J. Plant Prot. and Path., Mansoura Univ., Vol. 2 (11): 1037 - 1047, 2011

CONTROL OF SUGAR BEET LEAF SPOT DISEASE CAUSED BY THE FUNGUS *Cercospora beticola* (Sacc)

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ABSTRACT

In an attempt to control sugar beet leaf spot caused by *Cercospora beticola* with certain chemicals i.e. copper sulphate, magnesium sulphate, potassium oxide, calcium+ magnesium as well as by biological (*Trichoderma album* [Bio-Zeid] and *Bacillus megaterium* [Bio-Arc]) treatments beside two fungicides i.e. difenconazole [Secore] and tetraconazole [Eminent] which were evaluated under laboratory and field conditions. Also, the effect of the tested treatments on some sugar beet characteristics eg. leaf dry weight, root fresh weight, soluble solid content, sucrose content and purity of sugar was investigated. Results indicated that all tested treatments were effective against the causal fungus as indicated by disease severity and sugar beet yield characters. The fungicide tetraconazole was the most effective treatment against the disease, however, the two tested biocontrol agents showed considerable efficacy. The moderate efficacy of the tested biocontrol agents relative to fungicides suggested an integrated approach towards *C. beticola*, preferring the application of the fungicide in the first phase of the disease, where as application of either *Bacillus* or *Trichoderma*-based formulations in the later phases. The spray of calcium, magnesium or potassium against *Cercospora beticola* suggested the ability of using such chemicals for controlling the disease either alone or mixed with the fungicides to reduce the applied amount of fungicides.

Keywords: analysis; extract; pathogen; Sugar beet

INTRODUCTION

Sugar beet (*Beta vulgaris* L., Chenopodiaceae) is one of the most important crops grown in temperate regions for sugar production. In Egypt, it is ranked as the second crop after sugar cane for sugar production (Eweis *et al*., 2006). Due to daily demand for sugar, there is a need to increase the production of sugar beet crop.

Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola* (Sacc.), is the major foliar pathogen of sugar beet world-wide (Holtschulte, 2000) and may cause a reduction of 42% gross sugar yield (Shane and Teng, 1983) which leads to problems (less extractable sugar) at the sugar factory and less income for growers. In the Netherlands, CLS has spread from the southeastern part (the province of Limburg), where it has been present for 25 years, to the entire country in only 3 years. The disease reduces root and extractable sucrose yields, and increases impurity concentrations, resulting in higher processing losses (Lamey *et al*., 1987; Lamey *et al*., 1996). Losses in recoverable sucrose as high as 30% are common under heavy disease conditions and revenue losses as high as 43% have been reported (Lamey *et*

al., 1987; Lamey *et al*. 1996). Roots of diseased plants do not store as well as roots from healthy plants in storage piles that are processed in a 7–9 month period in North Dakota and Minnesota (Smith and Ruppel, 1973). Cercospora leaf spot is managed by fungicide applications, reducing inoculum by crop rotation and tillage, and by planting disease tolerant varieties (Miller *et al*., 1994). Four to five genes are responsible for Cercospora leaf spot resistance (Smith and Gaskill, 1970). Combining high levels of Cercospora leaf spot resistance with high yield in sugar beet is difficult (Smith and Campbell, 1996). As a result, commercial varieties generally have only moderate levels of resistance and require fungicide applications to obtain adequate levels of protection against Cercospora leaf spot (Miller *et al*., 1994). Fungicides used in 1998 were fentin hydroxide, mancozeb and thiophanate methyl (Dexter and Luecke, 1999). Most growers experienced inconsistent leaf spot control, probably because of ineffective fungicides as a result of a high population of benzimidazole resistant and fentin hydroxide tolerant strains of *C. beticola* (Weiland and Smith, 1999), or untimely applications. Cercospora leaf spot was most severe in the warmer southern Minnesota sugar beet growing district, resulting in some growers applying 11 fungicide applications compared to about 3–4 applications in most years. There was an urgent need to find new chemistry fungicides that will provide effective Cercospora leaf spot control and result in high extractable sucrose.

