Minufiya J. Agric. Res. Vol. 28 No. 6 : 1821 - 1836 (2003)

STUDIES ON CUCUMBER POWDERY MILDEW DISEASE CAUSED BY *Sphaerotheca fuliginea* UNDER COMMERCIAL PLASTIC HOUSE CONDITIONS IN EGYPT 2- NOVEL CONTROL METHODS BY USING SYSTEMIC RESISTANCE INDUCERS, NATURAL AND MINERAL OILS AND FUNGICIDES

A.M.E. El-Toony
Plant Pathol.Res. Inst., Agric. Res. Cent. Giza ,Egypt .

(Received: Aug, 17 , 2003)

ABSTRACT: *As a true attempt to control cucumber powdery mildew disease under commercial plastic greenhouses by novel control methods using ten systemic resistance inducers, three natural oils, three mineral oils and three recmmended fungicides were compared for their antifungal effects on cucumber powdery mildew disease before and after infection with Sphaerotheca fuliginea.*

All systemic resistance inducer treatments obviously proved the best results in controlling the disease . Cobalt sulphate, Cali-Green, Potassium silicate, Lithium chloride and Agri - fos significantly reduced the disease (determined by five different parameters) especially Potassium silicate, Cobalt sulphate and Cali-green. In this regard, monobasic potassium phosphate (high dose) only succeeded in reducing disease percentage, and disease severity percent whereas dibasic Sodium phosphate gave satisfactory results only in reducing disease severity parameters. In addition, light effect of the systemic resistance inducers, Vapour-guard was noticed .On the other hand, all the other tested substances, three natural oils,three mineral oils and three fungicides, significantly controlled the disease before and after infection.

The tested fungicides (Afugan, Sumi-eight and micronized Surel), the mineral oil Super masrona and the natural oils Trilogy and Naterolow gave excellent results in reducing the disease severity percent , followed by the natural oil Neemix then the Kz mineral oil. Moreover, all tested substances strongly decreased the average number of colonies / leaf comparing with the check .Acute decreasing was markedly resulted when the fungicides were used followed by mineral oils and natural oils. The results of this research suggest that the promissing systemic resistance inducers or mineral oils could be replaced the fungicides to control S. fuliginea, the causal pathogen of cucumber powdery mildew, in greenhouses.

Key Words: *Cucumber, powdery mildew, Sphaerotheca fuliginea , control.*

During relatively dry warm seasons, the fungus agressively attacks cucumber (*Cucumis sativus* L.) and causes severe damage to these plants and acute losses on fruit quantity and quality (Arimoto and Homma , 1995) .

As a true attempt to control cucumber powdery mildew disease under commercial plastic house conditions, there are new manners proved satisfied results in controlling this disease all over the world such as: (1) Using systemic resistance inducers as Lithium chloride (Abood *et al*,1992 and Losel *et al,* 1994); Potassium silicate (Samuels *et al* ,1991 a,b &1993 and Menzies *et al*,1992) ; Sodium and Potassium phosphates Reuveni *et al* ,1993,1995 a,b and 1996). (2) Using natural oils (Steck and Schneider,1993 and Dik *et al* ,1994; Daayf *et al* ,1995 and Konstantinidou –Doltsinis , 1998. (3) Using mineral oils (Ontsuka *et al*, 1991). Consequently, this study almed to research about the ideal, standard, suitable and economical methods to control this dangerous disease under commercial plastic greenhouses far away polluting the environment and maintainance of human health using systemic resistance inducers,natural oils and mineral oils comparing with the effect of the most common recommended fungicides .The experimental results were cofirmed using five different disease assessment parameters.

MATERIALS AND METHODS

1- Effect of ten systemic resistance inducers on the disease incidence:

Ten chemical systemic resistance inducers (12 treatments); Cobalt sulphate, dibasic Sodlum phosphate, monobasic Sodium phosph-ate, dibasic Potassium phosphate (high and low doses), monobasic Potassium phosphate (high and low doses), Cali– green, Agri –fos , Potassium silicate , Vapour– guard and LIthium chloride ; were tested for their ability to control cucumber powdery mildew disease under greenhouse conditions (Table-1)

Four seeds of the susceptible Anas cucumber hyb. were planted In 20 cm in diameter pot contalning sandy – clay soil (1:1). Plants, at the two or three true leaf stage, were sprayed with each of the resistance inducers according to their rate of applicatlon with constant volume for each plant . Four pots were devoted for each resistance inducer . Set of pots receiving no resistance Inducer but sprayed with distilled water served as a check.

