# EVALUATION OF FUNGICIDES IN CONTROLLING WHITE MOLD DISEASE OF MUSTARD CAUSED BY *SCLEROTINIA SCLEROTIORUM*


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## ABSTRACT

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White mold caused by *Sclerotinia sclerotiorum,* one of the most destructive diseases of mustard, incurred huge crop loss every year in Bangladesh. Seven fungicides viz. Rovral 50 WP (Iprodione) @ 2 g/l, Score 250 EC (Difenoconazole) @ 2 ml/l, Folicur 250 EC (Tebuconazole) @ 2 ml/l, Indofil M 45 (Mancozeb) @ 2 g/l, Contaf 5 EC (Hexaconazole) @ 2 ml/l, Secure 600 WG (Fenamidione+Mancozeb) @ 2 g/l and Tilt 250 EC (Propiconazole) @ 1 ml/l were tested at the Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during rabi seasons of 2015-2016 and 2016-2017 to find out the effective fungicides in controlling white mold disease of mustard. All the fungicides reduced the white mold disease compared to the control. The fungicide Folicur 250 EC (2 ml/l) successfully reduced the incidence of white mold disease in mustard followed by Rovral 50 WP (2 g/l) and Tilt 250 EC (1 ml/l). Folicur 250 EC (2 ml/l) reduced the disease incidence (80.26%-91.80%) compared to unsprayed control plots. Maximum seed yields of 1.51 t/ha-1.55 t/ha were produced in Folicur 250 EC (2 ml/l) treated plots though Rovral 50 WP (2 g/l) and Tilt 250EC (1 ml/l) were at per. Folicur 250 EC (2 ml/l), Rovral 50 WP (2 g/l) and Tilt 250EC (1 ml/l) might be the suitable options for the management of white mold disease of mustard.



**Key words:** Fungicides, white mold, *Sclerotinia sclerotiorum,* mustard


## INTRODUCTION

Rapeseed-mustard belongs to the family of Brassicaceae or Cruciferae under genus *Brassica* are most important oilseed crops ranked first among oilseed crops in Bangladesh as well as one of the most important oil seed crops of the world after soybean and groundnut (FAO 2012). Bangladesh occupying 3.308 lakh ha of land and the production was 4.096 lakh ton (BBS 2022). It's an important source of cooking oil in Bangladesh meeting one third of the comestible oil demand of the country (Ahmed 2008). The nutritional value of mustard oil, which is determined by its fatty acid components, protein content and corresponding amino acid content, fiber, antioxidants and various factors such as glucosinolate, phytic acid, sinapin, etc., has a medicinal function (Kaur *et al.* 2019). White mold caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is one of the major mustard disease and the most important yield limiting factor in Bangladesh. In Bangladesh, *S. sclerotiorum* was first recorded in mustard in 2008 (Hossain *et al.* 2008). Before it was considered as minor problem but now it has appeared as a major disease of mustard and alarming to mustard production in Bangladesh. Necrotrophic fungal pathogen *Sclerotinia sclerotiorum* (Lib.) de Bary is widely distributed and capable of infecting about 408 plant species from 75 families (Boland and Hall 1994). It causes rot, also known as white mold or Sclerotinia stem and root rot, and is considered one of the most damaging pathogens. The crop is highly susceptible to this pathogen when atmospheric conditions are favourable for disease development. In the early stages of infection, it develops water-soaked lesions usually form on the leaves, which rapidly expand downward and travel through the stem. When they enter into the stem, water soaked lesions develop at the junction of the stem and petiole. These lesions gradually become necrotic and produce a white mycelial mass. As the infection progresses, it damages the vascular tissue and eventually the plant wilts. Large, often irregularly shaped black sclerotia, which are melanized resting structures, form inside and outside the stem, fruit, and other tissues. Sclerotinia rot causes an estimated US $200 million in annual losses in the United States alone (Bolton *et al*. 2006). The disease can cause catastrophic crop failure as disease incidences have been reported from 60% - 80% and variable yield losses ranged from traces to 100% in several economically important crops worldwide (Mehta 2009, Shukla 2005). Various approaches have been developed to control Sclerotinia rot, including cultural, biochemical and chemical means (Garg *et al*. 2008). Once the pathogen is established, it is hard to manage due to its soil borne nature and broad host range. Control of this disease with different chemicals has been described in the literature with varying success (Mehta *et al*. 2005) but no efficient and possible solution through the use of fungicides has been made yet. In Bangladesh, little work has been done on the management practices to control white mold disease caused by *S. sclerotiorum*. Therefore, the present study was undertaken to find out the effective fungicides in controlling white mold disease of mustard.

