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IMPACT OF SOME SAFETY BIOTREATMENTS IN CONTROLLING CHERRY TOMATO POWDERY MILDEW

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ABSTRACT

Plant extract of anise *(Pimpinella anisum* L.), blue gum (*Eucalyptus globules* L.), cumin (*Cuminum cyminum* L.), garlic (*Allium sativum* L.), marjoram (*Majorana hortensis* L.) and thyme (*Thymus vulgaris* L.) were tested as foliar application to control Cherry tomato powdery mildew, caused by *Leveillula taurica* (Lèv.). All treatments tested were significantly reduced the disease incidence and severity over untreated control. The plant extraction methods *i.e.,* hot water, acetone and ethanol gave the superior results in controlling Cherry tomato powdery mildew disease incidence and severity, specially with each of blue gum, marjoram and thyme. With the exception of garlic plant extract, the cold water extraction method used with other plant materials unable to control the disease incidence and severity at all time of experimental application. Spraying Cherry tomato plant with microelements (Fe+Zn +Mn) led to an reduction of disease incidence and severity at all time of experiment. Also, the same trend was observed in case of the tested salts specially after 30 dayes of treatment.

Key words: Cherry tomato, powdery mildew, plant extract, *Leveillula taurica*, microelements- salts.

INTRODUCTION

The development of alternative control strategies to reduce the dependency of using synthetic fungicides in controlling plant diseases ultimate aim of recent research. The plant extracts have ability to synthesize aromatic secondary metabolites, like phenols, phenolic acid, quinones, flavones, flavonoids, flavonols, tannins and coumarins (Cowan, 1999). The components with phenolic structures, like carvarol, eugenol, and thymol, were highly active against the plant pathogens. These groupes of compounds show antimicrobial effect and serves as plant defence mechanisms against pathogenic microorganisms (Das *et al.,* 2010). The volatile antimicrobial substance allicin (dialyzed thiosulphinate) is synthesized in garlic when the tissues are damaged and the substrate alliin (S-allyl- cysteine sulphoxide) mixes the enzyme alliin-layse (Slusarenko *et al.,* 2008).

Bader (2006) reported that, to control cucumber powdery mildew, plants were treated with garlic, thyme, rosmary and mustard plant extracts before or after inoculation with *Sphaerotheca fuliginea* the causal organism of the disease. The treatments significantly controlled the disease incidence compared with check. The best result was achieved by the application of mustard and garlic extracts.

Extracts of five plant extracts (cloves, cinnamon, thyme, fenugreek, black pepper) and three essential oils (geranium, black cumin seeds and blue gum) were evaluated for their antifungal effect on the mycelial growth, disease incidence and severity of *Botrytis allii*, the causal pathogen of onion neck rot disease. The antifungal properties of cloves extract was more effective than black pepper followed by fenugreek on inhibiting mycelial growth and disease incidence, while, thyme and cinnamon showed the lowest effect (Abo-Elnaga and Ahmed, 2006).

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The popularity use of botanical pesticides is once again increased and some plant products are being used globally as green pesticides (Gurjar *et al.*, 2012).

The effects of spraying cucumber plants with some aqueous plant extracts and oils (garlic, clove, withani, nigella, olive and rocket) on *Sphaerotheca fuliginea* led to marked reduction in conidial germination as well as disease incidence and its severity (Mahdy *et al.*, 2006).

Marschner (1995) reported that the effect of three micronutrients (Fe, Zn and Mn) on reducing the severity of some diseases could be attributed to the involvement in physiology and biochemistry of the plants. All three micronutrients were involved in many processes that can affect the response of plants to pathogens.

El-Kafrawy (1997) used three microelements *i.e.*, Fe, Zn and Mn as foliar treatment and applied separately or combined to study their effect on pepper powdery mildew caused by *Leveillula taurica*. Application of Fe microelement gave the lowest percentage of powdery mildew infection. Combination of the three tested microelements showed the lowest percentage of infection, while (Fe + Zn), (Fe + Mn) and (Mn + Zn) fell in between. Generally, all tested treatments exhibited the lowest percentage of infection compared to the control.

Abd El-Latef (2009) indicated that all foliar treatments with microelements, *i.e.* iron, zinc and manganese reduced the percentage of tomato powdery mildew infection under greenhouse conditions as well as in open field.

Ziv *et al.* (1994) reported that the use of sodium and potassium bicarbonates, horticultural oil and surfactant solution reduced the incidence of *L. taurica* on capsicum plant foliage. Lesson and Crisp (2004) conducted a study to evaluate the potential effect of a commercial formulate of potassium biocarbonate tank - mixed with a vegetable oil-based through spraying adjuvant for the control of tomato powdery mildew in greenhouse caused by *Leveillula taurica*. The severity of powdery mildew was significantly reduced in all treatments, comparable to the control.

Yanar *et al.* (2011) suggested that application of potassium silicate (K_2 SiO_3, 200mg/l) and thealternation of systemic fungicide Bayleton WPs (Triadimenol 25 mg/l) and Thiovit 80% (Sulfur 2.49g/l) with 12 days interval were highly protective against tomato powdery mildew.

Plant spray treatments with calcium chloride, chitosan, potassium biocarbonate and thyme oil resulted in the highest reduction in foliar downy and powdery mildew diseases incidence, severity and increase the obtained yield of cucumber plants grown under plastic houses condition (Abd El-Kader *et al.*, 2012).