Inoculation

Diseased cucumber (Beit –Alpha ,hyb.), showing typical symptoms of powedery mildew disease ,were collected from commercial plastic houses of Bostan reglon,Beheira governorate. The leaves wereshaken 24 h before conidial harvest to dislodge the old conidia and ensure a high viability of inoculum .Powdery mildewed colonies were kindly brushed with water and immediately were used in inoculating the plants. The leaves of all plants

Table (1) :Chemical name, active ingredients and rate of application of different resistance inducers.

Chemical and trade name	Active ingredients	Rate of application
1-Cobalt sulphate (COSO4-7 H2O)	Cobalt (Co)	Equal to: 0.1 mM
2-Dibasic sodium phosphate (Na2H2PO4)	Sodium and phosphate	Equal to: 100 mM
3-Mono-basic sodium phosphate (NaH2PO4)	Sodium and phosphate	Equal to: 100 mM
4-Dibasic potassium phosphate (N2HPO4)	Potassium and phosphate	Equal to: 100 mM (high dose) and 6 mM (low dose)
5-Mono-basic potassium phosphate (K2HPO4)	Potassium and phosphate	Equal to: 100 mM (high dose) and 6 mM (low dose)
6-Cali – Green	80% potassium bicarbonate in the from of ester of fatty acid	150g/ 100 litre water
7-Agri. – Fos	Mono and di potassium phosphate	400ml/ 100 litre water
8-Potassium silicate (KSiO3)	Silicon (Si)	Equal to: 17 mM
9-Vapour Guard	96% di-l- menthene	2% concentration
10-Lithium chloride (LiCl)	Lithium (Li)	Equal to: 1 mM

were inoclated with the optimum concentration of *Sphaerotheca fuliginea* conidia (3 x 10 conidia / ml ^{4}) one day after conidial harvest (Reuveni *et al*,1995).

Disease measurements

Five different assessment parameters were followed to assay cucumber powdery mildew disease ,seven days after inoculation:

- Disease severity which depends on the infected leaf area using the formula suggested by Townsend and Huberger (1943)
- Average counts of colonies / leaf .
- Average diameter of colonies .
- Average counts of conidia / leaf .
- Average of disease percentage .

(Gyongyver , 1987 ; Floris and Alvarez , 1991 ; Menzies *et al* ,1991 ; Haberie and Schlosser,1993 ;Boiteux *et al* ,1995 and Awad , 2000) .

2-Effect of some natural and mineral oils in comparison with the common recommended fungicides:

Three natural oils (Naterolow,Neemix and Trilogy) ,three mineral oils (Super –masrona, Kz- oil and Chemisol) and three common recommended fungicides (Afugan , Sumi-eight and micronized Surel) were tested against cucumber powdery mildew disease before and after inoculation with *S. fuliginea* (Table-2) .

Cucumber Anas hyb., grown under greenhouse conditions , at 26C+2 in 20 cm in diameter sandy – clay soil (1:1) pots was used in this trial. Four pots (each was sown by four 21 day-old cucumber seedlings) were devoted for each substance . The substances were applied before or after inoculation.

A- Befor inoculation:

Set of the pots were sprayed with the substances, four pots for each, at the rates shown in (Table-2). Aceton was used as a solvent in the case of natural oils at the rate of 1ml / liter .Two days later from application, the seedlings were inoculated with *S. fuliginea* .

B- after inoculation:

Other set of pots were inoculated with the pathogen and 2 days later the inoculated seedlings were sprayed with the tested substances, four pots also for each .Untreated but inoculated seedlings were used as check .

RESULTS

1-Effect of ten systemic resistance inducers on the disease incidence:

It is clear from data in (Table-3) that Cobalt sulphate,Cali-green, Potassium silicate , monobasic Potassium phosphate(high dose),Lithium chloride, Agri-

Table (2) :Trade name, Chemical name, active Ingredients and rate of application of natural and mineral oils and fungicides.

