Effect of Some Essential Oils on Controlling Sugar Beet Root Rot Disease Caused by *Rhizoctonia solani* Kuhn

Gouda M .I .* and EL-Souraky Fathia, S. *

* Plant Pathology Research Institute ARC,Giza-Egypt

Received: 20/6/2006

Abstract: *Effects of four essential oils had been studied on the growth of* Rhizoctonia solani *Kuhn., the causal pathogen of damping-off and root rots diseases of sugar beet plants In vitro. Under greenhouse and field conditions, the effect of improving the number of survived seedling and root rot. revealed that oils of* Syzygium aromaticum *L. (Clove) and* Cuminum syminum *L. (Cumin) were more effective than the other tested materials in reducing the pre-and post emergence damping-off and root rots of sugar beet as well as the disease severity. The rest oils were less effective in decreasing the disease incidence. At the same time, increasing the concentration of the tested materials significantly reduced the linear growth of* R. solani. *Oils of* Syzygium aromaticum *L. (Clove) and* Cuminum syminum *L. (Cumin) were more effective and increased morpholigical characters, plant height and Leaf area per plant, also increasing the yield component, total soluble sugars (TSS), sucrose percent in root and sugar purity. The fungicide Rhizolex T. 50 was used for comparative studies in controlling these diseases.*

Key word: *Sugar beet, Root rot diseases, Rhizoctonia , Essential Oils*

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) has become recently one of the most economically important crops in Egypt. This crop is liable to be attacked by certain soil-borne pathogens at all stages of growth causing pre-and post-emergence damping-off, as well as various degrees of root-rots. *Rhizoctonia solani* is considered the most destructive fungus among all pathogen diseases affecting yield crop in Egypt (El-Abyad *et al.,* 1992; El-Kazzaz *et al.,* 1999; El- Kholi 2000;Esh 2000 and Gouda 2001). Some essential oils have an allelopathic effect on some diseases on other plant hosts as previous investigators have reported (Jain, *et al.,*1992; Paran *et al.*,1996; El-Shoraky 1998 and Gouda,2001). The present work aimed to study the effect of certain plant oils on controlling sugar beet root rot disease caused by *Rhizoctonia solani.*

MATERIALS & METHODS

Essential oils:

The following essential oils used in this study such as: *Mentha viridis* (Mint), *Syzygium aromaticum* L (Clove), *Cuminum syminum* L (Cumin), *Ocimum basilicum* L.(Basil).They were purchased from ELGhomhoriya Comp.for Medicine and Chemicals

***In vitro* experiment:**

Essential oils were incorporated into melted PDA medium just before solidification at the required concentrations (1000, 1500 and 2000 p pm.) and poured into Petri dishes (9 cm in diameter). Plates with PDA medium without the essential oils were served as control. The plates were inoculated at the center with 5 mm-culture discs of *R. solani* culture, 7 days old and incubated at 28 °C. Radial growth of the fungus in each plate was determined by measuring colony diameter in each of four replicate plates, until surfaces of the control plates were covered with the fungal mycelium. Percentage of reduction in colony diameter was calculated for each treatment.

Greenhouse experiments:

Essential oils were evaluated for their efficiency against damping-off and root-rot diseases caused by *R. solani* under greenhouse conditions. Sugar beet seeds cv. (Kawmera) were soaked into a concentration of oils at1000 ppm for 8 hours before planting. Seeds were sown in *R. solani* infested soil (15 seeds/ pot). Three replicate pots (No.35) were used seeds treated with the oils and fungicide planted in uninfested soil and acted as control. Disease occurrence were recorded 15, 45 days after planting for pre, post emergence damping-off, respectively. Then the survived seedlings in each pot were thinned at two seedlings. At150 days after sowing the root rot disease was determined as disease incidence and disease severity according to Sharma, *et.al.,* 1994. Root yield per plant and yield losses due to infection were also estimated at harvesting time (150 days after planting). Yield component *i.e.* total soluble solids (TSS), sucrose percent and sugar purity were also estimated. TSS was estimated in fresh roots using the hand refractometer according to Mc Ginnis (1982). Sucrose percent was estimated according to (A. O. A. C., 1990). Purity percent was calculated by dividing the sucrose percent by TSS. Also plant height, leaf area and leaf dry weight were estimated 150 days after planting. Leaf area (cm2) was determined using LI-3100 area meter.

