Integrated Management of Damping off and Wilt (*Caused by Sclerotium Rolfsii*) of Sunflower

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ABSTRACT

An experiment was carried out to evaluate the effect of different treatments either alone or in combination to control the damping off and wilt disease (*Sclerotium rolfsii*) of sunflower.The experiment was carried out following randomized complete block design (RCBD) with ten treatments viz. T_1 = Soil drenching with Datura, T_2 = Seed treatment with Datura, T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Seed treatment with Neem, T_6 = Forestin (seed treatment), T_7= Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Seed treatment with zinger, T_9 = Poultry litter + Soil drenching with Datura and T_{10} = Control. The maximum number of field emergence (87%) was found at T_5 treated plot, followed by T_2 and T_8 (both 84%). The lowest percent (0%) damping off was observed at treatment T_2 and highest (4.92%) at T_{10} (Control). In case of wilting, disease incidence was lowest (0.6167%) at 30 DAS in case of T_7 and 0.3933% at 50 DAS in case of T_5, while T_2 showed statistically similar results with the lowest data. Highest disease incidence percentages were found at T_{10} (Control) in both 30 and 50 DAS. Among all the treatments, maximum yield was observed at T_2 treated plot (4.697 t/ha), while T_9 showed statistically similar results (4.593 t/ha). Overall the research result revealed that, Seed treatment with Datura (T_2) showed minimum disease incidence percentages for both damping off and wilt and also gave highest yield.

Keywords: *Integrated management, Scleotium rolfsii, Identification, Damping off, Wilting, Sunflower, Disease incidence.*

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Highlights of this paper

- Combination of Biological, chemical and soil amendments performed better than single treatmets.
- But Datura (Datura metel) performed best in case of controlling damping off and wilt disease.
- Farmer can use Datura, Neem and Zinger extract with the Combination of Soil amendments like Cowdung, poultry litter and Vermi-compost etc.

1. INTRODUCTION

The Sunflower (*Helianthus annuus* L.), belonging to the family Asteraceae, is globally recognized as one of the most important oil seed crops. It is grown on over 22 million hectares worldwide, with a production of 26 million tonnes [1, 2]. It is a high value cash crop and a source of high quality edible vegetable oil [3]. Sunflower is attacked by many diseases, which reduce the yield and quality significantly under optimal conditions [4]. More than 90 sunflower diseases have been reported worldwide [5]. Sunflower plants are attacked by a number of infection microorganisms mostly fungi, bacteria and nematodes which reduces yield and quality [6-8]. The most serious diseases of sunflower are caused by fungi. Wilt is one of the major diseases of sunflower caused by *Sclerotium rolfsii* and has become a big threat to crop production.

Sclerotium rolfsii, the causal agent of collar/foot rot of many crops [9] having a wider host range [10] attracted the attention of plant pathologist and professional researcher throughout the world. *Scleotium rolfsii* were found to be associated with damping-off and charcoal-rot of sunflower. Chakravarty and Bhowmik [11] studied symptoms and techniques of inducing collar-rot of sunflower caused by *S. rolfsii* Sacc. The fungus caused pre- and post-emergence damping off of sunflower seedlings and collar rot of adult plants. Okoli, et al. [12] reported that *S. rolfsii* caused heavy infection on sunflower; plants wilted and dried out with basal stem dry rot. Affected plants developed round-elliptical basal lesions, brown-tan colored with a whitish centre and producing sclerotia. Diseased plants wilted, produced chaff seeds and died. Symptoms included an initial acropetal wilting of the entire plants. Affected plants gradually dry-out but remain erect. Initially leaves remained green and attached to the stem. Infected plants can be spotted from a distance by seen sickly appearance. Later the entire plant withers and dies. White cottony mycelium and mustard seed sized sclerotial bodies are formed on the affected stems near soil level.

