INDUCTION OF RESISTANCE OF BION AND AMISTAR TO BANANA Var. SABRI AGAINST CERCOSPORA LEAF SPOT (SIGATOKA)

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ABSTRACT

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Bion (benzothiadiazole) and Amistar (azoxystrobin) were applied for controlling Cercospora leaf spot of banana variety Sabri in the field laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh by applying different treatments viz. dipping bottom of sucker for 6 hrs. in Bion (0.005%) before transplanting, dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, spraying of Bion @ 0.005% once on leaves after 80 days of transplanting, spraying of Bion @ 0.01% once on leaves after 80 days of transplanting, spraying of Amistar @ 0.05% once on leaves after 80 days of transplanting, spraying of Amistar @ 0.05% only on leaves after 80 and 140 days of transplanting, spraying of Bion @ 0.005%) once on leaves and pseudostem after 80 days of transplanting, spraying of Bion @ 0.01% once on leaves and pseudostem after 80 days of transplanting and Control (without chemical). From these above treatments it is revealed that Bion @ 0.005% and 0.01% (dipping before planting), Bion @ 0.01% (on leaves and pseudostem, 1 spray) and Amistar @ 0.05% (on leaves, 1 spray), Amistar @ 0.05% (on leaves, 2 spray) showed significant performance in reducing number of diseased leaf/ plant, number of diseased sucker/ plant, percent leaf area (cm^2) diseased/ sucker and mean spot size (mm^2)/ plant of banana var. Sabri.

Keywords: Banana, Resistance, Leaf spot, Bion, Amistar

INTRODUCTION

Banana (*Musa paradisiaca*, family Musaceae) is a central fruit crop of the tropical and subtropical regions of the world grown on about 8.8 million hectares (Hossain *et al*. 2016). In Bangladesh, the yield of this crop is only 16.82 t/ha, which is too low as compared to the developed countries of the world (BBS 2016). There are many constraints responsible for low yield of banana in Bangladesh of which diseases have been considered as one of the major factors. Cercospora leaf spot (sigatoka) of banana is a serious and common disease in Bangladesh. It reduces the yield of banana by reducing the photosynthesis of banana plant. In severe infection of banana plant, the whole plant may die or even it cannot bear fruits. Sometimes it causes 50% yield loss (Wardlaw 1972). Control of this disease by chemicals is difficult, specially during the rainy season. Moreover, use of chemicals in fruits has a bad impact on health. Use of plant inducer or resistance activator is a recent approach to plant disease management and it has drawn the special attention of the plant pathologist all over the world. Inducing resistance against the disease can be considered as an alternative to use frequent chemicals and less hazardous to nature. The banana disease may be minimized or controlled through inducing resistance in plant. Bion 50 is the first compound of a new generation of crop protection agents which activates plant defence mechanism called "systemic activated resistance" (SAR). Bion 50 WG copies this natural biological phenomenon and provides reliable and commercially acceptable protection in several crops against a number of diseases (Janczak and Bielecki 1997). It is a novel plant protection product that mimics the host-pathogen interaction and results in systemic acquired resistance in plants (Cole 1999). Inducing resistance is a new concept in Bangladesh and attempt had been made to use chemicals as resistance inducer to banana. The study was undertaken to evaluate Bion in inducing resistance to banana plant against Cercospora leaf spot (sigatoka).

MATERIALS AND METHODS

The experiment was carried out in the field laboratory, Department of Plant Pathology, Bangladesh Agricultural University (BAU), Mymensingh. Sword suckers of banana variety viz. Sabri were collected from Boira union, Sadar upazilla, Mymensingh, Bangladesh. Three weeks before planting, pits of 0.60 m diameter and 0.40 m depth were prepared by digging the soil with spade (Haque

