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MANAGEMENT PRACTICES AFFECTING POWDERY MILDEW DISEASE OF GRAPES IN EGYPT

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ABSTRACT: *Powdery mildew of grapes caused by Uncinula necator (Schw.) Burr. is very important disease which severely affect leaves, branches and cause fruit splitting. In Egypt; this disease showed low percentage and severity of infection in the northern governorates i.e., (Alexandria and Behaira) while it was more severe in the southern ones (Qualubia and Giza). Severity of infection was higher at July and August than recorded earlier. Application of the biocontrol agents to grape plants led to significant reduction of disease symptoms and increasing of yield production. As for disease reduction Plant guard showed the best results while Trichoderma harzianum application gave the best yield of Thompson grape cultivar .Individual application of Camphore, Cumman and/ or Mentha oils significantly reduced disease incidence and improved yield quantity and quality. Mentha and Cumman oils; respectively; gave the best results on Thompson grape cultivar. Similar results were obtained when extracts of the same plant leaves were applied. Bellis and powder sulfur were the best tested fungicides in disease reduction and yield production.*

Key words: *Grapes, Powdery mildew of grapes, Uncinula necator, Biological control, Plant oils, Plant extracts and fungicides.*

INTRODUCTION

Powdery mildew of grapes caused by Uncinula necator (Schw.) Burr. Is an important disease all over the world. Cleistothecia are the only known source of primary inoculum in the grape production regions as reported by Grove (2004) and Shahri *et al.,* (2005). Ascospores released from cleistothecia germinate, infect and gave rise to typical powdery mildew colonies (Pearson and Gadoury, 1987).

As for fungicides, different management practices were carried out to control this pathogen such as biological control, application of plant oils and/or plant extracts. Hofmann (1997) reported that lactic acid bacteria are antagonistic to powdery mildew pathogens. Crisp *et al.,* (2006) found that Bacillus subtilus applied at 10–14 day intervals reduced powdery mildew disease severity .However Angeli *et al.,* (2007) recorded that some yeasts, bacteria and fungi were significantly effective in reducing mildew symptoms. Application of different mineral and / or plant oils to grape plants provided good protection, excellent pre-lesion and post-lesion curative action and were antisporulative of Uncinula necator as reported by Dhaliwal *et al.,* (2002) Ko *et al.,* (2003) and Zerabetto *et al.,* (2004). Plant extracts were also effective against the disease as reported by Tsror *et al.,* (2004), Schmitt (2005) and Schmitt (2006). Sulfur (0.2–0.6%) alone or in combination with sodium silicate (2–5gr) and some other specific fungicides were significantly active against the pathogen and decreased the symptoms of grape powdery mildew as reported by Fuzl (2002), Zulini *et al.,* (2004) and Scholberg *et al.,* (2006) .

The aim of this study to improve the methods of powdery mildew control on grapes using biocontrol agent(s), plant extracts in comparison with known fungicides.

MATERIALS AND METHODS:

Disease Survey:

Severity of infection (S.I.) with powdery mildew disease was accomplished during 2008 growing season at Alexandria,Beheaira, Menoufiy, Qalubia and Giza governorates. Thompson grape cultivar was subjected for these determinations every two weeks starting June 20th. Disease index (0 - 5) was followed where (0) means healthy plants and (5) means complete leaf damage covered with Uncinula necator growth. Formula of Solemn, (1988) was followed for this purpose:

$$S.I. = \frac{a \times b}{N \times K} \times 100$$

Where: a = number of infected plants, b: grade of infection

N: Number of total examined plants and K= maximum grade of infection.

Hundred plants assembled each sample and the evaluations were carried out four times ending August 5th.Temperature degrees and relative humidity percent during the forecasting estimation period were achieved from for Center Lap (ARC) to know the relation between them and disease distribution.