Trade name	Chemical name and active ingredients	Rate of application
1-Naterolow	A mixture of fatty acid, triglycerids and vegetable oil 93% inert material 5%	7 ml/ 1 litre water
2-Neemix (Neem oil)	Azadirachtin 4.5%	3ml/1 litre water
3-Trilogy (Neem oil)	90% clarified hydrophobic extract of neem oil	10 ml/1 litre water
4-Super masrona	94% summer mineral oil	15 ml/1 litre water
5-KZ oil	Mineral oil 95% EC	15 ml/1 litre water
6-Chemisol	95% summer mineral oil	15 ml/1 litre water
7-Afugan 30%	Ethyl 2-Diethoxythiophosphoryloxy-5-methylpyrozolo (1, 5-a) pyrimidine 6- carboxylate (pyrazophos)	1 ml/1 litre water
8-Sumi eight	(E) 1- (2, 4-dichlophenyl)- 4, 4-dimethyl 2- (1, 2, 4, trizole 1 y 1) 1- penten 3- o1 (18% Diniconazol)	0.35 ml/1 litre water
9-Micronized surel 70% W.P.	70% Micronized sulphur	2.5 g/1 litre water

Table (3): Effect of some resistaneinducers on the cucumber powdery mildew disease incidence by five disease assessment parameters.

Resistant	Average disease %	Disease severity %	Average diameter (cm)	Average number/ leaf	Average conidia/ leaf (million)
Cobalt sulphate	37.50	19.70	0.3	16	13.0
Dibasic sodium phosphate	100.00	27.20	0.5	38	14.0
Monobasic sodium phosphate (high dose)	100.00	37.50	0.3	36	13.0
Dibasic Potassium phosphate (high dose)	100.00	31.50	0.4	58	18.0
Dibasic Potassium phosphate (low dose)	100.00	50.00	.4	39	12.5
Monobasic potassium phosphate (high dose)	50.00	30.00	0.4	44	21.0
Monobasic potassium phosphate (low dose)	100.00	50.00	0.3	24	16.0
Cali-Green	37.50	28.70	0.3	30	8.0
Agri-Fos	81.25	15.98	0.3	17	5.0
Potassium silicate	31.25	21.10	0.2	12	2.0
Vapour-Guard	100.00	40.00	0.5	50	28.0
Lithium chloride	56.30	35.20	0.3	37	12.0
Control	100.00	73.70	0.7	140	71.0
LSD at 0.05	17.21	5.07	0.14	6.71	2.93

fos systemic resistance inducers significantly reduced the disease incidence than others .

As for disease severity , Cobalt sulphate , Agri-fos , Potassium silicate , dibasic Sodium phosphate , Cali-green , monobasic Potassium phosphate (high dose) and Lithium chloride proved significant high effect. Similar effects of these systemic resistance inducers were recorded when the average diameter of colonies and counts of colonies were calculated . Meantime, the least counts of conidia /leaf (In millions) resulted in the case of spraying Potassium silicate, Agri-fos,Cali-green, Lithium chloride and Cobalt sulphate .

2-Effect of some natural and mineral oils in comparison with the common recommended fungicides:

It is clear from data in (Table–4) that all tested substances, natural and mineral oils and fungicides markedly reduced the disease percentage and disease severity percentage either before or after inoculation ,but with not significant differences between the application before and after inoculation in the case of disease severity. Continuance, data elucidated also that all fungicides especially Afugan, the mineral oil Super masrona and the natural oils Trilogy and Naterolow gave the best results in reducing the disease severity.

In point all substances strongly decreased the average number of colonies /leaf either before or after inoculation. Acute decreasing was recorded in the case of fungicides followed by mineral then naturaloils.

DISCUSSION

Some systemic resistance inducers had been tested in this work as an attempt to reduce the cucumber powdery mildew disease incidence far away polluting the environment conditions.Actually,some of these inducers proved their ability in reducing cucumber powdery mildew (*Sphaerotheca fuliginea*) as Cobalt sulphate, monobasic Potassium phosphate (high dose), Cali-green, Agri-fos, Potassium silicate and Lithium chloride,These inducers significantly reduced all used disease assessment parameters (disease percentage, percentage of disease severity, average colony's diameter on leaf blade, average colony s counts/ leaf and average conidia counts / leaf). Other inducers as,dibasic Sodium phosphate,monobasic Sodium phosphate, dibasic Potassium phosphate(high and low doses)and monobasic Potassium phosphate (low dose) showed intermediate results. These results confirmed the results of many Investigators.Abood and Losel(1991),Abood *et al*(1992) and Losel *et al*(1994). The first and second authers demonstrated that Lithium chloride treatment to inoculated cucumber plants with *S.fuliginea* reduced the number of conidia produced by pathogen colonies grown on leaves, or these treatments inhibited the development of the fungus

Table (4): Effect of nine different substances related to natural and mineral oils chemical fungicides on the powdery mildew disease incidence.

