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EFFECT OF POTASSIUM ON GROWTH AND YIELD OF TOMATO (*Lycopersicon esculentum* Mill.)

R Sultana[1] S Dilruba[2] N Parvin[3] and ABMJ Islam[4*]

Address
[1 & 2] Post graduate student Dept of Horticulture, SAU Dhaka [3]Senior Scientific Officer [4]Scientific Officer Rice Farming Systems Division, BRRI, Gazipur

Correspondence*
saurov.brri@gmail.com

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Abstract

The experiment was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka-1207 during October 2006 to March 2007 to find out the optimum level of potassium (K) for maximum yield of tomato. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The experiment consisted of four levels of potassium K_0: 0 kg K/ha, K_1: 124.5 kg K/ha, K_2: 132.8 kg K/ha and K_3: 141.1 kg K/ha. In case of potassium, K_3 produced the maximum fruits per plant (37.08) and highest yield (65.96 t/ha) and the lowest yield (43.83 t/ha) and minimum fruits per plant (26.19) was from K_0.

Keywords: Potassium, growth, yield and tomato

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is a member of Solanaceae family is one of the important, popular and nutritious vegetables grown in Bangladesh during winter season and cultivated mostly in all parts of the country (Haque*et al.*, 1999). It is adapted to a wide variety of climates. At present, tomato ranks third, next to potato and sweet potato, in terms of world vegetable production (FAO, 2002). The leading tomato producing countries of the world are China, India, Egypt, Turkey, Iran, Italy, Mexico, Brazil and Indonesia (FAO, 2002). Its food value is very rich because of higher contents of vitamins A, B and C including calcium and carotene (Bose and Som, 1990). It is much popular as salad in the raw state and is made into soups, juice, ketchup, pickles, sauces, conserved puree, paste, powder and other products (Ahmad, 1976; Thompson and Kelly, 1983 and Bose and Som, 1990). Bangladesh produced 102 thousand tons of tomato in 15,790 thousand hectares of land during the year 2002-2003 and the average yield being 6.46 t ha^{-1} (BBS, 2004). The yield of tomato in our country is not satisfactory enough in comparison to requirement (Aditya *et al*., 1999). The low yield of tomato in Bangladesh, however, is not an indication of low yielding ability of this crop, but of the fact that the tomatoes grown here are not always of high yielding cultivars and that the cultural practices commonly used by the growers are not improved. Since the soil and climatic conditions of Bangladesh during the winter season are congenial to proper growth of tomato, it is expected that improved management practices would augment the yield considerably.

Potassium is especially important in a multi nutrient fertilizer application (Brady, 1995). Potassium application increases the flower number, the peduncle length, the fruit set and the number of fruit (Besford and Maw, 1975). It has marked effect on the quality of tomato fruits particularly on colour (Wall, 1940 and Ozbun *et al.*, 1967). Potassium also has an important role on balancing physiological activities. Therefore, the present study was aimed to find out the optimum level of potassium for the maximum yield.

Materials and Methods

The experiment was conducted at the experimental farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka -1207 during October 2006 to March 2007. Soil of the study site was silty clay loam in texture representing the Agro-Ecological Zone of Madhupur Tract (AEZ-28) with PH 5.8-6.5, ECE-25.28 (Haider*et al*., 1991).The experimental area is characterized by subtropical rainfall during the month of May to September (Annon., 1988) and Scattered rainfall during the rest of the year. The experiment consisted of four levels of potassium K_0: 0 kg K/ha, K_1: 124.5 kg K/ha, K_2: 132.8 kg K/ha and K_3: 141.1 kg K/ha. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. An area of 41.5 m x 13 m and the size of each plot was 3.2 m x 2 m. The tomato variety used in the experiments was "Ratan" and the seeds were collected from the Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI) at Joydebpur. Tomato seedlings were raised in five seedbeds of 3 m x 1 m size. All weeds and stubbles were removed and 5 kg well rotten cow dung was mixed with the soil. Ten gram of seeds was sown on each seedbed on 27 October 2006. After sowing, seeds were covered with light soil. Heptachlor 40 WP was applied @ 4 kg ha^{-1}, around each seedbed as precautionary measure against ants and worm. The land of the experimental field was ploughed with a power tiller. After ploughing and laddering, all the stubbles and uprooted weeds were removed and then the land was ready. Potassium was applied as per treatment and Urea and TSP was applied at the rate of 550 kg/ha and 450 kg/ha (Razzak *et al.* 2000). The quantity of manure, cow dung was also determined as recommended at the rate of 10 t/ha (BARC, 1997).The

