Using a Biofungicide (Coniothyrum minitans Campbell.) In Controlling Some Soilborne Plant Pathogenic Fungi in Egypt

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Abstract: In vitro, growth of sclerotia forming fungi i.e., Sclerotinia sclerotiorum, Sclerotium rolfsii and S. cepivorum was reduced significantly when these fungi were cultured in the front of the biofungicide Coniothyrum minitans. Delaying of inoculation the sclerotia forming fungi by 72 h after the dishes had been inoculated by the biofungicide greatly reduced growth of sclerotia forming fungi than inoculation by biofungicide and sclerotia-forming fungi were carried out in the same time (0 time). Moreover, formation of sclerotia by the previously mentioned fungi greatly affected in the presence of the biofungicide and superior reduction was shown when inoculation by sclerotia-forming fungi was delayed 72 h after C. minitans had been inoculated in petri dishes. Examination of cross sections of infected sclerotia of S. sclerotiorum and S. rolfsii by C. minitans revealed the presence of several histological changes in comparison with the healthy ones. The biofungicide caused breaking the outer shell of sclerotia and invade the inner content, led to destroyed, malformation, lysis, decay and changes of sclerotial colour. Under greenhouse condition, a biofungicide (C. minitans) significantly increased the percentage of healthy plants of bean (Phaseolus vulgaris L.), grown in soil infested by S. sclerotiorum or S. rolfsii and onion (Allium cepae L.) grown in soil infested by S. cepivorum and significantly decreased the percentage of infected plants comparing with un-treated control. The presence of biofungicide in soil infested with sclerotia forming fungi led to great increase of growth parameters in comparison to its absence. It significantly increased root and plant length and fresh weight of survival plants. Moreover, the biofungicide caused great increase of flowers and pods of bean plants as well as the weight of bean pods and the weight of onion plants.

Key words: Biocontrol, Coniothyrum minitans, Sclerotium sclerotiorum, S. rolfsii, S. cepivorum

INTRODUCTION

Plant diseases caused by sclerotial fungi are wide spread and cause considerable losses to many crops. Resistant varieties are not available and chemical control is not effective. Biological control has shown promise as a partial agricultural for the control of disease causing by sclerotia forming fungi. Sclerotinia sclerotiorum, Sclerotium rolfsii and Sclerotium cepivorum are widely distributed plant pathogenic fungi in Egyptian agricultural soil. The first two fungi are very serious on many crops i.e. as bean (Phaseolus vulgaris L.), sunflower (Helianthus annus), Ashour et al. [8], El-Helaly et al. [12], Mohamed [39,40], Mahdy et al. [29], Mohamed [41] and Abd El-Moniem (Maisa) [23].

Sclerotium cepivorum is widely distributed in Egypt causing white rot of onions and garlic Mikhail et al. [38], Abd El-Moity [1,2], Rushdi [40], Abd El-Razik [4], Tohamy et al. [51], Embaby [13] and others.

The present study was aimed to test the fungus Coniothyrum minitans as biocontrol agent on the previously mentioned sclerotial forming fungi, this biocontrol agent gave results by many authors, Turner and Tribe [54], Ahmed and Tribe [7], George [15], Adams [5], Hung [21], Grendene and Marciano [20], Benuzzi and Albonetti [9], Gerlagh et al. [16,18] and Aertsens and Michi [6].

The efficiency of this biocontrol agent was tested for different points of view i.e. on mycelial growth, formation of sclerotia and the parasitism of the bioagent on sclerotia and study the histological changes occurring in sclerotia. Moreover, the efficiency of such bioagent in controlling some diseases caused by these fungi under greenhouse conditions was also studied.

MATERIALS AND METHODS

Source of the pathogenic fungi and biofungicide: Three different pathogenic fungi, i.e. Sclerotinia sclerotiorum, Sclerotium rolfsii and Sclerotium cepivorum, were obtained from Plant Pathology Department, National Research Centre (NRC), Cairo, Egypt, while abiofungicide Coniothyrum minitans was kindly provide by Prof. Dr. Hassan (Essmat), Bot. Dept. NRC.

