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Evaluation of an Integrated Control Program for Downey Mildew of Grapes in Egypt

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ABSTRACT

The main objective of this study is to evaluate the effect of fungicides ,essential oils , biocides and fertilizers on *Plasmopara viticola* the causal organism of downy mildew in three varieties of grapes at three governorates (Aldaqahlia, Albehira and Almonofia) on three seasons, the first season evaluated the effect of fungicides in reducing the disease severity, Ridomil gold plus ,Equation pro and Antracol gave high effect in decreasing the disease, the second season tested essential oils , biocides and fertilizers separately on the pathogen; cinnamon and rosemary were the best in controlling the disease however Plantaguard, Rhizo N and Chitosan decreasing the disease, the thirdseason evaluated integrated control program which contained all tested compounds combined but in certain order according to dormancy stage, flowering and fruiting to reduce number of sprays fungicides and using eco-environmental compounds on vine leaves and fruits in field conditions, the program gave very high effect in reducing the disease severity of downy mildew in grapes for all governorates in three varieties of grapes (flame , crimson and thompson).

INTRODUCTION

The grape crop is considered one of Egypt's very important fruit crops from an export standpoint. It occupies second place after citrus fruits, and its cultivation is spread throughout the Republic from Alexandria to Aswan due to the difference and diversity of its varieties and the quality of its cultivation in different types of sandy and clay soils. Due to this spread in the Republic, early and late-maturing varieties appeared in the period from May to November. Beheira Governorate is considered the largest governorate in exporting grapes, representing 40% of the total grape export to Europe and 14% of the total grape production in the public. One of the most popular varieties in the European market is the Thompson and Flame variety, which mature in May to September.

Downy mildew disease in grapes, which is caused by the fungus *Plasmopara viticola.*, is considered one of the most important diseases that affect grapes and causes major losses in the crop. The infection begins from the vegetative growths until it reaches the clusters. Yellow spots spread between the veins and may appear oily until they spread and cover the entire leaves. Downy growth appear on the backs of the leaves and the Clusters. Chemical control is considered one of the most important methods of controlling the disease. So, the application with fungicides should be sprayed twice, first once at the stage of opening the flower buds, before blooming, then, the second spraying after setting and fruiting. In this respect, the most efficient fungicidescontrolling were recording captan, copper, fosetyl-Al, mancozeb, maneb, and ziram. Elizabeth Bush, Virginia Polytechnic Institute and State University, Bugwood.org2022

Chemical control that is carried out either before or after infection has a positive effect on reducing the severity of the disease or avoiding it significantly. This depends on the time of treatment with fungicides, as treatment with copper and dithiocarbamte compounds is done before infection, when the length of the shoot reaches 10 cm at the time of swelling of the flower buds. These fungicides are characterized by their There is no resistant to the fungus, but application before infection. The fungicides that are applied after infection are mostly systemic to provide efficiency in controlling the disease, but their cost is somewhat high, but they give excellent results with programs for forecasting and early detection of the disease.Most of prominent models of disease predictive programs was Australian D-Model (Magarey *et al*., 1991), DMCast model in the US (Park *et al*.,1997), EPI model (Stryzik, 1983) and POM model in France and complex mechanistic UCSC model in Italy (Rossi *et al*., 2008). All of these program were used in the integrated control program (Gessler*et al.,* 2011). By using post-infection fungicides include fosetyl-aluminum, melalaxyl, azoxystrobin and mandipropamid. According to mode of action of them, some of these fungicides are recommended for controlling grape

downy mildew. Given the recent trend to distinguish between environmentally friendly and alternatives to fungicides, fungicides and bacteria (Chagas.,*et al* 2014; Maia *et al*., 2014). The most important of these oils is cinnamon oil, which has given excellent results in reducing plant diseases (Ranasinghe *et al*., 2002; Kishore *et al.,* 2007; Maqbool*et al*., 2010), eucalyptus (Lorenzetti *et al.*, 2012), marjoram (Fialho, 2012), melaleuca (Frasson*et al.*,2010), peppermint (Chagas *et al*., 2014) oregano (Mallet *et al*., 2014) and white thyme oils (Perina*et al*., 2015). This study aimed to evaluate the effect of five essential oils on downy mildew of grapevine. The Clove, Cinnamon, Peppermint, Rosemary and Thyme Oils were compared with the Ridomil gold SI , Ridomil gold plus , Equation pro ,Mancozeb and Antracol fungicides, and two biocides Plantaguard and Rhizo N. finally in the last season we designed an integrated control program including fungicides ,essential oils ,biocides and fertilizers with certain order to control the disease and reducing the spraying of fungicides with using eco-environments compounds.