When a severe epidemic develops, beet growers can control the disease by spraying fungicides. The Dutch sugar industry, in Germany (Maier *et al*., 2000) and in North America (Pitblado, 2002), supports supervised rather than prophylactic control of this disease. Supervised control may reduce the number of fungicide sprays required in a season, leading to lower costs for growers, slower resistance build up in the pathogen population and reduced environmental pollution.

Whereas fungicide treatments to control CLS in the Netherlands were thus far only necessary in the southeast, in 2002–2004, fungicide treatments were recommended by the Cercospora warning service in all the areas. The warning service is based on two action thresholds which have to be assessed by growers in their beet fields (Anonymous, 1998).An assessment of the impact of CLS on sugar beet yield is needed to assess crop losses in epidemics of varying intensity and for the development of management strategies.

The objectives of the present study were to evaluate the efficacy of some biological and chemical control methods against *Cercospora beticola* under laboratory and field conditions. Also to investigate the efficacy of these control methods on some sugar beet yield characters with respect to leaf dry weight, root fresh weight, soluble solid content, sucrose content and purity of sugar.

MATERIALS AND METHODS

Isolation, identifications and pathogenecity test of the plant pathogen and treatments:

Samples of sugar beet plants, Oscar poly variety that showing leaf spot disease symptoms caused by *Cercospora beticola* were collected from Kafr-El-Shiekh governorate. The sugar beet leaves were washed carefully with tap water, cut into small pieces, surface sterilized in 0.5 sodium hypochlorite solution for three minutes. As soon as washed several times in sterilized water, blotted between two sterilized filter papers and transferred onto Petri dishes containing sugar beet leaf extracts dextrose agar medium (SBLEDA). The fresh sugar beet leaf blades were sliced and 200 g was boiled in one liter distilled water for 15 minutes and strained through double layers cheese cloth. The SBLEDA medium consists of beet leaf extract (100 ml) dextrose (20 g) and agar (15 g). Streptomycin as antibiotic was added to the media (40 ppm) to avoid the bacterial contamination. Plates were incubated at 27 + 2 ^{o}C for 3-7 days and examined daily or occurrence of fungal growth. The growing fungi were examined microscopically and purified using hyphal tip technique described by Dhingra and Sinclair (1959). Pure cultures of each isolate wee maintained on PDA slants at 4 ^{o}C for further examination.The causal fungal pathogen isolate was identified by morphological and microscopic examination according to Barnet and hunter (1972). Pathogenicity test was carried out in 30 cm diameter pots under greenhouse conditions. Pots were filled with sandy-loam soil (1:2 w/w). Pure fungal isolate from diseased plants was tested for its pathogenecity using Oscar poly sugar beet cultivar, the sensitive cultivar to *Cercospora beticola*. The isolate was grown in liquid CZ-a pek, s medium and incubated at 27 +3^{0}C for 15 days to obtain the required inoculate. Ninety day old plants were sprayed with 50x 10^{3} conidia (spore/ml) of each isolate using atomizer Crane and Calpouzos (1984) in four replicates comprising 4 plants for each. Before inoculation, plants were sprayed with water to make a thin film of water on leaf surface. Two grams sucrose and 0.1 ml tween 80 per liter were added to spore suspension to enhance infection. Inoculated plants were kept in moist polyethylene chamber for 7 days. Disease severity % was recorded according to Shane and Teng (1992) after 100 days from planting. The used fungicides in this study were difenconazole and tetraconazole with a trade name of score 250 EC and eminent WP 12.5%, respectively. These fungicides were applied at its recommended field rate of 0.5 and 1 ml/L, respectively. Copper sulphate and magnesium sulphate were used at rate of 3 gm /l. and obtained as technical compounds from Al-Gomhoria Company for Chemicals and Glasses, Cairo, Egypt. Calcium + magnesium (16% Ca + 0.135 Mg %) and potassium oxide with a trade name Inheeb and Voster-V (36% K) were obtained from Stoller Enterprises LNC, USA and Vira Chima for Agriculture Company, Egypt , respectively. The tested microbial bioagents were *Trichoderma album* and *Bacillus megaterium* with trade names of Bio-Zeid 2.5 % and Bio-Arc 6 %, respectively, produced by Ognatic Company for New Technology, El-

Behara, Egypt. Each gram contains 25 x 10^6 and 10x10^6 spores for *Bacillus megaterium* and *Trichoderma album*, respectively. These two bioformulations applied at rate of 3 gm /l for both.