A- Laboratory studies:

1- Antagonistic test: The inhibition of sclerotial-forming fungal growth due to the presence of the antagonistic.
fungus (C. minitans) was studied in Petri plate dishes (9 cm) contained sterilized PDA medium\[33,34,35\]. The tested bioagent was inoculated in one side of Petri dish than the tested host fungi were inoculated in the other side at different intervals, i.e. 0 time, 24 h and 72 h. Plates inoculated with sclerotial forming fungi only were used as a control. Three Petri dishes for every particular treatment were used as replicates. Plates were incubated at 24±2°C. Percentage of reduction in mycelial growth rate and in sclerotial formation (as affected by abioagent), were calculated and recorded when the control plates were filled with growth of the pathogenic fungi.

\[
\text{Reduction} \% = \frac{R1 - R2}{R1} \times 100
\]

Where :
R1 = growth in control plates (free of antagonist)
R2 = growth in the presence of the antagonist.

2- Histological studies: Sclerotia of Sclerotinia sclerotiorum and Sclerotium rolfsii were placed at the periphery 4 d. old of C. minitans growth grown on PDA medium in Petri dishes. Plates were incubated at 24±2°C for 10 days. Samples of sclerotia were taken and dipped in formalin acetic-acid (FAA) solution, dehydrated in ethyl alcohol, zylol series, then embedded in paraffin wax, sections (10-15 mm) were carried out using rotary microtome and stained with Methyl Blue-Erythrosin and Safranine – Fast green staining according to Sass\[47\] and Willey\[60\]. Stained sections were examined microscopaly and photographed.

B- Greenhouse experiments: Biological control experiment(s) were carried out under greenhouse condition in National Research Centre (NRC) during 2004/2005 season. Clay loamy soil were sterilized with formaline solution 2%, then covered with plastic sheet for three weeks. Plastic sheets were removed and the soil was left for one month for formaline evaporation. Sterilized soil was filled in plastic pots (20 cm in Dim.) each containing 1.5 kg soil/pot. Bioagent Coniothyrum minitans was grown on sand barley water medium (1: 1: 2, w/w/v), then used for soil at rate of 3%, (inoculum thoroughly mixed with soil), irrigated and left for one week to activate the inocula. Pathogenic fungal inocula were prepared in autoclaved corn meal sand water substrates (1: 1: 2, w/w/v) in flasks 250 ml. Each flask (contained 100 ml medium). Medium was inoculated with 4mm Dim. disk of pathogenic fungi which taken from 7 days old culture of PDA, then incubated at 24± 2°C for 3 weeks. After one week later from soil had been infested with bioagent, the first group of potted soil was infested with inocula of each pathogen separately, at rates 50 sclerotia /kg soil for S. sclerotiorum, S. rolfsii,\[40,41\] and 3 sclerotia / g soil for S. cepivorum\[13\], then irrigated and left for one week. Other potted soil (second group) were infested with pathogenic fungi only (free bioagent) as comparison. After 7 days from infestation, the prepared potted soil were sown with the host plant of healthy bean seeds (Phaseolus vulgaris L.) after their surface had been sterilized at rate 5 seeds / pot for S. sclerotiorum and S. rolfsii and five onion (Allium cepae L.) transplants/pot with S. cepivorum in both two potted groups. Four pots were used as replicates for each treatment. Pre and post emergence damping-off were recorded after 4 and 8 weeks. All survived plants were uprooted after 8 weeks and the percentage of diseases incidence were recorded. On the other hand, some morphological characters such as root and plant length (cm), fresh weight (g), percentage of flowering and pods / plant and fresh weight of pods (as yield) were measured and recorded between treated and control (untreated).