## MATERIALS AND METHODS

The experiment was carried out in randomized complete block design with three replications in the experimental field of Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during rabi seasons of 2015-2016 and 2016-2017. The land was prepared one week before sowing and the fertilizers were applied @ 260, 170, 90, 160, 5 and 10 kg/ha of Urea, TSP, MOP, Gypsum, Zinc-sulphate and Boric acid, respectively. Half of the Urea was applied at the initial stage of flowering. The seeds of BARI Sharisa-14 were sown on 2$^{nd}$ November, 2015 and 12$^{th}$ November, 2016 in the unit plot of 3m x 3m following row to row distance 40 cm with continuous sowing. Eight treatments (including seven fungicides) were used in this experiment viz. $T_1$= Rovral 50 WP (Iprodione) @ 2 g/l, $T_2$ = Score 250 EC (Difenoconazole) @ 2 ml/l, $T_3$= Folicur 250 EC (Tebuconazole) @ 2 ml/l, $T_4$ = Indofil M 45 (Mancozeb) @ 2 g/l, $T_5$ = Contaf 5 EC (Hexaconazole) @ 2 ml/l, $T_6$ = Secure 600 WG (Fenamidione+Mancozeb) @ 2 g/l, $T_7$ = Tilt 250 EC (Propiconazole) @ 1 ml/l and $T_8$= Control (check). The crop was allowed to grow under natural condition and subjected to natural infection. The experiment was monitored regularly to observe the onset of white mold or sclerotinia rot disease. Spraying was conducted three times at 7 days interval starting from immediate appearance of disease symptom. Irrigation and other cultural practices were performed as and when necessary. Data were recorded on disease incidence, plant height (cm), number of siliqua/plant, and grain yield (t/ha) and finally the percent disease incidence of white mold that caused by *S. sclerotiorum* was calculated by following formula:

$$\text{Percent Disease Incidence} = \frac{\text{Number of infected plant per plot}}{\text{Total number of plant per plot}} \times 100$$

The percent data were transformed (square root) before statistical analysis. Grain yield was obtained from each plot and it was converted into ton/ha. The data were analyzed statistically using statistix-10 software for test of significance and means were compared following the Least Significant Difference (LSD) test (p=0.05).

## RESULTS AND DISCUSSION

### Effect of fungicides on white mold incidence of mustard

All the fungicides significantly reduced the white mold disease of mustard as compared to control plots in both the years (Table 1). In both the cropping season, white mold incidence of mustard varied significantly among the tested fungicides. The lowest white mold disease incidence of 1.43% in 2015-2016 and 3.95% in 2016-2017 cropping seasons was obtained from Folicur 250 EC (2 ml/l) sprayed plots which was followed by Rovral 50 WP (2 g/l) and Tilt 250 EC (1 ml/l) sprayed plots. The control plots showed the highest incidence of white mold disease as 17.43% in 2015-2016 and 20.01% in 2016-2017 cropping season. The maximum disease reduction over control of 91.80% and 80.26% was observed in

Folicur 250 EC (2 ml/l) sprayed plots in both the years. The fungicide Secure 600 WG (2 g/l) gave the lowest disease reduction over control as 31.61% in 2015-2016 and Contaf 5 EC (2 ml/l) gave 21.79% disease reduction in 2016-2017 cropping season.