Treatments	Disease Measures						
	Before Inoculation			After Inoculation			
	Disease %	Disease severity %	Av.No. of colonies/ leaf	Disease %	Disease severity %	Av. No. of colonies/ leaf	General mean
A-Natural oils							
Naterolow	56.25	23.80	72.00	37.50	9.50	74.80	21.65
Neemix	50.00	16.30	80.00	100.00	32.50	87.00	24.40
Trilogy	50.00	15.00	88.50	50.00	24.30	60.00	19.65
B-Mineral oils							
Super masrona	31.25	8.80	17.00	31.25	6.80	22.00	7.65
KZ – oil	50.00	36.30	33.00	43.75	19.00	31.50	27.65
Chemisol	50.00	33.80	26.00	37.50	32.50	27.00	33.15
Fungicides							
Afugen	6.25	2.50	4.50	0.00	0.00	0.00	1.25
Sumi-Eight	0.00	0.00	0.00	12.50	7.50	7.50	3.75
Micronized Surel	12.50	3.75	7.75	25.00	20.00	12.80	11.88
Control	100.00	77.50	313.8	100.00	77.50	313.80	77.50
General Menan		21.55			21.90		

Time of application (M) = N.S.
Treatments (T) = 2.32
Time of application x Treatments (M x T) = 9.01

structures and lowered the effecacy of conidia. The second authers also confirmed these results and attributed the effectiveness of Lithium chloride in reducing the infection to the interference with phosphatidyl inositol turnover .

The results proved also the excellent activity of Potassium silicate in reducing the disease incidince. However, Menzies *et al* (1991) found nigative correlation between Silicon content of plant tissues and cucumber powdery mildew severity. Samuels *et al* (1991 and 1993) explained the mobility and deposition of Silicon in cucumber plants. They found that when the cucumber plants, grown in Silicon insufficient medium and transferred to Silicon contianing media showed rapid silification of leaf tissue primarily trichome bases and exhibited increasing in disease resistance to *S.fuliginea* and high concentration of Silicon in the leaf epidermis surrounding the invading

pathogen s hyphae. However,plants grown in Silicon-supplemented media and transferred into Silicon-deficient media contained residual Silicon in the leaf trichome bases, but failed to display disease resistance or silification of, the host tissues surrounding the invading pathogen s hyphae. Likewise, Powen *et al.* (1992) found that when potted grape plants feeded with 1.7mM, Silicon didn t exhibited resistance against powdery mildew (*Uncinula necator*) but foliar sprays at 17 mM Silicon substantially reduced the number of mildew ed colonies. Scanning electron micrographs showed that on Silicon sprayed leaves, hyphae didn t develop where thick Silicon deposited and where surface deposits were not present , Silicon translocated laterally through the leaf and surrounded the appressoria.The authers suggested that the reducing in severity of grape mildew by Silicon sprays may partly due to a physical barrier to hyphal penetration and to a resistance response involving the lateral movement of Silicon and its deposition within the leaf at fungal penetration sites.Also, in that regard Jim Menzies *et al* (1992) concluded that cucumber plant sprays of > 17 mM Silicon developed fewer colionies. They also concluded that the active ingredient of Potassium silicate sprays was Silicon and 17mM Silicon spray ,applied 7 days before inoculation with *S.fuliginea* reduced mildew colony formation .

In view of the effect of Sodium and Potassium phosphates in this investigation, these salts proved good to moderate results at their used doses. Reuveni *et al* (1993) found that a single spray of 100 mM solutions of dibasic Potassium phosphate , monobasic Potassium phosphate, Sodium phosphate & Sodium pyrophosphate on the upper surface of the first true cucumber leaf, 2 h before inoculation with *S.fuliginea* conidia, induced systemic protection against the disease to the second and third leaves. However, dibasic Sodium phosphate had little or no effect.Moreover, spraying of dibasic Potassium phosphate at the same conditions actively induced systemic protection and reduced the number of pustules/