Field experiments: Experiments were carried out to study the effect of some essential oils on root rot incidence and yield per plot. These experiments were performed in the farm of Sakha Agric .Res. Stn. in two successive seasons i.e. 2002-2003 and 2003-2004. Randomized complete blocks design with three replicate plots (1/400 feddan) was designed. Root rots and yield were estimated and recorded per plot at harvesting time (about 180 days of planting). Disease

readings were recorded as percentage of infection and disease severity at harvest

Statistical analysis: Duncan's multiple range test (DMRT) using Irristat Michigan State Univ., USA, 1993.

RESULTS

In vitro experiments: Effect of the tested plant oils for their effect on the linear growth of *R. solani* in Petri dishes is shown in Table (1) and illustrated fig.(1) indicate that all experimented materials were generally positively effective in reducing the linear growth of *R. solani.* The effect was obviously increased by increasing the concentration of oils from 1000 to 2000 ppm. The obtained data in Table (1) and illustrated fig.(1) show that the essential oils of *C. cyminum* (cumin), *S. aromaticum* (clove), *M. viridis* (mint) and *O. basilicum* (basil) were effective in reducing the linear growth of *R. solani* by (90.89; 85.00; 74.67 and 74.49 respectively).

Pot experiments: Data presented in Table (2) revealed the effect of essential oils on the disease incidence of sugar beet damping off and root rot caused by *R.. solani,* which show that all tested essential oils have significant effect in improving the number of survived seedlings due to controlling the pre & post emergence damping-off. Oils of *C. cyminum* and *S. aromaticum* were also effective in reducing damping off and root rot as well as the severity of rot diseases of sugar beet. However, the rest oils of *M. viridis* & *O. basilicum* were high effective in decreasing the disease incidence,. Similar results were obtained from both seasons 2002-2003.

Data are shown in Table (3). Results of plant growth indicate that all oils improved plant growth expressed as plant height, leaf area, and leaves dry weight. Rhizolex T was superior in enhancing the plant growth comparable to the other treatments. Results in both seasons had the same trend.

Root fresh weight increased by decreasing the disease incidence of root rot incited by *R. solani* due to treating beet seeds by any of the oils tested. Table(4). *Cuminum cyminum* and *Syzygium aromaticum* oils have the superior effect of increasing leaf dry weight, total soluble solids (TSS), sucrose percent in roots and sugar purity. At the same time, it decrease percent of the losses (yield & sucrose). The results gave the same trend at the second seasonl.

Field experiments: Different essential oils were studied for their effect on root rot of sugar beet under natural infection at the Farm of Sakha in 2002-2003 and 2003-2004 seasons.

Data presented in Table (5) reveal that oils of *S. aromaticum* & *C. cyminum* were superior than the other materials in reducing the root rot of sugar beet as well as the disease severity in both seasons. The yield per plot was found also to be increased due to treatment with these materials. Rhizolex T 50 caused the least level of infection and disease severity comparing with the other treatment. It is abvious from the obtained results that root yield has been increased in all treatment by essential oils.

DISCUSSION

Trials were conducted to study the possibility of controlling sugar beet damping off and root rots caused by *R. solani.* The essential oils tested inhibited growth of the fungal mycelium *R. solani in Vitro.* Also the tested oils could successfully reduce damping off and root rots of sugar beet in the greenhouse and field. Yield per plot was also significantly increased due to these applications. *Syzygium aromaticum* .L *Cuminum cyminum* L. were the superior among all materials in suppressing damping off and root rots in greenhouse and field. Its positive effect against sugar beet root rot diseases reflects, in turn on the root yield, whereas, it improved the yield potentiality comparable to the untreated control.

Parameters of plant growth were enhanced due to these treatments. Increasing in total soluble solids (TSS) and sugar purity in roots due to these applications were observed. This result causes, in turn an improve to the sugar quality within the roots. These results are consistent with those obtained by other investigators who found an antimicrobial activity of some oils against many pathogens *in vitro* (Farag *et al.,* 1989; Mc Cutcheon *et al.,* 1994 and Navarro *et al.,* 1996). Some essential oils have an allelopathic effect on some diseases on other plant hosts as previous investigators have reported (Jain, *et al.,* 1992; Paran *et al.,* 1996; El-Shoraky, 1998 and Gouda, 2001). El-Kazzaz *et al.,* 2003 studied the effect of essential oil, Mint, Clove, Cumin and Basil on *Sclerotium rolfsii* Sacc., the causal pathogen of suger beet damping off and root rot disease. They found that all of these oils inhibited the linear growth and sporulation of the fungus at the concentration of 1000 ppm .Similar results were found by Taha, 2004 on *Sclerotinia sclerotiorum* the causal pathogen of white rot disease of many vegetable crops.

