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Effect of Soil and Foliar Application of Plant Nutrients on Purple Blotch and Tip-Burn of Garlic

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Abstract

An experiment was conducted in the field of Plant Pathology Division, BARI, Joydebpur to evaluate the efficacy of available plant nutrient for the development of purple blotch disease and tip-burn of onion. Eight different treatments viz. Potassium (MP fertilizer), Phosphorus (TSP fertilizer), Boron (Boron fertilizer), Zinc (ZnSO4 fertilizer), Calcium ($CaSO_4$ fertilizer), Copper ($CuSO_4$), Silicon (silica gel) and Manganese ($MnSO_4$ fertilizer) were tested against purple blotch disease and tip-burn of garlic. The present study revealed that soil and foliar application of plant nutrients viz. Potassium, Phosphorus, Boron, Zinc, Calcium, Copper, Silicon and Manganese gave appreciable reduction of purple blotch disease and tip-burn incidence and increased plant growth parameters such as shoot and root growth as well as yield of garlic. Among the nutrients Potassium, Phosphorus, Silicon, Zinc and Calcium were performed better for reducing purple blotch disease severity, tip-burn disease incidence and increasing plant growth as well as yield of garlic. Application of Boron and Manganese also performed better than control. So, soil and foliar application plant nutrients Potassium, Phosphorus, Silicon, Zinc, Boron and Manganese may be recommended for tip-burn and purple blotch disease management and for garlic production in Bangladesh.

Introduction

Garlic (*Allium sativum* L.) is one of the most important aromatic herbaceous annual spices under the family Alliaceae [1]. It is the second most widely used cultivated Allium after onion[2]. Garlic has been recognized all over the world as a valuable spice for cooking different dishes. In Bangladesh garlic cultivated in 73595 ha land and produces 485447 metric

ton with an average yield of 4.43 t ha-1 [3]. The yield is quite low in the world context. This low yield may be due to the cultivation of the low yielding local varieties, incidence of diseases and insects, lack of technical knowledge etc. Both soil borne and foliar diseases are one of the major constrains for low yield of garlic in Bangladesh. Purple blotch caused by *Alternaria porri* is a common destructive disease of garlic which adversely effects on garlic cultivation and and causes severe yield loss [4-7]. Now a days tip-burn become one of the major problem for garlic production. At present all the garlic cultivars are susceptible to purple blotch disease and tip burn. In Bangladesh, only fungicidal management is the effective means to manage the purple blotch disease but none of information available about tip burn problem. The control of plant diseases using pesticides raises serious concerns about food safety, environmental quality and pesticide resistance, which have dictated the need for alternative pest management techniques [8]. So, it is important to find alternative measures to control plant diseases which do not harm the environment and at the same time increase yield and improve product quality [9-11]. Nutrients are important for growth and development of plants and also microorganisms. They are important factors for disease suppression [12]. All the essential nutrients can affect disease severity [13]. It is important to manage nutrient availability through fertilizers or change the soil environment to influence nutrient availability, and in that way to control plant disease in an integrated pest management system [13 and 14]. In addition, nutrients can affect the development of a disease by affecting plant physiology or by affecting pathogens, or both of them. The level of nutrients can influence the plant growth, which can affect the microclimate, therefore affecting infection and sporulation of the pathogen [15]. But unfortunately there is no available information about the effect of nutrients on disease management in Bangladesh. Therefore the present study has taken to observe the effect of plant nutrients on purple blotch disease and tip-burn of garlic.

Materials and Methods

The experiment was conducted in the field of Plant Pathology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur during robi 2015-16, 2016-17 and 2017-18 cropping seasons. There were 9 treatments viz. T_1= Spray in the furrow soil during transplanting + Foliar spray of Potassium (MP fertilizer @2% water solution), T_2= Spray in the furrow soil during transplanting + Foliar spray of Phosphorus (TSP fertilizer @2% water solution), T_3= Spray in the furrow soil during transplanting + Foliar spray of Zinc ($ZnSO_4$ fertilizer @1% water solution), T_4= Spray in the furrow soil during transplanting + Foliar spray of Silicon (Silica gel @2% water solution), T_5= Spray in the furrow soil during transplanting + Foliar spray of Boron (Boro fertilizer @1% water solution) T_6= Spray in the furrow soil during transplanting + Foliar spray of Calcium ($CaSO_4$ fertilizer @1% water solution), T_7= Spray in the furrow soil during transplanting + Foliar spray of Manganese ($MnSO_4$ fertilizer @ 1% water solution), T_8= Spray in the furrow soil during transplanting + Foliar spray of Copper ($CuSO_4$ @1% water solution) and T_9= Control (only used recommended dose of fertilizers). The unit plot size was 2 m x 2.5m. RCB design was followed with 3 replications. The variety BARI Rashun-1 was used. The treatments were applied four times viz. 1st application at the time of seedling transplanting, 2nd application 40-45 days after seedling transplanting, 3rd application 15 days after 2nd application and 4th application 15 days after 3rd application. Standard cultivation recommended by BARI was followed to grow garlic [16]. During crop season necessary weeding, irrigation and other intercultural operations were done as per recommendation of the crop.