plant.However the induction of systemic protection by mono & dibasic Pptassium phosphate were consistently the most effective treatments. The same authers (1995) recorded that a single spray by o.1 M mono or dibasic Potassium phosphate on the upper surface of the first cucumber true leaf before inoculation with *S.fuliginea* induced highly protection to the second to fifth leaves up to 25 days after inoculation. The same authors (1996) added that *S.guliginea* was succsessfully controlled on greenhouse grown cucumber by a foliar spray (pre-inoculation) with 20 mM of mono or dibasic Potassium phosphate. They also found that 25 mM of mono or dibasic Potassium phosphate was protective against *S.fullnigea* natural infection under greenhouses. These salt solutions are not phytotoxic to plant foliage, continuance, it is suggested the inhibitory effect of phosphate and Potassium salts makes them useful biocompatible fungicides and possibly ideal foluiar fertllizers . Moreover, Cobalt sulphate is considered the most important inducer in this research. It proved excellent control against cucumber powdery mildew.These results are in harmony with Gamil (1995).

The natural oils (Naterolow, Neemix and Trilogy), mineral oils (Super-masrona, Kz oil and Chemisol and common recommended fungicides (Afugan , Sumi-eight and micronized Surel) proved satisfactory control to cucumber powdery mildew under artificial inoculation and greenhouse conditions particularly Afugan, Sumi-eight, Super masrona Trilogy and Naterolow which clearly reduced disease severity followed by Neemix and Kz oil. In point ,all substances strongly decreased the number of colonies / leaf (fungicides, mineral oils and natural oils respectively). Costache, *et al* (1984), Qvarnstrom (1989), Iqbal *et al* (1994) and Mustafa *et al* (1994) concluded that Afugan showed good control against cucumber powdery mildew disease under both field and greenhouse conditions.Similar results were obtained in the case of Sulfur applIcation and are in complete agreement with Charifi-Tehrani (1984 &1987),Bhatia and Thakur (1989). As for the role of mineral and natural oils in reducing the disease,Ohtsuka *et al* (1991) demonstrated that ultrastructural alterations induced by spraying the inoculated cucumber seedlings with an oil suspension included deformation of the hyphae, separation of the hyphal plasma membrane and the degeneration of the cytoplasm, led to death of the treated hyphae. The machine oil didn t obviously affect the morphology of the haustorium in the epidermal cells, suggesting that control of the mildew is happened by direct action on the hyphae. Also natural oils, in this research, showed good effect against the disease. Similar results are consistance with that of Herger,*et al* (1988) , Steck and Schneider (1993) , Dik *et al* (1994) and Daayf *et al*(1995). They found that applications of aqueous and ethanolic leaf extracts of *Reynoutria sachalinesis* (Milsana) controlled *Sphaerothica fuliginea* and reduced disease severity on cucumber under greenhouse conditions.

A rapid and distinct accumulation of fungitoxic phenolic compounds occurred in leaves treated with Milsana especially in infected leaves. A slight inhibition of conidial germination was the only direct effect of Milsana on *S.fuliginia.* These results support the hypothesis that Milsana may act indirectly by inducing plant defence reactions and that may be useful in the integrated management of cucumber powdery mildew. These results are in agreement with those obtained by Konstantinidou Doltsinis (1998). They added that extract treated cucumbers yielded as many or more fruit as fungicide treated plants.Qvarnstrom (1992) and Reimers *et al* (1993) observed good prevention on glasshouse cucumber against powdery mildew infection by using 1-5% emulsion of garlic extract (ajoene compound).

REFERENCES

Abood-Jk and D.M. Losel (1991). Lithium chloride and cucumber bowdery mildew infection.Plant Pathology, 40:(1),108-117.

Abood,J.K.; D.M. Losel and P.G. Ayres (1992).Changes in abundance and infectivity of powdery mildew conidia from cucumber plants treated systemically with lithium chloride.Plant Pathology, 41 : (3) 255-261 .

Arimoto,Y. and Y. Homma (1995). Influence of sucrose on development of *Sphaerotheca fuliginea* (Schlect) Polacci on carbohydrate free *Cucumis sativus* L. Ann. of the Phytopathol- ogical Society of Japan,61(1):82-87.Rev . Plant . Pathol ., 75 (5) : 414.

Awad, N.G.H. (2000). Reaction of some cucurbits against *Sphaerotheca fuliginea* in relation to their physiological and histopathological changes. Arab Universities J. of Agric.Sci.,Ain Shams Univ.,Cairo,8(3):829-851.