Al-Rawashed (2012) studied the effect of different mineral salts to control infection of apple by powdery mildew pathogen. Calcium chloride and calcium carbonate led to more than 50% significant reduction in percentage disease severity and were more effective than ammonium phosphate and potassium hydrogen phosphate. Thus, this work was conducted to evaluate the efficacy of different plant extracts (anise, blue gum, cumin, garlic, marjoram and thyme), three microelements (Fe + Zn and Mn) and some salts (bicarbonate sodium+ multi brotch + trafose potasium) on the disease incidence and severity of Cherry tomato powdery mildew caused by *Leveillula taurica*.

MATERIALS AND METHODS

The efficacy of some plant extracts, microelements and salts against powdery mildew foliar diseases incidence and severity was evaluated as spray treatments under greenhouse conditions. Plant extract evaluation was carried out four times with seven days intervals starting at 60 days after transplanting. The six tested Egyptian medicinal and aromatic plants (Table 1) were used as fresh and dried materials throughout this investigation. These medicinal and aromatic plants used throughout this study were collected from, Hort. Res. Inst, Agric. Res. Center, Giza, Egypt. expect seeds of anise and cumin which were collected from Seakam company at El-Sharkia Governorate while garlic cloves were collected from a farm located in El-Sharkia Governorate. Each plant was used at the rate of 50 g/l.

Table 1. The particulars tested plant species used in this study

English name	Latin name	Family	Parts used
Anise	*Pimpinella anisum* L.	Umbellifereae	Seeds
Blue gum	*Eucalyptus globules* L.	Myrtaceae	Leaves
Cumin	*Cuminum cyminum* L.	Umbellifereae	Seeds
Garlic	*Allium sativum* L.	Amaryllidaceae	Cloves
Marjoram	*Majorana hortensis* L.	Labiateae	Herb
Thyme	*Thytnus vulgeris* L.	Labiateae	Herb

Preparation of Plant Extracts

Cold water extracts

Cold water extracts were carried out according to the method described by Ismail *et al.* (1989).

Hot water extracts

The hot water extracts were prepared according to the method reported by Zedan (1993).

Organic solvent extract

The finaly grounded air dried plant materials (25 and 50g) arise seeds, marjoram and thyme herbs were soaked for 48-hr., in one liter of each solvent seperately (Acetone and Ethanol). The mixtures were shacked through the extraction time. Extracts were filterated through filter paper Whattman No. 1. The solvents were evaporated using rotary evaporator under the suitable temperature for each one. The resulted residues were dissolved in 96% ethanol, then kept in refrigerator at 5 °C for demand. At the expermintal time ethanol was evaporated and the residues were disseolved in one liter of distilled water then sterilized by Zeist's filter (Kshirsagar and Metha, 1972).

Effect of foliar spraying with cold and hot water plant extracts as well as organic solvent on incidence and severity of powdery mildew was carried out after 30 days from transplanting. Inoculum spores used were collected from the farm of Ismailia Governorate. Microscopic preparation for identification the causal fungus were made by placing epidermal strips, taken from the infect tomato leaves, (bearing the fungal conidiophores and conidia) on glass slides then stained with lacto phenol cotton blue and covered with cover glass then examined using light microscope at plants were sprayed with water (Abou-Zaid *et al.*, 2011), inoculation was carried out by dusted plants with the conidia of *Leveillula taurica* (Lèv.) , through shaking the mildewed leaves of cherry tomato, one week after inoculation. Infected plants were sprayed with each one of the extract tested 50 g/l water. The plants sprayed with tap water only were used to serve as control treatment. The inoculated Cherry tomato plants were sprayed with plant extracts four times at 7 days intervals from first inculcation. Four replicates were used for each particular treatment. Inoculated plants were kept on wet benches until disease development realized. The percentage of disease incidence as well as disease severity (disease parameters) were determined after 7 days from the last spray. Percentage disease incidence, was determined as the percentage of infected leaves relative to the total number of leaves per plant then averaged. The disease severity was determined according to the scale reported by Townsend and Heuberger (1943). Plants of each particular treatment were classified (0 - 7) categories as follows:

0=leaves completely healthy.

1= 1- 2 spots per leaflet.

2= 3 - 5 spots per leaflet.

3= 6 - 10 spots per leaflet

4= up to 25 percent of the leaflet area affected.

5= up to 50 percent of the leaflet area affected.

6= up to 75 percent of the leaflet area affected.

7= more than 75 percent of the leaflet area affected.

The percentage of disease severity (DS) for each particular treatment was calculated using the following formula.

$$DS = \frac{\text{Sum of } (n \times v)}{\text{Total No. of leaves observed in sample Max. Grading (7)}} \times 100$$

n= number of infected leaves in each category.

v= numerical value of each cateogery.

Percentage of infection was determined on both upper and lower leaflet surfaces and averaged as one value.

Effect of Foliar Application With Some Microelements on Cherry Tomato Powdery Mildew Development

The objective of this experiment was to reveal the effect of foliar application with some microelements including Iron chelate (Fe-EDTA 6%) at 0.5 g/l., Zinc chelate (Zn- EDTA 12%) at 0.25 g/l. and Manganese chelate (Mn-EDTA 12%) at 0.25 g/l. and used as induce resistance substances on occurrence and severity of Cherry tomato powdery mildew.

The tomato seedlings were sprayed with combination of (Fe + Zn + Mn) after one day from inoculation with *leveillula taurica* conidia using the aforementioned dusting method. Cherry Tomato plants were inoculated with the pathogen after one month from transplanting, and before spraying with the previous microelements. Microelements application were occurred 4 times (7, 14, 21 and 30) and percentages of disease incidence and severity were recorded as previously mentioned, according to Townsend and Heuberger (1943).