Data Collection

Data were recorded on purple blotch disease severity, tip-burn incidence, plant growth parameter such as plant height, shoot weight, root length and root weight and yield per unit area. Data on plant growth parameters were recorded 65 days after seedling transplanting. Disease data were recorded 15 days after 4th time

treatments application. Data were calculated in terms of disease incidence and disease severity (PDI) by following formulae:

$$\text{Disease incidence} = \frac{\text{Number of infected plant}}{\text{Total number of inspected plant}} \text{ X } 100$$

$$\text{PDI} = \frac{\text{Total sum of numerical ratings}}{\text{Number of observation X Maximum disease rating in the scale}} \text{X}100$$

The 0-5 disease scoring scale was used to estimate the disease severity (PDI-Percent Disease Index) of purple blotch complex of onion for each unit plot under each treatment. The scale was followed by Islam *et al.* [17] and Rahman and Rashid [18] as described below:

0 = no disease symptoms in the plant

1 = a few spots towards the tip, covering less than 10% leaf area

2 = several dark purplish brown patches covering less than 20% leaf area

3 = several patches with paler outer zone, covering up to 40% leaf area

4 = long streaks covering upto 75% leaf area or breaking of leaves / stalks from the centre

5 = complete drying of the leaves/ stalks or breaking of the leaves / stalks from the base

The percent data were converted into arcsine transformation values before statistical analysis. Data were analyzed statistically by using the MSTATC program. The treatment effects were compared by applying the least significant different (LSD) test at P=0.05 level.

Results and Discussion

Plant Growth

Average plant height of onion under control was 27.27 cm plant^{-1} in the first year, 44.67 cm plant^{-1} in the second year and 39.33 cm plant^{-1} in the third year (Table 1). The plant height was increased to 31.73-38.80 cm plant^{-1} in the first year, 47.47-57.00 cm plant^{-1} in the second year and 42.00-54.00 cm plant^{-1} in the third year due to soil and foliar application of different plant nutrients. In the first year, soli and foliar application TSP fertilizer, MP fertilizer and Silica gel gave higher plant height followed by $ZnSO_4$ fertilizer and $MnSO_4$ fertilizer and (Table 1). Lower increased of plant height over control was recorded from the treatment $CuSO_4$ followed by $CaSO_4$ fertilizer and Boron fertilizer. In the second year, the highest plant height was recored from MP fertilizer treatment followed by TSP fertilizer, Silica gel, $ZnSO_4$ fertilizer, $MnSO_4$ fertilizer and $CaSO_4$ fertilizer (Table 1). The least effective treatment in increasing of plant over control was recorded from $CuSO_4$ followed by Boron fertilizer treatment. In the third year, the all the treatment gave significantly higher plant height compared to control except $CuSO_4$ where the plant height was lower than other treatment (Table 1).

In first year, the plant weight of garlic was 8.20 g plant^{-1} under control. It increased to 10.27-15.80 g plant^{-1} due to soil and foliar application of different nutrients (Table 1). Soil and foliar application of TSP fertilizer, MP fertilizer and Silica gel gave higher plant height followed $ZnSO_4$ fertilizer treatment. The least effective treatment to increase plant weight was $CuSO_4$ followed by and $CaSO_4$ fertilizer, Boron fertilizer and $MnSO_4$ treatments. In second year, the lowest plant weight of onion was 16.93 g plant^{-1} recorded in the control. Soil and foliar application of MP fertilizer gave the highest plant weight 22.53 g plant^{-1} followed by the TSP fertilizer, $ZnSO_4$ fertilizer, $CaSO_4$ fertilizer, Silica gel and $MnSO_4$ treatments where the plant weight was 21.87, 21.47, 21.40, 20.73 and 19.87 g plant^{-1}, respectively (Table-1). In third year, the lowest plant weight of onion was 14.20 g plant^{-1} recorded in the control. Soil and foliar application of MP fertilizer, TSP fertilizer, Silica gel and $ZnSO_4$ fertilizer gave higher plant height followed by Boro fertilizer, $CaSO_4$ and $MnSO_4$ treatments (Table 1). In all the years the least effective treatment was $CuSO_4$ treatment (Table 1).

