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EFFECT OF SOIL AND FOLIAR APPLICATION OF PLANT NUTRIENTS ON PURPLE BLOTCH AND TIP-BURN OF ONION

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Abstract

An experiment was conducted in the field of Plant Pathology Division, BARI, Cazipur, during Robi 2015-16, 2016-17 and 2017-18 cropping seasons to evaluate the efficacy of available plant nutrients against purple blotch disease and tip-burn of onion. Eight different plant nutrients viz. Potassium (ZnSO4 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 onion. Soil and foliar application of plant nutrients viz. Potassium, Phosphorus, Boron, Zinc, Calcium, Copper, Silicon and Manganese in the formed of water solution gave appreciable reduction of purple blotch disease and tip-burn incidence and increased plant growth such as shoot and root growth as well as yield of onion. Among the nutrients solution Potassium, Phosphorus, Silicon, Zinc and Calcium were performed better for reducing purple blotch disease severity (upto 62.78%), tip-burn incidence (upto 72.22%) and increasing plant growth as well as yield of onion. Application of Boron and Manganese also performed better than control. So, soil and foliar application plant nutrients viz. Potassium, Phosphorus, Silicon, Zinc, Boron and Manganese might be recommended for tip-burn and purple blotch disease management and also for onion production in Bangladesh.

Keywords: Onion, purple blotch, *Alternaria porri*, tip burn, plant nutrients**.**

Introduction

Onion (*Allium cepa* L.) is one of the most important and familiar spices crop specially bulb onion throughout the world. It is a member of the family Alliaceae. It is also used as popular vegetable in many countries of Asia and also very common and favorable spice in Bangladesh. It ranks first in the area (419122 ha) and production (1704402 MT) (BBS, 2015). It covers almost 46% of the total areas under spices (BBS, 2015). The national average yield is only 4.07 t/ha which is quite low compared to world average of 17.27 t/ha (FAO, 1998). Onion crop is affected by a number of soil borne and foliar diseases (Munoz *et. al*., 1984; Ahmed and Hossain, 1985; Meah and Khan, 1987). Both soil borne and foliar diseases are the major constrains for low yield of onion in the country. Among the diseases, purple blotch caused by *Alternaria porri*, is noted as the major foliar disease throughout the world including Bangladesh (Meah and Khan, 1987; Bose and Som, 1986; Castellanes-Linares *et. al*., 1988). Now a day's tip-burn becomes one of the problems for onion cultivation in Bangladesh. In Bangladesh, detail and

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comprehensive studies were done for the management of purple blotch disease but none of the informations are available about tip burn problem. Only fungicidal management is the effective means to manage the purple blotch disease. But indiscriminate use of chemicals pesticides causes environmental pollution and health hazards (Gerhardson, 2002). 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 (Atkinson and McKinlay, 1997; Batish *et al*., 2007; Camprubí *et al*., 2007). Nutrients are important for growth and development of plants and also for microorganisms. In addition, nutrients can affect the development of a disease by affecting plant physiology or by affecting pathogens, or both of them. They are important factors for disease suppression (Agrios, 2005). All the essential nutrients can affect disease severity (Huber and Graham, 1999). So, it is important to manage nutrients availability through fertilizers or change the soil environment to influence nutrient availability, and in that way to control plant disease (Huber and Graham, 1999; Graham and Webb, 1991). The level of nutrients can influence the plant growth, which can affect the microclimate, therefore affecting infection and sporulation of the pathogen (Marschner, 1995). But in Bangladesh there is no available information about the effect of nutrients on the onion disease management. Therefore the present study has taken to observe the effect of plant nutrients on purple blotch disease and tip-burn of onion.

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 (MOP 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 treatments were applied four times viz. 1st application in the soil at the time of seedling transplanting, 2nd foliar application 40-45 days after seedling transplanting, 3rd foliar application 10-12 days after 2nd application and 4th foliar

application 10-12 days after 3rd application. Forty five days old onion seedlings of cv. BARI Piaz-1 grown on sterilized soils was transplanted in the experimental plots maintaining row to row and plant to plant distance of 15 cm and 10 cm, respectively. Standard cultivation procedures including method of fertilizer application recommended by BARI were followed to grow onion (Azad *et al*., 2019). Recommended doses of different fertilizers viz. cowdung @ 5 t/ha, Urea @ 240 kg/ha, TSP @ 260 kg/ha and MOP @ 150 kg/ha were used in all the treatment including control treatment (Azad *et al.*, 2019). 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. Data on purple blotch disease severity and tip burn incidence were collected 10 days after 4th time treatments application. Data were calculated in terms of disease incidence and disease severity (PDI) by following formulae-