Effect of Foliar Application With Some Salts on Preventing the Cherry Tomato Powdery Mildew Developments

The effect of four salts were tested against powdery mildew of Cherry tomato at different concentrations (Table 2) under greenhouse conditions. The effect of salts as preventive and /or therapeutant treatment were evaluated on incidence and severity of Cherry tomato powdery mildew under artificial inoculation. Growing plants were sprayed with each of salt alone. The plants were inoculated by dusting spores on the upper surface then sprayed after 7 days with different tested salts according to the methods described by Reuveni *et al.* (1994). The treated plants were incubated under greenhouse conditions at 27± 2°C and the control treatments were sprayed with tap water. On the other hand, the severity of the powdery mildew was assessed according the equation by calculate the infected area of 10 leaves from each treatment. Treatments efficacy were calculated using the following equation.

$$\text{Efficacy} = \frac{\text{Control - treatment}}{\text{Control}} \times 100$$

Cherry Tomato Fruit Yield Calculation

Two experiments were carried out in 2011 and 2012 growing seasons. In both seasons the seedlings were transplanted in plastic houses (20m x 4m), the distance between seedlings were 50cm., while the row length was 20m, the distance between rows was 1m, each plastic house had 4 rows, the average of transplants were 160 seedling/plastic house, while 8000 transplants/faddan in open field. Four plastic houses were used for each particular biotreatment (640 transplants /treatment) which equal 1/ 12.5 faddan.

The fruit yield / faddan = the production of 640 transplants x12.5= ton / faddan.

RESULTS AND DISCUSSION

Data presented in Table 3 indicate that spraying Cherry tomato with all of the tested plant extracts caused reduction in both disease incidence and severity percentages of Cherry tomato powdery mildew compared with the control. All treatments tested were significantly reduced the disease incidence and severity with the exception of using cold extract of anise and cumin plants.

The results of spraying tomato plants 7 days after planting with different plant extracts indicated that, the best result of affecting Cherry tomato powdery mildew incidence and severity was obtained by the spraying treatment with blue gum, marjoram and thyme (hot extract), being 1.3, 1.7 and 1.8% disease incidence and 0.8 , 1.3 and 1.5% disease severity, respectively. Moreover, the low control effect on Cherry tomato powdery mildew obtained by application hot water extraction of garlic and cumin which record 2.4 and 2.9% disease incidence, and 1.9 and 2.1% disease severity, respectively.

Table 2. The tested salts used in this study

Trade name	Chemical Formula	Concentration
Bicarbonate sodium	Na HCO_3	5g/l
Multi brotch (potassium phosphate)	36% K_2O+ 26% P_2O_5	5g/l
Trafose potassium (mono potassium phosphate)	45% K_2O+ 10% P_2O_5	5g/l
Transelements EDTA (Fe+Mn+Zn)	6% Fe EDTA 12% Mn EDTA 12% Zn EDTA	1g/l

EDTA (Ethylene diamine tatera acetic acid)

Table 3. Effect of spraying plant extracts on powdery mildew of Cherry tomato plants after seven days from application

Type of extract	Hot water		Cold water		Acetone		Ethanol	
Plant extract	**DI (%)**	**DS (%)**	**DI (%)**	**DS (%)**	**DI (%)**	**DS (%)**	**DI (%)**	**DS (%)**
Anise	2.1 b	1.8 b	3.0 c	2.9 c	2.4 b	2.0 b	2.3 b	2.0 b
Blue gum	1.3 a	0.8 a	2.3 b	1.2 a	1.7 a	1.3 a	1.3 a	0.9 a
Cumin	2.9 b	2.1 c	3.6 c	3.1 c	2.8 b	2.3 b	2.5 b	2.2 b
Garlic	2.4 b	1.9 c	1.8 a	1.2 a	2.8 b	2.5 b	2.4 b	2.3 c
Marjoram	1.7 a	1.3 b	2.9 b	2.1 b	1.7 a	1.2 a	1.5 a	1.1 a
Thyme	1.8 a	1.5 b	2.8 c	2.4 b	2.0 a	1.7 a	1.8 a	1.3 b
Control	4.1	2.7	4.1	3.7	4.1	2.7	4.1	2.7
LSD at 5%	0.66	0.45	0.51	0.45	0.54	0.57	0.55	0.44

DI (%) = Disease incidence percentage DS (%) = Disease severity percentage

Respecting the effect of cold water extract results appeared that, the highest significant effect on the reduction of disease incidence and severity percentages was showed by garlic plant extract treatment (1.8% disease incidence and 1.2% disease severity). In addition the intermediate effect was observed by blue gum and thyme plant extract treatments being 2.3 and 2.8% disease incidence and 1.2 and 2.4% disease severity percentages, respectively.

In general, all treatments with cold water plant extracts enhanced Cherry tomato powdery mildew control compared to untreated plants.

It is also clear from data presented in Table 3 that significant decreased in the percentage of disease incidence and severity of Cherry tomato powdery mildew of acetone compared to untreated ones (control).

The preferable result was obtained by blue gum and marjoram plant extracts treatment, which led to reduce the disease incidence and severity percentages (1.7 and 1.3% for blue gum and 1.7 and 1.2% for marjoram plant extract, respectively). While the less effect were detected in case of anise, cumin and garlic plant extracts application, which led to 2.4, 2.8 and

2.8% disease incidence and 2.0, 2.3 and 2.5% disease severity, respectively.