Evaluation of the tested treatments against *Cercospora beticola* under laboratory conditions

The eight treatments were tested for their efficacy against *Cercospora beticola* in a completely randomized design. The efficacy of the tested treatments was determined as percent of reduction in fungal fresh and dry weight relative to the control treatment. The concentration used of the tested materials was presented in table 1. The required concentrations for each treatment were obtained by adding the appropriate amount of stock solution used to 60 ml portions of auto-calved PD broth media cooled to about 45^o C. Four flasks, 250 ml in volume, were used as a replicate for each concentration of each treatment, including control. Control treatment was carried out without adding treatments. Each flask was inoculated with a disk (5 mm diameter) of 15 days old culture of *Cercospora beticola* culture. The flasks were sealed with parafilm to avoid the evaporation of volatile compounds. The flasks were incubated at 22-25^o C until the full growth (mycelium reaching the edge of the flask) of the control treatment after 12 days. The fungal growth was collected and its fresh weight was determined after that it was transferred to the oven for drying at 70^o C for one week (until weight stabilized) and dry weight was determined.

Evaluation of the tested treatments against *Cercospora beticola* under field conditions

This study was carried out at the Research Experimental Farm of Plant Pathology Research Institute, Sakha Station, Kafr-El-Shiekh, Egypt in two seasons (2009/2010) using the randomized complete block design with three replicates. Each replicate was 6 rows with 900cm long and 60 cm width. Each row contained 45 hills with 20 cm apart. All recommended culture practice was performed in the proper time. Plants were sprayed with each of the following 8 treatments cupper sulphate, magnesium sulphate, potassium oxide, calcium+ magnesium, *Trichoderma album*, *Bacillus megaterium*, difenconazole and tetraconazole spraying was started when disease symptoms was detected (after 90 days of cultivation). Untreated plot left as control. All treatments applied three times with 14 days intervals between each application. Disease severity was assessed 14 days after the last treatment according to the method described by Shane and Teng (1992). Statistical analysis was done according to Gomez and Gomez (1983). Root fresh weight as well as total soluble solid (T.S.S.%) were determined in fresh root of sugar beet using hand refractometer according to McGinnis (1982). Sucrose percent was estimated according to A.O.A. C. (1990). Purity percent was determined as described by Carruthers and Oldfield (1961).

RESULTS

Isolation, purification and identification of sugar beet leaf spot pathogen

Isolation trials which were carried out during sugar beet growing season associated with leaf spots resulted in the identification of the causal fungus as *Cercospora beticola*. The identification was carried out using morphological and microscopical characteristics.

Pathogenicity test

The pathogenicity test which was carried out under greenhouse conditions using sugar beet cultivar oscar-poly, the most susceptible sugar beet cultivar to Ceroscospora leaf spot showed that the isolated *Cercospora beticola* caused disease severity with nearly 60% sugar beet leaf plant.

Efficacy of the tested treatments against *Cercospora beticola* under laboratory conditions

All the tested treatments at selected concentrations significantly reduced the fresh and dry weight of the tested fungal growth of compared to the control as shown in Table (1). Tetraconazole, difenconazole, *Bacillus megaterium*, *Trichoderma album* were the most effective treatments against *Cercospora beticola* followed by cupper sulphate, potassium oxide, magnesium sulphate, potassium + magnesium, respectively. However, the tested fungicides (tetraconazole and difenconazole) were the most effective treatments against *Cercospora beticola*, compared to the others.