MATERIAL AND METHODS

Field experiment. Mature, field-grown grapevines (*Vitisvinifera*) on Flame Crimson and Thompson) were used during the 2021-2023 growing seasons. The experimental vineyards were located at ALmansoura (Aldaqahlia Governorate), South of Tahreer (Albehira Governorate) and Alkhatatba (Almonofia Governorate), The grape vines were treated with all the agricultural and horticultural processes followed on a regular basis.Vines are grown in clay soil; the distance between rows was 2 and 3 m within rows, under flood irrigation system at Almansoura and under drip irrigation system at South of Tahree and Alkhatatbain sandy soil .The experiment was arranged in a complete randomized block design with three replicates per treatment, four vines for each one.

In the first season 2021 we applied five fungicides i.e (Ridomil gold SI , Ridomil gold plus, Equation pro, Mancozeb and Antracol), the beginning of spraying was in February when the trees were 25% flowering each fungicide was sprayed once every week for three times. In the second season 2022 we applied alone the biocides (Plantaguard and Rhizo N) and essential oils (Clove Oil, Cinnamon Oil, Peppermint Oil, Rosemary Oil and Thyme Oil). The oils were obtained from ElGomhoria Company for Oils and Pharmaceutical Industries, Cairo, Egypt. The oils were emulsified with 3 %Tween80. Oil emulsion was separately sprayed as mentioned in Table(2) and the fertilizers (Calcium Silicates, Calcium Chloride, Potassium Chloride, Chitosan and Potassium phosphate) the beginning of spraying was in the dormancy stage twice/week in case of oils and once/week in case of fertilizers and biocides .in the third season 2023 we applied the integrated control program by spraying all treatments but in certain order which gave the best results where the beginning was in November at dormancy stage before swelling buds. All doses were recorded in tables 1and 2

Disease severityrate:

The disease severity was assessed using a six-point scale based on the area of the leaves covered in white lesions:

0(no symptoms);
1(below 5%symptoms of infections);
3(6 to 25% symptoms of infections);
5(26 to 50% symptoms of infections);
7 (51 to 75% symptoms of infections);
And 9 (more than 75% symptoms of infections).

(Yu et al. 2016). Leaves without treatments served as a control. Each treatment consisted of three detached leaves, and each treatment was undertaken in three replicates (Chiouand Wu 2001).

The control effect was calculated using the disease severity (Equations):

$DI= \sum (AXB)/ M X B_{max} x100$

Where:

A- the number of diseased leaves from all the levels;
B- the level of each diseased leaf;
M- the total number of the leaves;
Bmax -the highest level of the disease.

Table 1: Tested fungicides and biocides treatments

TREATMENTS	Rate/100 liter water	Active ingredient
Ridomil Gold Sl	150ml	Mefenoxam
Ridomil Gold Plus 42.5% Wp	150g	Metalaxyl and Copper oxychloride
Mancozeb 80% Wp	200g	Mancozeb
Antracol 70% wp	200g	Propineb
Equation pro 52% WG	40 ml	Cymoxanil and Famoxadone
Plantguard	250g	*Trichoderma* sp. 3×10^6 spore/ml
RhizoN	250g	*Bacillussubtillis*. 3×10^6 c.f.u/ml

Table 2: Tested essential oils and fertilizers treatments

TREATMENTS	Rate alone	Rate in the integrated control program
Clove oil	2 ml/litter +3 %Tween80	1 ml/litter +3 %Tween80
Cinnamon oil	2 ml/litter +3 %Tween80	1 ml/litter +3 %Tween80
Peppermint oil	2 ml/litter +3 %Tween80	1 ml/litter +3 %Tween80
Rosemary oil	2 ml/litter +3 %Tween80	1 ml/litter +3 %Tween80
Thyme oil	2 ml/litter +3 %Tween80	1 ml/litter +3 %Tween80
Chitosan	0.5g/ litter	0.5g/ litter
Calciumsilicates	2 g/litter	1 g/litter
Calciumchloride	2 g /litter	1 g/litter
Potassium chloride	2 g/litter	1 g/litter
Potassium phosphate	2 g/litter	1 g/litter

Statistical analysis

This experiment was arranged as a complete randomized block design with four replicates, three vines per each one. Data were subjected to analysis of variance (ANOVA) using Costat Statistical Software (1986). Means of all data were compared by LSD method at 5% according to Snedecor and Cochran (1994).