One week after the foliar application with ethanol extraction data obtained revealed that blue gum, marjoram and thyme were more significantly effective than the other treatments in reducing the disease incidence and severity percentages of Cherry tomato powdery mildew, which led to 1.3, 1.5 and 1.8% for disease incidence and 0.9, 1.1 and 1.3% for disease severity in respective order.

On the other hand, extraction methods of acetone and ethanol gave the superior results on reducing Cherry tomato powdery mildew incidence and severity. Aforementioned extraction methods resulted in an increase of Cherry powdery mildew control specially for blue gum, marjoram and thyme plant extracts. Data also showed that the cold water extraction method negatively affected the disease control of Cherry tomato powdery mildew. On the other hand, garlic plant extract gave the best control of disease incidence and severity of Cherry tomato powdery mildew.

The results obtained in Table 4 revealed that all applied treatments after two weeks have positive effect on Cherry tomato powdery mildew disease incidence and severity comparing with control. Furthermore, the application of cold water garlic treatments showed significant suppressive effect on Cherry powdery mildew disease incidence and severity comparing with hot water extract and untreated check controls.

Data in Table 5 indicate the effect of spraying Cherry tomato plants with the different tested plant extracts at 21 days from application including blue gum, marjoram and thyme plant extracts (extracted by hot water, acetone and ethanol extraction methods) on disease incidence and severity. Results in this table indicate the highest significant reduction of both disease incidence and severity of Cherry tomato powdery mildew.

Application of garlic plant extract (cold water extraction) was highly protective against Cherry tomato powdery mildew (disease incidence and severity percentages), which led to 10.8 and 10.6% in respective order. Data in Table 6 show the results after fourth plant extract application of Cherry tomato the same trend was observed in reducing the disease incidence and severity. Hot water extraction of acetone and ethanol for blue gum, marjoram and thyme plants lead to reduce both disease incidence and severity of Cherry tomato powdery mildew. While, cold water of garlic plant extract gave the same trend (28.6 and 27.5 disease incidence and severity, respectively).

It is worthy to mention that, investigations carried out to determine the optimal solvent for extracting antioxidants from plant materials are limited. In separate studies Liorach *et al.* (2003) and Koksal and Gulcin (2008) compared the solvents ethanol and water for the extraction of antioxidants in cauliflower. In each case ethanol was superior to water in extracting total phenolic contents.

Extraction of antioxidants from plant materials most often involves the method of solvent extraction. The choice of solvent has been shown to have a significant influence on the concentration of antioxidants extracted (Sultana *et al.*, 2009; Ahmed *et al.*, 2011).

The solvent systems involving both water and organic solvents are more effective towards recovering optimal amount of antioxidant components from cauliflower (Anwar *et al.*, 2013).

Four plant extracts, garlic, rosmary, thyme and mustard were used to control the powdery mildew *Sphaerotheca fuliginea* on cucumber, the best result was achieved by the application of Mustard and Garlic extracts (Bader, 2006).

Morsy *et al.* (2009) reported that garlic and onion extracts resulted in suppressing damping off as well as powdery mildew disease and growth characteristics of cucumber.

Successful development of such compounds as antifungal would not only provide a potential for control of vegetables foliar diseases, but also could promise success in multipurpose biorational alternative to conventional fungicides for the management of other plant diseases (Abd El-Kader *et al.*, 2012).

When compost teas are applied to foliage, there may be direct effects on the pathogen and indirect effects through improvement in plant resistance (Ketterer *et al.*, 1992 and Litterick *et al.*, 2004).

Table 4. Effect of spraying plant extracts on powdery mildew of Cherry tomato after forteen days from application

Type of extract	Hot water		Cold water		Acetone		Ethanol	
Plant extract	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)
Anise	4.9 b	4.3 b	8.9 c	8.8 c	8.3 b	7.5 b	5.3 b	4.7 b
Blue gum	3.0 a	2.9 a	6.9 b	5.8 b	3.0 a	2.5 a	2.5 a	1.9 a
Cumin	5.6 b	4.6 b	10.7 c	9.2 c	7.7 b	6.5 b	5.3 b	5.0 b
Garlic .	7.5 c	6.5 c	3.8 a	2.8 a	8.7 b	7.6 c	8.4 c	6.7 c
Mar joram	3.6 a	3.2 a	6.7 b	5.8 b	3.5 a	3.2 a	2.8 a	2.4 a
Thyme	4.3 b	3.7 a	8.1 c	6.5 b	3.9 a	3.4 a	3.7 a	3.1 a
Control	12.3	11.0	12.3	11.0	12.3	11.0	12.3	11.0
LSD at 5%	1.2	0.9	2	1.7	1.6	1.4	1.3	1.2

DI (%)= Disease incidence percentage DS (%)= Disease severity percentage

Table 5. Effect of spraying plant extracts on powdery mildew of Cherry tomato after twenty one days from application

Type of extract	Hot water		Cold water		Acetone		Ethanol	
Plant extract	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)
Anise	13.6 b	12.5 b	18.6 b	16.1 c	14.7 b	12.7 a	12.4 b	10.3 b
Blue gum	9.3 a	6.6 a	13.8 a	13.1 b	10.5 a	8.5 a	7.3 a	6.0 a
Cumin	14.6 b	13.2 b	20.0 c	16.9 c	16.1 b	13.5 b	12.9 b	11.3 b
Garlic	19.2 c	16.9 c	10.8 a	10.6 a	17.3 c	16.4 c	15.2 c	16.3 c
Mar joram	10.6 a	10.3 b	11.3 a	14.3 b	10.7 a	9.4 a	9.4 a	8.6 a
Thyme	12.0 b	10.2 b	17.0 b	14.5 b	12.6 a	10.5 a	9.1 a	7.8 a
Control	21.8	19.8	21.8	19.8	21.8	19.8	21.8	19.8
LSD at 5%	3.1	3.0	5.8	3.2	3.6	4.4	3.1	2.8