Table 1: Efficacy of different applied treatments against *Cercospora beticola* growth under laboratory conditions (25-30C)

Treatments	Conc.	Fungal fresh weight (gm)	Fungal dry weight (gm)
Copper sulphate	3 gm /l	0.93 bcd	0.090 b
Magnesium sulphate	3 gm /l	1.22 bc	0.109 b
Potassium oxide	3 ml /l	1.18 bc	0.106 b
Potassium + Magnesium	3 ml /l	1.32 b	0.117 b
Trichoderma album	3 gm /l	0.92 bcd	0.016 c
Bacillus megaterium	3 gm /l	0.81 cd	0.015 c
Difenconazole	0.5ml /l	0.62 d	0.013 c
Tetraconazole	1ml /l	0.55 d	0.013 c
Control	0.00	3.42 a	0.346a

Efficacy of the tested treatments against *Cercospora beticola* of sugar beet under field conditions

Data in Tables (2) showed the relative efficacy and disease severity of the tested treatments against *Cercospora beticola* under field conditions in two seasons (2009/2010). Disease severity of *Cercospora beticola* was significantly reduced in all tested treatments relative to control in both tested seasons. Among the tested treatment, tetraconazole was the most effective one against *Cercospora beticola* in both tested seasons followed by difenconazole, cupper sulphate, magnesium sulphate, calcium+ magnesium, potassium oxide, *Trichoderma album* and *Bacillus megaterium*, respectively. The efficacy of the tested treatments against *Cercospora beticola* in the first season was higher than the second seasons.

Table 2: Disease severity and efficacy of different applied treatments against *Cercospora beticola* in two seasons

Treatments	Conc.	Disease severity		Efficacy (%)	
		First season	Second season	First season	Second season
Copper sulphate	3 gm /l	14.16 ef	13.3 c	69.41 b	76.6 c
Magnesium sulphate	3 gm /l	16.6 ef	17.5 c	64.14 bc	69.1 d
Potassium oxide	3 ml /l	24.5 cd	26.6 b	54.00 d	53.0 h
Potassium + Magnesium	3 ml /l	19.16 de	23.3 b	61.00 cd	58.8 e
Trichoderma album	3 gm /l	30.00 bc	24.0 b	35.20 e	57.5 f
Bacillus megaterium	3 gm /l	35.00 b	25.3 b	24.40 f	55.3 g
Difenconazole	0.5ml /l	15.00 ef	7.3 d	67.60 b	87.1 b
Tetraconazole	1ml /l	10.00 e	6.6 d	78.40 a	88.3 a
Control	0.00	46.3 a	56.6 a	0.00 g	0.00 i

Effect of the tested treatments on sugar beet leaf dry weight under field conditions in both tested seasons (2009/2010)

Data in Tables (3) showed the effect of the tested treatments on leaf dry weight of 100 sugar beet leaves under field conditions in both tested seasons. Leaf dry weight of sugar beet was significantly increased in all tested treatments relative to control in both tested seasons. Among the tested treatments, potassium oxide and tetraconazole were the most effective treatments followed by magnesium sulphate, *Bacillus megaterium*, *Trichoderma album*, cupper sulphate, and difenconazole and calcium + magnesium in both tested seasons, respectively.

Table 3: Leaf dry weight of sugar beet plants as affected by different applied treatments against *Cercospora beticola* in two seasons

Treatments	Conc.	Leaf dry weight (gm)		Efficacy (%)	
		First season	Second season	First season	Second season
Copper sulphate	3 gm /l	21.2 ab	20.7 bc	66.1 f	16.9 g
Magnesium sulphate	3 gm /l	22.5 ab	22.2 ab	77.2 c	25.4 d
Potassium oxide	3 ml /l	24.9 a	24.5 ab	96.0 a	38.4 b
Potassium + Magnesium	3 ml /l	20.8 ab	20.6 bc	63.7 h	16.3 g
Trichoderma album	3 gm /l	21.6 ab	21.3 bc	70.1 e	20.3 f
Bacillus megaterium	3 gm /l	21.7 ab	22.6 ab	70.8 d	27.7 c
Difenconazole	0.5ml /l	21.0 ab	21.6 ab	65.4 g	22.0 e
Tetraconazole	1ml /l	24.1 ab	25.2 a	89.7	42.4 a
Control	0.00	21.2 ab	17.7 c	0.0 i	0.0h