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1988). After one week of pit preparation with manures and fertilizers, uniform sized selected rhizomes of banana variety viz. Sabri were planted. The rhizome in a pit was covered by about 10 cm soil and the soil around it was pressed firmly. There were two chemicals namely Bion (benzothiadiazole), an inducer of resistance and Amistar (azoxystrobin), a fungicide used in this experiment. The treatments were:T_1 = Dipping bottom of sucker for 6 hrs. in Bion (0.005%) before transplanting, T_2 = Dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, T_3 = Spraying Bion (0.005%) once only on leaves after 80 days of transplanting, T_4 = Spraying Bion (0.01%) once only on leaves after 80 days of transplanting, T_5 = Spraying Amistar (0.05%) once only on leaves after 80 days of transplanting, T_6 = Spraying Amistar (0.05%) only on leaves after 80 and 140 days of transplanting, T_7 = Spraying Bion (0.005%) once on leaves and pseudostem after 80 days of transplanting, T_8 = Spraying Bion (0.01%) once on leaves and pseudostem after 80 days of transplanting and T_9 = Control (without chemical). Each spray solution was prepared by mixing definite amount of chemicals with tap water and the bottom of suckers carefully treated. In case of single spray, Amistar (0.05%), Bion (0.005% and 0.01%) were sprayed at 80 days after planting. The second spray of Amistar (0.05%) was done at 140 days after planting. The experimental plots were inspected at 15 days interval for the appearance of Cercospora (sigatoka) leaf spot. The data on the following parameters were considered for collection: i). Plant height (cm), ii). Number of leaves per plant, iii) Number of sucker per plant, iv) Healthy and diseased sucker per plant, v) Percent leaf area diseased per sucker, vi) Mean spot size per main plant. The experiment was carried out in Randomized Completely Block Design (RCBD) with three replications. Each replication contains four banana plants.

RESULTS AND DISCUSSION

The effect of Bion and Amistar on plant height (cm) of banana var. Sabri varied significantly among the different treatments (Table 1). The highest plant height (156.50 cm) was recorded in T_8 at 240 DAP and the lowest (8.50 cm) in T_2 at 60 DAP. The effect of Bion and Amistar on number of leaf per plant of banana var. Sabri was found significant (Table 2). The highest number of leaves /plant (13.50) were recorded in T_7 at 240 DAP and the lowest (2.50) in T_1 at 60 DAP.

The effect of Bion and Amistar on number of sucker per plant of banana variety Sabri was determined at 120, 150, 180, 210 and 240 days after planting (DAP) and presented in Fig. 1. The treatments showed significant influence on number of sucker per plant at different days after planting. At 120 DAP, the highest number of sucker per plant (2.0) was found in T_4 and sucker was not found in T_1, T_2, T_5, T_7, T_8 and T_9. At 150 DAP, the highest number of sucker per plant (2.0) was found in T_4 and sucker was not found in T_1, T_2, T_5, T_7 and T_8. At 180 DAP, the highest number of sucker per plant (3.0) was found in T_4 and sucker was not found in T_1, T_2 and T_8. At 210 DAP, the highest number of sucker per plant (3.0) was found in T_4 and sucker was not found in T_1 and T_2. At 240 DAP, the highest number of sucker per plant (4.5) was found in T_7 and the lowest number of sucker per plant (1.0) was found in T_2.

The effect of Bion and Amistar on healthy and diseased sucker per plant of banana variety Sabri was determined at 170, 185, 200, 215 and 230 days after planting (DAP) and presented in Fig. 2. The treatments showed significant influence on healthy and diseased sucker per plant at different days after planting. At 170 DAP, the highest number of healthy sucker per plant (3.0) was found in T_4 (Fig. 2). At 185 DAP, the highest number of healthy sucker per plant (0.5) was found in T_9 and sucker was not found in T_1, T_2, T_3, T_4, T_5, T_6, T_7 and T_8. At 200 DAP, the highest number of healthy sucker per plant (1.5) was found in T_4 and sucker was not found in all other treatments. At 215 DAP, the highest number of healthy sucker per plant (1.8) was found in T_3 and sucker was not found in T_2, T_4, T_5, T_6 and T_9. At 230 DAP, the highest number of healthy sucker per plant (4.0) was found in T4 and sucker was not found in T_8 and T_9 (control) plant.