RESULTS AND DISCUSSIONS

A- Laboratory studies:
1- Effect of abiofungicide (C. minitans) and time of application on growth rate (cm) of some soilborne plant pathogenic fungi: Data in Table (1) indicate that the growth rates of all tested fungi were significantly reduced in the presence of biofungicide (C. minitans) comparing with control. On the other hand, the growth rates of all tested fungi were significantly decreased by increasing the time of application period comparing with the same (zero) time. Mycelial growth of the third group (72 h.) of all tested fungi was greatly affected. The most affected fungi under this condition is Sclerotinia sclerotiorum followed by Sclerotium cepivorum, which record 95.6% and 81.1% of reduction respectively, but the lowest affected fungus of Sclerotium rolfsii which gave 71.1 reduction percent. According to time of application, the growth rate of S. sclerotiorum was decreased from 5.8 to 4.0 and 0.4 cm by increasing the time of inoculation from zero to 24 hr and 72 hr with 35.6%, 55.6% and 95.6% of reduction. The same results were recorded with other tested fungi.

2- Effect of abiofungicide (C. minitans) and time of application on sclerotial formation of some sclerotia forming fungi: Data were recorded in Table (2). Data presented that, a biofungicide (C. minitans) significantly reduced the total count of sclerotia and increased reduction percent with the three tested fungi in comparing with control. Also, increased reduction percent with increasing the time period of application in comparison with the same (zero) time. Generally, 72 h application significantly reduced numbers of sclerotia with all the three tested fungi. Sclerotinia sclerotiorum was the most
affected fungus followed by *Sclerotium cepivorum* which gave reduction percent 100%, 96.9% and 84.5% with all the three tested fungi, respectively. On the other hand, the reduction percent of sclerotial formation were 75%, 91.7% and 100% for *S. sclerotiorum*, 47.1%, 61.7% and 96.9% for *S. cepivorum* and 26.4%, 34.9% and 84.5% for *S. rolfsii*. It depends on the time of application at the same (zero) time, after 24 h, or 72 h, respectively. Data also show that, sclerotial formation completely inhibited (100%) of *S. sclerotiorum* when the antagonistic fungus *C. minitans* was inoculated 72 h before inoculated the pathogen.

3- **Histological effect(s):** Examination of cross sections of infected and healthy sclerota of *S. sclerotiorum* and *S. rolfsii* under light microscope revealed several changes in all infected sections in comparison with the healthy ones (Fig. 1 and 2). As it is shown the healthy sections, compact and regular granulate inner content. Whereas, the antagonistic fungus (*C. minitans*) led to break the outer shell of sclerotia and invade the inner content causing destroying the sclerotia. Also, infected sclerotia of the pathogenic fungi by the antagonistic fungus led to several histological changes as malformation, lysis and decay of the outer wall and the inner content, as well as changing of sclerotial colour in comparison to healthy ones.

**B- Greenhouse experiment:**

4- **Effect of add a bioagent on diseases incidence causing by sclerotial forming plant pathogenic fungi:** Effect of bioagent (*C. minitans*) on the survival and infection of host plants i.e. bean infected with *S. sclerotiorum*, *S. rolfsii* and onion transplants infected by *S. cepivorum* under greenhouse condition were recorded. Data in Table (3) indicate that, bioagent (*C. minitans*) gave positive reactive in controlling all diseases causing by the three tested pathogens compared with the free bioagent treatments. It increased

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**Table 1:** Effect of a biofungicide (*C. minitans*) and time of application on growth rate (cm) of some soilborne plant pathogenic fungi.

<table>
<thead>
<tr>
<th>Time of application</th>
<th><em>S. sclerotiorum</em></th>
<th><em>S. rolfsii</em></th>
<th><em>S. cepivorum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G. R.</td>
<td>G. R.</td>
<td>G. R.</td>
</tr>
<tr>
<td>Zero</td>
<td>5.8 35.6</td>
<td>7.1 21.1</td>
<td>5.4 40.0</td>
</tr>
<tr>
<td>24 hr.</td>
<td>4.0 55.6</td>
<td>7.0 22.2</td>
<td>5.1 43.3</td>
</tr>
<tr>
<td>72 hr.</td>
<td>0.4 95.6</td>
<td>2.6 71.1</td>
<td>1.7 81.1</td>
</tr>
<tr>
<td>Control</td>
<td>9.0 -</td>
<td>9.0 -</td>
<td>9.0 -</td>
</tr>
<tr>
<td>Mean</td>
<td>4.8 -</td>
<td>6.42 -</td>
<td>5.25 -</td>
</tr>
<tr>
<td>L.S.D. 5%</td>
<td>For fungi (A)</td>
<td>For Time (B)</td>
<td>Interaction (A x B)</td>
</tr>
<tr>
<td></td>
<td>0.339 sig.</td>
<td>0.39 sig.</td>
<td>0.679 sig.</td>
</tr>
</tbody>
</table>