II- Effect of some biocontrol agents on disease incidents and yield production:

Liquid potato Dextros (PD) medium was used for growing each of Trichoderm harzianum, T. viride, Bacillus subtilus and Pseudomonas fluorescens. Biocontrol agents were achieved from Bot. Dept, Fac.Of Agric., Minoufiya University. The cultures were incubated for 7 days at 25°c in 250ml flasks. The obtained growth was filtered through muslin layer and the average of cell fructification units (cfu) was estimated. The filtrates were individually applied on grape Thompson cultivar (2009) season. Plants received five sprays (two weeks interval) starting first of February at the rate of 2 liters / plant uses back automizer, which was washed thoroughly between the variable applications. Plant guard was also applied at the same rate/ plant but three concentrations i.e. 2, 2.5 and 3ml/ liter were used. In the meantime, Bioranafilm at the rate of 2.5 ml/ liter was used as spreader and adhesive material. Percentage and severity of infection were evaluated 15 days after the last application. While yield parameters were estimated at harvesting. Data were statically analyzed and LSD at 5 % was calculated.

III- Effect of some plant oils on disease incidence and yield production:

The concentrations of 500, 1000 and 1500 ppm of commercial oils i.e., Camphore, Mentha and Cumman were individually applied on Thompson grape cultivar at (2009) growing season. The same methods and data estimation of the biocontrol agents experiment was followed.

IV-Effect of leaf extracts of some aromatic plants on disease incidence and yield production:

Leaves of Camphore, Cumman and Mentha plants were surface sterilized using 1% sodium hypochlorite, washed several times with sterilized distilled water and left in open air to dry. The amount of 30 gram leaves was separately ground and soaked in one liter sterilized distilled water for 24h to obtained 3% water extract. The concentrations of 1 and 2% were adopted. The abovementioned procedures and the experimental design were followed at the same farm using both grape cultivars.

V-Effect of different concentrations of some fungicides on disease incidence and yield production:

Different concentrations of Amistar, Bellis, Liqued sulfur and Powder sulfur

were applied to grape plants five times at 15 day intervals starting February 15th at the rate of two liters/plant. Data of powdery mildew infection and yield were estimated as mentioned before. Both percentage and severity of infection with Uncinula necator were determined 15 days after the last application. However yield Parameters i.e., average number of clusters / plant, average yield / plant and average grain diameter were estimate at harvesting. All obtained data were statistically analyszed and LSD at 5 %was a estimated.

RESULTS AND DISCUSSION

I. Survey of powdery mildew disease in different governorates:

Survey of powdery mildew disease incidence was carried out during 2008 growing season. Five different governorates i.e., Alexandria, Behaira, Minoflya, Qalubiya and Giza were chosen for this survey which conducted four times, (15 days interval) from June 20th to August 5th. Results present in Table (1) clear that severity of infection with Uncinula necator was increased by delaying time of estimation. It was also noticed that powdery mildew disease incidence was lower at the northern governorates (Alex, and Behaira) than the southern ones (Qalubiya and Giza). Severity of infection at Alexandria ranged from O at June, 20 to 15% at August, 5. At the same dates; these were 0-25%, 7-30%, 11-33% and 15-37%, respectively at Behaira, Minoufya, Qalubia and Giza governorates. Such results clear that powdery mildew disease of grapes was more favored by high temperature. The above results are in agreement with Angeli. (2006).

II. Effect of some biocontrol agents on powdery mildew disease incidence and yield production:

Results present in Table (2) clear that application of the biocontrol agents on Thompson grape cultivar, at (2009 season) significantly reduced powdery mildew disease incidence and improved yield quantity and quality. As for disease incidence, Plant guard (6×106 cfu/ml) and Trichoderma harzianum (4.7× 105 cfu/ml), were the best used agents, where all treated plants were free from the disease. Bacillus subtitlus (7.5×108 cfu/ml), Plant guard (6×106 cfu/ml) and Pseudomonas fluorescens (5.5×107 cfu/ml) had the second rank in reducing powdery mildew infection. Percentage and severity of infection were 12.0 & 7.0%, 12.5 & 7.0 and 14.0 & 4.0%, respectively. These are in accordance with Hofman (1997), Crisp *et al.*, (2006) and Angeli *et al.*, (2007).