The effect of Bion and Amistar on diseased sucker per plant of banana variety Sabri was determined at 170, 185, 200, 215 and 230 days after planting (DAP) and presented in Fig. 3. At 185 DAP and 200 DAP, the highest diseased sucker (0.5) was found in T_9 (control) plant and diseased sucker was not found in all other treatments. At 215 DAP, the highest number of diseased sucker (1.5) was found in T_9 (control) plant (Fig. 3). The highest diseased sucker (2.0) was found in T_9 (control) plant and diseased sucker was not found in T_1, T_2, T_4, T_6 and T_8.

The effect of Bion and Amistar on percent leaf area diseased per sucker of banana was determined at 170, 185, 200, 215 and 230 days after planting (DAP) and presented in Fig. 4. The treatments showed significant influence on percent leaf area diseased per sucker of banana at different days after planting. At 170 DAP, 0.2 % diseased leaf area was found only in T_9 (control) plant and leaf area diseased was not found in other treatments. At 185 DAP, percent leaf area diseased was not found in all other treatments. At 200

DAP, 0.28 percent leaf area diseased was found only in T_9 (control) plant and leaf area diseased was not found in other treatments. At 215 DAP, 1.0 percent leaf area diseased was found only in T_9 (control) plant and leaf area diseased was not found in other treatments. At 230 DAP, the highest percent leaf area diseased (1.6) was found in T9 (control) plant and leaf area diseased was not found in T_1, T_2, T_4, T_6 and T_8.

The effect of Bion and Amistar on mean spot size per plant (mm^2) of banana variety Sabri was determined at 150, 165, 180, 195, 210, 225 and 240 days after planting (DAP) and presented in Fig.5. The treatments showed significant influence on mean spot size per plant (mm^2) of banana at different days after planting. At 150 DAP, the highest mean spot size per plant (8.5 mm^2) was found in T_9 (control) plant and spot per plant was not found in T_1 and T_2. The highest size of Sigatoka spot (19.5 mm^2) T_9 at 240 DAP followed by (17.9 mm^2) at 225 DAP and no spot was found in treatment T_1 and T_2.

Altogether nine different treatments were used for controlling *Cercospora* leaf spot of banana in the field. Bion and Amistar (spray) were found more effective in increasing plant height in banana. It had been observed that Bion@ 0.005% (dipping bottom of sucker) and Bion 0.01% (dipping bottom of sucker) significantly decreased plant height of banana Bion @ 0.01% (1 spray on leaves and pseudostem) was more effective in increasing plant height of banana. The reduced number of leaves per plant had been observed when banana sucker dipped in 0.005% solution of Bion for 6 hrs. before transplanting. Bion and Amistar both were more effective in banana at all counting periods to reduce the number of spot per plant as well as size of spots caused by Cercospora (sigatoka) leaf spot compared to the untreated control plants. Perez *et al.* (2003) reported that acibenzolar-S-methyl (ASM; Bion 50 WG) a benzothiadiazole (BTH), is a novel compound that resulting in systemic acquired resistance (SAR) in plants to pathogens. ASM treated plants showed fewer *Cercospora nicotianae* and *Alternaria alternata* spots than the untreated plants. Csosz *et al.* (1999) reported that Bion 50 WG is a member of a novel class of inducers of systemic acquired resistance that activates gene expression and disease resistance was also effective in banana var. Sabri to reduce the number of spot per plant. Takacs and Dolej (1998) treated tomato plants infected by *Fusarium oxysporum* f.sp. *radicis-lycopersici* with the plant activator BION a product from CIBA GEIGY at 0.01%-1%. They observed that treated plants became less infected with the disease than untreated ones, which indicates the importance of systemically acquired resistance in plant protection, not only in cereals but also horticultural crops. Amistar @ 0.05% (on leaves, 1 spray) and Amistar @ 0.05% (on leaves, 2 spray) were effective to reduce percent leaf area diseased per plant of banana. Robak and Sobolewski (1997) stated Amistar 250 SC (azoxystrobin) as the most effective fungicide to control plant pathogens which provided levels of disease control equivalent to or better than current commercial standards. The findings of the present investigation it is clearly pointed out that banana infected by Cercospora (sigatoka) leaf spot *(Cercospora musae)* may be successfully controlled by Bion or Amistar. Bion (inducer of resistance) and Amistar (new fungicide) can be advocated to our farmers for controlling Cercospora (sigatoka) leaf spot of banana.