DI (%)=Disease incidence percentage DS (%)= Disease severity percentage

Table 6. Effect of spraying plant extracts on powdery mildew of Cherry tomato after thirty days from application

Type of extract	Hot water		Cold water		Acetone		Ethanol	
Plant extract	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)	DI (%)	DS (%)
Anise	36.9 c	33.5 b	41.7 d	42.6 c	39.6 c	35.4 b	38.3 c	33.0 c
Blue gum	22.9 a	22.8 a	33.2 b	24.2 b	27.4 a	25.1 a	21.0 a	20.6 a
Cumin	39.3 d	38.2 c	41.2 d	36.2 b	40.7 c	38.5 b	37.9 c	39.5 d
Garlic	39.3 d	34.2 c	28.6 a	27.5 a	42.6 c	36.3 b	38.5 c	48.1 e
Mar joram	28.7 b	27.1 a	35.8 b	32.7 b	31.3 b	29.6 a	26.7 b	25.0 b
Thyme	31.6 a	29.3 b	39.4 c	37.1 b	35.3 b	33.0 a	29.9 b	26.3 b
Control	70.0	67.8	70.0	67.8	70.0	67.8	70.0	67.8
LSD at 5%	3.9	5.3	3.7	5.6	3.6	6.3	3.0	4.2

DI (%)=Disease incidence percentage DS (%)= Disease severity percentage

Segarra *et al.* (2009) observed that inducible enzymes which played a role in disease resistance (peroxidase and chitinase) were not activated by compost tea treatment. Other authors reported an increase in peroxidase, polyphenoloxidase and phenylalanin.

Shetty *et al.* (1989) stated that the difference in activity between the extracts might be due to variation in the concentration and composition of antifungal compounds in the different plants (thyme, blue gum, cumin, anise, marjoram and garlic against seed borne infection of *Trichoniella padwickii in pady "Oryza stavia"*). On the other hand, the hot water extract per each plant tested was superior in decreasing value of spores germination criteria than the cold one, except with garlic since the reverse result was recorded. The superiority of hot water for each plant extract over its cold water extract might be due to:1- changing in phsio-chemical properties of the extract such as viscosity, pH, ... *ect.* due to the appearance of new compounds and / or disappearance of the other by heat effectiveness, 2- the high release of the antifungal toxic compounds by heat, 3- high temperature might help another toxic substance(s) of antifungal effect to emanate, 4- heat might suppressed chemical substance(s) or factor(s) activities which are responsible for the disappearance of the antifungal compounds toxicity. As regards the cold water extract of garlic, was found more toxic against germination of powdery mildew fungal spores that its hot water extract might by attributed to the active principles which were released more in cold water. This explanation was similar to that previously mentioned be Kurucheve and Padmavathi (1997) on the antifungal action of the cold water of garlic and *Eucalyptus globulus* in comparison with their hot water extract.

The hot water of blue gum and thyme, the solvent extract (Acetone and Ethanol) of blue gum, thyme and marjoram were tested , however, the best treatment in decreasing values of infection and increasing total phenol contents if compared with the control treatment (spraying with water only). This increase in the total phenol amount levels gave surely an increase in the capability of ground nut plants to defense against *Crotaloria paledo* infection process and disease development, since the role of secondary metabolic substance, such as phenolic compounds, on the disease resistance mechanisms is well known (Kalaichelvan and Mahadevan, 1989; Kalaichelvan and Nagarajon, 1992; Nada, 2002 and Al-Surhanee, 2013).

The suitable application time of plant extracts was tabulated in Table 7. Data revealed that the favourable time among all hot extraction of plant extracts was at 14 days, for Cherry tomato powdery mildew disease severity and its incidence. While inversely results was observed when plant extracts were extracted by cold water with the exception of garlic extract among all treatment times (7, 14, 21 and 30 days).

In addition the acetone and ethanol extraction methods of blue gum, marjoram and thyme gave significant decrease in severity and disease incidence of Cherry tomato powdery mildew at 14 days of application, being 23, 29 and 31% severity in acetone and 20, 23 and 30% in ethanol, respectively while, 25, 28 and 32% incidence in acetone and 20, 23 and 30% in ethanol, respectively.

Our conclusion, from Tables (3 , 4 , 5 , 6 and 7), revealed that the highest statically significant values of controlling Cherry tomato powdery mildew was determined for plant extracts of blue gum, marjoram and thyme when extracted by hot water, acetone and Ethanol extraction methods and also in case of cooling extraction of garlic plant.

The impact of plant extracts application on the yield production of Cherry tomato infected by *Leveillula taurica* the causal organism of Cherry tomato powdery mildew was presented in Fig. 1. Data indicated that blue-gum and marjoram plant extract treatments resulted in significant an increase of Cherry tomato fruit yield by 33.7 and 30.9 ton/faddan, then thyme plant extract by 28.6 ton/ faddan.

The powdery mildew disease causes a considerable loss because it reduces the photosynthetic area of leaves and greatly yield (50-100% in the absence of control) in mature plants. Treatment with an ecological agent increased apple fruit yield by 25.9- 12.2% in comparison to untreated (Al-Rawashed, 2012).