Table (1): Severity of infection (%) with uncinula necator on grape cultivar Thompson grown at five governorates (2008 season):

Governorate	Date of Estimation			
	June 20	July, 5	July 20	August, 5
Alexandria	0%	0%	3%	15%
Beheira	0%	5%	19%	25%
Minoufiya	7%	12%	22%	30%
Qalubiya	11%	17%	27%	33%
Giza	15%	24%	30%	37%

Table (2): Effect of some biocontrol agaents on powdery mildew disease incidence and yield production of Thompson grape cultivar grown at Sadat city, (2009 season):

Bioagent		Percentage of infection	Severity Of infection (%)	Av. No. of clusters	Yield/plant (kg)	Av. grain Diameter (cm)	Av.cluster length (cm)
Trichoderma harizianum		0	0	26.5	22.5	2.2	21.5
Trichoderma virlde		18.5	9.5	24.0	19.5	1.8	22.0
Bacillus subtilus		12.0	7.0	21.0	17.0	1.7	18.5
Pseudomonas flourescens		14.0	4.0	19.5	16.5	2.0	20.5
Plant guard	2ml/L	22.5	13.5	17.5	15.0	1.6	19.0
	2.5ml/L	12.5	7.0	20.0	18.5	1.9	21.0
	3ml/L	0	0	23.0	22.0	2.0	23.0
Control		50.0	27.0	15.0	12.5	1.3	15.0
L.S.D 0.05		7.2	4.6	3.7	2.8	1.2	2.5

*Control= untreated grape plants.

III: Effect of some plant oils application on powdery mildew disease incidence and yield production.

Application of Camphor, Cumman and Mentha oils, individually at the concentrations of 500, 1000 and 1500ppm on grape Thompson cultivar at (2009 season) significantly minimized powdery mildew disease infection and improved both quantity and quality of yield. Results given in Table (3) clear that percentage and severity of infection were 14.8 & 8.5, 10.0& 6.2 and 15.7 & 11.2, respectively, when 500 ppm of the Mentioned oils were applied. Whereas they were 50.0 & 22% for the untreated control plants. Both percentage and severity of infection were decreased by increasing the oils concentration and resulted grape plants free of infection at 1500 ppm of any used oil.

As for yield production Mentha oil (1500ppm) was the best where it produced the average of 25 clusters/ plant (19.5kg) followed by Cumman oil (1500ppm), 23.8 clusters/ plant (17.8kg). Number of produced clusters per plant and their average weight were respectively 12 and 9.5kg for the untreated control plants. Fruit quality was also positively affected with oil applications and Mentha oil gave the best results where the average cluster length was 24.5cm and the average grain diameter was 2.2cm. Those were respectively 15 and 1.2 cm for the untreated control plants.

Application of different mineral and / or plant oils to grape plants provided good protection, excellent pre-lesion and post-lesion curative action and were antisporulative of Uncinula necator as reported by Dhaliwal *et al.*, (2002) Ko *et al.*, (2003) and Zerabetto *et al.*, (2004).

Table (3): Effect of different plant oils application on powdery mildew infection and fruit yield of Thompson grape cultivar grown at Sadat city, (2009 season).

Oil concentration		Percentage of infection	Severity Of infection (%)	Av. No. of clusters	Yield/ plant (kg)	Av. grain diameter (cm)	Av. cluster length (cm)
Camphor	500ppm	14.8	8.5	17.8	13.3	1.7	19.8
	1000ppm	11.5	6.5	18.8	14.6	1.8	21.5
	1500ppm	0	0	21.8	16.3	2.1	23.0
Cumman	500ppm	10.0	6.2	18.5	13.5	1.6	22.2
	1000ppm	8.5	5.0	19.8	14.7	1.7	23.0
	1500ppm	0	0	23.8	17.8	1.9	23.5
Mentha	500ppm	15.7	11.2	18.5	13.8	1.8	18.5
	1000ppm	13.5	7.3	22.2	16.7	16.7	20.2
	1500ppm	0	0	25.0	19.5	19.5	24.5
Control		50.0	22.	12.0	9.5	1.2	15.0
L.S.D 0.05		5.2	3.2	3.8	2.5	1.2	2.4

*Control= untreated grape plants.

