	10	4.400	0.221	0.400	0.250

Appendix VII: Layout of the experimental field