**Effect of fungicides on yield contributing characters and yield of mustard**

Effect of fungicides on plant height, number of siliqua per plant and yield of mustard are presented in Table 2. In both years all the fungicides didn't show significant effect on plant height compared to control plots. Number of siliqua per plant varied significantly from 44.20 to 60.33 in 2015-2016 and 42.53 to 58.07 in 2016-2017 cropping seasons. During 1st year the highest number of siliqua per plant was recorded from Folicur 250 EC (2 ml/l) sprayed plots which was statistically similar to Rovral 50 WP (2 gl/l), Score 250 EC (2 ml/l) and Indofil M 45 (2 g/l) treated plots and that was followed by Tilt 250EC (1 ml/l) and Contaf 5 EC (2 ml/l), while the lowest number of siliqua per plant was obtained from control plots. The results were in consistent with those of 2016-2017 cropping year. The grain yield of mustard varied from 1.18 to 1.51 t/ha and 0.87 to 1.55 t/ha during 2015-2016 and 2016-2017, respectively. During 2015-16 cropping season, the highest grain yield was recorded in Folicur 250 EC (2 ml/l) treated plots which was at par to Rovral 50 WP (2 g/l), Tilt 250 EC (1 ml/l), Score 250 EC (2 ml/l) and Contaf 5 EC (2 ml/l) sprayed plots, while the lowest yield was found in control plots. The trend of grain yield in 2016-2017 was almost similar to that of previous year.

Table 1. Effect of fungicides in controlling white mold disease of mustard during 2015-2016 and 2016-2017 cropping seasons

| Fungicides | 2015-2016 | | 2016-2017 | |
|---|---|---|---|---|
| | Incidence of white mold (%) | Disease reduction over control (%) | Incidence of white mold (%) | Disease reduction over control (%) |
| $T_1$= Rovral 50 WP (2 g/l) | 3.91 f (1.97) | 77.57 | 5.11de (2.25) | 74.46 |
| $T_2$= Score 250 EC (2 ml/l) | 9.56 cd (3.08) | 45.15 | 12.94b (3.59) | 35.33 |
| $T_3$= Folicur 250 EC (2 ml/l) | 1.43 g (1.19) | 91.80 | 3.95e (1.96) | 80.26 |
| $T_4$= Indofil M 45 (2 g/l) | 10.98 bc (3.31) | 37.01 | 8.26 c (2.87) | 58.72 |
| $T_5$ = Contaf 5 EC (2 ml/l) | 8.68 d (2.94) | 50.20 | 15.65b (3.95) | 21.79 |
| $T_6$= Secure 600 WG (2 g/l) | 11.92 b (3.45) | 31.61 | 14.75b (3.84) | 26.29 |
| $T_7$ =Tilt 250EC (1 ml/l) | 5.94 e (2.44) | 65.92 | 6.41cd (2.53) | 67.97 |
| $T_8$= Control | 17.43 a (4.17) | - | 20.01a (4.47) | - |
| LSD ($p \geq 0.05$) | 0.1696 | | 0.1845 | |

The values within parenthesis were the square root transformed data

Means in a column with similar letter(s) did not differ at 1% level of significance

Table 2. Effect of fungicides on plant height, number of siliqua per plant and yield of mustard during 2015-2016 and 2016-2017 crop seasons

| Treatments | Plant height (cm) | | No. of siliqua/plant | | Grain yield (t/ha) | |
|---|---|---|---|---|---|---|
| | 2015-16 | 2016-17 | 2015-16 | 2016-17 | 2015-16 | 2016-17 |
| $T_1$= Rovral 50 WP (2g/l) | 83.27 | 75.83 | 59.80 a | 56.55 ab | 1.49 ab | 1.51 ab |
| $T_2$= Score 250 EC (2ml/l) | 83.47 | 72.53 | 59.40 a | 47.94 cd | 1.32 a-d | 1.30 c |
| $T_3$=Folicur 250 EC (2ml/l) | 83.53 | 79.42 | 60.33 a | 58.07 a | 1.51 a | 1.55 a |
| $T_4$=Indofil M 45 (2g/l) | 84.73 | 78.61 | 58.53 a | 50.77 abc | 1.30 bcd | 1.33 c |
| $T_5$ = Contaf 5 EC (2ml/l) | 85.93 | 79.13 | 51.80 ab | 49.41 bcd | 1.40 abc | 1.28 c |
| $T_6$=Secure 600wg (2g/l) | 83.00 | 79.42 | 46.47 b | 49.30 bcd | 1.29 cd | 1.29 c |
| $T_7$ =Tilt 250EC (1ml/l) | 83.73 | 81.03 | 54.07 ab | 53.49 abc | 1.43 abc | 1.38 bc |
| $T_8$= Control | 83.53 | 73.33 | 44.20 b | 42.53 d | 1.18 d | 0.87 d |
| LSD ($p \geq 0.05$) | 1.8920 | 7.3276 | 5.2280 | 3.4391 | 0.0911 | 0.0716 |
| CV (%) | NS | NS | 11.79 | 8.26 | 8.18 | 6.67 |