G. = Growth rate (cm)  R. = Reduction percent.

1 The pathogenic fungi and antagonistic fungus were inoculated at the same time.
2 The pathogenic fungi were inoculated on media 24 hrs after inoculum with the antagonistic fungi.
3 The pathogenic fungi were inoculated on media 72 hr after inoculum with the antagonistic fungus.
4 Free of bioagent (control).

**Table 2:** Effect of a bioagent (*C. minitans*) and time of application on sclerotial formation sclerotia forming fungi.

<table>
<thead>
<tr>
<th>Time of application</th>
<th><em>S. sclerotiorum</em></th>
<th><em>S. rolfsii</em></th>
<th><em>S. cepivorum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MN R. %</td>
<td>MN R. %</td>
<td>MN R. %</td>
</tr>
<tr>
<td>Zero</td>
<td>3.0 75.0</td>
<td>171.5 26.4</td>
<td>1516.7 47.1</td>
</tr>
<tr>
<td>24 hr.</td>
<td>1.0 91.7</td>
<td>36.0 84.5</td>
<td>90.0 46.9</td>
</tr>
<tr>
<td>72 hr.</td>
<td>0.0 100.0</td>
<td>233.0 -</td>
<td>2866.7 -</td>
</tr>
<tr>
<td>Control</td>
<td>12.0 -</td>
<td>147 -</td>
<td>1393 -</td>
</tr>
<tr>
<td>Mean</td>
<td>4.0 -</td>
<td>147 -</td>
<td>1393 -</td>
</tr>
<tr>
<td>L.S.D. 5%</td>
<td>For fungi (A)</td>
<td>For Time (B)</td>
<td>Interaction (A x B)</td>
</tr>
<tr>
<td></td>
<td>77.08 sig.</td>
<td>89.0 sig.</td>
<td>154.2 sig.</td>
</tr>
</tbody>
</table>

M.N = The main number of sclerotial formation.  R % = Reduction percent.

1 Zero time.
2 The pathogenic was inoculated after 24 hrs from bioagent.
3 The pathogenic was inoculated after 72 hrs from bioagent.
4 Control (free bioagent).
significantly the healthy of survival plants as well as reduced the percentage of infection. Data in this table show that white mould disease of bean caused by *S. sclerotiorum* were decreased from 53.3% to 26.7% with 49.9% reduction after 4 weeks from sowing, and from 86.7% to 46.7% after 8 weeks with 46.1% reduction. On the other hand, the healthy survival bean plants were increased by using *C. minitans* from 46.7% to 73.3% with 36.3% increasing after 4 weeks and increased the healthy of survival bean plants from 13.3% to 53.3% with 75.0% increasing after 8 weeks from sowing. The same results were recorded with *S. rolfsii* disease on bean plants. Also, white rot of onion caused by *S. cepivorum* were decreased from 24.0% to zero percent in the presence of bioagent with 24.0% reduction after 4 weeks and from 64.0% infected to 28.0% with 56.3% reduction after 8 weeks from transplanting. On the other hand, bioagent (*C. minitans*) increased the healthy of survival onion transplanting from 76.0% to 100% with 24.0% increasing and from 36.0% to 72.0% with 50.0% increasing after 4 and 8 weeks respectively. Statically analysis show that, bioagent (*C. minitans*) gave significantly results in between fungi, period time and in the interaction between them.