Bhatia, J. N. and D.P. Thakur (1989). Chemical control of powdery mildew of cucurbits.Plant Dis.Res.,4(2) : 146- 147.

Boiteux,L.S.; F.J.B. Reifschneider and H.B.S.Y. Pessoa (1995). Phenotypic expression of quantitative and qualitative components of partial resistance to powdery mildew (*Sphaerotheca fuliginia*) in melon (*Cucumis melo*) ermplasm. Plant Breeding,114(2):185-187.

Bowen,P.; J. Menzies; D. Ehret; I. Samuels and A.D.M. Glass (1992). Soluble silicon spray inhibit powdery mildew development on grape leaves. J.of the merican Soc.for Hort.Sci.,117 (6) : 906-912.

Charifi-Tehrani, A. (1984). Comparative study of the activity of some fungicides under field conditions on cucumber mildew [*Sphaerotheca fuliginea* (Schlect, ex Fr.)Pol.].Med-edelingen- van- de- Faculteit-Landbouwwetenschappen, Rijksuni- versiteit- Gent., 49(2a):407-410.

Charifi-Tehrani, A. (1987). Comparative study on the effect of sulpher, benomyl and tridemorph on cucumber powdery mildew[*Sphaerotheca*

fuliginea (Schlect,ex Fr.)Pol.] Mededelingen- van- de- Faculteit-Landbouwwetenschappen, Rijksuni- versi- teit-Gent.m,52:3a:924-932.

Costache,M.; G. Marinescu; F. Traudaf; M. Iosifescu; N. Manole; R. Vinju and T. Munteanu (1984). Simultaneous control of pathogens on cucumber and melon crops .Anale Institutal de Ceretari pentru Legumicultura s Floricultura, VII,367-380 .

Daayf-F.; A. Schmitt and R.R. Belanger (1995). The effects of plant extracts of *Reynoutria sachalinensis* on powdery mildew development and leaf physiology of long English cucumber. Plant Disease, 79,(6):577-580.

Dik,A.J.; Staay,M. Van-der and M. Van-der Staay (1994). The effect of Milsana on cucumber powdery mildew under Dutch conditions 46th International symposium on crop protection ,Gent,Belgium, 3 May,1994 Mededelingen – Fuculteit – Landbouwkundige – en -Toegepaste-Biologische-Wetenschappen – Universitelt-Gent.1994.59(3a);1027-1034.

Floris,E.and Alvares,J.M. (1991). A rapid and sensitive method for evaluation of melon resistance to *Sphaerotheca fuliginea*.Report Cucurbit Genetics Cooperative,(14):46-48. Rev.Plant Pathol.,72(8);621.

Gamil, N.A.M. (1995). Induced resistance in squash plants against powdery mildew by cobalt and phosphate spray. Annals of Agricultural Science, Moshtohor.33,(1):183-194.

Gyongyver,S.N. (1987). Inter-relation between nutrient supply in cucumber and its susceptibility to mildew. Novenyvedelem,23(4):145-153.Plant Prot. Inst. Acad. Sci. Bodapest Hungary.Rev.Plant.Pathol.,67(5):285.

Haberle,R. and E. Schlosser (1993). Protective and curative effects of Telmion on *Sphaerotheca fuliginea* on cucumber.Mededelingen van de Faculteit Landbouwwetenschapen Univers-Iteit Gent,58(36):1461-1467.

Herger,G.; F. Klingauf; D. Mangold; E.H. Pommer and M. Scherer (1988). Efficacy of extracts of *Reynoutria sachalinensis (F.schmidt)* Nakai against fungal diseases, especially powdery mildews. Nachrichtenblatt- des-Deutschen- Pflanzenschutzdienstes,40(4):56-60.

Iqbal,J.; M. Riaz and Saud Al-Misbah (1994). Fungicidal control of powdery mildew of cucumber in Kuwait.Pakistan J. of Phytopathology,6(1);65-66.

Konstantinidou-Doltsinis,S. and Schmitt,A. (1998). Impact of treatment with plant extracts from *Reynoutria sachalinensis* (*F.Schmidt*) Nakai on intensity of powdery mildew severity and yield in cucumber under high disease pressure. Crop Protection,17(8):649-656.

Losel,D.M.;Meilleur,E.T. and Abood, J.K. (1994). Role of membrane lipids in powdery mildew infection of cucumber.J.of Plant Physiology,143(4-5):575-577.