Table 7. Effect of application time of plant extract on Cherry tomato powdery mildew disease incidence and severity

Days	Extract type	Plant extract of : Anise	Blue gum	Cumin	Garlic	Marjoram	Thyme	Extract type	Plant extract of : Anise	Blue gum	Cumin	Garlic	Marjoram	Thyme
7	Hot Water DI (%)	52a	30a	68c	71b	41b	44a	Aceton DI (%)	58a	42a	70b	69a	42a	49a
14		40a	24a	46a	61a	29a	35a		68b	25a	63a	71c	28a	32a
21		65b	43b	67b	89c	49c	56a		68b	49c	76b	86b	49b	58b
30		52a	33a	56a	65a	41b	45a		51a	37b	57a	61a	48b	43a
7	Hot Water DS (%)	70b	32a	76c	81c	48b	58b	Aceton DS (%)	78c	49c	88b	96c	47b	66c
14		39a	26a	42a	59a	29a	34a		68b	23a	68b	69a	29a	31a
21		63b	33a	67b	80c	52b	52b		64a	43c	64a	84b	47b	52b
30		49a	34b	56a	65b	39a	43a		61a	39b	61a	79a	43b	50b
7	Cold Water DI (%)	76b	57a	88c	44a	71a	70b	Ethanol DI (%)	56b	32b	62b	60a	38b	43b
14		76b	88b	55a	32a	74a	72b		43a	20a	44a	70a	23a	30a
21		64a	93c	65b	44a	86b	79b		57b	35b	59b	75b	43c	43b
30		61a	86b	51a	35a	84b	66a		.69c	42c	58b	69a	45c	48b
7	Cold Water DS (%)	91c	86a	83c	47b	76a	71a	Ethanol DS (%)	77c	33c	85c	87c	42b	55c
14		52a	80a	50a	26a	84b	59a		42a	17a	46a	61a	21a	28a
21		73b	78b	67b	48b	82b	77b		60b	30b	65b	78b	43b	40b
30		67b	62a	56a	45b	61a	73a		48a	29b	53a	63a	36a	38a
LSD at 5%for Hot water DI (%)=		23	12	18	15	10	15	**for Aceton DI (%)=**	16	12	12	14	14	21
LSD at 5%for Hot water DS (%)=		22	11	14	12	13	16	**for Aceton DS (%)=**	08	11	11	13	13	10
LSD at 5%for Cold water DI (%)=		13	15	14	16	11	09	**for Ethanol DI (%)=**	11	12	13	12	10	13
LSD at 5%for Cold water D S (%)=		21	14	15	16	18	12	**for Ethanol DS (%)=**	14	14	18	12	17	12

DI (%)= Disease incidence percentage DS (%)= Disease severity percentage

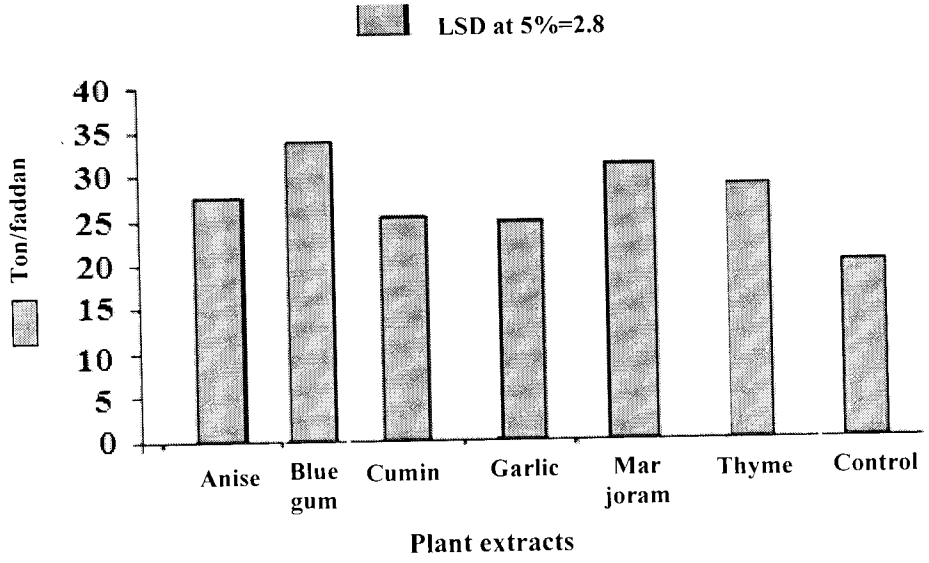

Fig 1. Effect of some plant extracts treatment on fruit production of Cherry tomato infected by *Leveillula taurica* the powdery mildew causal organism

Effect of some Induce Resistance Treatment on Cherry Tomato Powdery Mildew Infection

Three microelements (Fe, Zn and Mn) were applied as foliar spray on Cherry tomato plants in combination, while sodium bicarbonate (Bicarbonate), potassium phosphate (Trafose potassium) and mono potassium phosphate (Multi brotch) were singly applied for 4 times (7, 14, 21 and 30 days after 60 days from transplanting) to study their effects on infection of Cherry tomato with powdery mildew caused by *leveillula taurica.*

Data presented in Table 8 show that foliar application with microelments (Fe, Zn and Mn) in combination was significantly more efficient than addition of other induce resistance. In this regard, the average of disease incidence values were 2.7, 5.2, 11.8 and 20.9% after 7, 14, 21 and 30 days from application, respectively, while the control treatment values were 6.3, 12.2 , 27.36 and 63.30% after 7, 14, 21 and 30 days, respectively.

