Biological Control of Seedling Damping-off and Root Rot of Sugar Beet Plants

M. K. EL-KAZZAZ[1], M. M. BADR[1], H. M. EL-ZAHABY[1] and M. I. GOUDA[2]*

[1]Department of Agricultural Botany, Faculty of Agriculture, Tanta University, Kafr El-Sheikh, Egypt; [2]Plant Pathology Research Institute ARC, Giza, Egypt

[*]E-mail: elkazzaz@agri-kafr.edu.eg

Abstract

Some fungal and bacterial bioagents as well as an *Actinomycete* isolate were screened for their antagonistic effects against *S. rolfsii, R. solani, M. phaseolina, F. oxysporum* and *F. solani in vitro*. *Trichoderma hamatum, T. harzianum, T. pseudokningii*, certain isolates of *Bacillus subtilis* and one isolate of *Pseudomonas fluorescens* were the most effective bioagents in suppressing the radial growth of the four pathogens, in general. Yet, they were less effective in retarding growth of *Fusarium* spp. as compared with the other pathogens under study. Studying biological control showed the possibility of controlling sugar beet damping-off and root rot by certain bioagents as *T. hamatum, T. hazianum, Pseudomonas fluorescens* and *B. subtilis* under greenhouse (*S. rolfsii*-infested soil) and field (natural infection) conditions. These treatments also caused and increase root yield per plot.

Keywords: damping off; root rot; sugar beet; biocontrol

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is the second important sugar crop after sugar cane in Egypt in terms of acreage and total production.

This crop is liable to be attacked by many soil-borne pathogens at all stages of growth causing pre- and post-emergence damping-off, as well as various degrees of root rots. *Sclerotium rolfsii* and *Rhizoctonia solani* were reported to cause serious root-rot diseases affecting yield crop in Egypt (EL-KAZZAZ *et al*. 1999).

The present work aimed to study the effect of certain isolated biocontrol agents from the rhizosphere of healthy sugar beet plants on certain serious soil-borne pathogens.

MATERIALS AND METHODS

Isolation of bioagents. The used bioagents in the present study were isolated from rhizosphere of healthy sugar beet producing areas of Egypt. The used bioagents were isolated on selected media according to the methods recommended by many authors (MARTIN 1950; JOHANSON *et al*. 1960; SCHAAD 1980).

Identification of the bioagent isolates. The total number of the isolated microorganisms (fungi, bacteria and *Actinomycetes*) were divided each into groups or types according to shape, rate of growth etc. Accordingly, 15 fungal, 9 bacterial isolates and an actinomycetal isolate were selected for further study.

In vitro experiments. The antagonistic effects of the used bioagents were performed according the methods adopted by many workers (BELL *et al*. 1982; IBRAHIM *et al*. 1987; FERREIRA *et al*. 1991).

In vivo experiments. Infested soil with *S. rolfsii* was at the rate of 2% of soil weight, then after one week pots No. 35 were planted with 15 seeds. At the same time diluted suspensions from each of the used bioagents were added at specific rates. Pre and post emergence damping-off were recorded after 15 and 45 days of planting, respectively. Plants thereafter, were thined to 2 plants and root rots were estimated and recorded as infection percent and disease severity 150 days of sowing.

Fungicide. Rhizolex T50 [20% 0-2 dichlaro-4-methylphenyl 0-0 dimethyle phosphoro thioate + 30% bis-(dimethyl thio carbomyl)] was used as a reference for these treatments at the recommended dose (3 gm/kg seeds).

Field experiments. An aqueous suspension at the concentrations of 10^6, 10^8 and 10^7/ml were prepared from *T. hamatum, B. subtilis* and an *Actinomycete* isolate, respectively. The three antagonists were used in a field trial each in three different formulae, suspension, powder or granules.

RESULTS AND DISCUSSION

In vitro experiments. The *in vitro* results indicated that the majority of the used bioagents i.e. *Trichoderma harzianum*, *T. hamatum*, *Gliocladium virens*, *Actinomycete* isolate, *Bacillus subtilis* and *Pseudomonas fluorescence* had antagonistic effects against the phytopathogenic fungi under study. *Trichoderma* spp. were found to be the most effective fungal bioagents followed by some isolates of *B. subtilis* and *P. fluorescence* (Tables 1 and 2).

Pot experiments. Data presented in Table 3 show that most of the screened bioagents were effective in reducing damping-off of sugar beet plants expressed as the survived seedlings after 30 days of planting.