Means in a column with similar letter(s) did not differ at 5% level of significance; NS=Not significant

From the above study it was clear that all the fungicides shown significant effect in controlling white mold disease of mustard caused by *Sclerotinia sclerotiorum.* However, Folicur 250 EC was found to be best followed by Rovral 50 WP and Tilt 250 EC in two consecutive years in terms of reducing disease incidence and increasing grain yield. These results were in accordance with the findings of Alireza *et al.* (2015). They reported that tebuconazole, propiconazole, cyproconazole and Rovral-TS showed 100% inhibition of *S. sclerotiorum* mycelial growth at highest dose (1 ppm), as well as by the doses of 0.1 and 0.01 ppm of tebuconazole, propiconazole and cyproconazole. Manhas *et al.* (2022) reported that maximum inhibition was recorded in tebuconazole in which less growth of pathogen was obtained at all the three concentrations (50, 75, 100 ppm) followed by hexaconazole *in vitro*. The results were also in line with the findings of Bradley *et al.* (2006) who studied the efficacy of different fungicides against *S. sclerotiorum* and they reported that azoxystrobin, benomyl, boscalid, iprodione, prothioconazole, tebuconazole, thiophanate-methyl, trifloxystrobin, and vinclozolin consistently reduced Sclerotinia stem rot incidence in canola.

**Relationship between white mold disease incidence and grain yield of mustard**

The coefficient of determination was estimated between white mold disease incidence and grain yield of mustard. The relationship showed that the yield was negatively correlated with white mold incidence in both the crop seasons. Coefficients of determination $R^2 = 0.968$ in 2015-2016 and $R^2 = 0.799$ in 2016-2017 indicated that the incidence of white mold disease influenced 96.80 % and 79.90% towards the grain yield of mustard in both the years, respectively (Fig. 1). The correlation equations also revealed that one percent increase in white mold disease reduced mustard grain yield by 0.022 t/ha in 2015-2016 and 0.031 t/ha in 2016-2017 crop seasons (Fig. 1).

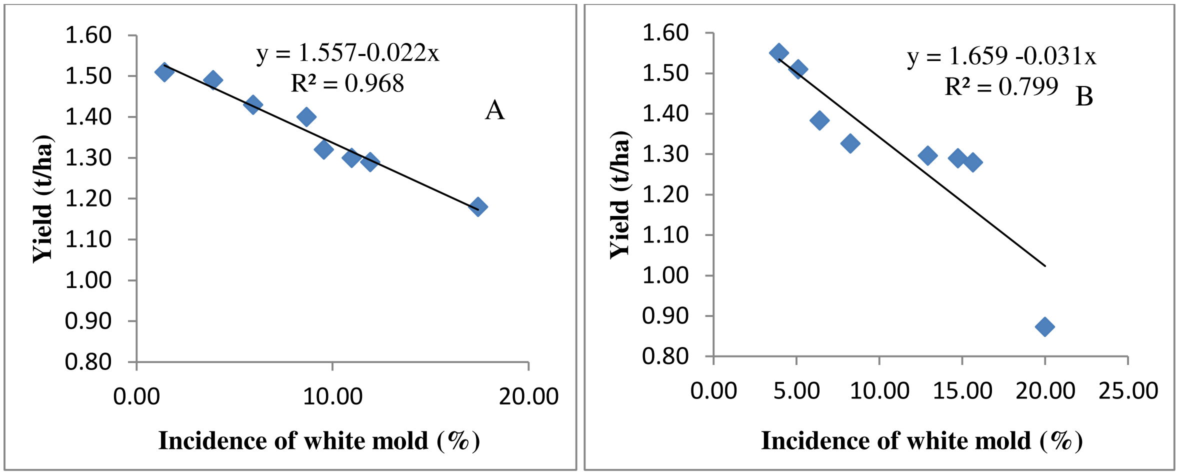


Figure 1. Relationship between white mold disease incidence and grain yield of mustard during 2015-2016 (A) and 2016-2017 (B) crop seasons