Table1. Effect of Bion and Amistar on plant height of banana var. Sabri

Treatments	Plant height (cm)						
	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP	210 DAP	240 DAP
T_1	10.00jk	17.00ij	17.50i	22.00g	27.00g	33.00e	69.50f
T2	8.50jk	14.00j	16.50i	18.50g	20.00g	24.00e	27.50g
T3	41.50a	49.50b	61.50ab	72.00ab	85.00ab	100.00a	122.50b-d
T4	30.00cd	40.50d-f	53.50cd	64.00a-e	75.50b-e	90.00ab	129.50b-d
T5	19.00gh	24.50h	39.50g	51.00e	64.50e	70.50cd	125.00b-d
T_6	34.50b	45.00c	56.00cd	65.00a-d	77.50b-e	91.50ab	131.50a-d
T_7	25.00ef	40.00ef	53.00d	64.50a-e	76.00b-e	97.50ab	138.50a-d
T_8	39.00a	53.50a	61.00ab	72.00ab	84.00ab	101.00a	156.50a
T9	35.00b	42.50c-e	53.00d	65.00a-d	79.00b-d	92.50ab	120.00c-e
CV(%)	5.99	6.70	4.18	10.03	7.95	9.76	8.73
$LSD_{(p>0.05)}$	2.993	3.939	3.993	11.96	11.42	16.85	22.50

Table 2. Effect of Bion and Amistar on number of leaf per plant of banana var. Sabri

Treatments	Number of leaf per plant						
	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP	210 DAP	240 DAP
T_1	2.50f	4.50h	4.50c	5.50b	6.00b	7.00bc	9.00c
T_2	3.00f	4.50h	4.50c	4.50b	5.00b	5.00c	5.00d
T_3	6.50cd	8.00d-g	9.00ab	9.50a	11.00a	9.50ab	12.00a-c
T_4	6.00de	8.50c-f	9.50ab	11.00a	12.00a	10.50a	11.50a-c
T_5	5.50de	7.50e-g	8.50ab	10.00a	10.00a	10.50a	12.50ab
T_6	8.00ab	8.00d-g	9.00ab	10.00a	11.00a	9.50ab	12.00a-c
T7	6.00de	9.50cd	9.50ab	10.00a	10.50a	11.50a	13.50a-c
T8	5.50de	7.50e-g	7.50b	9.25a	9.50a	10.50a	12.50ab
T_9	5.00e	7.00fg	9.00ab	10.00a	11.00a	11.00a	11.00a-c
$LSD_{(p>0.05)}$	1.092	1.714	2.244	2.894	2.894	2.814	2.860

DAP = Days after planting,T1 = Dipping bottom of sucker for 6 hrs in Bion (0.005%) before transplanting, T_2 = Dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, T_3 = Spraying Bion (0.005%) once on leaves after 80 days of transplanting, T_4 = Spraying Bion (0.01%) once on leaves after 80 days of transplanting, T_5 = Spraying Amistar (0.05%) once on leaves after 80 days of transplanting, T_6 = Spraying Amistar (0.05%) on leaves after 80 and 140 days of transplanting, T_7 = Spraying Bion (0.005%) once on leaves and pseudostem after 80 days of transplanting. T_8 = Spraying Bion (0.01%) once on leaves and pseudostem after 80 days of transplanting. T_9 = Control (without chemical)