Root Growth

Soil and foliar application of different plant nutrients showed positive effects on root growth of garlic as compared to control (Table 2). In first year, higher root length 8.67 cm and 8.60 was recorded from Silica gel and

Table 1. Effect of soil treatment and foliar application different nutrients on the plant growth of garlic during three consecutive years

Soil and foliar application of different plant nutrient with dose	Plant height (cm)			Plant weight (gplant^{-1})		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MP fertilizer @2%)	36.40 a	57.00 a	54.00 a	15.37 a	22.53 a	23.17 a
Phosphorus (TSP fertilizer @2%)	38.80 a	53.93 ab	54.00 a	15.80 a	21.87 ab	22.00 a
Zinc ($ZnSO_4$ fertilizer @1%)	33.60 b	53.20 b	53.00 a	13.87 b	21.47 ab	21.90 a
Silicon (Silica gel @2%)	38.67 a	53.43 b	51.67 a	15.27 a	20.73 ab	21.30 a
Boron (Boro fertilizer @1%)	31.87 bc	49.07 cd	51.33 a	12.53 c	19.53 bc	20.37 ab
Calcium ($CaSO_4$ fertilizer @1%)	31.73 bc	51.40 bc	49.67 a	12.20 c	21.40 ab	19.93 ab
Manganese ($MnSO_4$ fertilizer @1%)	33.47 b	53.13 b	51.33 a	12.80 c	19.87 ab	20.37 ab
Copper ($CuSO_4$ @1%)	29.40 cd	47.47 de	42.00 b	10.27 d	16.93 cd	17.10 bc
Control	27.27 d	44.67 e	39.33 b	8.20 e	15.93 d	14.20 c
LSD (P=0.05)	2.507	3.523	4.987	0.7683	2.79	3.963

Table 2. Effect of soil treatment and foliar application different nutrients on the root growth of garlic during three consecutive years

Soil and foliar application of different plant nutrient with dose	Root length (cm)			Root weight (gplant^{-1})		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MP fertilizer @2%)	8.60 a	6.73 a	8.00 a	1.00 ab	1.73ab	2.60 ab
Phosphorus (TSP fertilizer @2%)	7.73 ab	7.07 a	7.73 a	1.07 a	1.87a	2.93a
Zinc ($ZnSO_4$ fertilizer @1%)	7.20 bc	6.60 a	7.73 a	0.80 bc	1.80 ab	2.67 ab
Silicon (Silica gel @2%)	8.67 a	6.47 a	7.27 a	1.33 a	1.87 a	2.77 ab
Boron (Boron fertilizer @1%)	7.47 bc	6.73 a	7.17 a	0.73 cd	1.80 ab	2.47 ab
Calcium ($CaSO_4$ fertilizer @1%)	7.27 bc	6.73 a	7.47 a	0.73 cd	1.67 ab	2.73 ab
Manganese ($MnSO_4$ fertilizer @1%)	7. 80 ab	6.60 a	7.47 a	0.93 abc	1.67 ab	2.33 bc
Copper ($CuSO_4$ @1%)	6.73 cd	5.20 b	5.83 b	0.77 c	1.53 b	1.83 cd
Control	6.10 d	4.67 b	5.23 b	0.53 d	1.20 c	1.57 d
LSD (P=0.05)	0.968	0.654	1.099	0.232	0.268	0.581

MP fertilizer treatments followed by $MnSO_4$ fertilizer, TSP fertilizer, Boron fertilizer, $CaSO_4$ fertilizer and $ZnSO_4$ where the root length was 7.80, 7.73, 7.47, 7.27 and 7.20 cm, respectively and the minimum root length 6.10 cm was recorded from control (Table 2). In the second and third years, all the treatments gave significantly higher root length over control except $CuSO_4$ wher root length was significantly lower than other treatments (Table 2). In all years the least effective treatment was $CuSO_4$ followed by $CaSO_4$ (Table 2). Root weight under control was 0.53, 1.20 and 1.57 g/plant in the first year, second year and third year, respectively. The root weight was increase to 0.73-1.33, 1.53-1.87 and 1.83-2.93 g/plant in the first year, second year and third year, respectively due application of different treatments (Table 2).