This disease can be effectively controlled by using fungicides but it is costly as well as not easily available to farmers' door. Since, the present day agriculture is aiming towards sustainable agriculture, use of chemicals are mostly discouraged because chemicals are costly and unfriendly to our ecosystem. These chemicals lead to health hazards and ecological effluence due to frequent use. Therefore development of eco-friendly integrated management strategy is necessary to control this pathogen. Single approach of control measure in many cases was not adequate to control the disease. Rather, integration of different treatments has been found to be effective in management of disease in comparison with individual treatments [13]. For example, amendment of compost with *Trichoderma harzianum* accelerated composting and improved its disease suppressive effect (61.6%) [14]. Few works have been done by using tobacco, neem, garlic and some other plant extracts to control some fungi. Different natural biocides also used separately or in combination with plant extracts to control some fungi by the farmers. The antifungal activities of garlic, neem, allamanda are well recognized [15] and have been reported by many researchers. It is thus dire necessity to work extensively to examine the effect of different concentration of tobacco, neem, garlic and other indigenous plant extract and natural biocides like ginger, turmeric, cow's urine etc. in controlling disease which are easily available. These botanical pesticides are affordable by low income.

2. MATERIALS AND METHODS

The study was conducted in the disease infected sunflower field of the field laboratory, Department of Plant Pathology during the year of 2017. Some botanicals and fungicides were selected for controlling damping off and wilt of sunflower caused by *Sclerotium rolfsii*. These approaches was integrated into several treatment combinations and tested to determine their efficacy for controlling the diseases. Ten treatment combinations were used to conduct this research. Those are as follows-T_1= Soil drenching with Datura, T_2 = Seed treatment with Datura, T_3 = Vermicompost, T_4 = Poultry litter, T_5= Poultry litter + Seed treatment with Neem, T_6 = Seed treatment with Forestin, T_7= Vermicompost +Seed treatment with Forestin, T_8 = Cow dung + Seed treatment with Zinger, T_9 = Poultry litter + Soil drenching with Datura and T_{10} = Control.

Soil amendments used in this study were vermi-compost, cow dung and poultry litter. Cow dung and poultry litter were collected from local farmers and vermicompost was collected from contract farmers of Regional Horticultural Research Station, Patuakhali.

Cow dung and poultry manure were well rotten, dried and grinded before amended with soil. Vermicompost were grinded properly before amended with soil. All amendments were applied to soil and mixed properly. The amended field then was kept for 15 days before seed sowing. The soil amendments were applied on each respective plot of 3 replications {(3x2) m^2 x 3= 18 m^2

The experiment was set up in a Randomized Complete Block Design (RCBD) with 3 replications. The land was divided into three blocks. Each block was divided into 10 plots. So, there were 30 plots in the experimental field. The size of individual plots was 6 m^2 (3m X 2m).The space between blocks and plots is 0.5 m. 10 treatments were randomly assigned in each block. Hysun-33 variety of sunflower seed was used in this study. Seeds of the cultivar were collected from local market of Patuakhali. Seeds of sunflower were sown in holes on 16th January 2017 maintaining optimum hole to hole and row to row distance. In each plot there were 4 rows and in each row there were 15 holes. Thus, there were 60 holes in an individual plot. 2-3 healthy seeds per hole were sown at a depth of 1.5 to 2 cm of the soil. Holes were then covered with loose soil. One healthy seedling was maintained in each hole after germination and allowed to grow on.

2.1. Data Collection

Collection of data on damping off of sunflower started from 15 days after sowing (DAS) at 10 days interval. The incidence of wilting was recorded at 20 days interval up to its final harvesting by Visual Diagnosis Method (VDM). Data were also collected on plant stand, plant height, head diameter and ultimate yield.