Based on the obtained results, it could be recommended to use for controlling the major pathogens of the root rots of sugar beet. This oils offer an allelopathic excellent source of biologically active natural product through its effect. Allelopathy, as defined by Rice (1984) is any direct or indirect benficial harmful effect of one organism (including plant or microorganism) on other through release of chemicals into the environment. Other oils used in this study may be attributed to the known and unknown chemical compounds having synergistic effect on the pathogen. Besides, they may affect the populations of soil microflora around the host roots which may cause, in turn a rise of antagonistic and biological agents. Therefore, the author highly recommends, in the time being to soak seed of sugar beet with oils for 8 h before planting for satisfactory control of such disease in the field. It is worth mentioning that using other means of disease control rather than fungicides is strongly encouraged to decrease environmental pollution caused by fungicides.

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Table (1). Effect of some essential oils on linear growth (cm) of *R. solani.*

Essential oils	Concentrations						Mean	
	1000 ppm		1500 ppm		2000 ppm			
	L.G.	R.	L.G.	R.	L.G.	R.	L.G.	R.
1- ***Mentha viridis*** L	5.65b	37.22	0.60b	93.33	0.60b	93.33	2.28	74.67
2- ***Syzygium aromaticum.***	2.38c	73.56	1.08b	88.00	0.60b	93.33	1.35	85.009
3- ***Cuminum cyminum*** L.	1.25ed	86.11	0.60b	93.33	0.60b	93.33	0.82	0.8974.
4- ***Ocimum basilicum***	5.70 b	36.67	0.60b	93.33	0.60b	93.33	2.30	4993.3
5- **Rhizolex T-50.**	0.60*d	93.33	0.60b	93.33	0.60b	93.33	0.60	3
6- **Control**	9.00	0.00	9.00a	0.00	9.00a	0.00	9.00	0.00

Means followed by the same letter are not significantly different at 5% level by DMRT.
L.G. = Fungal linear growth in (cm). R. = Reduction in colony diameter %.

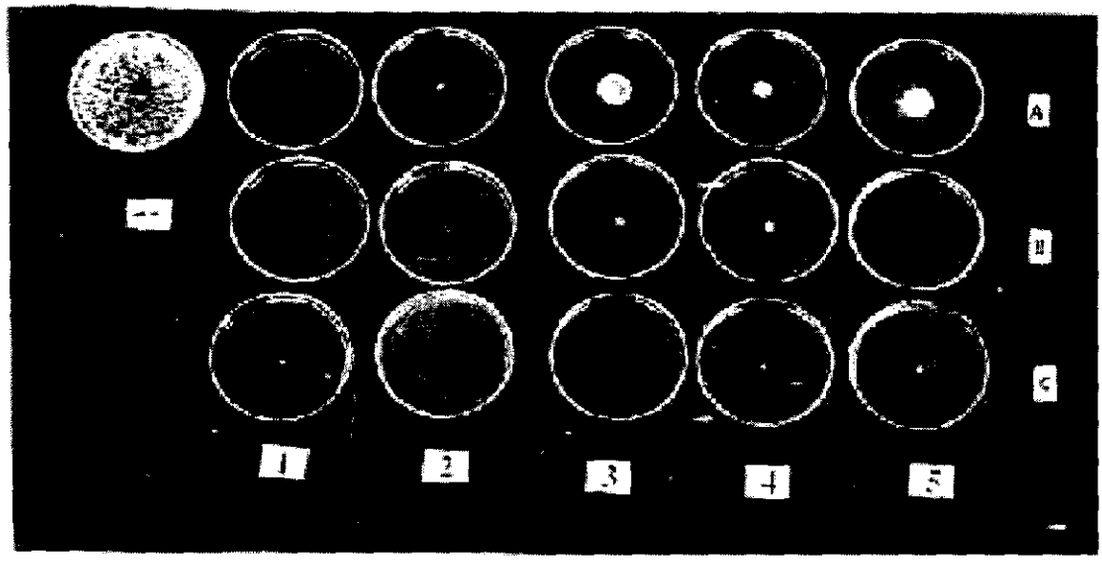

Fig. 1. Effect of the tested essential oils on linear growth of *R. solani* inPDA- plates at the concentrations of 1000 (A), 1500 (B),2000 ppm. (C) . 1- Rhizolex T. 50 2-*M virids.* 3-*S. aromaticm.* 4-*C cymimum.* 5- *O. basilicum.* (-) Control.