The same trend was observed after 7 and 14 days for trafose potatssium treatment (2.6 and 4.9%) as a disease incidence.

Furthermore, combination treatment with the three microelements (Fe + Zn + Mn) recorded the best effect on the pathogen where mean of the disease severity recorded 1.8, 2.2, 7.5 and 17.4% after 7, 14, 21 and 30 days of treatment, respectively. The same trend was observed after 14 and 21 days of treatment for trafose potassium which led to 3.0 and 8.50%.

On the other hand, all treatments were significantly decreased the disease incidence and severity compard with the control treatment.

Results of four induce resistance substances (Bicarbonat, Trafose potassium, Multi brotch and Transe elements combination (Fe + Zn + Mn) were recorded after 7 , 14 , 21 and 30 days from application.

Data in Table 9 show that the fourth application of bicarbonate, trafose potassium and multi brotch at 30 days successive by reduced disease incidence and severity of Cherry tomato powdery mildew. The better effect time application was recorded when plants were sprayed with the treated substances at the fourth date (after 30 days), which recorded 46, 39, 32 and 42% disease incidence and 53, 28, 42 and 25% disease severity for bicarbonate, trafose potassium, multi brotch and the combination of microelments (Fe + Zn + Mn), respectively.

Table 8. Effect of some induce resistance treatments on powdery mildew of Cherry tomato

Days of Application	7		14		21		30	
Induce substance	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**
Bicarbonate (Sodium)	3.2a	2.17 b	8 b	3.9 b	17.4 c	13.8 b	36.3c	29.4 d
Multi brotch (potassium phosphate)	3.13 a	1.5 a	7.3 b	4.6 b	9.5 a	8.3b	26.7b	23.1c
Trafose potassium (mono potassium phosphate)	2.6a	2.07 b	4.9 a	3 a	11.23 b	8.5 a	24.9 b	22.9 b
Transe elements(Fe+Mn+Zn)	2.7a	1.8 a	5.2a	2.2 a	11.8b	7.5 a	20.9 a	17.4a
Control	6.3	5.13	12.2	8.8	27.36	22.8	63.3	54.8
LSD at 5%	2.6	0.94	1.96	1.5	2.05	2.5 7	8.8	4.6

DI (%)= Disease incidence percentage DS (%)=Disease severity percentage

Table 9. Effect of time application of some induce resistance on Cherry tomato powdery mildew

Induce substance	Bicarbonate		Multi brotch		Trafose potassium		Transe elments	
Days of Application	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**	**DI(%)**	**DS(%)**
7	5 1 a	42 a	43 a	47 a	65 a	38 a	50 b	50 a
14	50 a	44 a	44 a	36 b	41 a	38 a	62 a	51a
21	52 a	52 a	43 a	38 a	40 a	40 a	37 c	36 b
30	46 a	53 a	32 a	42a	39 a	28 a	42b	25 b
LSD at 5%	16	13	14	11	38	14	18	14

DI (%)= Disease incidence percentage DS (%)=Disease severity percentage

El-Kafrawy (1997), reported that all application with microelements tested (Iron, Zinc and Manganese) exhibited the lowest percentage of pepper powdery mildew infection, as a result of increase the plant fitness. Moreover, reduction in pepper powdery mildew might be due to the role of the microelements in closing the stomata, delaying the penetration and development the pathogen or having a toxic effect, which causes growth reduction of the pathogen. Application of microelements can enhance the formation of mechanical barriers (lignifications) as well as the synthesis of toxins (Phytoalexins). Also micronutrients can affect disease resistance indirectly, as nutrient-deficient in plants not only exhibit an impaired defense response, but often might also become more suitable for feeding as many metabolites such as, reducing sugars and amino acids leak outside the plant cell. For example, plants suffering from Zn deficiency increase the disease severity after infection by *Oidium* spp. (Bolle-Jones and Hilton, 1956). In addition Reuveni *et al.* (1997) as well as Reuveni and Reuveni (1998) suggested that application of nutrient such as Mn can exchange and therefore release Ca cations from cell walls, which interact with salicylic acid and activate systemic acquired resistance mechanisms.

The microelements *i.e.* Fe, Zn and Mn play a great role in enzyme functions in plants and their growth, where many enzymes are of organic mineral complex structure. Zorbas *et al.* (1997) mentioned that microelements affect the oxidative-reduction system in the plants, for example zinc is a part in the structure of

transpiration enzyme carbonic anhydrate. On the other hand, Leidi *et al.* (1986) recorded that Fe and Mn supply and their uptake influence the plant growth, and the activity of peroxidase and catalase.

Screening of 8 salts used as foliar spraying to control tomato powdery mildew showed that all the tested salts reduced percentage of disease severity under greenhouse conditions (before and after artificial inoculation with *L. taurica)* and in open field, during the 2 successive seasons, 2006 and 2007 in El-Khawagat village, Fayoum Governorate. Abd El-Latef (2009) reported that sodium carbonate, potassium carbonate, sodium bicarbonate and potassium bicarbonate recorded the highest effect on disease severity. While the lowest effect on disease severity was recorded when plants were sprayed with each of sodium chloride and potassium chloride each alone. Moreover, the intermediate effect on disease severity was recorded when plants were treated with sodium phosphate dibasic and potassium phosphate dibasic separalely. These results are in agreement with those obtained by Reuveni *et al.* (1994); Ziv *et al.* (1994); Palmer *et al.* (1997); Reuveni *et al.* (1998); Demir *et al.* (1999); Souza and Cafe (2003); Lesson and Crisp (2004); Abd El-Kareem (2007) and Walters (2009).