2.2. Calculation of Percent Seed Germination

Percent seed germination was calculated by using following formula:

$$\text{Seed germination (\%)} = \frac{\text{No. of seedling actually emerged}}{\text{Total no. of seeds used for seedlings emergence}} \times 100$$

2.3. Calculation of Percent Disease Incidence

Percent disease incidence was calculated by using following formula:

$$\text{Incidence / Diseases severity(\%)} = \frac{\text{No. of infected plants by } \textit{Sclerotium rolfsii}}{\text{Total no. of plants germinated}} \times 100$$

2.4. Yield Related Parameters

After harvesting, yield data were recorded on the following parameters- Diameter of head, Weight of head, Yield per plot & Yield per ha. The diameter of head recorded in cm measured by a meter scale as the horizontal distance from a side to another side of widest part of the sectioned head and mean value was recorded. The average weight of head per plant was recorded in gram measured by a balance. The yield per unit plot was calculated in kg by adding the yields of all (five) plants of each plot and expressed in kg. The yield per hectare was calculated out by converting form per plot yield data to per hectare and was measured in ton.

2.5. Statistical Data Analysis

All the collected data were analyzed by randomized complete block design (RCBD) following the analysis of variance (ANOVA) technique using MSTATc package and the mean differences were adjudged by LSD technique at 5% level of significance

3. RESULTS & DISCUSSION

3.1. The Disease and the Causal Pathogen

The performance of sunflower against *Sclerotium rolfsii* was observed in the field of plant pathology field laboratory, PSTU, Dumki, Patuakhali. The crop was subjected to infection by *Sclerotium rolfsii* under natural conditions. Symptom of infection was severe necrosis followed by death of the plant due to stem and primary root infections. Affected plants developed round-elliptical basal lesions, brown-tan colored with a whitish centre and producing sclerotia. Affected plants gradually dry-out but remain erect. It showed characteristics yellowing of leaves associated with white mycelium at dry rotted root system or at the infected collar region. Small roundish mustard seed like sclerotia are found on the infected plant part Figure 1.

The causal pathogen was isolated from infected parts of sunflower plants at plant pathology laboratory, PSTU, Dumki, Patuakhali. It produced abundant white septate mycelia with clamp connections at each septation, aerial hyphae and also numerous spherical, or ellipsoidal, white sclerotia, which turned brown as they matured. Similarly, white mycelial growth and sclerotia were abundantly produced on host-inoculated test plants. Based on the morphological and cultural characteristics, the disease-causing organism was identified as *Sclerotiumrolfsii* Figure 1.

Figure-1. Signs of pathogen in the field and pathogen grown on petridish after isolation.
Source: Experimental field and pathology laboratory.

3.2. Field Emergence

The variation among field emergence of sunflower obtained from different plots was significant due to the application of different treatments Table 1. The maximum number of field emergence was found at T_5 (Poultry litter + Neem) and minimum number of field emergence was found at T_6(Forestin).

Table-1. Effect of different treatments on field emergence.

Sl. No.	Treatments	Field emergence
1	T_1	72.67 bcde
2	T_2	84.00 ab
3	T_3	66.67 def
4	T_4	60.00 ef
5	T_5	87.00 a
6	T_6	58.67 f
7	T_7	80.00 abc
8	T_8	84.00 ab
9	T_9	80.00 abc
10	T_{10}	67.00 cdef
LSD		13.04

Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD. T_1 = Datura (soil drenching), T_2 = Datura (seed treatment), T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Neem (seed treatment), T_6 = Forestin (seed treatment), T_7= Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Zinger (seed treatment), T_9 = Poultry litter + Datura (soil drenching) and T_{10} = Control.

3.3. Percent Disease Incidence (Damping off)

The effects of different treatments on disease incidence are shown in Table 2. Damping off disease incidence varied from 0-4.92%, where highest disease incidence occurred at control (4.920), followed by Forestin (4.057%) and disease was not seen at at datura (seed treatment) treated plot (T_2). The findings of the present study clearly supported those obtained by many researchers throughout the world [16-21].

Table-2. Effect of different treatments on disease incidence (damping off) caused by *Sclerotiumrolfsii* of sunflower.