Table (2). Effect of some essential oils used for soaking seeds on the incidence of sugar beet damping-off, root rot and disease severity caused by *R. solani,* under greenhouse condition, 2002-2003 and 2003-2004 seasons.

Treatment	2002-2003 season					
	Damping-off		Surviving Plants	Root rot		Healthy Roots
	pre-emergence %	Post-emergence %		Disease incidence %	Disease Severity %	
1- ***Mentha viridis*** L	44.45 c	25.92 e	29.63 b	33.33 d	1.67 cd	66.67 b
2- ***Syzygium aromaticum.***	37.04 b	22.22 de	40.74 c	11.11 b	0.33 a	88.89 d
3- ***Cuminum cyminum*** L	37.04 b	11.11 c	51.85 d	11.11 b	0.33 a	88.89 d
4 - ***Ocimum basilicum***	51.85 d	18.52 d	29.63 b	22.22 c	1.33 bc	77.78 c
5- **Rhizolex T-50.**	0.00 a	3.67 b	96.30 f	0.00 a	0.00 a	100.00e
6- **Control**	92.66 e	3.67 b	3.67 e	88.89 e	8.33 d	11.11 a
	2003-2004 season					
1- ***Mentha viridis*** L	33.33 b	11.11 c	55.56 d	42.44 d	2.67 cd	55.56 b
2- ***Syzygium aromaticum.***	33.33 b	22.22 f	44.44 c	22.22 b	1.33 bc	84.45 d
3- ***Cuminum cyminum*** L	33.33 b	14.81 d	51.86 e	0.00 a	0.00 a	100.00 e
4 - ***Ocimum basilicum***	44.44 c	18.52 e	37.04 b	33.33 c	2.33 c	66.67 c
5- **Rhizolex T-50.**	0.00 a	7.41 b	92.59 f	0.00 a	0.00 a	100.00 e
6- **Control**	85.19 d	3.67 a	11.14 a	88.89 e	6.67 g	11.11 a

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

Table (3). Effect of certain essential oils on growth parameters of sugar beet plants, under greenhouse condition, 2002-2003 and 2003-2004 seasons.

Treatment	2002-2003 season			2003-2004season		
	Plant height (cm)	Leaf area (cm2)	Leave Dry weight (g)	Plant Height (cm)	Leaf area (cm2)	Leave Dry weight (g)
1- ***Mentha viridis*** L	48.67 cd	1074.38 b	12.47 a	41.33 c	1003.42 b	11.53 bc
2- ***Syzygium aromaticum***	53.67 b	1263.54 a	11.40 b	40.33 cd	1140.92 a	12.60 a
3- ***Cuminum cyminum*** L.	47.33 d	810.41 d	9.90 c	45.00 b	908.87 d	9.43 d
4- ***Ocimum basilicum***	48.33 cd	945.32 c	10.80 d	53.00 ab	960.36 c	11.13 cd
5- **Rhizolex T-50.**	55.67 a	1075.09 b	11.73 ab	55.33 a	1073.18 b	12.20 b
6 - **Control :**	39.67 e	710.90 e	8.70 e	32.67 e	705.83 e	8.27I e

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

Table (4). Effect of certain essential oils on disease incidence, disease severity, root weight/plant percentage of total soluble solids (TSS), percentage of sucrose, purity and losses (%) in yield and sucrose of sugar beet root rot under artificial infestation with *R. solani*, , under greenhouse condition, 2002-2003 and 2003-2004 seasons.