Table (4): Effect of leaf extracts of some aromatic plants on powdery mildew disease incidence and yield production of Thompson grape cultivar grown at Sadat city, (2009 season).

Plant extracts (concentration)		Percentage of infection	Severity Of infection (%)	Av. No. of clusters	Yield/ plant (kg)	Av. grain diameter (cm)	Av.cluster length (cm)
Camphor	1%	30.5	22.2	17.8	13.3	1.6	18.8
	2%	25.0	17.5	20.5	15.5	1.7	20.5
	3%	11.5	5.0	21.8	16.7	2.0	22.0
Cumman	1%	23.5	14.5	18.0	13.3	1.8	18.2
	2%	19.5	11.0	19.0	14.2	1.9	20.2
	3%	0	0	22.0	16.0	2.0	23.0
Mentha	1%	20.5	12.5	19.5	14.5	1.5	16.0
	2%	13.5	7.5	21.5	17.0	1.6	20.0
	3%	0	0	24.0	19.0	1.9	23.0
Control		60.0	35.0	12.0	9.5	1.2	14.0
L.S.D 0.05		6.5	4.2	3.1	2.3	1.3	2.9

*Control= untreated grape plants.

IV: Effect of leaf extracts of some aromatic plants on powdery mildew disease incidence and yield production.

Juices of Camphor, Cumman and Mentha leaves at the concentration of 1, 2 and 3% were individually applied to grape Thompson at (2009) growing season. Results present in Tables (4) clear that these applications significantly decreased both percentage and severity of infection with U.necator .The best effect was noticed when Mentha juice was applied to Thompson cultivar. It was also noticed that increasing the concentration of any tested juices had more efficiency in decreasing the disease parameters. Yield production was positively responded by different tested plant juices. The best average number of clusters and their weight were respectively 24 & 19 kg for Thompson plant treated with Mentha juice. The average length of clusters and the average diameter of grape grains also showed the same trend. On the other hand, the untreated control plants of Thompson cultivar showed 60% percentage of infection, 35% severity of infection and produced the average of 12 clusters per plant which only weighed 9.5kg. Plant extracts were also effective against the disease as reported by Tsror *et al.*,(2004), Schmitt (2005) and Schmitt (2006).

V: Effect of different concentrations of some fungicides on powdery mildew disease incidence and yield production.

Different concentrations of some chemical fungicides i.e., Amistar, Bellis, Liquid sulfur and Powder sulfur were tested for their effect on grape powdery mildew disease incidence and fruit yield production. Results shown in Table (5) clear that all tested compounds significantly reduced the disease and improved fruit yield in comparison with the untreated control plants. However, higher concentrations of any fungicide were more effective in disease control and yield production, where the highest concentration of each used fungicide resulted plants free of infection with U. necator. However the best results of yield were achieved when Bellis 236 ppm and Powder sulfur 1440 ppm were applied. The average of cluster numbers and quantity were respectively, 25.5, 22.0 kg and 24.0, 21.0 kg / plant. The same trend was noticed for fruits quality where clusters length and grain diameter were respectively 23.5 and 2.1 cm (Bellis 236 ppm) and 21.0 and 2.0 cm (Powder sulfur 1440 ppm). Amistar at the concentration of 175 ppm resulted the average of 23.0 clusters / plant which weighed 19.5 kg. While (Liquid sulfur 1440 ppm) gave 22.0 clusters / plant 20.5 kg. Seventy five percent of the untreated control plants were infected with powdery mildew with average of 40% severity of infection. Such plants produced an average of 15.0 clusters / plant 12.0 kg which showed the average of 14.5cm cluster length and 1.4cm grain diameter.