Effect of the tested treatments on root fresh weight of sugar beet under field conditions in both tested seasons

Data in Tables (4) show the effect of the tested treatments on the fresh weight of sugar beet roots in both two seasons (2009/2010). Root fresh weight of sugar beet significantly increased in all tested treatments relative to the nontreated control plants in both tested seasons. Among the tested treatments, tetraconazole and *Bacillus megaterium* were the most effective ones which increased the root fresh weight in both tested seasons followed by *Trichoderma album*, difenconazole, cupper sulphate, magnesium

sulphate, potassium oxide and calcium+ magnesium, respectively. The efficacy of the tested treatments on the root fresh weight of sugar beet in the first growing season was higher than that of second growing season.

Table 4: Fresh weight of sugar beet roots as affected by different applied treatments in two seasons

Treatments	Conc.	Root fresh weight		Efficacy (%)	
		First season	Second season	First season	Second season
Copper sulphate	3 gm /l	15.5 c	10.8 bc	13.3 d	68.4 a
Magnesium sulphate	3 gm /l	14.56 c	10.6bc	6.5 de	55.2 b
Potassium oxide	3 ml /l	14.4 c	9.7 cd	5.1 de	42.1 e
Potassium + Magnesium	3 ml /l	14.0 c	8.6 de	2.2 e	48.7 c
Trichoderma album	3 gm /l	21.3 ab	11.3 ab	55.4 b	39.5 f
Bacillus megaterium	3 gm /l	22.1 ab	11.8 bc	61.3 ab	13.2 h
Difenconazole	0.5ml /l	20.0 b	10.9 bc	45.9 c	27.6 g
Tetraconazole	1ml /l	23.9 a	12.8 a	65.4 a	43.4 d
Control	0.00	13.7 c	7.6 e	0.0 e	0.0 i

Effect of the tested treatments on soluble suspended solid, sucrose and purity of sugar beet product in both 2009/2010 tested seasons

Data in Tables (5) showed the relative efficacy of the tested treatments on total soluble solids (TSS), sucrose and sugar purity under field conditions in both (2009/2010 tested seasons. The total soluble solid, sucrose and purity of sugar were significantly increased in all tested treatments relative to nontreated control plants in both tested seasons. However, cupper sulphate treatment was the most effective one in both tested seasons.

Table 5: Total soluble solids (TSS), sucrose and purity of sugar beet root extract under different applied treatments in two seasons

Treatments	Conc.	TSS (%)		Sucrose (%)		Purity (%)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season
Copper sulphate	3 gm /l	25.9 a	26.6a	18.3a	18.1ab	70.7 b	68a
Magnesium sulphate	3 gm /l	25.5ab	25ab	17.9ab	18.3a	70.2 c	73.2b
Potassium oxide	3 ml /l	24.8ab	25ab	16.9ab	17.1cd	68.1 a	68.4a
Potassium + Magnesium	3 ml /l	25.5ab	25.4ab	17.9ab	17.9abc	70.2 c	70.5b
Trichoderma album	3 gm /l	24.9ab	25ab	17.9ab	17.9abc	71.9f	71.6c
Bacillus megaterium	3 gm /l	23.8ab	24ab	16.3ab	16.8d	68.6 e	70d
Difenconazole	0.5 ml /l	24.5ab	24.3ab	17.5ab	17.6abc	71.4 e	72.4cd
Tetraconazole	1ml /l	25.1ab	25.4ab	17.9ab	17.7abcd	71.3d	69.7b
Control	0.00	24.3ab	23.7b	17.1ab	17.3bcd	70.4g	73d

Purity= Sucrose %/TSS% x 100

DISCUSSION

The application of the tested fungicides (tetraconazole, difenconazole and copper sulphate) in the present study lead to effective control against *Cercospora beticola* either under laboratory or field conditions as indicated by reduction of disease severity and sugar beet yield characters (leaf dry

weight, root fresh weight, TSS%, sucrose % and purity %). The obtained results is in agreement with the finding of Kahn and Smith (2005) who found that tetraconazole when applied alone, consistently provided effective Cercospora leaf spot control and resulted in high sucrose yield.