Sl. No.	Treatments	% Disease incidence (damping off) at 20 DAS
1	T_1	2.873 abc
2	T_2	0.000 d
3	T_3	1.710 bcd
4	T_4	2.010 bcd
5	T_5	1.927 bcd
6	T_6	4.057 ab
7	T_7	0.723 cd
8	T_8	0.680 cd
9	T_9	0.900 cd
10	T_{10}	4.920 a
LSD		2.358

Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD. T_1 = Datura (soil drenching), T_2 = Datura (seed treatment), T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Neem (seed treatment), T_6 = Forestin (seed treatment), T_7= Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Zinger (seed treatment), T_9 = Poultry litter + Datura (soil drenching) and T_{10} = Control.

3.4. Percent Disease Incidence (Wilting)

Disease incidence increased almost uniformly along with time apparently independent of treatments. It has been noted throughout the growth periods, the percent disease incidence was highest at T_{10} (control). So, the treatments effect differed significantly from control and amongst them Table 3.

At 30 DAS, maximum disease incidence occurred at T_{10} (7.869%) and minimum showed at T_7 plot (0.617%). T_2 and T_5 gave identical result as T_7 plot. T_1, T_3, T_4 and T_9 showed disease incidence 2.42%, 2.46%, 2.31% and 2.25% respectively. There was no statistical difference among results of those four treatments.

At 50 DAS, maximum disease incidence occurred at T_{10} (11.6%) and minimum disease incidence (0.393%) were shown at T_5. There was no statistical difference between T_2 and T_5.T_6 showed maximum disease incidence after control. T_1, T_7 and T_9 showed minimum number of disease incidence after T_5 and T_{10}. Control (T_{10}) showed maximum disease incidence over all the treatments at 30 and 50 DAS. At 70 and 90 DAS, the percent disease incidence did not vary significantly. Dabur, et al. [22] also noticed the antifungal activity of Datura against

phytopathogens. Similar observations were made by Kulshrestha, et al. [23]. They reported that Datura improve seed germination and controlled the pathogen.

Table-3. Effect of different treatments on disease incidence (wilt) of sunflower.

Sl. No	Treatments	% Disease incidence (Wilting)			
		30 DAS	50 DAS	70 DAS	90 DAS
1	T_1	2.420 d	2.619 bcd	0.707	0.000
2	T_2	0.8933 e	0.8533 d	0.667	0.000
3	T_3	2.460 d	3.537 bc	0.000	0.900
4	T_4	2.307 d	3.609 bc	0.000	0.000
5	T_5	0.773 e	0.3933 d	0.617	0.793
6	T_6	6.469 b	4.112 b	0.877	0.000
7	T_7	0.6167 e	2.863 bcd	0.000	0.000
8	T_8	4.002 c	1.417 cd	0.667	0.000
9	T_9	2.250 d	2.340 bcd	0.000	0.000
10	T_{10}	7.869 a	11.60 a	2.257	2.067
LSD		1.117	2.667	-	-

Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD. T_1 = Datura (soil drenching), T_2 = Datura (seed treatment), T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Neem (seed treatment), T_6 = Forestin (seed treatment), T_7 = Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Zinger (seed treatment), T_9 = Poultry litter + Datura (soil drenching) and T_{10} = Control.

3.5. Head Diameter

It was observed that head diameter was highest at Datura treated plot (21.10 cm) and lowest at poultry litter + neem treated plot plot (15.17 cm). T_2 gave identical result (19.13 cm) as poultry litter treated plot. The head diameter at T_3 and T_9 plot gave statistically identical result (17.23 cm) Table 4.

Table-4. Effect of different treatments on plant height and head diameter of sunflower.

Sl. No.	Treatments	Head diameter (cm)
1	T_1	15.90 c
2	T_2	21.10 a
3	T_3	17.23 bc
4	T_4	19.13 ab
5	T_5	15.17 c
6	T_6	15.67 c
7	T_7	15.27 c
8	T_8	16.50 c
9	T_9	17.23 bc
10	T_{10}	16.67 c
LSD		2.81

Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD. T_1 = Datura (soil drenching), T_2 = Datura (seed treatment), T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Neem (seed treatment), T_6 = Forestin (seed treatment), T_7= Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Zinger (seed treatment), T_9 = Poultry litter + Datura (soil drenching) and T_{10} = Control.