Menzies, J. G.; D.L. Ehret; A.D.M. Glass; T. Helmer; C. Koch and F. Seywerd (1991a). The effects of soluble silicon on the parasitic fitness of *Sphaerotheca fuliginea* on Cucumis sativus. Phytopathology, 81: 84-88.

Menzies, J.; P. Bowen and D. Ehret (1992). Foliar aplications of potassium silicate reduce severity of powdery mildew on cucumber, muskmelon and zucchini squash. J.Amer.Soc.Hort. Sci.,117(6):902-905.

Mustafa,T.M.; J.H. Al-Rifai and Y.T. Al-Shuraiqi (1994). Residues of pyrazophos in cucumber in the central highlands of Jordon. Dirasat Series- B,Pure and Applied Sciences,21(2);7-14.

Ohtsuka, N. and Y. Nakazawa (1991). The influence of machine oil on conidia and hyphae of cucumber powdery mildew,*Sphaerotheca fuliginea*.Annals of the phytopathological Society of Japan,57(4);598-602.

Ohtsuka,N.; Y. Nakazawa and O.Horino(1991).The influence of machine oil on morphology of cucumber powdery mildew fungus(II).Electron microscopic observation on hyphae and haustoria of *Sphaerotheca fuliginea*. Annals of the Phytopathological Society of Japan, 57(5):711-715.

Qvarnstrom,K. (1989). Control of powdery mildew (*Erysiphe cichoracearum*) on cucumber plants. Vaxtskyddsnotiser,53 (3):54-57.

Qvarnstrom,K.(1992).Treatment of powdery mildew (*Erysiphe cichoracearum*) on cucumber plants with low toxic measures. Vaxtskyddsnotiser, 56 (1): 17- 20.

Reimers,F.; S.E. Smolka; S. Werresd; K. Plank-Schumacher and G. Wagner (1993). Effect of ajoene,a compound drived from *Allium sativum* on phytopa-thogenic and epiphytic microorganisms. Zeitschrift–fur-Pflanzenkrankheiten und Pflanzenschutz,100(6):622-633.

Reuveni,M.; V. Agapov and R. Reuveni (1993). Induction of systemic resistance to powdery mildew and growth increase in cucumber by phosphates . Biological, Agriculture and Horticulture,1993, 9(4):305-315.

Reuveni,M.; V. Agapov and R. Reuveni (1995 a). Suppression of cucumber powdery mildew *(Sphaerotheca fuliginea)* by foliar sprays of phosphate and potassium salts. Plant Pathology,44(1):31-39.

Reuveni,M.; V. Agapov and R. Reuveni (1995 b). Induced systemic protection to powdery mildew in cucumber by phosphate and potassium fertilizers :Effect of inoculum consentration and post inocula- tion treatment. Canadian J.of Plant Pathol.,17(3):247-251.

Reuveni,M.; V. Agapov and R. Reuveni (1996). Controlling powdery mildew caused by *sphaerotheca fuliginea* in cucumber by foliar sprays of phosphate and potassium salts .Crop Protection,15(1);49-53.

mildew fungus (*Sphaerotheca fuliginea*).Canadian J.of Botany,69(1):140-146

Samuels,A.L.; A.D.M. Glass; D.L. Ehret and J.G. Menzies (1991 b). Mobility and deposition of silicon in cucumber plants.Plant cell and Environment , 14 (5):485-492.

Samuels,A.L.; A.D.M. Glass; D.L. Ehret and J.G. Menzies (1993). The effects of silicon supplementation on cucumber fruit and changes in surface characteristics. Annals of Botany,72(5):433-440.

Steck, U. and H. Schneider (1993). On the effect of so called "biotonics"in horticulture. Gesuude Pflanzen, 45(3):98-105.

Townsend, G.R. and J.W. Huberger (1943). Methods for estimating losses caused by diseases in fungicide experi- ments. Plant Dis.Repter,27: 340-343.