Successful development of calcium chloride, chitosan, potassium biocarbonate and thyme oil as antifungal would not only provide a potential for control of vegetables foliar diseases, but also could promise success in multipurpose biorational to conventional fungicides for management of other plant diseases (Abd El-Kader *et al.*, 2012).

Data in Fig. 2 indicated that the tested resistance inducers showed the efficacy in increasing of Cherry tomato fruit yield compared with control. Transelements treatment resulted in an increase significantly of fruit yield by 34.2 ton/faddan, then trafose potassium, multi brotch and biocarbonate sodium, respectively. These results are in agreement with those obtained by Litterick *et al.* (2004) and Al-Rawashed (2012).

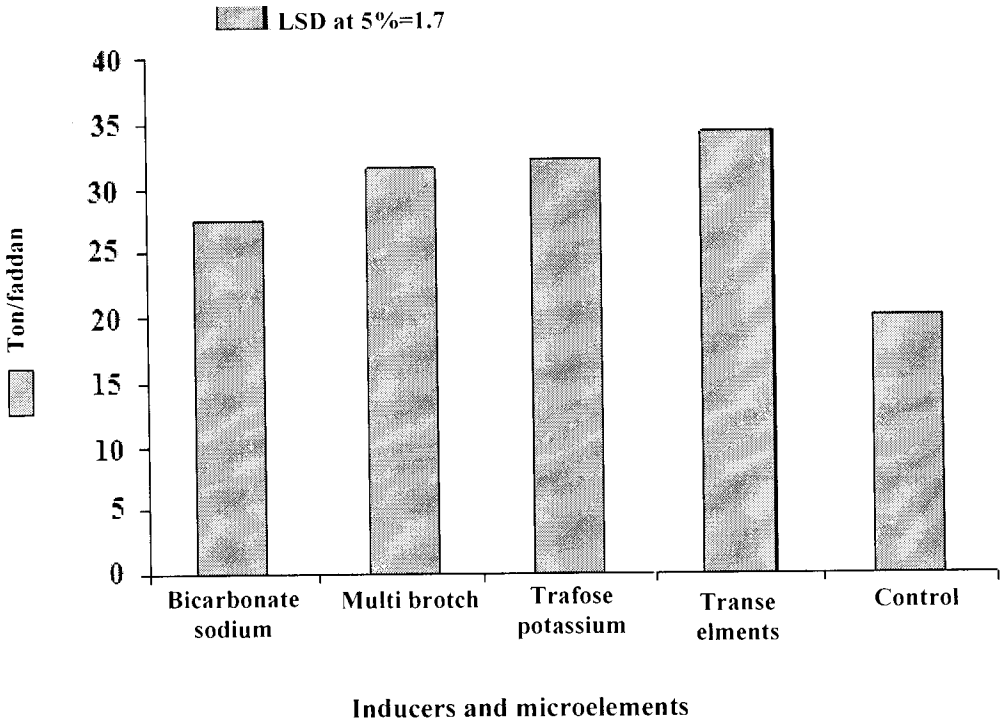

Fig. 2. Effect of some induce resistant treatments on fruit yield of Cherry tomato infected with powdery mildew causal organism *Leveillula taurica*

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المردود الآمن لبعض المعاملات الحيوية في مقاومة البياض الدقيقي في الطماطم الشيري

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تم معاملة المجموع الخضري لنباتات الطماطم الشيرى برش مستخلصات نباتات الينسون- الكافور الليمونى- الكمون- الثوم- البردقوش- الزعتر وذلك لمقاومة مرض البياض الدقيقى بها والمتسبب عن الفطر ليفليولا تايوريكا، وقد تبين أن جميع معاملات رش تلك المستخلصات قد خفضت معنوياً من حدوث المرض وشدته مقارنة بالنباتات غير المعاملة، وقد كان لمستخلصات النباتات التى تم استخلاصها بالماء الساخن والأسيتون والإيثانول أثر فعال فى مقاومة البياض الدقيقى على نباتات الطماطم الشيرى خاصة مستخلصات نباتات البرودقوش والزعتر، وجدير بالذكر أن طريقة الاستخلاص بالماء البارد لم يكن لها تأثير فى مقاومة المرض ما عدا مستخلص الثوم على البارد إذ أبدى فعالية عالية في تقليل شدة وحدوث المرض. والنتائج السابقة جميعها تحققت على جميع أوقات التجربة، كما أوضحت مستخلصات الكافور الليمونى والبردقوش تأثيراً إيجابياً معنوياً فى زيادة إنتاج محصول ثمار الطماطم الشيرى المصاب بالبياض الدقيقى وتلاهم فى ذلك تأثير مستخلص الزعتر، أدت معاملة نباتات الطماطم بالعناصر الدقيقة (الحديد، الزنك والمنجنيز) إلى تقليل حدوث الإصابة بالبياض الدقيقى، كما قلل شدة الإصابة فى النباتات المصابة وذلك على مدار إجراء التجربة، وقد اتضح نفس التأثير عند المعاملة بمستحثات المقاومة (بيكربونات الصوديوم - ترافوس بوتاسيوم ومالتى بروتك) خاصة عند المعاملة الرابعة بعد ٣٠ يوم.

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