entire amount of cow dung and TSP were applied as basal during land preparation. Urea and MP were used as top dressing in equal splits at 20, 30 and 40 days after transplanting. 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 1 December, 2006 maintaining a spacing of 50 cm x 40 cm between the rows and plants respectively. This allowed an accommodation of 32 plants in each plot. All Intercultural operations were done when necessary. Fruits were harvested at 3 days intervals during early ripe stage when they attained slightly red color. Harvesting was started from 26 February, 2007 and was continued up to 29 March 2007. Ten plants were selected randomly from each plot for data collection. The data were collected on Plant height, flower clusters per plant**,** flowers per plant, flowers per cluster, fruits per plant, fruits per cluster, weight of individual fruit, fruit length, fruit diameter, dry matter of leaves, dry matter of fruits, yield of fruits per plot (kg), yield of fruits per hectare (ton). The recorded data on various parameters were statistically analyzed using MSTAT statistical package programme and means were determined by Duncan`s Multiple Range Test (DMRT) according to Gomez and Gomez, (1984) at 5% level of significance.

Results and Discussion

Plant height

Plant height varied significantly due to the application of different levels of potassium at 40, 50, 60, 70 DAT and at maturity. At 40 DAT, the longest (57.51 cm) plant height was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically similar (56.27 cm) to K_2 (132.8 kg K ha^{-1}), while the shortest (48.70 cm) plant was obtained from K_0 (0 kg K ha^{-1}). Similarly, the longest (74.68 cm) plant was found from K_3 which was statistically similar (73.78 cm) to K_2, while the shortest (68.67 cm) plant was recorded from K_0 at 50 DAT. At 60 DAT, the longest (100.27 cm) plant was recorded from K_3 which was statistically similar (98.13 cm) to K_2, while the shortest (86.68 cm) plant was found from K_0. The longest (113.80 cm) plant was recorded from K_3 which was statistically similar to K_2 (111.26 cm) and K_1 (108.96 cm) and the shortest (92.46 cm) plant was obtained from K_0 at 70 DAT. At maturity the longest (138.78 cm) plant was recorded from K_3 which was statistically similar (127.66 cm) to K_2, and the shortest (102.08 cm) was found from K_0 (Figure 1). Application of potassium progressively increased plant height up to maximum doses. Probably, potassium ensured the availability of other essential nutrients as a result maximum growth was occurred and the ultimate results is the maximum plant height. Murphy (1964) found that application of potassium increased plant height by up to 65%.

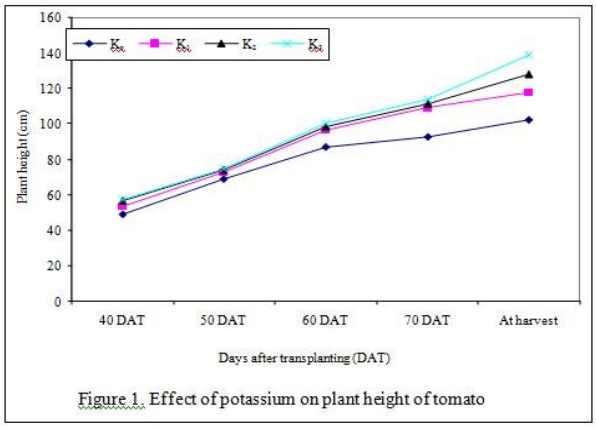

Figure 1. Effect of potassium on plant height of tomato

Flower clusters per plant

Significant variation was recorded on number of flower cluster per plant due to the application of different levels of potassium. The maximum (10.33) number of flower cluster per plant was recorded from K_3 (141.1 kg K ha^{-1}) which was closely followed (9.69) by K_2 (132.8 kg K ha^{-1}), while treatment K_0 (0 kg K ha^{-1}) showed the minimum (7.97) number of flower cluster per plant (Table 1).

