EFFICACY OF SEED TREATMENT AND FOLIAR SPRAY WITH FUNGICIDES TO CONTROL STEM ROT (*MACROPHOMINA PHASEOLINA*) OF SESAME

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ABSTRACT

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Stem rot caused by *Macrophomina phaseolina* is one of the destructive diseases of sesame. A field experiment was conducted to test the efficacy of seed treatment with Provax- 200 WP (Carboxin + Thiram) @ 0.2 % and foliar spray with Dithane M-45 (Mancozeb) @ 0.2% + Bavistin DF (Carbendazim) @ 0.1%, Nativo 75 WG (Tebuconazole + Trofloxystobin) @ 0.1%, Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%, Secure 600 WG (Fenamidone + Mancozeb) @ 0.1%, Score 250 EC (Difenoconazole) @ 0.1%, Aimstar Top 325 SC (Azoxystrobin +Difenoconazole) @ 0.1%, Neoben 72 WP (Mancozeb + Metalexyl) @ 0.1% and two bio-control agents viz., Neem leaf extract (1:1) and *Trichoderma harzanium* to control the disease. Control treatment received spray with plain water. In 2015-16, the maximum percent disease index (PDI) of 48.92% and the lowest yield of 895 kg/ha was recorded from control. The PDI was reduced to 11.00-30.89%, yield was increased to 1024-1393 kg /ha due to seed treatment, and foliars spray. In 2016-17 crop season, the PDI was 54.33% and yield was 895 kg/ha under control. Due to fungicidal treatments, the PDI was reduced to 9.00-17.00% and yield was increased to 900-1400 kg/ha. The most effective treatment was seed treatment with Provax- 200 WP and fungicidal spray with Dithane M-45 + Bavistin DF followed by Nativo 75 WG, Aimstar Top 325 SC, and Secure 600 WG to control the stem rot and to increase the seed yield. Maximum disease reduction of 77.5% and 83.78% and yield increase of 1392 kg/ha and 1400 kg/ha were obtained when both seed treatment with Provax-200 and foliar spay were applied with Dithane M-45 + Bavistin DF followed by Nativo 75 WG, Aimstar Top 325 SC.

Keywords: Stem rot, *Macrophomina phaseolina***,** sesame, seed treatment, foliar spray

INTRODUCTION

Sesame (*Sesamum indicum* L.) is the 2nd important edible *Kharif* oilseed crop in Bangladesh (BBS, 2014). Seeds of sesame are a rich source of edible oil 50%, protein 20%, oleic acid 47%, and linolenic acid 39% (Shyu and Hwang 2002). Sesame adorned as "Queen of oilseeds" for its quality food, nutrition, edible oil, bio-medicine, and health care. The crop suffers from various fungal, bacterial, viral, and phytoplasma diseases. Among the fungal diseases, stem rot (*Macrophomina phaseolina* (Tassi.) Goid) is the most economically important disease around the world (Rajput *et al.* 1998, Dinakaran and Mohammed 2001, Durai *et al.* 2006) and also in Bangladesh (Miah and Mondal 2017). The estimated yield loss is 5.0-100.0% in farmer's experimental fields (Verma and Daftari 1974). However, in severe conditions, the loss may rise up to 67.0% (Durai *et al.* 2006). Heavily infected fields, pre-mature defoliation occurs, plants fail to produce normal branches, flowers, capsules, and seeds which result in total low yield of the crop (John *et al.* 2010). The pathogen is seed-borne as well as soil-borne that make it difficult to control (El-Barougy 1990). As the fungus survives in leftover trashes, it is difficult to manage the disease using any single approach. The resistant variety of the crop is not yet available. Many researchers tried to control the pathogen by seed treatment with thiophanate-methyl, carbendazim, and carboxin (John *et al*. 2010), spraying with Bavistin followed by Topsin M, hexaconazole, metalaxyl, and traidemifon (Ammajamma and Hegde 2009, Jaiman and Jain 2010, Kumar *et al.* 2011). Rani *et al*. (2009) reported that *T. viride*, *T. harzianum*, and *Bacillus subtilis* can inhibit in-vitro mycelium growth of *M.phaseolina*. Bayounis and Al-Sunaidi (2008) found that water extracts of *Azadirachta indica*, *Thevetia neriifolia* inhibit mycelium growth of *M. phaseolina*. Therefore, an attempt was made to assess the effect of seed treatment and foliar spray with fungicides on incidence of stem rot and seed yield of sesame.