RESULTS

Data in table (3) showed that all treatments reduced % disease severity significantly hence fungicides (Ridomil gold plus, Equation pro and Antracol gave the highest efficacy in controlling Downey mildew in grape in all varieties (flame, crimson and Thompson) whether on leaves or fruits at Almansoura in Aldaqahlia governorate. Ridomil gold plus gave disease severity (27.5 %, 44% and 40.5%) on leaves of flame, crimson and Thompson respectively; in case of fruits the fungicide gave 17.5 %, 25% and 25% in the same varieties respectively in comparing with the control which was in case of leaves (76% ,83% and 95%) respectively. Table (4) showed that in south of tahreer at Albehera governorate the percentage of disease severity decreased clearly with all treatments especially with Ridomil gold plus and Equation pro. Data in table (5) gave also high effect of fungicides to control Downey mildew disease compared with control, the best one was Ridomil gold plus and the next one was Equation pro at Alkhatatba in Almnofia governorate.

Table 3: Fungicidal effect of percentage of disease severity of Downey mildew in three verities of grapes at Almansoura on season 2021

Treatments	ALMANSOURA						
	Time	Flame		Crimson		Thompson	
		leaves	fruits	leaves	fruits	leaves	Fruits
Zero time	25% flowering	37.5	17.5	55	30	55	32.5
Ridomil gold Sl	three sprays	32.5	17.5	40	25	50	25
Ridomil gold plus	A week between each spray	27.5	17.5	44	25	40.5	25
Equation pro		27.5	17.5	48	25	45	27
Mancozeb		47	22.5	57.5	30	60	35
Antracol	three sprays	28.5	18	43	25	48	25
CONTROL		76	53	83	83	95	90
LSD 0.05		6.250	5.070	6.6	5.5	7.08	6.312

Table 4: Fungicidal effect of percentage of disease severity of Downey mildew disease in three verities of grapes at South of tahreer on season 2021

Treatments	South of Tahreer						
	Time	Flame		Crimson		Thompson	
		Leaves	fruits	leaves	fruits	leaves	Fruits
Zero time	**25% flowering**	40	17.5	55	30	37	35
Ridomil gold Sl	three sprays	43	30	60	45	53	45
Ridomil gold plus	A week between each spray	42	25	57	45	55	45
Equation pro		40	20	50	30	53	35
Mancozeb		58	25	65	35	70	45
Antracol	three sprays	45	35	55	35	60	35
CONTROL		75	48	85	82	93	85
LSD 0.05		5.615	5.8	9.453	3.77	7.87	5.837

Table 5: Fungicidal effect of percentage of disease severity of Downey mildew in three verities of grapes at Alkhatatba on season 2021

Treatments	ALKHATATBA						
	Time	Flame		Crimson		Thompson	
		Leaves	fruits	leaves	fruits	leaves	fruits
Zero time	25% flowering	28	17.5	38	35	55	35
Ridomil gold Sl	three sprays	24	25	32	25	48	35
Ridomil gold plus	A week between each spray	22	24	30	25	45	25
Equation pro		25	17	30	20	50	35
Mancozeb		45	30	50	35	55	45
Antracol	three sprays	36	20	45	25	55	35
CONTROL		77	65	85	75	75	90
LSD 0.05		4.575	5.308	3.926	6.274	4.088	5.272

Data in tables 6, 7 and 8: all experiments carried out in the second season 2022 and all treatments were applied in dormancy stage and buds swelling, there was a significant differences between essentials oil alone and control under field condition at three different locations, in three varieties hence we found that the most effective treatments were cinnamon oil and rosemary oil at all locations.

In the second season 2022 also we applied the biocides (Plantaguard and RhizoN) in the dormancy stage with buds swelling, as table (9) recorded a significant differences between the biocides and control at all locations in all varieties of grapes in leaves and fruits, hence % disease severity decreased clearly with plantaguard and the next was Rhizo N.

Tables (10,11 and12) showed the effect of fertilizer treatments on the percentage of the average disease severity on each of leaves and fruits of three varieties of grapes in the second season 2022 at Almansoura, South of Tahrir and Alkhatatba ,The results showed that there were clear significant differences between the treatments, where chitosan, showed the best results compared to the rest of fertilizers, where the percentage of disease severity on the leaves were (55, 55 and 70) compared to the control(80%,85 and 80) at Almansoura the same results obtained in South of tahreer and Alkhatatba.