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

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

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.* (1999) and Rahman and Rashid (2008) 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 38.13 cm plant^{-1} in the first year, 40.73 cm plant^{-1} in the second year and 40.33 cm plant^{-1} in the third year. The plant height was increased to 44.73-48.73 cm plant^{-1} in the first year, 48.53-60.07 cm plant^{-1} in the second year and 46.33-64.67 cm plant^{-1} in the third year due to soil and foliar application of different plant nutrients (Table 1). In the first year, the highest plant height was obtained by the soil and foliar application MOP fertilizer followed by TSP fertilizer, $ZnSO_4$ fertilizer and Silica gel (Table 1). Lower increased of plant height over control was recorded from the treatment $CuSO_4$ followed by $CaSO_4$ fertilizer, $MnSO_4$ and Boron fertilizer. In the second year, the highest plant height was recored from Silica gel treatment followed by TSP fertilizer, MOP fertilizer, $ZnSO_4$ fertilizer, Boron fertilizer and $CaSO_4$ fertilizer (Table 1). The least effective treatment in increasing of plant height over control was recorded from $CuSO_4$ followed by $MnSO_4$ treatment. In the third year, the maximum plant height was recorded from MOP fertilizer treatment followed by TSP fertilizer, Silica gel, $ZnSO_4$ and Boron fertilizer treatment. The least effective treatment to increase plant height was $CuSO_4$ followed by $CaSO_4$ fertilizer treatment (Table 1).

Table 1. Effect of soil treatment and foliar application different nutrients on the plant growth of onion 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 (MOP fertilizer @2%)	48.73 a	59.00 ab	64.67 a	25.67 a	68.00 a	72.67 a
Phosphorus (TSP fertilizer @2%)	48.53 ab	57.67 ab	59.33 b	23.13 b	56.20 b	68.33 b
Zinc ($ZnSO_4$ fertilizer @1%)	47.80 ab	57.13 ab	56.00 bc	22.60 bc	56.60 b	61.67 c
Silicon (Silica gel @2%)	47.67 ab	60.07 a	59.00 b	22.80 bc	56.67 b	66.00 b
Boron (Boro fertilizer @1%)	46.13 bc	56.93 ab	55.00 bc	20.33 de	51.33 c	61.33 c
Calcium ($CaSO_4$ fertilizer @1%)	45.07 c	56.73 ab	52.33 c	21.93 bc	53.40 bc	58.00 cd
Manganese ($MnSO_4$ @1%)	46.13 bc	56.27 b	55.00 bc	21.53 cd	53.67 bc	59.33 c
Copper ($CuSO_4$ @1%)	44.73 c	48.53 c	46.33 d	19.93 e	41.33 d	54.00 d
Control	38.13 d	40.73 d	40.33 e	16.33 f	40.73 d	41.00 e
LSD (P=0.05)	2.476	3.472	4.714	1.531	4.677	4.164

Values in a column having same letter did not differ significantly (P=0.05) by LSD

In first year, the plant weight of onion was 16.33 g plant^{-1} under control. It increased to 19.33-25.67 g plant^{-1} due to soil and foliar application of different nutrients (Table 1). The highest plant weight was achieved with MOP fertilizer treatment followed by TSP fertilizer, Silica gel, ZnSO4 and $CaSO_4$ fertilizer. The least effective treatment to increase plant weight was $CuSO_4$ followed by Boron fertilizer and $MnSO_4$ treatments. More or less similar trend was also observed in the second and third year trials. In second year, the lowest plant weight of onion was 40.73 g plant^{-1} recorded in the control. Soil and foliar application of MOP fertilizer gave the highest plant weight 68.00 g plant^{-1} followed by Silica gel, $ZnSO_4$ and TSP fertilizer treatments where the plant weight was 56.67, 56.60 and 56.20 g plant^{-1}, respectively (Table 1). In the third year, the highest plant weight was 72.67 g plant^{-1} recorded from MOP fertilizer treatment followed by TSP, Silica gel, $ZnSO_4$ and Boron fertilizer treatments where the plant weight was 68.33, 66.00, 61.67 and 61.33 g plant^{-1}, respectively. In second year and third year the least effective treatment was $CuSO_4$ followed by $CaSO_4$ and $MnSO_4$ treatments (Table 1).