Flowers per cluster

Different levels of potassium showed significant differences on number of flowers per cluster under the present trial. The maximum (7.64) number of flowers per cluster was recorded from K_3 (141.1 kg K ha^{-1}), while the minimum (5.89) number of flowers per cluster was obtained from K_0 (0 kg K ha^{-1}) (Table 1). Clarke (1944) found little effect of potassium application on flower production, although the proportion of flowers that matured into marketable fruit which supported to the present investigation.

Flowers per plant

Number of flowers per plant differs significantly due to the application of different level of potassium. The maximum (78.83) number of flowers per plant was recorded from K_3 (141.1 kg K ha^{-1}), while the minimum (47.48) number of flowers per plant was obtained from K_0 (0 kg K_2O ha^{-1}) (Table 1).

Dry matter content of leaves

Potassium application significantly increased the dry matter content on leaves compared to K_0. The maximum (10.88%) dry matter content on leaves was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (10.85% and 10.54%) to K_2 (132.8 kg K ha^{-1}) and K_1 (124.5 kg K ha^{-1}), while the minimum (8.99%) dry matter content on leaves was recorded from K_0 (0 kg K ha^{-1}) (Table 1).

Dry matter content of fruits

Similarly, dry matter content on fruits increased significantly due to the application of different levels

Table 1. Effect of potassium on yield contributing characters of tomato, 2006

Treatment(s)	Number of flower cluster per plant	Number of flowers per cluster	Number of flowers per plant	Dry matter content of leaves (%)	Dry matter content of fruits (%)
Potassium					
K_0	7.97 d	5.89 c	47.48 d	8.99 b	8.85 b
K_1	8.53 c	6.58 b	55.69 c	10.54 a	11.65 a
K_2	9.69 b	6.89 b	66.96 b	10.85 a	11.95 a
K_3	10.33 a	7.64 a	78.83 a	10.88 a	12.08 a
$LSD_{(0.05)}$	0.371	0.396	4.197	0.574	1.635
Level of significance	**	**	**	**	**
CV(%)	6.28	6.36	9.94	6.82	10.12

Table 2. Effect of potassium on yield contributing characters and yield of tomato

Treatment(s)	Number of fruits per plant	Diameter of fruit (cm)	Weight of Individual fruit (g)	Number of fruits per cluster	Yield (kg/plot)
Potassium					
K_0	26.19 c	5.17 b	77.03 c	2.72 d	28.05 c
K_1	32.52 b	5.85 a	89.89 b	3.55 c	37.15 b
K_2	34.46 ab	5.92 a	97.70 ab	4.06 b	40.41 a
K_3	37.08 a	6.15 a	102.45 a	4.42 a	42.22 a
$LSD_{(0.05)}$	2.961	0.296	8.770	0.329	2.216
Level of significance	*	**	**	**	**
CV(%)	11.54	6.36	11.92	11.61	7.42

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

K_0 : 0 kg K ha^{-1} | K_1 : 124.5 kg K ha^{-1} K_2 : 132.8 kg K ha^{-1} | K_3 : 141.1 kg K ha^{-1}

of potassium compared to K_0. The maximum (12.08%) dry matter content on fruits was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (11.95% and 11.65%) to K_2 (132.8 kg K ha^{-1}) and K_1 (124.5 kg K ha^{-1}), while the minimum (8.85%) dry matter content on fruits was found from K_0 (0 kg K ha^{-1}) (Table 1).

Fruits per plant

Number of fruits per plant differed significantly due to the application of different level of potassium. The maximum (37.08) number of fruits per plant was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically similar (34.58) to K_2 (132.8 kg K ha^{-1}), while the minimum (26.19) number of fruits per plant was obtained from K_0 (0 kg K ha^{-1}) which was closely followed (32.61) by K_1 (124.5 kg K ha^{-1}) (Table 2).