MATERIALS AND METHODS

The experiment was conducted at Regional Agricultural Research Station, Rahmatpur, Barishal during Kharif-1, 2015-16, and 2016-2017. The experiment was carried out in randomized complete block design (RCBD) with three replications. A high yielding variety of sesame, BARI Til-4 was used. The size of the plots was 4.0m x 3.0m.

The experiment was conducted under natural epiphytotic conditions. Recommended doses of fertilizers (Urea 125 kg, TSP 150 kg, MoP 50kg, Zypsum 110 kg and Zinc sulphate 5 kg, Boric acid 10 kg per hectare) were used. Presowing seed treatment was done with Provax- 200 WP (Carboxin + Thiram) @ 0.2 % except control. Foliar sprays were given at 30 and 45 days after sowing with Dithane M-45 (Mancozeb) @ 0.2% + Bavistin DF (Carbendazim) @ 0.1%, Nativo 75 WG (Tebuconazole + Trofloxystobin) @ 0.1%, Ridomil gold MZ 68 WG (Mancozeb + Metalexyl) @ 0.2%, Secure 600 WG (Fenamidone + Mancozeb) @ 0.1%, Score 250 EC (Difenoconazole) @ 0.1%, Aimstar Top 325 SC (Azoxystrobin + Difenoconazole) @ 0.1%, Neoben 72 WP (Mancozeb + Metalexyl) @ 0.1%, Neem leaf extract (1:1) and *Trichoderma harzanium.*

Data on disease severity was indexed on a 0-4 rating scale (Rahman and Rashid 2008). Percent disease index (PDI) was computed using a standard formula suggested by Krishna Prasad *et al*. (1979) as shown below:

$$PDI = \frac{\Sigma \text{ (Class rating X class frequency)}}{\text{Total number of leaves counted X maximum rating value}} \times 100$$

Data on plant population/m^2, total number of pods/plant, and yield/plot were recorded. Statistical analyses were performed using MSTAT-C and Microsoft Office Excel 2010. Treatment means were compared using the least significant differences test (LSD) at 5% (P= 0.05) probability level.

RESULTS AND DISCUSSION

Percent disease index (PDI)

PDI of Stem rot ranged 11.00-48.92% and 9.00-54.33% in 2015-2916 and 2016-2017, respectively. The highest PDI was recorded from control in both seasons and all treatments reduced disease severity to 11.00-30.89% in 2015-2016 and 9.00-17.00% in 2016-2017. The reduction was significant over control in both seasons. In 2015-2016, the lowest PDI was obtained with foliar spray of Dithane M-45 @ 0.2% and Bavistin DF @ 0.1%, which was statistically similar to Nativo 75 WG @ 0.1%. The PDI under treatments with Ridomil gold MZ 68 WG @ 0.2%, Secure 600 WG @ 0.1%, Score 250 EC @ 0.1%, Aimstar Top 325 SC @ 0.1%, Neoben 72 WP @ 0.1% and *Trichoderma harzanium* were statically similar but comparatively higher compared to only Dithane M-45 @ 0.2% and Bavistin DF @ 0.1%, and Nativo 75 WG @ 0.1%. In 2016-2017, efficacy of all treatments except Neem leaf to reduce PDI was statistically similar. All treatments, except Neem leaf, reduced PDI values within the range 70.18-83.78% in 2015-2016 and 55.34-77.50% in 2016-2017 (Table 1).