Treatment	Disease incidence	Disease severity	Root Weight kg/plant		TSS		Sucrose %		Purity %		Losses %	
			Infected	Helthy	Infected	Helthy	Infected	Helthy	Infected	Helthy	Yield	Sucrose
2002-2003 season												
1- Mentha viridis L	54.44 f	5.17 de	1.133c	1.528a	15.20e	18.40 a	12.67 b	13.33 f	83.35	72.45	25.85	4.95
2- Syzygium aromaticum.	11.11 b	0.67 a	1.237b	1.420b	17.20b	17.67 cd	12.87 b	15.00 bc	74.82	84.89	12.88	14.20
3- Cuminum cyminum L.	0.00 a	0.00 a	1.123cd	1.278d	15.60f	18.20 b	12.40 b	14.07 d	79.48	77.31	12.12	11.86
4- Ocimum basilicum	44.44 e	4.67 d	1.018d	1.318c	16.20c	18.00 bc	11.67 c	16.03 a	72.03	89.06	22.76	27.19
5- Rhizolex T-50.	0.00 a	0.00 a	1.502a	1.518a	17.80a	18.27 ab	14.60a	14.73 c	79.91	80.62	0.10	0.88
6- Control :	100.00 h	9.17 g	0.617e	1.239e	10.00f	17.60 c	3.13 d	15.20 b	51.30	86.36	50.20	66.25
2003-2004 season												
1- Mentha viridis L	33.33 d	6.33 d	1.030 e	1.280c	16.87c	19.00a	12.80e	15.67bc	75.87	82.47	19.53	18.32
2- Syzygium aromaticum.	11.11 b	0.67 ab	1.113 c	1.280c	17.33b	18.80b	14.27b	15.73b	82.34	83.67	13.04	9.28
3- Cuminum cyminum L.	0.00 a	0.00 a	1.035 d	1.172d	17.00bc	17.40c	13.20c	13.73d	77.64	78.90	11.37	3.86
4- Ocimum basilicum	44.44 e	4.83 c	1.020 e	1.225cd	16.20cd	18.47bc	12.93d	14.53cf	79.81	78.67	16.73	11.07
5- Rhizolex T-50.	0.00 a	0.00 a	1.399 a	1.435a	18.93a	19.00a	15.80a	16.47a	83.56	86.68	2.50	4.06
6- Control :	82.22 i	8.5 f	0.607 k	1.358b	9.80d	19.00a	6.40e	14.73c	65.31	77.52	55.35	56.55

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

Table (5). Effect of some essential oils on root rot disease under field conditions, Sakha, 2002-2003 and 2003-2004 seasons.

Treatments	2001-2002 season			2002-2003 season		
	Disease Incidence %	Disease severity %	Yield/plot (kg)	Disease incidence %	Disease severity %	Yield/plot (kg)
1- *Mentha viridis* L	1.84 c	0.83 b	42.00 c	1.31 b	0.83 c	46.00 c
2- *Syzygium aromaticum*.L	0.54 a	0.33 a	54.00 b	0.66 a	0.33 a	56.00 bc
3- *Cuminum cyminum* L	0.65 a	0.33 a	52.00 b	0.57 a	0.33 a	46.00 c
4- *Ocimum basilicum* L	2.33 d	1.33 c	52.00 b	1.24 b	0.67 b	54.00 bc
5- Rhizolex T-50 *	0.63 ab	0.20 a	64.00 a	0.65 a	0.50 ab	64.02 a
6- Control	8.05 e	3.67 e	36.00 d	9.32 d	3.67 d	26.00 d

Means followde by the same letter are not significantly different at the 5% level by DMRT.

تأثير بعض الزيوت النباتية الطيارة على مقاومة عفن جذور بنجر السكر المتسبب عن فطر *Rhizoctonia solani* Kuhn

مصطفى ابراهيم جودة ، فتحية سليمان الشراكى
معهد بحوث امراض النباتات – مركز البحوث الزراعية – الجيزة – مصر

ادت معاملة الفطر *Rhizoctonia solani* المسبب لمرض موت البادرات وعفن الجذور فى بنجر السكر على الاطباق فى المعمل بواسطة اربع زيوت نباتية عطرية الى انخفاض ملموس للنمو القطرى للفطر . وتحت ظروف الصوبة والحقل زادت عدد البادرات السليمة وقلت نسبة الاصابة بعفن الجذور عند معاملة البذور بتلك الزيوت وقد تفوق كلا من زيتى الكمون و القرنفل فى تقليل تساقط البادرات(قبل وبعد الانبات) واعفان الجذور وكذا الشدة المرضية عنه بالنسبة لزيتى النعناع والريحان حيث كانا اقل تاثيرا فى تقليل نسبة الاصابة وايضاً ادى استخدام تلك الزيوت الى تحسين ملموس فى الصفات المورفولوجية للنبات وايضا زيادة فى مكونات المحصول ونسبة السكر والنقاوة وقد استخدم المبيد الفطرى Rhizolex.T للمقارنة بين تأثيره وتأثير تلك الزيوت المختبرة فى قدرتها على مقاومة امراض البادرات وعفن الجذور المتسبب عن هذا الفطر