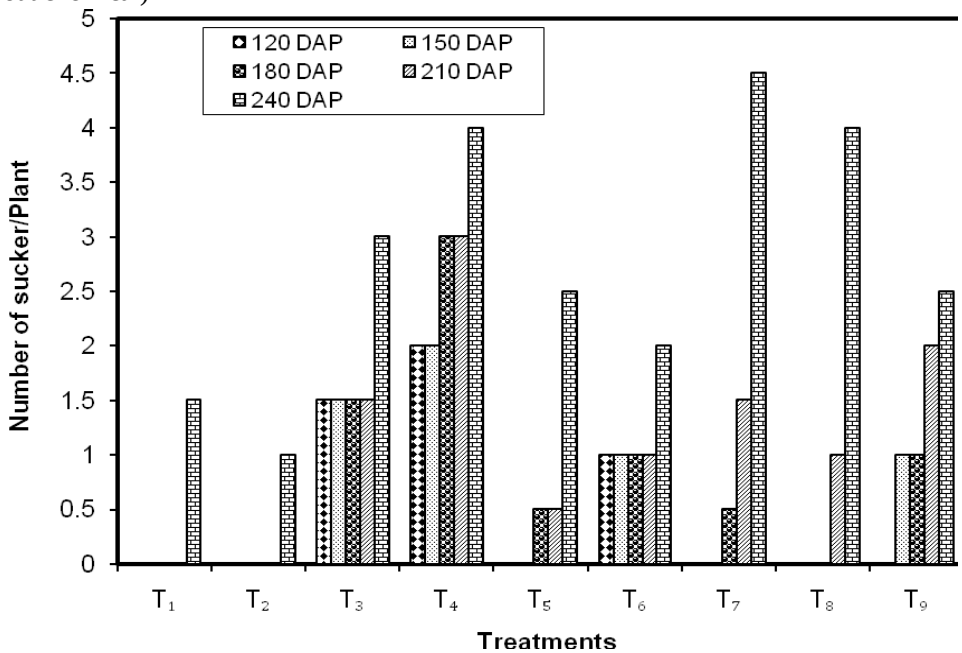

Fig.1. Effect of Bion and Amistar on number of sucker per plant of banana var. Sabri at different days after planting

DAP = Days after planting

T_1 = Dipping bottom of sucker for 6 hrs in Bion (0.005%) before transplanting, T_2 = Dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, T_3 = Spraying Bion (0.005%) once on leaves after 80 days of transplanting, T_4 = Spraying Bion (0.01%) once on leaves after 80 days of transplanting, T_5 = Spraying Amistar (0.05%) once on leaves after 80 days of transplanting, T_6 = Spraying Amistar (0.05%) once on leaves after 80 and 140 days of transplanting, T_7 = Spraying Bion (0.005%) once on leaves and pseudostem after 80 days of transplanting, T_8 = Spraying Bion (0.01%) once on leaves and pseudostem after 80 days of transplanting, T_9 = Control (without chemical)

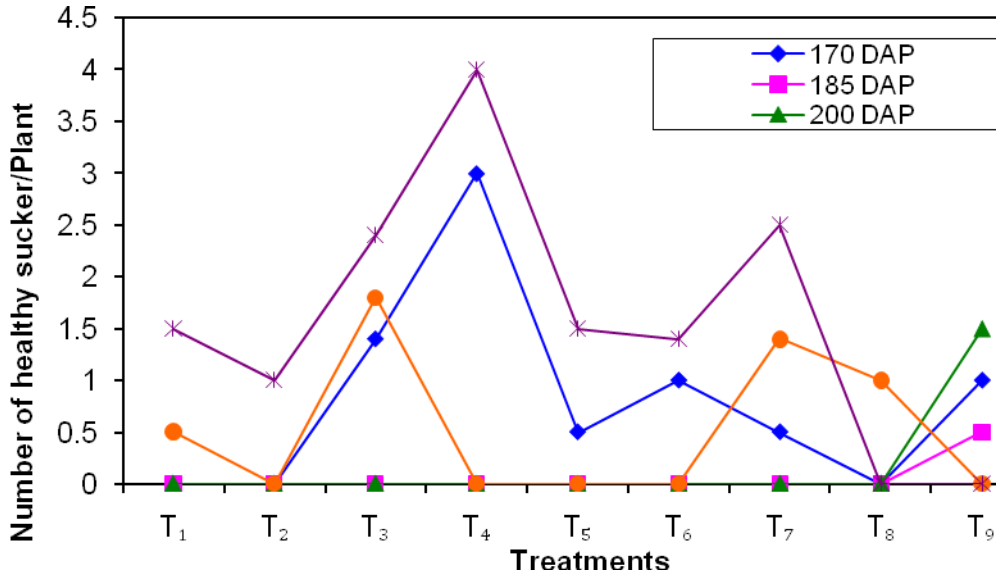

Fig. 2. Effect of Bion and Amistar on healthy sucker per plant of banana var. Sabri at different days after planting.