Length of fruit

Length of fruit differed significantly due to the application of different levels of potassium. The maximum (7.87 cm) length of fruit was recorded from K_3 (141.1 kg K ha^{-1}) which was closely followed (7.18 cm and 7.00 cm) by K_2 (132.8 kg K ha^{-1}) and K_1 (124.5 kg K ha^{-1}), while the minimum (6.09 cm) length of fruit was found from K_0 (0 kg K ha^{-1}) (Figure 2)

Diameter of fruit

Diameter of fruit varied significantly due to the application of different levels of potassium. The maximum (6.15 cm) diameter of fruit was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (6.00 cm and 5.87 cm) to K_2 (132.8 kg K ha^{-1}) and K_1 (124.5 kg K ha^{-1}), while the minimum (5.17 cm) diameter of fruit was found from K_0 (0 kg K ha^{-1}) (Table 2).

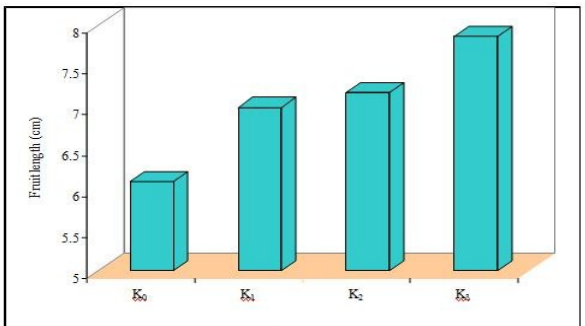

Figure 2. Effect of potassium on fruit length of tomato

Weight of individual fruit

Weight of individual fruit differed significantly due to the application of different level of potassium. The maximum (102.45 g) weight of individual fruit was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (97.70 g) to K_2 (132.8 kg K ha^{-1}), while the minimum (77.03 g) weight of individual fruit was recorded from K_0 (0 kg K ha^{-1}) (Table 2).

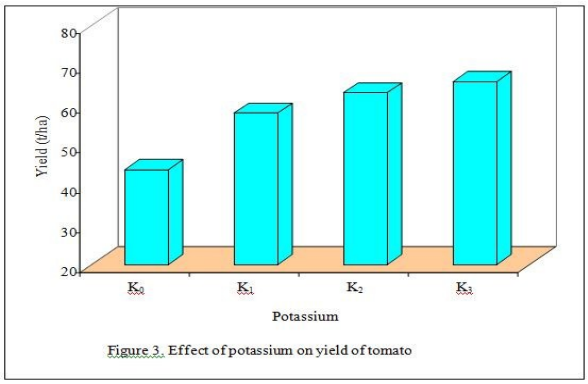

Figure 3. Effect of potassium on yield of tomato

Fruits per cluster

Number of fruits per cluster differs significantly due to the application of different levels of potassium. The maximum (4.42) number of fruits per cluster was recorded from K_3 (141.1 kg K ha^{-1}), while the minimum (2.72) number of fruits per cluster was recorded from K_0 (0 kg K ha^{-1}). (Table 2)

Yield (kg/plot)

Yield per plot differs significantly due to the application of different level of potassium. The highest (42.22 kg/plot) yield was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (40.41 kg/plot) to K_2 (132.8 kg K ha^{-1}), while the minimum (28.05 kg/plot) yield was recorded from K_0 (0 kg K ha^{-1}) (Table 2).

Yield (t/ha)

Different level of potassium showed significant variation for yield per hectare of tomato. The highest (65.96 t/ha) yield was recorded from K_3 (141.1 kg K ha^{-1}) which was statistically identical (63.14 t/ha) with K_2 (132.8 kg K ha^{-1}), while the lowest (43.83 t/ha) yield was found from K_0 (0 kg K ha^{-1}) (Figure 3). Pansare *et al*. (1994) reported that the maximum yield tomatoes were obtained when straight fertilizers were added in the 83 kg K/ha.

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