Application of fungicides to grape plants significantly reduced the infection of grape powdery mildew and improved yield production as reported by Fuzi (2002), Morando *et al.*, Zulini *et al.*, (2004) and Scholbery *et al.*, (2006).

Table (5): Effect of different concentration of some fungicides on powdery mildew disease incidence and yield production of Thompson grape cultivar grown at Sadat city, (2009season).

Fungicide conc. ppm		Percentage of infection	Severity Of infection (%)	Av. No. of clusters	Yield/ plant (kg)	Av. grain diameter (cm)	Av.cluster length (cm)
Amistar	75	25.0	12.0	19.5	14.6	1.4	19.0
	125	18.0	8.5	21.0	16.5	1.6	20.5
	175	0	0	23.0	19.5	1.9	21.5
Bellis	144	20.5	11.0	21.5	16.2	1.5	19.7
	190	14.0	5.5	24.0	20.0	1.8	22.0
	236	0	0	25.5	22.0	2.1	23.5
Liqued	960	35.0	19.0	17.0	15.7	1.5	16.5
Sulfur	1200	25.5	15.0	19.5	18.5	1.7	19.0
	1440	0	0	22.0	20.5	1.9	21.0
Powder	960	38.0	22.0	16.5	15.0	1.5	17.5
Sulfur	1200	25.0	17.0	19.0	19.5	1.8	18.5
	1440	0	0	24.0	21.0	2.0	21.0
Control		75.0	40.0	15.0	12.0	1.4	14.5
L.S.D 0.05		9.5	5.4	3.7	2.9	1.3	2.2

*Control= untreated grape plants.

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طرق مكافحة مرض البياض الدقيقى على العنب فى مصر

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الملخص العربى

يعتبر مرض البياض الدقيقى من أهم أمراض العنب حيث يسبب جفاف الاوراق وتشوهها وتشقق الثمـــار ونقص المحصول.أجرى هذا البحث بهدف التوصل لطرق أمنة وصديقة للبيئة لمكافحة هذا المرض ، ويمكـــن تلخيص أهم النتائج فيما يلى:

وجدا أن نسبة وشدة الاصابة بالمرض أعلى بصورة معنوية فى المحافظات الجنوبية (القليوبية –الجيزة) مقارنة بالمحافظات الشمالية (الاسكندرية – البحيرة). كما أن شدة الاصابة بالمرض تزداد فى شهرى يوليو وأغسطس. وقد أدت معاملة النباتات بكائنات التضاد الحيوى الى تقليل الاصابة بالمرض وزيادة المحصول بصورة معنوية لصنفى الدراسة طومسون و كريمسون. وكانت أفضل المعاملات هى بلانت جارد ثم ترايكودرما هارزيانم فى تقليل الاصابة بالمرض، فى حين كانت المعاملة بالفطر ترايكودرما هارزيانم هى الافضل فى المحصول للصنف طومسون. أدى رش النباتات بزيوت(الكافور،الكمون و النعناع) منفردة الى تقليل الاصابة بالمرض وزيادة المحصول ، وكان أفضلها هو زيت النعناع بتركيز(١٥٠٠ جزء فى المليون) على الصنف طومسون وزيت الكمون بتركيز(١٥٠٠ جزء فى المليون) على الصنف كريمسون.أدت معاملة نباتات العنب تحت الدراسة بمستخلصات النباتات العطرية (الكافور– الكمون – النعناع) الى نفس النتائج على صنفى طومسون و كريمسون. أظهرت المبيدات الفطرية بيللز؛ أميستار وأيضا مسحوق الكبريت أفضل النتائج فى تقليل الأصابة بالمرض وزيادة المحصول كما وكيفا.