Plant population/m^2

The lowest plant population of 35 and 33/m^2 was recorded from control during 2015-2016 and 2016-2017 crop seasons, respectively. In both seasons, all treatments with fungicides and bio-control agents gave a significant increase in the plant populations compared to control. The range of increase was 47-60/m^2 in 2015-2016 and 49-63/m^2 in 2016-2017. In both the years, the maximum increase in this parameter was obtained with Dithane M-45 and Bavistin DF which was statistically similar to Nativo 75 WG, Aimstar Top 325 SC, Ridomil gold MZ 68 WG @ 0.2% Ridomil gold MZ 68 WG @ 0.2%, Secure 600 WG, Score 250 EC @ 0.1% and Aimstar Top 325 SC @ 0.1%. The minimum increase of the parameter was obtained with Neem leaf (Table 2).

Pod number

In 2015-2016, the pod number per plant recorded from control was 58. All treatments increased the yield attribute to 60-76/plant. The increase was significant only under Dithane M-45 and Bavistin DF @ 0.01%, which was statistically similar to Nativo 75 WG 0.01%, Secure 600 WG @ 0.1% and Aimstar Top 325 SC @ 0.1% (Table 2).

Grain yield

Marketable grain yield of Sesame seeds ranged 1000-1392 kg/ha and 895-1400 kg/ha in 2015-2016 and 2016-2017, respectively. The highest yield was recorded when plots were sprayed with Dithane M-45 and Bavistin DF, on the other hand, the lowest yield was harvested from untreated control plots. All treatments gave a significant increase in seed yield compared to control. The increase ranged 2.4-39.20 and 0.56-56.42% over control in 2015-2016 and 2016-2017, respectively. Every year, the maximum yield increase was achieved with Dithane M-45 and Bavistin DF followed by Nativo 75 WG, Aimstar Top 325 SC, and Secure 600 WG. The increase in this parameter was slightly higher during 2016-2017 than 2015-2016 (Table 2).

Table 1. Effect of different treatments on PDI and yield of Sesame during 2015-16 and 2016-17

Treatments	PDI		Disease reduction over control (%)	
	2015-2016	2016-2017	2015-2016	2016-2017
Dithane M-45 @ 0.2% and Bavistin DF @ 0.1%	11.00 d* (19.36)**	9.00 c (17.45)	77.5	83.78
Nativo 75 WG @ 0.1%	14.15 d (22.09)	9.33 c (17.78)	71.08	82.82
Ridomil gold MZ 68 WG @ 0.2%	21.25 c (27.44)	13.00 bc (21.13)	56.56	72.13
Secure 600 WG @ 0.1%	20.76 c (27.09)	10.67 c (19.06)	57.56	78.92
Score 250 EC @ 0.1%	21.23 (27.43) c	13.67 bc (21.69)	56.60	70.18
Aimstar Top 325 SC @ 0.1%	18.26 c (25.29)	9.67 c (18.10)	62.67	81.83
Neoben 72 WP @ 0.1%	21.40 c (27.54)	14.33 bc (22.23)	56.26	68.26
Neem leaf extract (1:1)	30.89 b (33.75)	17.00 b (24.34)	36.86	60.48
Trichoderma harzanium	21.85 c (27.86)	13.67 bc (21.69)	55.34	70.18
Untreated Control	48.92a (44.36)	54.33 a (47.46)	-	-

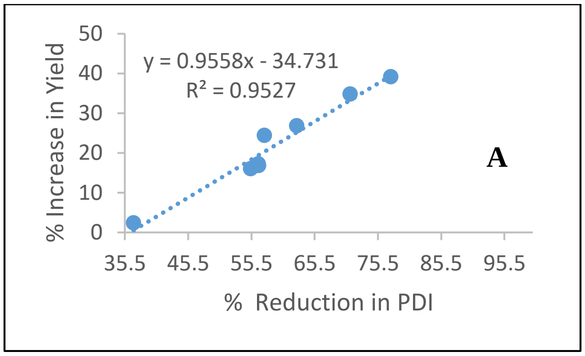
*Means within the same column with a common letter(s) do not differ significantly (P=0.05).
**Figures within parentheses are arc sine transformed values.