5- **On growth parameters and yield:** The effect of bioagent treatment (*C. minitans*) on some growth parameters of bean and onion plants incited by the three of pathogenic fungi are present in Table (4). In general, bioagent treatment let to significant increase of all growth parameters (as root and plant length (cm), fresh weight(g), percentage of flowering and pods, in addition to pods weight) than untreated (control), Fig. (3 & 4) compared with untreated (free bioagent) treatment. On bean plants, data show that, *S. rolfsii* was the most serious fungus than *S. cepivorum* specially on root and plant length and flowering percent. Also, data in the same Table presented that, bioagent increased the growth parameters of bean plants infected by *S. sclerotiorum* as, root length (cm) from 3.6 to 8.0 cm with 55.0% increasing plant length from 20.5 to 29.5 cm with 30.5% increasing, fresh weight from 3.9 to 9.6 g with 59.4% increasing, flowering...
Plant diseases caused by sclerotial forming fungi are widespread and cause considerable losses to crop plants. Resistant varieties and biological control have shown increasing effectiveness. For example, the length of bean plants infected with S. rolfsii increased from 7.4 to 19.8 cm with 68.6% increasing and onion plant length from 1.3 to 2.3 cm with 43.5% increasing. Bioagent treatment increased root length of S. cepivorum growing in soil infested by biofungicide. 

<table>
<thead>
<tr>
<th>Parameters</th>
<th>U%</th>
<th>T%</th>
<th>R%</th>
<th>U%</th>
<th>T%</th>
<th>R%</th>
<th>U%</th>
<th>T%</th>
<th>R%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy 4</td>
<td>46.7</td>
<td>73.3</td>
<td>36.3</td>
<td>60.0</td>
<td>93.3</td>
<td>35.7</td>
<td>76.0</td>
<td>100.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Infected 4</td>
<td>53.3</td>
<td>26.7</td>
<td>49.9</td>
<td>40.0</td>
<td>6.7</td>
<td>83.3</td>
<td>24.0</td>
<td>0.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Healthy 8</td>
<td>13.3</td>
<td>53.3</td>
<td>75.0</td>
<td>33.3</td>
<td>53.3</td>
<td>37.5</td>
<td>36.0</td>
<td>72.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Infected 8</td>
<td>86.7</td>
<td>46.7</td>
<td>46.1</td>
<td>66.7</td>
<td>46.7</td>
<td>30.0</td>
<td>64.0</td>
<td>28.0</td>
<td>56.3</td>
</tr>
</tbody>
</table>

Mean 2.33 3.00 6.25

L.S.D. (5%) For fungi (A) :1.23 sig.; For Time (B): 1.01 sig.; For U & T (C):1.01 sig.

**Table 3:** Effect of a bioagent (C. minitans) on the healthy survival, infected plants by S. sclerotiorum, S. rolfsii and S. cepivorum under greenhouse conditions.

**Table 4:** Effect of a bioagent (C. minitans) on growth parameters and yield production of bean and onion transplanting incited by the three of pathogenic fungi.

percent from 18.5% to 81.5% with 77.3% increasing, percentage of increasing of pods increased 18.2% to 81.8% with 77.8% increasing and average weight of pod from 0.4 g to 2.5 g with 84.0% increasing. Similar results were recorded in bean plants infected with S. rolfsii when growing in soil infested by biofungicide C. minitans. Also, the growth parameters of onion plants infected by S. cepivorum (the causal agent of white rot disease) were increased significantly by using C. minitans as a bioagent control. Bioagent treatment increased root length of onion from 1.3 to 2.3 cm with 43.5% increasing plant length from 7.4 to 19.8 cm with 68.6% increasing and fresh weight of bulb from 5.6 to 31.6 g with 22.3% increasing.