دراسات على مرض البياض الدقيقى على الخيارالمتسبب عن الفطر *Sphaerotheca fuliginea* تحت ظروف الصوب فى مصر

٢-الطرق الحديثة فى مقاومة المرض باستخدام مستحثات المقاومة الجهازية وبعض الزيوت الطبيعية والمعدنية والمبيدات الفطرية

عادل محمد السيد التوني

معهد بحوث امراض النباتات – مركز البحوث الزراعية –الجيزة – مصر

الملخص العربى

كمحاولة حقيقية وجادة للحد من خطورة مرض البياض الدقيقى على الخيار ومقاومته والذى يعد بالفعل واحدا من اهم واخطر امراض الخياردداخل صوب الانتاج البلاستيكية وذلك باستخدام أبسط وايسرالطرق الحديثة فى مقاومة المرض بعيدا عن ملوثات البيئة وخطوة للأمام من اجل اعـادة الـتوازن البيئى المفتقد من جديد اختبر لهذا الغرض عشرة مواد كيماوية (اثنتى عشر معاملـة) لاسـتحثاث المقاومة الجهازية داخل نباتات الخيار كما تم اختبار ستة زيوت طبيعية ومعدنـية (ثلاثـة لكـل مـنها) قـبل وبعـد العدوى بالفطرالمسبب ***Sphaerotheca fuliginea*** مقارنة بأفضل ثلاثة مبيدات فطرية موصى بها .

حققـت النتائج الغرض المرجو من هذا البحث واشادت بقوة الى فعالية المواد المختبرة بدرجـات مخـتلفة فـى استحثاث مقاومة نباتات الخيار مقارنة بالنباتات الغير معاملة. أظهرت النـتائج تفوقا ملحوظا للمواد المستحثة كبريتات الكوبلت ، الكاليجرين ، سيليكات البوتاسيوم ، كلوريـد الليثـيوم ، والأجـريفوس مقارنة بباقى المواد فى خفض كل مقاييس المرض (النسبة المئوية للمرض – النسبة المئوية لشدة المرض- متوسط عدد المستعمرات لكل ورقة- متوسط قطـر المسـتعمرات -متوسط عدد الجراثيم الكونيدية بالمليون لكل ورقة) الا ان التفوق كان لصالح سيليكات البوتاسيوم ، كبريتات الكوبلت ، الكاليجرين . كما بينت النتائج ايضا ان المادة المسـتحثة فوسفات البوتاسيوم احادية القاعدية بالجرعة العالية قللت فقط نسبة وشدة الاصابة بالمـرض بينما حققت فوسفات الصوديوم ثنائية القاعدية نتائج طيبة فى خفض النسبة المئوية

لشـــدة المـــرض فقـــط في حين احتلت المادة المستحثة فابور-جارد المرتبة الأخيرة من حيث الكفـــاءة فـــى مقاومـــة المرض. وهكذا يمكن استخدام مستحثات المقاومة الجهازية التى اثبتت كفاءة فى الحـــد من خطورة هذا المرض.

علـــى الجانـــب الآخـــر اكـــدت النـــتائج فعالية كل من الزيوت الطبيعية(تريلوجى-ناترولو ونيمـــيكس) والـــزيوت المعدنـــية (ســـوبر مصرونا - ك زد- كيميسول) والمبيدات الفطرية (افيوجان-سومى ايت- كبريت ميكرونى) المختبرة ضد المرض سواء عوملت بها النباتات قبل او بعـــد العـــدوى بالفطـــر المسبب للمرض(سفيروثيكا فلاجينيا) حيث حققت المبيدات الفطرية افيوجان ، سومى ايت والكبريت الميكرونى والزيت المعدنى سوبر مصرونا والزيتين الطبيعيين تـــريلوجى و ناتـــيرولو افضل النتائج فى خفض النسبة المئوية لشدة المرض يليها فى الفعالية الزيت الطبيعى نيميكس والزيت المعدنى ك-زد .

اوضـــحت النتائج ايضا ان كل المواد المختبرة قللت بوضوح متوسطات اعداد المستعمرات الفطـــرية لكـــل ورقـــة مقارنـــة بالنباتات الغير معاملة . وقد تفوقت فى هذا الغرض المبيدات الفطـــرية يلـــيها الزيوت المعدنية ثم الزيوت الطبيعية وهكذا تؤكد النتائج فعالية مقنعة للزيوت المعدنـــية وخاصة سوبر مصرونا ، ك-زد حيث تأتى فى المرتبة الثانية بعد المبيدات الفطرية. وهكـــذا يمكـــن اســـتخدامها فى مقاومة هذا المرض سواء قبل الاصابة(وقائيا) او بعد الاصابة (علاجـــيا)، كمـــا يمكـــن استخدام الزيتين الطبيعيين تريلوجى وناتيرولو لنفس الغرض بدلا من استخدام المبيدات الفطرية