## CONCLUSION

The findings of this study revealed that three times spraying of Folicur 250 EC (2 ml/l) or Rovral 50 WP (2 g/l) or Tilt 250EC (1 ml/l) at 7 days interval starting from the first appearance of the white mold disease might be better option for the management of white mold and thereby increased seed yield of mustard. The results might be recommended to the field level to boost up mustard production through decreasing white mold incidence in Bangladesh.

## LITERATURE CITED


Ahmed, A. 2008. Results of farm level socio-economic study on mustard production. Bangladesh Journal of Agricultural Research, 13(1): 20-23.

Alireza, D., Saeed B., Hossein B. and Majid, A. 2015. Effect of some fungicides against the growth inhibition of *Sclerotinia sclerotiorum* mycelial compatibility groups. J. Plant Protection Res., 55 (4):354-361

BBS (Bangladesh Bureau of Statistics). 2022. Yearbook of Agricultural Statistics-2022. 34th Series. May 2023. Statistics and Informatics Division (SID) Ministry of Planning, Govt People's Repub Bangladesh; 2022. 119 p.

Boland, G. J. and Hall, R.1994: Index of plant hosts of *Sclerotinia sclerotiorum*. Can. J. Plant Pathol.16, 94-108.

Bolton, M. D., Thomma, B. P. H. J. and Nelson, B.D. 2006: *Sclerotinia sclerotiorum* (Lib.) de Bary: biology and molecular traits of cosmopolitan pathogen. Mol. Plant Pathol. 7, 1-16.

Bradley, C. A., Lamey, H. A., Endres, G. J., Henson, R. A., Hanson, B. K., McKay, K. R., Halvorson, M., Legare, D. G. and Porter, P. M. 2006. Efficacy of fungicides for control of Sclerotinia stem rot of Canola. Plant Disease 90 (9): 1129–1134.

FAO (Food and Agriculture Organization). 2012. FAO Production Year Book. Food and Agriculture Organization of the United Nations, Rome 00100, Italy, 56: 118.

Garg, H., Sivasithamparam, K., Banga S. S. and Barbetti, M. J. 2008. Cotyledon assay as a rapid and reliable method of screening for resistance against *Sclerotinia sclerotiorum* in *Brassica napus* genotypes. Australasian Plant Pathology 37 (2):106–111.

Hossain, M. D., Rahman, M. M. E., Islam, M. M., and Rahman, M. Z. 2008.White rot, a new disease of mustard in Bangladesh. Bangladesh J Plant Pathol 24:81-82.

Kaur, R., Sharma, A. K., Rani, R., Mawlong, I., and Rai, P. K. 2019. Medicinal Qualities of Mustard Oil and Its Role in Human Health against Chronic Diseases: A Review. Asian J Dairy Food Res, 38(2):98-104.

Manhas, A., Sharma, R. and Dorjey, S. 2022. Evaluation of fungicide and bio-control agents against Sclerotinia stem rot of chickpea (*Sclerotinia sclerotiorum*). The Pharma Innovation J.; SP-11(2): 358-365

Mehta, N. 2009. Sclerotinia stem rot-an emerging threat in mustard. Plant Dis. Res.; 24: 72–73.

Mehta, N., Sangwan, M. S. and Saharan, G. S. 2005. Fungal Diseases of Rapessed-Mustard. In: Diseases of Oilseed Crops. (Ed. Saharan, G. S., Naresh Mehta and M. S. Sangwan) Indus Publishing Co. New Delhi, India. 15-86 pp.

Shukla, A. N. 2005. Estimation of yield losses to Indian Mustard *Brassica juncea* due to Sclerotinia stem rot. J. Phytol. Res.; 18:267-268.