Plant diseases caused by sclerotial forming fungi are widespread and cause considerable losses to crop plants. Resistant varieties and biological control have shown promise as a partial agricultural method for the control of plant diseases caused by sclerotial forming fungi, Muker and Garg[42]. Data in this research indicated that, biofungicide (C. minitans) reduced the mycelial growth rate(s) of all the three tested fungi i.e. Sclerotinia sclerotiorum, Sclerotium rolfsii and S. cepivorum compared with bioagent free growth. Higher reduction percent in the growth rate were recorded with S. sclerotiorum followed by S. cepivorum than S. rolfsii which record 95.6, 81.1 and 71.1% of reduction, when the pathogenic fungi were inoculated on media 72 h after inoculation with antagonistic fungus (C. minitans). Similar results were obtained by Hung and Hoes[24], Mcquilken et al.[15], they reported that C. minitans killing hyphae and sclerotia of S. sclerotiorum. Muker and Garg[42] also, reported that, in dult cultures S. sclerotiorum is inhibited by C. minitans. Bioagent (C. minitans) gave positive reaction between the time of application and percentage of reduction in the rate of mycelial growth of the three tested fungal pathogens. The effective time of application was noticed when the mycoparasite add 72 h before pathogenic fungi. Gerlagh et al.[17] screened for
antagonisms to *S. sclerotiorum* in a petri dish bioassay. Antagonism, expressed as a reduction in the rate of colonization by *S. sclerotiorum* occurred whether *C. minitans* was co-inoculated at the same time, 1 d before 1 d after *S. sclerotiorum* but was slightly restricted when *S. sclerotiorum* was given a lead of 1 d. Similar results were also agreement with Budge et al.[11], McLaren et al.[30], Benuzzi and Albonetti[9], Gerlagh et al.[16] and Gerlagh et al.[18]. Dual culture of bioagents of sclerotia forming fungi led to decrease the numbers of sclerotial formation with all the three tested fungi than un-treated control. *S. sclerotiorum* was highly affected and gave hundred reduction percent of sclerotial formation, followed by *S. cepivorum* 96.9% and *S. rolfsii* 84.5%. These confirmed the results obtained by Adams[5] who found that, up to 85% and 99% of sclerotia of a number of soilborne plant pathogens were killed by *C. minitans*. Muker and Garg[42] and Mcquilken et al.[37] also, reported that, the mycoparasite infected sclerotia and decreased sclerotial survival.

Bioagent led to a reduction in the number of *S. sclerotiorum* sclerotia. Budge et al.[11] and Grendene and Marciano[20] found that application of mycoparasite (*C. minitans*) in soil infested with sclerotia of *S. sclerotiorum* led to reductions of up to 90% in the numbers of apothecia of the pathogen. Also, Gerlagh[19] found that application of *C. minitans* results in a reduction in the number, viability and survival of sclerotia. Positive reaction were recorded in between the time of *C. minitans* application and reduction percent of sclerotial formation. Three days (72 hrs) gave the best effective time of application than 24 hrs and/or zero time.

Similar results were also reported by Budge et al.[11], Gerlagh et al.[19], McLaren et al.[30], Stewart et al.[50], Benuzzi and Albonetti[9], Gerlagh et al.[16] and Gerlagh et al.[18].
Examination of cross sections of infected sclerotia of S. sclerotiorum and S. rolfsii with C. mimitans, showed several histological changes compared with the healthy sclerotal sections. As it is shown malformation, broke the outer shell, lysis, decayed, destroyed, invaded the inner content and changes its colour with either pathogenic fungi in comparison with the healthy ones. The present finding are in harmony with those reported by Tu[53], who reported that, the mycoparasite hyphae grew inter- and intracellulary within the sclerotia and formed pycnidia near the sclerotial surface. Sclerotia become flattened, soft and disintegrated. Sclerotia parasitized by C. mimitans failed to germinate either myceliogenically or carpogonically. Hung and Koko[22] found that, hyphae of the hyperparasite C. mimitans invade sclerotia of S. sclerotiorum resulting in the destruction and disintegration of the sclerotium tissues. Evidence from cell wall etching at the penetration site suggests that, chemical activity is required for hyphae of C. mimitans to penetrate the thick, melanized rind walls. The medullary tissue infected by C. mimitans show signs of plasmolysis, aggregation and vacuolization of cytoplasm and dissolution of the cell walls, while most of the hyphal cells of C. mimitans in the infected sclerotium tissue are normal, some younger hyphal cells in the rind tissue were lysed and devoid of normal content. Also, Stewart and Harrizon[49] reported that, parasitized sclerotia appeared shrunk and decayed and failed to germinate. The surface of parasitized sclerotia was extensively covered by spores or fruiting bodies the mycoparasite. In addition Phillips[44] and Wang and Vincelli[56] reported that, C. mimitans affected on apotheica of Sclerotinia trifoliorum. The apotheicum eventually decayed and shrank.