As the referring to the effect of biocontrol agents against *Cercospora beticola* either under laboratory or field conditions, the obtained results showed considerable efficacy of the two tested bioagents (*Trichoderma album* and *Bacillus megaterium*) against *Cercospora beticola* with respect to reduction of disease severity and sugar beet yield products (leaf dry weight, root fresh weight, TSS, sucrose and purity) (El-Fahhar-Samia 2003; Galletti *et al*., 2008). The fungicidal activity of *Trichoderma* spp. and *Bacillus* spp. are probably depends on some lytic enzyme including chitinase b-1,3-gluconase and protease which are thought to be involved in mycoparasite process (Antal *et al*., 2000).

The moderate efficacy of the tested biocontrol agents relative to fungicides suggested studying an integrated approach towards *C. beticola*, preferring the application of a fungicide in the first appearance of the disease, where *Trichoderma* and *Bacillus* seems to be less effective, to counteract the primary infections, and distributing *Bacillus* and *Trichoderma*-based formulations in the later phases, affect secondary inoculum formation coming from spore characters of the necrotic spots. The reduction of the spore yield is considered a very important parameter for the control of *C. beticola* and one of the most effective resistance components for sugar beet genotypes (Rossi *et al*. 2000).

Magnesium sulphate, potassium oxide and calcium + magnesium showed significant effect against *Cercospora beticola* either under laboratory or field conditions with respect to disease severity reduction and sugar beet yield characters (leaf dry weight, root fresh weight, TSS %, sucrose% and purity %). The efficacy of calcium application against plant pathogens have been reported (Kaiser *et al*., 2011), however, the effect of calcium application against *Cercospora beticola* have not been reported before and is considered first report. Also, Krupinsky and Tanaka (2000) found that K application reduced the severity of the leaf spot disease. This result also agrees with the limited previous findings by Regmi *et al*. (2002) and Sharma *et al*. (2004), who reported that K application reduced the severity of plant pathogen and increase crop yield. However, the effect of K application against *Cercospora beticola* have not been reported before and is considered first report. The possible mechanism of calcium salts against plant pathogens may be due to the ionic components, adversely affecting enzyme activities of the pathogen (Miceli *et al*., 1999). The antifungal activity of potassium application against *Cercospora beticola* may be due to a contact osmotic mode of action at the phylloplane level (Mann *et al*., 2004). The efficacy of calcium, magnesium and potassium against *Cercospora beticola* suggest the ability of using them for leaf spot control either alone or mixed with fungicides to reduce the applied amount of fungicides.

Results from this study indicate that the tested treatments can suppress the leaf area affected by *Cercospora beticola* and serve to delay the loss of green leaf area due to disease infection, and so to increase yield as leaves

can photosynthesize for longer (Paveley *et al*., 1997). Therefore the decrease in leaf area affected by *Cercospora beticola* by the tested treatments was expected to lead to an increased sugar beet yield.

CONCLUSIONS

The tested treatments were potentially useful for controlling leaf spot disease of sugar beet caused by *Cercospora beticola*. Antifungal activity was confirmed in all the assayed treatments, despite some variation in their efficacy against *Cercospora beticola*. The moderate efficacy of the tested biocontrol agents relative to fungicides suggested an integrated approach towards *C. beticola*, preferring the application of a fungicide in the first phase of the disease, where as biocontrol agents to be applied in the later phases. Calcium, magnesium and potassium could be mixed with fungicides to reduce its amount and subsequently reduce the environmental hazardous as well as costs.

REFERENCES

Anonymous, 1998. Jaarverslag IRS 1997. Stichting IRS, Bergen op Zoom, The Netherlands.

Antal, Z.; L. Manczinger G. Szakacs R. P. Tengerdy and L. Ferenzy (2000). Colony growth in vitro antagonism and secretion extracelluar enzymes in cold-tolerant strains of Trichoderma spp Mycological research 104 5: 545-549.

A.O.A. C. (Association of Official Aanalytical Chemistry) (1990). Official methods analysis of the association of official analytical chemists.