It was observed that head diameter was highest at T_4 (21.10 cm) and lowest at T_5 plot (15.17 cm). T_2 gave identical result (19.13 cm) as poultry litter treated plot. The head diameter at T_3 and T_9 plot gave statistically identical result (17.23 cm). T_1, T_6, T_7 and control showed statistically identical results with T_5.

3.6. Yields

The variation among yield of sunflower obtained from different plot was significant due to the different treatments Table 5. Among all the treatments, maximum yield was observed at T_2 (Seed treatment with Datura) treated plot (4.697 ton/ha) and minimum yield was found on T_6 (Forestin) treated plot (2.777 ton/ha). T_9 (Poultry litter + soil drenching with Datura), T_5 (Poultry litter + Neem seed treatment), T_7 (Vermicompost + Forestin seed treatment) and T_8 (Cow dung + Zinger Seed treatment) showed yields 4.593, 4.597, 4.170 and 4.637 respectively

which did not show statistical difference with Poultry litter + Datura (seed treatment) treated plot. Control showed minimum yield after Forestin (seed treatment) treated plot Table 5.

Table-5. Effect of different treatments on yield of sunflower.

Sl. No.	Treatments	Yield (t/ha)
1	T1	3.747 abc
2	T2	4.697 a
3	T3	3.813 ab
4	T4	3.773 abc
5	T5	4.597 a
6	T6	2.777 c
7	T7	4.170 a
8	T8	4.637 a
9	T9	4.593 a
10	T10	3.047 bc
LSD		1.021

Means followed by same letter(s) in a column did not differ significantly at 5% level by LSD. T_1 = Datura (soil drenching), T_2 = Datura (seed treatment), T_3 = Vermicompost, T_4 = Poultry litter, T_5 = Poultry litter + Neem (seed treatment), T_6 = Forestin (seed treatment), T_7= Vermicompost + Forestin (seed treatment), T_8 = Cow dung + Zinger (seed treatment), T_9 = Poultry litter + Datura (seed treatment) and T_{10} = Control.

In general, results showed integrated effect of different practices was much more effective in case of disease management caused by *Sclerotium rolfsii*, than the individual effect of different practices. This finding is similar to the findings of Madhavi and Bhattiprolu [13]. They also observed that integration of different treatments was found to be effective in management of disease in comparison with individual treatments.

4. CONCLUSION

The incidence of damping off and wilting disease of sunflower caused by *Sclerotiumrolfsii* was observed highest at control plots while the lowest incidence were under the treatment T_2 (in case of damping off) treatment T_7 (in case of wilting). Forestin might have some chemical effect on seed germination as it has showed less germination percentage than any other treatments and its ultimate yields was also less than any other treatments used in this experiment. Control resulted less yields than any other treatment except Forestin.

Among all the treatments, maximum yield was observed at T_2 (Seed treatment with Datura) treated plot (4.697 ton/ha). Also statistical similar yields were observed at T_9 (Poultry litter + Soil drenching with Datura), T_5 (Poultry litter + Neem seed treatment), T_7 (Vermicompost + Forestin seed treatment) and T_8 (Cow dung + Zinger Seed treatment). This results indicate that integrated effect of different practices were much more effective in case of yield than the individual effect of different practices.

Thus, it can be concluded that the incidence of damping off and wilting disease can be significantly reduced by the combined used of botanicals and soil amendments in order to have a higher yield as well as eventual higher economic return with minimum environment pollution.

Therefore, the sunflower growers of the Patuakhali region of Bangladesh may be advised to take an integrated approach, which should include plant extracts, soil amendments and chemical measures to reduce disease incidence of damping off and wilting of sunflower

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