Under greenhouse: bioagent (C. mimitans) gave positive reaction in controlling all the three tested pathogens compared with un-treated (control). It was significantly increased percentage of the healthy survival plants and decreased the infection percent. Similar results were obtained by McLaren et al.[31] who reported that, application of C. mimitans and Talaromyces flavus to soil at sowing reduced disease incidence and subsequent loss in seed yield of sunflower. Bioagent (C. mimitans) applied to soil before planting, significantly reduced infection of lettuce caused by S. sclerotiorum, Budge et al.[11]. Sclerotinia diseases in bean caused by S. sclerotiorum were decreased from 53.3% to 26.7% with 49.9% reduction after 4 weeks from sowing and from 86.7% to 46.7% after 8 weeks with 46.1% reduction as well as increased the healthy of survival bean plants from 46.7% to 73.3% with 36.3% increasing after 4 weeks and from 13.3% to 53.3% with 75% increasing after 8 weeks from sowing. The same results were recorded with S. rolfsii on bean plants. Also, white rot of onion causing by S. epivorum was decreased from 24.0% to zero percent with 24.0% reduction after 4 weeks and from 64.0% to 28.0% with 56.3% reduction after 8 weeks from sowing when used a biofungicide (C. mimitans). On the other hand increased the healthy of onion plants from 76.0% to 100% with 24.0% increasing and from 36.0% to 72.0% with 50.0% increasing after 4 and 8 weeks, respectively. Stewart et al.[30] found that, C. mimitans gave effective control (70%) of Sclerotinia minor disease of lettuce when applied at planting time and protected lettuce plants from infection during the first 4 weeks after transplanting.

Generally, bioagent treatment increased all growth parameters, i.e. root and plant length, fresh weight, percentage of flowering and pods as well as weight of pod(s) than un-treated control and enhanced the yield production. On bean plants, S. rolfsii was the most affected fungus than S. sclerotiorum. Bioagent increased the growth parameters of bean plants infected by S. sclerotiorum as rot length (cm) from 3.6 to 8.0 cm, with 55.0% increasing, plant length from 20.5 to 29.5 cm with 30.5% increasing, fresh weight from 3.9 to 9.6 g with 59.4% increase, flowering percent from 18.5% to 81.5% with 77.3% increase of pods from 18.2% to 81.8% with 77.8% increase and weight of pod from 0.4 g to 2.5 g with 84.0% increase of pod weight. Similar results were recorded in bean plants infected with S. rolfsii when treated by C. mimitans. On onion, bioagent treatment increased root length from 1.3 to 2.3 cm with 43.5% increase, plant length from 7.4 to 19.8 cm with 68.6% increase, and fresh weight of bulb from 5.6 to 31.6 g with 22.3% increase. These results are partially agreed with the obtained results of the application of C. mimitans and Talaromyces flavus to soil at sowing sunflowers which led to reduce disease incidence and subsequent loss in seed yield, McLaren et al.[31].

ACKNOWLEDGEMENT

I’m grateful to Dr. Moustafa Helmy Prof. and Head of Plant Pathology Dept., Fac. of Agric. Ain Shams Univ. for his continuous help and scientific advice throughout this research. Also, grateful to Dr. Essmat A. Hassan Prof. of Botany Dept. National Research Center (NRC) for her help, offered and provide the bioagent (C. mimitans).

REFERENCES