Barnett, H. I. and B.B. Hunter (1972). Illustrated genera of imperfect fungi. 3 the ed. Burgess Minneapolis Minnesota pp 241.

Carruthers, A. and J.F. T. Oldfield (1961). Methods for the assessment of beet quality Int. Sugar J. 103-105.

Crane , G.L. and S. Calpouzos (1984) synergism of *Cercospora beticola* and beet yellow virus in killing sugar beet leaves. Phyopath. 74: 1338.

Dexter, A.G., Luecke, J.L., 1999. Survey of fungicide use in sugarbeet in eastern North Dakota and Minnesota—1998. 1998 Sugarbeet Res. Ext. Rep. 29, 243–245.

Dhingra, O. D. and J.B. Sinclair (1959). Basic plant pathology methods 2nd ed. Press inc. pp 434.

El-Fahar–Samia, A. (2003) Integrated management of Cercospora leaf spot disease of sugar beet in delta area PhD Thesis A. of Agric Kafr-El-Sheikh ,Tanta University pp133.

Eweis, M.; S.S. Elkholy and M.Z. Elsabee (2006) .Antifungal efficacy of chitosan and its thiourea derivatives upon the growth of some Sugar-Beet pathogens. Int. J. of Biol. Macromol. 38:1-8.

Galletti,S.; P.L. Burzi, C. Certo, S. Marinello and E. Sala (2008). Trichoderma as a potential biocontrol agent for cercospora spot of sugar beet. Biocontrol. 53: 917-930.

Gomez, K. and A.C. Gomez (1983) Statistical procedure for agricultural research international rice research institute book John Wiley and sons New York pp 403.

Khana, M. F.R. and L. J. Smith (2005). Evaluating fungicides for controlling Cercospora leaf spot on sugar beet Crop Protec. 24: 79–86.

Kaiser, C.; P. B. Hamm, S. G. N. David, L. Long, M. Meland, and J. M. Christensen (2011). In Vitro Fungicidal Activity of Calcium and Potassium Salts on Several Commercially Significant Plant Pathogens HortScience 46:913-916.

Krupinsky, J.M. and D.L. Tanaka (2000). Leaf spot diseases on spring wheat influenced by the application of potassium chloride. In: Schlegel, A.J. (Ed.), Great Plains Soil Fertility conference Proceedings, vol. 8, Kansas State University, USA. pp. 171–176.

Lamey, H.A.; A.W. Cattanach and W.M. Bugbee (1987) Cercospora leaf spot of sugarbeet. North Dakota State Uni. Ext. Cir. PP-764 Revised, 4 pp.

Lamey, H.A.; A.W. Cattanach W.M. Bugbee and C.E. Windels (1996). Cercospora leaf spot of sugar beet. North Dakota State Univ. Ext. Circ. PP-764 Revised, 4 pp.

Maier, J.; K. Burcky and R. Kohler (2000). Blattkrankheiten-Monitoring und Bewarnung der Anbauer im su¨ ddeutschen Zuckerru¨ benanbau. Zuckerindustrie 125: 432– 435.

Mann, R. L.; P. S. Kettlewell and P. Jenkinson (2004). Effect of foliar-applied potassium chloride on septoria leaf blotch of winter wheat. Plant Pathol. 53: 653 –659.

McGinnis, R.A. (1982). Sugar beet technology 3rd ed. Beet sugar development foundation fort Collins pp 855.

Miceli, A.; A., Ippolito V. Linsalata and F. Nigro (1999). Effect of preharvest calcium treatments on decay and biochemical changes of table grape during storage.Phytopathol.Mediterr.38: 47–53.

Miller, S.S.; M. Rekoske and A. Quinn (1994). Genetic resistance, fungicide protection and variety approval politics for controlling yield losses from Cercospora leaf spot infection. J. Sugar Beet Res. 31: 7–12.

Pitblado, R., 2002. BeetCast. www.michiganbeets.com

Regmi, A.P.; J.K. Ladha E.M. Pasuquin H. Pathak P.R. Hobbs L.L. Shrestha D.B. Gharti and E. Duveiller (2002). The role of potassium in sustaining yields in a long-term rice–wheat experiment in the Indo-Gangetic plains of Nepal. Biol. Fertil. Soils 36: 240–247.