Table 2. Effect of soil treatment and foliar application different nutrients on the root growth of onion 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 (MOP fertilizer @2%)	9.20 a	8.07 a	7.20 a	2.33 a	2.50 a	2.63 a
Phosphorus (TSP fertilizer @2%)	8.67 ab	6.40 b	6.13 b	2.30 a	2.27 ab	2.33 ab
Zinc ($ZnSO_4$ fertilizer @1%)	8.47 b	5.93 bc	6.13 b	1.93 b	2.37 a	2.50 ab
Silicon (Silica gel @2%)	8.27 bc	6.07 b	6.07 b	1.87 bc	2.10 ab	2.67 a
Boron (Boro fertilizer @1%)	8.67 ab	5.80 bc	6.07 b	1.83 bcd	2.00 ab	2.17 ab
Calcium ($CaSO_4$ fertilizer @1%)	7.57 cd	5.93 bc	6.00 bc	1.73 cd	2.40 a	2.33 ab
Manganese ($MnSO_4$ fertilizer @1%)	8.27 bc	5.80 bc	6.07 b	1.87 bc	2.00 abc	2.57 ab
Copper ($CuSO_4$ @1%)	7.23 d	5.13 c	5.20 cd	1.67 d	1.80 bc	1.83 bc
Control	6.03 e	4.13 d	4.60 d	1.43 e	1.53 c	1.33 c
LSD (P=0.05)	0.709	0.830	0.821	0.189	0.504	0.76

Values in a column having same letter did not differ significantly (P=0.05) by LSD

Root growth: Soil and foliar application of different plant nutrients showed positive effects on root growth of onion as compared to control (Table 2). In first year, the maximum root length 9.20 cm was recorded from MOP fertilizer treatment followed by TSP, Silica gel and $ZnSO_4$ where the root length was 8.67, 8.67 and 8.47 cm, respectively and the minimum root length 6.03 cm was recorded from control (Table 2). More or less similar trend was observed in the second and third years. In second year, average root length under control was 4.13 cm. It was increased to 5.13-8.07 cm/plant due to application of different treatments. In the third year, the lowest root length was 4.60 $cmplant^{-1}$ recorded in control. In this year MOP fertilizer treatments gave the highest root length 7.20 cm followed by TSP, $ZnSO_4$, Silica gel, $MnSO_4$ and Boron fertilizer where the root length was 6.13, 6.13, 6.07, 6.07 and 6.07 cm, respectively. In all years the least effective treatment was $CuSO_4$ followed by $CaSO_4$ (Table 2). Root weight under control was 1.43, 1.53 and 1.33 g/plant in the first year, second year and third year, respectively. The root weight was increase to 1.67-2.33, 1.80-2.50 and 1.83-2.67 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 onion was reduced significantly over control due to soil and foliar application with different plant nutrients (Table 3). In the first year, application of MOP fertilizer gave the lowest tip-burn incidence 25% followed by TSP fertilizer, Silica gel, $ZnSO_4$ and Boron fertilizer treatments where the tip-burn incidence was 35%, 38.67%, 43.33% and 43.37%, respectively (Table 3). Application of $CuSO_4$ gave higher 56.67% tip burn incidence followed by $CaSO_4$ and $MnSO_4$ with 48.33% and 48.33 tip burn incidence, respectively. The highest tip-burn incidence 68.33% was recorded in control treatment. Application of MOP fertilizer reduced 63.41% tip-burn incidence followed by the application of TSP fertilizer, Silica gel, $ZnSO_4$ and Boron fertilizer treatments where the reduction was 48.78%, 43.41%, 36.59% and 36.53%, 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 higher than other treatments (Table 3). The lowest tip burn incidence 16.67% was recoded from MOP fertilizer treatment followed by TSP fertilizer, $ZnSO_4$, Silica gel, $MnSO_4$, $CaSO_4$ and Boron fertilizer with tip burn incidence of 20%, 21.67%, 21.67% 23.33% , 23.33% and 25%, respectively though all the treatment were statistically similar (Table 3). The highest tip burn incidence 60% was recoded in control. Application of MOP fertilizer reduced 72.22% tip-burn incidence followed by TSP fertilizer, $ZnSO_4$, Silica gel, $MnSO_4$ and Boron fertilizer where the reduction of tip-burn incidence of onion was 66.67%, 63.88%, 63.88%, 61.12%, 61.12% and 58.33%, respectively compared to control. In the third year, application of MOP fertilizer, TSP fertilizer, Silica gel and ZnSO4 gave the significantly lower 32.33%, 32.33%, 34.33% and 36.33%, respectively tip burn incidence followed by $MnSO_4$, $CaSO_4$ and Boron fertilizer treatment. The least effective treatment was $CuSO_4$ where the tip burn