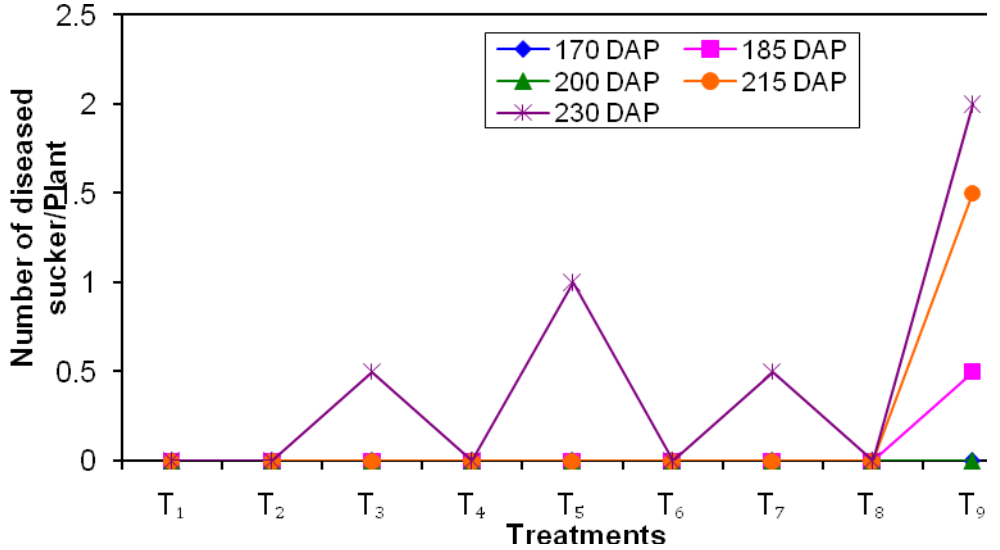

Fig. 3. Effect of Bion and Amistar on diseased sucker per plant of banana var. Sabri at different days after planting.

DAP = Days after planting

T_1 = Dipping bottom of sucker for 6 hrs in Bion (0.005%) before transplanting, T_2 = Dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, T_3 = Spraying Bion (0.005%) once on leaves after 80 days of transplanting, T_4 = Spraying Bion (0.01%) once on leaves after 80 days of transplanting, T_5 = Spraying Amistar (0.05%) once on leaves after 80 days of transplanting, T_6 = Spraying Amistar (0.05%) once on leaves after 80 and 140 days of transplanting, T_7 = Spraying Bion (0.005%) once on leaves and pseudostem after 80 days of transplanting, T_8 = Spraying Bion (0.01%) once on leaves and pseudostem after 80 days of transplanting, T_9 = Control (without chemical)