Table 2. Effect of pre-sowing seed treatment and foliar spray with fungicides and bio-control agents on yield attributes and yield of sesame during 2015-2016 and 2016-2017

Treatment Combinations	Plant population/m^2		Pods/plant		Yield (kg/ha)		Yield increase over control (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Dithane M-45 @ 0.2% and Bavistin DF @ 0.1%	60 a*	63 a	76 a	80 a	1392 a	1400 a	39.20	56.42
Nativo 75 WG @ 0.1%	58 ab	60 ab	71 ab	76 ab	1348 ab	1362 ab	34.8	52.18
Ridomil gold MZ 68 WG @ 0.2%	52 abc	53 bc	64 ab	74 b	1172 bc	1116 abc	17.2	24.69
Secure 600 WG @ 0.1%	54 abc	54 abc	66 ab	75 ab	1244 ab	1180 abc	24.40	31.84
Score 250 EC @ 0.1%	51 abc	53 bc	64 ab	72 bc	1168 bc	1119 abc	16.80	25.03
Aimstar Top 325 SC @ 0.1%	54 abc	55 abc	68 ab	75 ab	1268 ab	1273 ab	26.80	42.23
Neoben 72 WP @ 0.1%	50 bc	50 bc	62 ab	71 bc	1168 bc	1085 bc	16.80	21.23
Neem leaf extract (1:1)	47 c	49 c	60 ab	70 bc	1024 c	900 c	2.40	0.56
Trichoderma harzanium	49 bc	50 bc	61 ab	71 bc	1160 bc	1075 bc	16.00	20.11
Untreated Control	35 d	33 d	58 b	67 c	1000 c	895 c	-	-

*Means within the same column with a common letter(s) do not differ significantly (P=0.05).

In both seasons of experiment, the relationship of reduction in severity of stem rot and marketable seed yield of sesame due to seed treatment and fungicidal spray was linear, positive and significant (r=0.976* and r=0.965*). Their relationship could be expressed by the regression equations, Y=0.9558x-34.771 in 2015-16 and Y=2.1172x-126.8 in 2016-17. The coefficient of determination (R^2) indicates that yield increase due to reduction in disease severity may be attributed to 77.50% in 2015-16 and 83.78% in 2016-17. (Fig. 1).



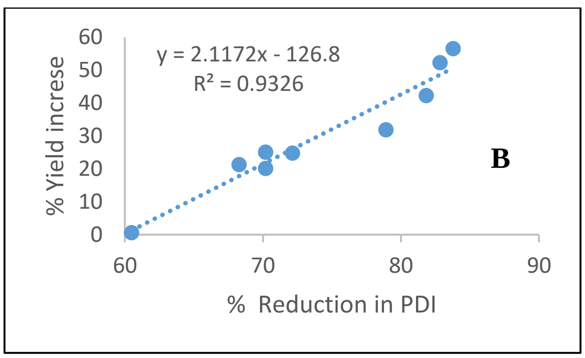


Fig. 1. Relationship of percent yield increase of Sesame with percent reduction of PDI of stem rot during 2015-2016 (A) and 2016-2017 (B) crop seasons

Plant populations and the number of pods per plant are the most important yield attributes of sesame. All treatments gave a considerable increase in plant populations and the number of pods per plant over control due to fungicidal treatments. The maximum plant population/m^2 of 63 was obtained with Dithane M-45 and Bavistin DF treated plots followed by Nativo 75 WG (60), Aimstar Top 325 SC, and Secure 600 WG. The minimum number of this parameter was obtained from untreated control plots Table 2).