Tip Burn Disease Incidence

In all the years, the incidence of tip burn of garlic was reduced significantly over control due to soil and foliar application with different plant nutrients compared to control (Table 3). In the first year, application of MP fertilizer gave the lowest tip-burn incidence 33.33% followed by Silica gel, TSP fertilizer, $MnSO_4$ fertilizer, $ZnSO_4$ fertilizer and Boron fertilizer treatments where the tip-burn incidence was 35.00%, 40.00%, 43.33%, 46.67%, and 46.67%, respectively (Table 3). Application of $CuSO_4$ gave higher 53.33% tip burn incidence followed by $CaSO_4$ with 51.67% tip burn incidence, respectively. The highest tip-burn incidence 71.67% was recorded in control treatment. Application of MP fertilizer reduced 53.50% tip-burn incidence followed by the application of Silica gel, TSP fertilizer, $MnSO_4$ fertilizer, $ZnSO_4$ fertilizer and Boron fertilizer treatments where the reduction was 51.16%, 44.19%, 39.53%, 34.88% and 34.88%, respectively compared to control. In the second year, all the treatments significantly reduced tip-burn incidence compared to control except $CuSO_4$ where the tip burn incidence was 48.33% which was significantly higher than other treatments (Table 3). The highest tip burn incidence 58.33% was recoded in control. Application of TSP fertilizer reduced 60.00% tip-burn incidence followed by MP fertilizer, Silica gel, $CaSO_4$ fertilizer, $ZnSO_4$, $MnSO_4$ and Boron fertilizer where the reduction of tip-burn incidence of garlic was 57.15%, 57.15%, 57.15%, 54.28%, 51.43% and 51.43%, respectively compared to control. More or less similar trend was also observed in the third year. The highest tip burn incidence 74.33% was reorded from control treatment. Tip burn incidence drastically reduced to 39.67%-53.33% due to application different treatments. Application of MP fertilizer reduced 46.63% tip-burn incidence followed by and TSP fertilizer, Silica gel, $MnSO_4$, $ZnSO_4$, Boron fertilizer and $CaSO_4$ fertilizer where the reduction of tip-burn incidence of garlic was 45.74%, 45.28%, 45.28%, 44.40%, 38.56% and 35.42%, respectively compared to control (Table 3).

Purple Blotch Disease Severity

All the treatments significantly reduced purple blotch disease severity compared to control during three consecutive years. In the first year all the treatments significantly reduced the purple blotch disease severity than control (Table 4). Soil and foliar application of Application of Silica gel reduced 59.66% purple blotch disease severity compared to control followed by TSP fertilizer, MP fertilizer, $ZnSO_4$ fertilizer, $MnSO_4$ fertilizer, Boron fertilizer, $CaSO_4$ fertilizer and $CuSO_4$treatments where the reduction of disease severity was 59.09%, 57.95%, 57.39%, 53.98%, 53.98% and 52.84%, respectively compared to control (Table 4). The highest purple blotch disease severity 58.67% was observed in control treatment. More or less similer trend of reduction of purple disease severity was observed in the second and third year's trials. In the second year, all the treatments significantly reduced purple blotch disease severity compared to control except $CuSO_4$ where the purple blotch disease severity was significantly higher than other treatments. The highest purple blotch disease severity 57.33% was observed in control treatment. Application of MP fertilizer and TSP fertilizer reduced 58.14% purple blotch disease severity compared to control followed by the application of $ZnSO_4$, Silica gel, Boron fertilizer, $MnSO_4$ and $CaSO_4$ treatments where the reduction was 55.82%, 54.65%, 53.48%, 53.48% and 52.33%, respectively than control. In the third year, application of MP fertilizer

Table 3. Effect of soil treatment and foliar application different nutrients on the incidence of tip burn of garlic during three consecutive years