incidence was 55.00%. The highest tip burn incidence 74.67% was recoded in control. Application of MOP fertilizer and TSP fertilizer reduced 56.70% tip-burn incidence followed by Silica gel, $ZnSO_4$, $MnSO_4$, $CaSO_4$ and Boron fertilizer where the reduction of tip-burn incidence of onion was 54.02%, 51.35%, 43.75%, 43.31% and 43.31%, respectively compared to control (Table 3).

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

Soil and foliar application of different plant nutrient with dose	Tip burn incidence of onion			Reduction of tip-burn incidence (%)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MOP fertilizer @2%)	25.00 f (29.93)	16.67 d (23.74)	32.33 d (34.64)	63.41	72.22	56.70
Phosphorus (TSP fertilizer @2%)	35.00 e (36.24)	20.00 cd (26.45)	32.33 d (34.64)	48.78	66.67	56.70
Zinc ($ZnSO_4$ fertilizer @1%)	43.33 cd (41.15)	21.67 cd (27.71)	36.33 d (37.05)	36.59	63.88	51.35
Silicon (Silica gel @2%)	38.67 de (38.43)	21.67 cd (27.71)	34.33 d (35.85)	43.41	63.88	54.02
Boron (Boro fertilizer @1%)	43.37 cd (41.16)	25.00 c (29.92)	42.33 c (40.58)	36.53	58.33	43.31
Calcium ($CaSO_4$ fertilizer @1%)	48.33 c (44.04)	23.33 cd (26.45)	42.33 c (40.58)	29.27	61.12	43.31
Manganese ($MnSO_4$ fertilizer @1%)	48.33 c (44.04)	23.33 c (28.85)	42.00 c (40.38)	29.27	61.12	43.75
Copper ($CuSO_4$ @1%)	56.67 b (48.85)	38.33 b (38.24)	55.00 b (47.87)	17.06	36.11	26.34
Control	68.33 a (55.85)	60.00 a (46.92)	74.67 a (59.83)	-	-	-
LSD (P=0.05)	4.254	4.567	3.29	-	-	-

Values in a column having same letter(s) did not differ significantly (P=0.05) by LSD; values within the parenthesis is the arcsin transformed value.

Purple blotch disease severity: All the treatments significantly reduced purple blotch disease severity over control during three consecutive years (Table 4). In the first year soil and foliar application of MOP fertilizer, TSP fertilizer, ZnSO4 and Silica gel gave significantly lower 22.33%, 22.33%, 22.67% and 22.67%, respectively purple blotch disease severity followed by Boron fertilizer, $MnSO_4$ and $CaSO_4$ fertilizer treatments where purple blotch disease severity was 24.33%, 25.33% and 28.33%, respectively (Table 4). Application of MOP fertilizer and TSP fertilizer reduced 62.78% purple blotch disease severity compared to control followed by $ZnSO_4$, Silica gel, Boron fertilizer, $MnSO_4$ and $CaSO_4$ fertilizer treatments where the reduction of disease severity was 62.21%, 62.21%, 59.45% and 57.78%, respectively (Table 4). The highest purple blotch disease severity 60% was

observed in control treatment. More or less similer trend of reduction of purple blotch 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 disease severity was significantly higher than other treatments. Application of MOP fertilizer reduced 60.68% purple blotch disease severity followed by TSP fertilizer, $ZnSO_4$, Silica gel, Boron fertilizer, $CaSO_4$ and $MnSO_4$ treatments where the reduction was 58.42%, 58.42%, 56.18%, 55.05%, 52.25% and 48.31%, respectively compared to control. The highest purple blotch disease severity 59.33% was observed in control treatment. In the third year, application of MOP fertilizer reduced 60.11% disease severity followed by TSP fertilizer, Silica gel, $ZnSO_4$, $CaSO_4$, Boron fertilizer and $MnSO_4$ treatments where the reduction was 57.92%, 57.38%, 56.28%, 55.20%, 54.64% and 53.00%, respectively compared to control. The highest purple blotch disease severity 61.00% was observed in control treatment. In all the years the least effective treatment in reduction of purple disease severity was $CuSO_4$ treatment (Table 4).