Results of the present experiment reveal that combination of seeds treatment with Provax- 200 WP and spraying with Dithane M-45 and Bavistin DF, Nativo 75 WG, Ridomil gold MZ 68 WG, Secure 600 WG, Score 250 EC, Aimstar Top 325 SC, Neoben 72 WP, Neem leaf extract and Trichoderma harzanium mixture cause appreciable reduction in stem rot disease severity and a substantial increase in yield of sesame. Many other workers also reported that seed treatment with quintozene, carbendazim, benomyl 50 WP, Carboxin 200 and thiram 75 WP, spraying with fungicides viz., Monceren, Pencycuron,, tolclofos-methyl, and Maximum AP, Thiophanate methyl + pyraclostrobin, carbendazim 50 WP, Nativo, Score, Topsin-M, Mancozib, Antracol and Topass significantly ($P<0.05$) reduced the incidence and severity of stem rot compared with an unsprayed treatment (Aly *et al.* 2001, Bashir 2018, Chauhan 1988, Choudhary *et al.* 2014, Dwivedi and Ghaube 1985, Omar 2005, Reznikov *et al.* 2016). Choudhary *et al.*, (2014) reported that seed treatment with a mixture of carbendazim 50 WP (0.1%) and thiram 75 WP, foliar spray of carbendazim 50 WP (0.05%) + second spray of *T. viride* (10^7 spores/g) provided excellent control of stem rot on sesame. Bashir (2018) and Jeyalakshmi *et al.* (2013) also reported that Nativo, (Trifloxystrobin 25% + Tebuconazole 50%), mancozeb (0.25%) + endosulfan (0.07%) against *Macrophomina phasiolina* and expressed significant reduction in colony growth as compared to other fungicides.

On the basis of the findings of two year's experiment, it can be concluded that seed treatment with Provax- 200 WP WP (Carboxin + Thiram) @ 0.2 % along with fungicidal spray viz., Dithane M-45 (Mancozeb) @ 0.2% + Bavistin DF (Carbendazim) @ 0.1%, Nativo 75 WG (Tebuconazole + Trofloxystobin) @ 0.1%, Aimstar Top 325 SC (Azoxystrobin +Difenoconazole) @ 0.1% and Secure 600 WG (Fenamidone + Mancozeb) @ 0.1% with an interval 30 DAS and 45 DAS are effective to control stem rot disease *(Macrophomina phaseolina)* and to increase seed yield of sesame. However, before final conclusion computation of BCR is required.

LITERATURE CITED

Aly, A. A., El-Shazly, A. M. M., Youssef, R. M., and Omar, M. R. 2001. Chemical and biological control of charcoal rot of cotton caused by *Macrophomina phaseolina*. J. Agric. Sci. Mansoura Univ 26:7661–7674

Ammajamma, R. and Hegde, Y.R. 2009. Efficacy of fungicides against *Rhizoctonia bataticola* causing wilt of *Coleus forskohlii* (Wild) Briq. Int. J. Plant Pro. 2(1):31-32.

Bashir, M.R. 2018. Evaluation of New Chemistry Fungicides against Charcoal Rot of Sesame caused by *Macrophomina phaseolina* in Pakistan. J. Hortic. 5:109. doi: 10.4172/2376-0354.1000e109

Bayounis, A.A. and Al-Sunaidi, M.A. 2008. Effect of some plant extracts on growth inhibition of *Macrophomina phaseolina*. Univ. Aden J. Nat. Appl. Sci. 12(3):469-480.

BBS. Bangladesh Bureau of Statistics. 2014. Yearbook of Agricultural Statistics of Bangladesh, Planning Division, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Chauhan, M. S. 1988. Relative efficiency of different methods for the control of seedling disease of cotton by *Rhizoctonia bataticola*. Indian Mycol. Plant Pathol. 18:25–30

Choudhary, C.S., Arun, Anjana and Prasad, S.M. 2014. Management of stem and root rot of sesame. Int. J. Agric. Sci., 10 (2): 755-760.