Soil and foliar application of different plant nutrient with dose	Tip burn incidence of garlic			Reduction of tip-burn incidence (%)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MP fertilizer @2%)	33.33 d (35.22)	25.00 c (29.92)	39.67 c (38.99)	53.50	57.15	46.63
Phosphorus (TSP fertilizer @2%)	40.00 cd (39.15)	23.33 c (28.85)	40.33 c (39.41)	44.19	60.00	45.74
Zinc ($ZnSO_4$ fertilizer @1%)	46.67 bc (43.09)	26.67 c (31.07)	41.33 c (40.00)	34.88	54.28	44.40
Silicon (Silica gel @2%)	35.00 d (36.18)	25.00 c (29.80)	40.67 c (39.62)	51.16	57.15	45.28
Boron (Boro fertilizer @1%)	46.67 bc (43.08)	28.33 c (32.14)	45.67 c (39.50)	34.88	51.43	38.56
Calcium ($CaSO_4$ fertilizer @1%)	51.67 b (45.96)	25.00 c (29.92)	48.00 bc (43.85)	27.91	57.15	35.42
Manganese ($MnSO_4$ fertilizer @1%)	43.33 bcd (41.07)	28.33 c (32.14)	40.67 c (39.61)	39.54	51.43	45.28
Copper ($CuSO_4$ @1%)	53.33 b (46.91)	48.33 b (43.08)	53.33 b (46.92)	25.58	17.14	28.25
Control	71.67 a (57.98)	58.33 a (49.83)	74.33 a (59.53)	-	-	-
LSD (P=0.05)	6.788	6.788	6.918	-	-	-

Table 4. Effect of soil treatment and foliar application different nutrients against purple blotch disease severity of garlic during three consecutive years

Soil and foliar application of different plant nutrient with dose	Severity of purple blotch disease of garlic (PDI)			Reduction of severity of purple blotch disease (%)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MP fertilizer @2%)	24.67 b (29.76)	24.00 d (29.30)	28.00 c (31.93)	57.95	58.14	50.00
Phosphorus (TSP fertilizer @2%)	24.00 b (29.21)	24.00 d (29.32)	28.67 c (32.37)	59.09	58.14	48.78
Zinc ($ZnSO_4$ fertilizer @1%)	25.00 b (29.94)	25.33 cd (30.22)	29.33 c (32.77)	57.39	55.82	47.63
Silicon (Silica gel @2%)	23.67 b (29.02)	26.00 cd (30.65)	29.00 c (32.56)	59.66	54.65	48.21
Boron (Boro fertilizer @1%)	27.00 b (31.31)	26.67 cd (31.08)	31.00bc (33.82)	53.98	53.48	44.64
Calcium ($CaSO_4$ fertilizer @1%)	27.00 b (31.30)	27.33 c (31.52)	29.67 c (32.99)	53.98	52.33	47.02
Manganese ($MnSO_4$ fertilizer @1%)	25.00 b (29.96)	26.67 cd (31.08)	30.33 c (33.41)	57.39	53.48	45.84
Copper ($CuSO_4$ @1%)	27.67 b (31.70)	45.33 b (42.32)	36.00 b (36.85)	52.84	20.93	35.71
Control	58.67 a (50.05)	57.33 a (49.22)	56.00 a (48.46)	-	-	-
LSD (P=0.05)	5.386	2.06	3.051	-	-	-

reduced 50.00% disease severity followed by the application of TSP fertilizer, Silica gel, $ZnSO_4$, $CaSO_4$, $MnSO_4$ and Boron fertilizer treatments where the reduction was 48.78%, 48.21%, 47.63%, 47.02%, 45.84% and 44.64%, respectively compared to control. The highest purple blotch disease severity 56.00% was observed in control treatment. In all the years the least effective treatment in reduction of purple disease severity was $CuSO_4$ treatment.