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

Soil and foliar application of different plant nutrient with dose	Severity of purple blotch disease of onion (PDI)			Reduction of severity of purple blotch disease (%)		
	2016-17	2017-18	2018-19	2016-17	2017-18	2018-19
Potassium (MOP fertilizer @2%)	22.33 c (28.19)	23.33 d (28.87)	24.33 c (29.53)	62.78	60.68	60.11
Phosphorus (TSP fertilizer @2%)	22.33 c (28.14)	24.67 cd (29.75)	25.67 c (30.41)	62.78	58.42	57.92
Zinc ($ZnSO_4$ fertilizer @1%)	22.67 c (28.42)	24.67 cd (29.76)	26.67 c (31.09)	62.21	58.42	56.28
Silicon (Silica gel @2%)	22.67 c (28.37)	26.00 cd (30.65)	26.00 c (30.65)	62.21	56.18	57.38
Boron (Boro fertilizer @1%)	24.33 bc (29.54)	26.67 cd (31.04)	27.67 bc (31.73)	59.45	55.05	54.64
Calcium ($CaSO_4$ fertilizer @1%)	28.33 bc (32.01)	28.33 cd (31.91)	27.33 bc (31.37)	52.78	52.25	55.20
Manganese ($MnSO_4$ fertilizer @1%)	25.33 bc (30.21)	30.67 c (33.55)	28.67 bc (32.35)	57.78	48.31	53.00
Copper ($CuSO_4$ @1%)	29.33 b (32.75)	45.33 b (42.32)	30.00 b (35.24)	51.12	23.60	50.82
Control	60.00 a (50.78)	59.33 a (50.43)	61.00 a (51.37)	-	-	-
LSD (P=0.05)	3.998	4.472	4.081	-	-	-

Values in a column having same letter(s) did not differ significantly (P=0.05) by LSD; values within the parenthesis is the arcsin transformed value.

Table 5. Effect of soil treatment and foliar application of different nutrients on the yield of onion 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 (MOP fertilizer @2%)	16.75 a	16.25 ab	17.64 ab	36.84	28.18	27.55
Phosphorus (TSP fertilizer @2%)	16.75 a	17.08 a	18.19 a	36.84	31.67	29.74
Zinc ($ZnSO_4$ fertilizer @1%)	15.42ab	16.00 ab	17.64 ab	31.39	27.06	27.55
Silicon (Silica gel @2%)	16.33 a	16.00 ab	16.80 ab	35.21	27.06	23.93
Boron (Boro fertilizer @1%)	13.92bc	15.42 b	16.67 ab	23.99	24.32	23.34
Calcium ($CaSO_4$ fertilizer @1%)	15.33abc	15.42 b	15.42 bc	30.98	24.32	17.12
Manganese ($MnSO_4$ fertilizer @1%)	14.33bc	15.83 b	16.25 abc	26.17	26.28	21.35
Copper ($CuSO_4$ @1%)	13.58 c	12.08 c	14.17 cd	22.09	3.39	9.81
Control	10.58 d	11.67 c	12.78 d	-	-	-
LSD (P=0.05)	1.77	1.127	2.366	-	-	-

Values in a column having same letter(s) did not differ significantly (P=0.05) by LSD.