Rossi, V.; P. Meriggi E. Biancardi and F. Rosso (2000). Effect of Cercospora leaf spot on sugar beet growth, yield and quality. In: Asher, M.J.C., Holtschulte, B., Richard-Molard, M., Rosso, F., Steinru¨ cken, G., Beckers, R. (Eds.), Cercospora Beticola Sacc. Biology, Agronomic Influence and Control Measures in Sugar Beet, Advances in Sugar Beet Research, vol. 2. IIRB, Brussels, Belgium, pp. 49–76.

Shane, W.W. and P.S. Teng (1983). Sugarbeet yield losses due to Cercospora leaf spot. Sugarbeet Res. Ext. Rep. 23: 193–198.

Shane , W.W. and P.S. Teng (1992). Impact of Cercospora leaf spot on root weight ,sugar yield and purity of beta vulgaris Plant Disease Rep. 76: 812-820.

Sharma, S.; Karki C.B., Duveiller E., Batsa B.K. and Basnet R. (2004). Effect of chemical fertilizers, farm manure and fungicides on leaf blight disease of wheat. Abstracts of the Fourth National Conference on Science and Technology. Royal Nepal Academy of Science and Technology, Kathmandu, Nepal, March 23–26, pp. 91–92.

Smith, G.A. and L.G. Campbell (1996). Association between resistance to Cercospora and yield in commercial sugarbeet. Plant Breed 115: 28–32.

Smith, G.A. and E.G. Ruppel (1973). Association of Cercospora leaf spot, gross sugar, percentage sucrose and root weight in sugar beet. Can. J. Plant Sci. 53: 695–696.

Smith, G.A. and J.O. Gaskill (1970). Inheritance of resistance to Cercospora leaf spot in sugar beet. J. Am. Soc. Sugar Beet Technol. 16: 172–180.

Weiland, J.J. and G.A. Smith (1999). A survey for the prevalence and distribution of Cercospora beticola tolerant to triphenyltin hydroxide and mancozeb and resistant to thiophanate methyl in 1998. 1998 Sugarbeet Res. Ext. Rep. 29: 289–291.

مكافحة مرض تبقع الاوراق السركسبورى فى بنجر السكر والمتسبب عن فطر *Cercospora beticola*

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فى محاولة لمكافحة مرض التبقع السيركسبورى فى أوراق البنجر والذي يسببه فطر *Cercospora beticola*. تم تقييم عدد من المعاملات لمكافحة هذا الفطر تحت ظروف المعمل والحقل. كما تم أيضا تقييم تأثير هذه المعاملات على بعض الصفات الإنتاجية لمحصول البنجر من خلال تقدير وزن الأوراق الجاف و وزن الجذور ونسبة المواد الصلبة الذائبة ونسبة السكر ونسبة النقاوة للسكر.أوضحت النتائج سواء المعملية أو الحقلية أن جميع المعاملات أدت الى نتائج جيدة مقارنة بالكنترول من حيث خفض الشدة المرضية للفطر و زيادة فى الصفات الإنتاجية لمحصول البنجر من حيث الوزن الجاف للأوراق والوزن الرطب للجذور ونسبة المواد الصلبة ونسبة السكر ونسبة النقاوة.المبيد الفطرى tetraconazole المعروف تجاريا بالايميننت [Eminent]كان أفضل المعاملات ضد المسبب المرضى تحت الظروف الحقلية والمعملية كما كان أفضل المعاملات فى زيادة إنتاجية البنجر. التجهيزات الحيوية كانت متوسطة التأثير على الفطر وعلى إنتاجية محصول البنجر هذا يجعل من الممكن استخدام هذه التجهيزات بعد استخدام المبيدات المتخصصة مرة على الأقل. تطبيق أملاح الكالسيوم والبوتاسيوم والماغنسيوم أدى الى نتائج جيدة ضد الفطر المسبب للتبقع فى البنجر كما أدى الى تحسين الخواص الإنتاجية للبنجر وهذا يجعل من الممكن

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