Crop Yield

In all the years, soil and foliar application of different plant nutrients gave signicantly higher yield of garlic (Table 5). In first year, the lowest yield of 3.16 t/ha was found under control. The yield was increased to 4.20-6.42 t/ha due to application of different treatments. Soil and foliar application of Silica gel gave the highest yield 6.42 tha^{-1} followed by the application of MP fertilizer, TSP fertilizer, $ZnSO_4$ fertilizer, $MnSO_4$ fertilizer and Boro fertilizer where the yield was 5.28, 5.28, 5.20, 5.19 and 4.75 tha^{-1}, respectively. Application of $CuSO_4$ gave lower yield 4.18 tha^{-1} followed by the application of $CaSO_4$ where the yield was 4.20 tha^{-1}. The maximum yield increased 50.78% compared to control was obtained by Silica gel followed by MP fertilizer, TSP fertilizer, $ZnSO_4$ fertilizer, $MnSO_4$ fertilizer and Boro fertilizer where the yield was 40.15%, 40.15%, 39.23%, 39.11% and 33.47%, respectively higher than control (Table 4). The lowest increase was achieved with $CuSO_4$ followed by $CaSO_4$ where yield was 24.40% and 24.76%, respectively higher than control. In the 2nd year, average yield of garlic was 4.22 t/ha under control and 4.85 to 6.77 t/ha under treated plots. All the treatments gave significantly higher yield of garlic than control except$CuSO_4$ treatment where the yield was significantly lower than other treatments. Application of MP fertilizer gave the 37.67% higher yield compared to control which was followed by the application TSP fertilizer, Silica gel, Boron fertilizer, $ZnSO_4$ fertilizer, $MnSO_4$ fertilizer and $CaSO_4$ fertilizer where the yield was 34.78%, 34.78%, 32.59%, 29.19%, 29.19% and 29.19%, respectively higher than control (Table 5). In the 3rd year, the highest yield was 7.15 tha^{-1} obtained with the application of MP fertilizer followed by the application of TSP fertilizer, Silica gel, Boron fertilizer, $ZnSO_4$, MnSO4 and $CaSO_4$ where the yield was 6.79, 6.69, 6.68, 6.61, 6.51 and 6.45 tha^{-1}. The lowest yield of garlic 4.72 tha^{-1} was recorded in control treatment which was followed by $CuSO_4$ with the yield of 5.35 tha^{-1}. Application of MP fertilizer gave the 33.98% higher yield compared to control which was followed by the application TSP fertilizer, Silica gel, Boron fertilizer, $ZnSO_4$, MnSO4 and $CaSO_4$ where the yield was 30.48%, 29.45%, 29.34%, 28.59%, 27.50% and 26.82%, respectively higher than control (Table 5).

From this study it is observed that application different plant nutrient have significant effect on plant growth, decreased purple blotch diseases severity and tip burn incidence as well as increase yield of garlic. Among the nutrients MP fertilizer, TSP fertilizer, $ZnSO_4$, Silica gel, Boron fertilizer and $CaSO_4$ were performed better than other treatments for reducing purple blotch disease severity, tip-burn and increasing plant growth as well as yield of garlic. Different workers reported that the use of fertilizers produces a more direct means of using nutrients to reduce the severity of many diseases [15, 9, 19, 20 and 21]. Dordas [22] reported that potassium fertilization can reduce the intensity of several infectious diseases of obligate and facultative parasites. A number of studies have shown that application Potassium, Phosphorus, Boron, Zinc, Calcium, Silicon and Manganese can reduce fungal, bacterial and viral diseases of many crops [13 and 23-34]. Agrios [12] reported that plant nutrients are important for growth and development of plants and also microorganisms and also important factors in disease control.

Conclusion

The present study revealed that soil and foliar application of plant nutrients viz. Potassium, Phosphorus, Boron, Zinc, Calcium, Copper, Silicon and Manganese gave appreciable reduction of purple blotch disease and tip-burn incidence and increased plant growth parameters such as shoot and root growth as well as yield of garlic. Among the nutrients Potassium, Phosphorus, Silicon, Zinc

Table 5. Effect of soil treatment and foliar application different nutrients on the yield of garlic during three consecutive years

Soil and foliar application of different plant nutrient with dose	Yield (tha^{-1})			Yield increased over control (%)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MP fertilizer @2%)	5.28 b	6.77 a	7.15 a	40.15	37.67	33.98
Phosphorus (TSP fertilizer @2%)	5.28 b	6.47 a	6.79 ab	40.15	34.78	30.48
Zinc ($ZnSO_4$ fertilizer @1%)	5.20 bc	5.96 a	6.61 b	39.23	29.19	28.59
Silicon (Silica gel @2%)	6.42 a	6.47 a	6.69 ab	50.78	34.78	29.45
Boron (Boro fertilizer @1%)	4.75 bc	6.26 a	6.68 b	33.47	32.59	29.34
Calcium ($CaSO_4$ fertilizer @1%)	4.20 c	5.96 a	6.45 b	24.76	29.19	26.82
Manganese ($MnSO_4$ fertilizer @1%)	5.19 bc	5.96 a	6.51 b	39.11	29.19	27.50
Copper ($CuSO_4$ @1%)	4.18 cd	4.85 b	5.35 c	24.40	12.98	11.78
Control	3.16 d	4.22 b	4.72 d	-	-	-
LSD (P=0.05)	1.03	1.03	0.471	-	-	-

and Calcium were performed better for reducing purple blotch disease severity, tip-burn disease incidence and increasing plant growth as well as yield of garlic. So, soil and foliar application plant nutrients Potassium Phosphorus, Silicon, Zinc, Boron and Manganese may be recommended for tip-burn and purple blotch disease management and for garlic production in Bangladesh.

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