Table 1. Effect of the antagonistic fungal isolates against the tested phytopathogenic fungi

Antagonists	*Sclerotium rolfsii*		*Rhizoctonia solani*		*Macrophomina phaseolina*		*Fusarium oxysporum*	
	L.G.	R.	L.G.	R.	L.G.	R.	L.G.	R.
Trichoderma harzianum	1.47 b	80.03 ab	1.73 a	78.43 a	1.77 a	78.88 a	2.83 b	46.37 d
Trichoderma hamatum	1.17 a	82.59 a	1.83 a	75.57 b	1.97 b	75.87 b	2.50 a	65.30 a
Trichoderma viride	2.67 d	59.88 cd	3.40 b	53.24 c	3.57 d	51.73 d	3.60 b	48.43 c
Trichoderma pseudokoningii	1.93 c	70.89 d	3.93 bc	45.25 d	2.27 c	71.34 c	3.82 c	51.37 b
Gliocladium virens	4.43 e	33.18 e	4.77 c	40.72 e	4.00 e	45.25 e	4.30 e	24.45 e
Control	6.63 f	0.00	6.93 d	0.00	7.00 f	0.00	5.03 d	0.00

R. = % reduction in colony diameter; L.G. = Fungal linear growth (cm)

Table 2. Relative power of antibiosis (R.P.A.) by bacterial and actinomycetal antagonists against the tested phytopathogenic fungi

Antagonists	Relative power antibiosis (R.P.A.) against			
	Sclerotium rolfsii	*Rhizoctonia solani*	*Macrophomina phaseolina*	*Fusarium oxysporum*
Bacillus subtilis	2.85 a	2.40 b	2.55 a	1.30 b
Pseudomonas uorescence	2.75 b	2.75 a	2.65 a	1.40 ab
Actinomycete isolate	2.50 c	1.10 c	2.10 b	1.50 a
Control	-	-	-	-

R.P.A. = Relative power of antibiosis

Table 3. Effect of some bioagents on surviving plants and root rot diseases caused by *S. rolfsii* in a greenhouse, during 1998–1999 and 1999–2000 seasons

Bioagent	1998–1999 season		1999–2000 season	
	Surviving plants	Root rotted plants	Surviving plants	Root rotted plants
Trichoderma harzianum	68.87 c	2.33 b	71.22 d	3.00 c
Trichoderma hamatum	73.33 d	1.67 ab	75.55 de	1.67 b
Gliocladium virens	55.55 b	5.00 d	55.55 b	4.50 d
Actinomycete isolate	60.00 bc	1.33 ab	62.22 cd	5.33 d
Bacillus subtilis	60.00 bc	3.33 c	60.00 c	5.33 d
Rhizolex T 50	95.55 e	0.33 a	97.78 e	0.00 a
Control	11.11 a	9.10 e	4.45 a	10.00 e

Mean followed by the same letter are not significantly different at the 5% level by DMRT

Table 4. Average biological control of seedling blight and root rot of sugar beet by seed dressing with different bioagents formula in the field at Sakha during, 1998–1999 and 1999–2000 seasons

Treatment	Formulae	Seedling blight	Root rot	Disease severity	Yield/plot (kg)
Trichoderma hamatum	Suspension	5.84 d	5.17 c	1.75 b	56.54 c
	Powder	2.84 b	2.34 b	1.33 ab	69.75 a
	Granules	7.34 e	4.34 bc	1.50 b	61.83 bc
Bacillus subtilis	Suspension	7.33 e	7.00 d	2.25 bc	44.42 cd
	Powder	4.83 c	4.33 bc	1.33 ab	63.58 b
	Granules	9.34 f	5.83 cd	2.00 bc	43.97 d
Actinomycete isolate	Suspension	7.50 e	6.00 cd	2.00 bc	52.17 c
	Powder	5.50 d	3.67 bc	2.00 bc	62.70 bc
	Granules	10.00 f	6.84 d	2.83 c	44.39 d
Rhizolex T 50	Powder	0.34 a	0.83 a	0.33 a	66.88 ab
Control		17.33 g	16.83 e	4.17 d	41.92 d

Mean followed by the same letter are not significantly different at the 5% level by DMRT

Came after the effect of the fungicidal treatment, specific isolates of *T. hamatum* followed by *T. harzianum* and *B. subtilis* which were highly effective in controlling the disease. Concerning root rot caused by *S. rolfsii,* the majority of the used bioagents successfully reduced the disease incidence. The most effective bioagents on root rot after Rhizolex T 50 were *P. fluorescence*, *T. hamatum* and *B. subtilis* over the two seasons of experimentation, i.e. 1998–1999 and 1999–2000. These results are consistent to a great extent with the finding of many workers (UPADHYAY & MUKHOPADHYAY 1986; ASAKA & SHODA 1998; EL-KAZZAZ *et al*. 2000).

Field experiments. Field experiments revealed that treatments with powder formulae of the tested bioagents i.e *T. hamatum*, *B. subtilis* and *Actinomycete* isolate had the efficacy to control soil-born diseases (Table 4). The results are similar to those obtained by other investigators (KHALIFA *et al*. 1995; ASAKA & SHODA 1998; EL-KAZZAZ *et al*. 2000).

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