Dinakaran, D. and Mohammed, N. 2001. Identification of resistant sources to root rot of sesame caused by *Macrophomina phaseolina* (Tassi.) Goid. Sesame and Safflower Newsl. No. 16: 68–71.

Durai, M., Reddy, N.P.E., Devi, M.C. and Reddy, G.L.K. 2006. Integrated management of charcoal rot of sesame incited by *Macrophomina phaseolina* (Tassi) Goid. J. Res. SKUASTJ, 5(1).

Dwivedi, T. S., and Ghaube, H. S. 1985. Effect of fungicides on the emergence and infection of cotton seedlings by *Macrophomina phaseolina* (Tassi) Goid. Indian Mycol. Plant Pathol. 15:295–296

El-Barougy, E.S. 1990. Pathological studies on sesame (*Sesamum indicum* L.) plant in Egypt. [Ms.D. Thesis.] Suez Canal University, Ismailia.

Jaiman, R.K. and Jain, S.C. 2010. Effect of fungicides on root rot of cluster bean caused by *Macrophomina phaseolina*. Environ.Ecol., 28(2A):1138-1140.

Jeyalakshmi, C., Rettinassababady, C. and Sushma Nema. 2013. Integrated management of sesame diseases. J. Biopesti. 6(1): 68-70

John, P., Tripathi, N.N. and Kumar, N. 2010. Efficacy of fungicides against charcoal-rot of sesame caused by *Rhizoctonia bataticola* (Taub.) Butler. Res. Crop. 11(2):508-510.

Krishna Prasad, K. S., Siddaramaih, A. S. and Hedge, R. K. 1979. Development of peanut (Groundnut) rust disease in Karnataka state, India. Plant Dis. Rept. 63 (8): 692-695.

Kumar, S., Sharma, S., Pathak, D.V. and Beniwal, J. 2011. Integrated management of jatropha root rot caused by *Rhizoctonia bataticola*. J.Trop. For. Sci. 23(1):35-41.

Miah, M.A.M. and Mondal, M.R.I. 2017. Oilseed sectors of Bangladesh: Challenges and opportunities. SAARC J. Agric. 15(1):161-172

Omar, M. R. 2005. Pathological and biochemical studies on *Macrophomina phaseolina* pathogenic on cotton. Ph.D. dissertation. Suez Canal University, Ismailia, Egypt.

Rahman, M. L, and Rashid, M. H. 2008. Rating scale and severity index of crop disease –a review. Bangladesh Phytopathological Society. Plant Pathology Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. 44 pp.

Rajput, M. A., Khan, Z. H., Jafri, K. A., Fazal, and Ali, J. A. 1998. Field screening of sesame germplasm for resistance against charcoal rot (*Macrophomina phaseolina*). Sesame and Safflower Newl.13: 63–66.

Rani, S.U., Udayakumar, R. and Christopher, D.J. 2009. Bio-efficacy of plant extracts and bio-control agents against *Macrophomina phaseolina*. Ann. Plant Protec. Sci. 17(2):389-393.

Reznikov, S., Gabriel, R., Victoria, V., Gonzalez, V., Atilio, P., Castagnaro, L. and Ploper, D. 2016. Evaluation of chemical and biological seed treatments to control charcoal rot of soybean. J. Gen. Plant Pathol. 82:273–280. DOI 10.1007/s10327-016-0669-4

Shyu, Y. S. and Hwang, L. S. 2002. Antioxidative activity of the crude extract of lignin glycosides from unroasted Burma black Sesame meal. *Int. Food* Res., 35: 357-365.

Verma, O.P. and Daftari, L.N. 1974. Amount of seed-borne inoculum of *Macrophomina phaseolina* and its effect on mortality and growth of Sesamum seedlings. *Indian* Phytopathol. 27:130-131.