Crop yield: In all the years, soil and foliar application of different plant nutrients gave appreciable higher yield of onion treatment (Table 5). In first year, the lowest yield of 10.58 t/ha was found under control (Table 5). The yield was increased to 13.58-16.75 t/ha due to application of different treatments. Application of MOP and TSP fertilizer gave the higher yield 16.75 tha^{-1} followed by Silica gel, $ZnSO_4$ and $CaSO_4$ where the yield was 16.33, 15.42 and 15.33 tha^{-1}, respectively. Application of $CuSO_4$ gave lower yield 13.58 tha^{-1} followed by Boron fertilizer and $MnSO_4$ where the yield was 13.92 and 14.33 tha^{-1}, respectively compared to other treatments. The maximum yield increase of 36.84% and 36.84% over control was obtained by MOP and TSP fertilizer followed by Silica gel, $ZnSO_4$ and $CaSO_4$ where the yield was 35.21%, 31.39% and 30.98%, respectively higher (Table 5). The lowest increase was achieved with $CuSO_4$ followed by Boron fertilizer and

$MnSO_4$ where yield was 22.09%, 23.99% and 26.17%, respectively higher compared to control. In the 2nd year, average yield of onion was 11.67 t/ha under control and 12.08-17.08 t/ha under treated plots (Table 5). Application TSP fertilizer gave the highest yield 17.08 tha^{-1} followed by MOP fertilizer, $ZnSO_4$, Silica gel, $MnSO_4$, Boron fertilizer and $CaSO_4$ where the yield was 16.25, 16, 16, 15.83, 15.42 and 15.42 tha^{-1}. The lower yield of onion 11.67 and 12.08 tha^{-1} was recorded in control and $CuSO_4$ treatments. Application of TSP fertilizer gave the 31.67% higher yield compared to control which was followed by MOP fertilizer, $ZnSO_4$, Silica gel, $MnSO_4$, Boron fertilizer and $CaSO_4$ where the yield was 28.18%, 27.06%, 27.06%, 26.28%, 24.32% and 24.32%, respectively. In the 3rd year, the highest yield was 18.19 t/ha obtained with the application of TSP fertilizer followed by MOP fertilizer, $ZnSO_4$, Silica gel, Boron fertilizer, MnSO4 and $CaSO_4$ where the yield was 17.64, 17.64, 16.80, 16.67, 16.25 and 15.42 tha^{-1} (Table 5). The lowest yield of onion 12.78 tha^{-1} was recorded in control treatment which was followed by $CuSO_4$ with the yield of 14.17 tha^{-1}. Application of TSP fertilizer gave the 29.74% higher yield compared to control which was followed by MOP, $ZnSO_4$, Silica gel, Boron fertilizer, $MnSO_4$ and $CaSO_4$where the yield was 27.55%, 27.55%, 23.93%, 23.34%, 21.35%, and 17.12%, respectively.

From this study it was observed that application different plant nutrient had a significant effect on increase in plant growth, decrease of purple blotch diseases severity and tip burn incidence as well as increase yield of onion. Among the nutrients MOP fertilizer, TSP fertilizer, $ZnSO_4$, Silica gel, Boron fertilizer and $CaSO_4$ performed better than other treatments for reducing purple blotch disease severity and tip-burn as well as increasing plant growth and yield of onion. Different workers reported that the appilication of fertilizers produced a more direct means of using nutrients to reduce the severity of many diseases (Marschner, 1995; Atkinson and McKinlay, 1997; OBoron fertilizerrn *et al*., 2003; Seebold *et al*., 2000; 2004). Dordas (2008) reported that potassium fertilization could reduce the intensity of several infectious diseases of obligate and facultative parasites. A number of studies showed that application Potassium, Phosphorus, Boron, Zinc, Calcium, Silicon and Manganese could reduce fungal, bacterial and viral diseases of many crops (Potash and Phosphate Institute, 1988; Huber and Graham, 1999; Kirkegaard *et al*., 1999; Reuveni *et al*., 1998; 2000; Alvarez and Datnoff, 2001; Heckman *et al*., 2003; SeeBoron fertilizerld *et al*., 2000; 2004; Sharma and Duveiller, 2004; Sharma *et al*., 2005; Simoglou and Dordas, 2006; Zhang *et al*., 2006). Agrios (2005) reported that plant nutrients were 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 onion. Among the nutrients Potassium, Phosphorus, Silicon, Zinc and Calcium performed better for reducing purple blotch disease severity, tip-burn disease incidence and increasing plant growth as well as yield of onion. So, soil and foliar application of plant nutrients Potassium, Phosphorus, Silicon, Zinc, Boron and Manganese might be recommended for tip-burn and purple blotch disease management as well as increase of onion production in Bangladesh.

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