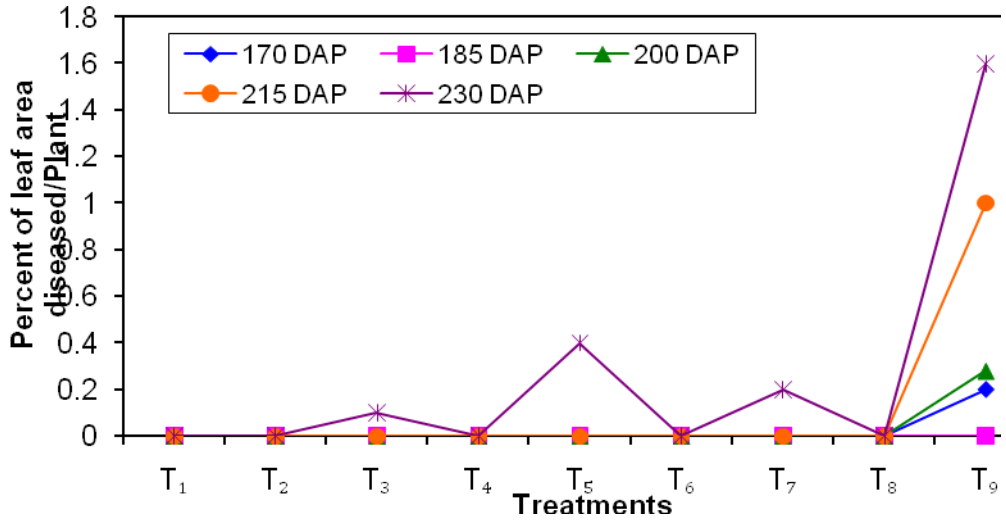

Fig.4. Effect of Bion and Amistar on percent leaf area diseased/sucker of banana var. Sabri at different days after planting

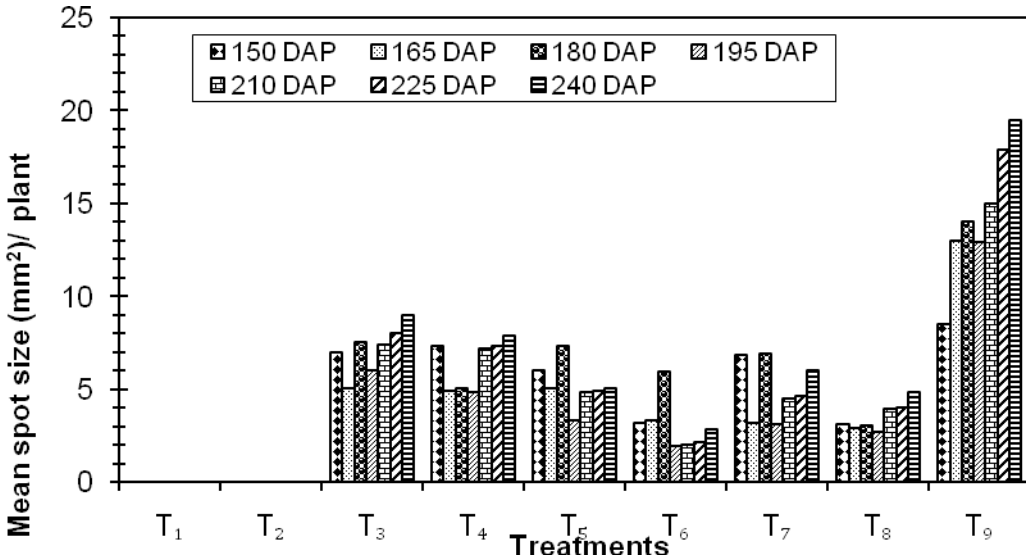

Fig.5. Effect of Bion and Amistar on mean spot size (mm^2)/ plant of banana var. Sabri at different days after planting

DAP = Days after planting

T_1 = Dipping bottom of sucker for 6 hrs in Bion (0.005%) before transplanting, T_2 = Dipping bottom of sucker for 6 hrs in Bion (0.01%) before transplanting, T_3 = Spraying Bion (0.005%) once on leaves after 80 days of transplanting, T_4 = Spraying Bion (0.01%) once on leaves after 80 days of transplanting, T_5 = Spraying Amistar (0.05%) once on leaves after 80 days of transplanting, T_6 = Spraying Amistar (0.05%) once on leaves after 80 and 140 days of transplanting, T_7 = Spraying Bion (0.005%) once on leaves and pseudostem after 80 days of transplanting, T_8 = Spraying Bion (0.01%) once on leaves and pseudostem after 80 days of transplanting, T_9 = Control (without chemical)

CONCLUSION

It is concluded that there is ample scope of using Bion (except sucker treatments) as inducer of resistance for controlling Cercospora (sigatoka) leaf spot of banana. Amistar, as fungicide, can successfully be used for controlling Cercospora (sigatoka) leaf spot of banana also in Bangladesh.

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