Table 6: Effectiveness of essential oils on percentage of disease severity of downy mildew disease in three verities of grapes alone at Almansoura on season 2022

Treatments	AL-MANSOURA						
	Time	Flame		Crimson		Thompson	
Zero time	Dormancystage and	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits
	buds swelling	0	0	0	0	0	0
Clove oil	Twice /week	60	45	64	45	73	45
Cinnamon oil	Twice /week	57	30	60	35	60	35
Peppermint oil	Twice /week	67	35	70	40	70	45
Rosemary oil	Twice /week	57	30	52	30	63	45
Thyme oil	Twice /week	70	50	75	70	90	70
Control		85	85	90	90	90	90
LSD 0.05		4.090	5.239	5.107	8.645	3.985	6.196

Table 7: Effectiveness of essential oils on percentage of disease severity of downy mildew disease in three verities of grapes alone at South of tahreer on season 2022

Treatments	SOUTH OF TAHREER						
	Time	Flame		Crimson		Thompson	
Zero time	dormancy stage	Leaves	fruits	leaves	fruits	leaves	Fruits
	and buds swelling	0	0	0	0	0	0
Clove Oil	twice /week	27	17	36	27.5	37.5	30
Cinnamon Oil	twice /week	17	17	23.5	17.5	35.5	25
Peppermint Oil	twice /week	47	25	40	25	45	30
Rosemary Oil	twice /week	37	30	28.5	20	45	30
Thyme Oil	twice /week	50	35	65	35	60	45
Control		70	50	78	45	80	55
LSD 0.05		2.967	5.050	3.379	4.409	3.441	3.400

Table 8: Effectiveness of essential oils on percentage of disease severity of downy mildew disease in three verities of grapes alone at Alkhatatba on season 2022

Treatments	ALKHATATBA						
	Time		Flame		Crimson		Thompson	
Zero time	dormancy stage and buds swelling		Leaves	fruits	leaves	fruits	leaves	Fruits
			0	0	2.5	0	3.3	0
Clove Oil	twice /week		23	17	26	17	30	20
Cinnamon Oil	twice /week		20	17	24	14	25	23
Peppermint Oil	twice /week		45	25	45	25	55	35
Rosemary Oil	twice /week		25	25	35	25	45	35
Thyme Oil	twice /week		55	40	60	45	68	45
Control			70	55	75	60	77	55
LSD 0.05			2.932	5.320	3.372	4.165	4.086	4.996

Table 9: Effect of two biocides alone on percentage of disease severity of downy mildew on three varieties of grapes at three locations on season 2022

Treatments	ALMANSOURA						
	Time	Flame		Crimson		Thompson	
Zero time	dormancy stage and buds swelling	leaves	fruits	leaves	fruits	leaves	fruits
		0	0	0	0	0	0
Rhizo N	once/ week	55	35	60	45	68	50
Plantagard	once/ week	40	20	45	20	55	20
control		65	40	65	45	65	60
LSD 0.05		2.342	3.785	2.838	3.881	2.545	2.124
	SOUTH OF TAHREER						
Zero time	dormancy stage and buds swelling	0	0	0	0	0	0
Rhizo N	once/ week	45	25	55	30	70	35
Plantagard	once/ week	35	17	25	17	45	20
control		65	65	65	40	65	55
LSD 0.05		2.666	3.738	3.081	2.823	2.653	3.201
	ALKHATATBA						
Zero time	dormancy stage and buds swelling	0	0	0	0	0	0
Rhizo N	once/ week	35	17	45	20	45	30
Plantagard	once/ week	25	17	35	17	35	20
control		65	30	45	40	60	55
LSD 0.05		3.704	3.492	3.341	2.945	3.230	no significant

Table 10:- Effect of fertilizers alone on three varieties of grapes to reduce the percentage of disease severity of Downey mildew at Almansoura on season2022

Treatments	ALMANSOURA						
	Time	Flame		Crimson		Thompson	
Zero time	dormancy stage and buds swelling	leaves	fruits	leaves	fruits	leaves	Fruits
		6	0	16	0	13	0
Calcium Silicates	once/week	61	40	67	45	70	70
Calcium Chloride	once/week	65	45	65	65	70	65
Potassium Chloride	once/week	63	45	66	70	75	75
Chitosan	once/week	55	30	55	35	70	60
Potassium phosphate	once/week	55	55	55	57	70	55
Control		80	70	85	85	85	80
LSD 0.05		7.067	4.092	5.067	6.593	4.766	4.574

Table 11: Effect of fertilizers alone on three varieties of grapes to reduce the percentage of disease severity of Downey mildew at South of tahreer on season2022

Treatments	SOUTH OF TAHREER						
	Time	Flame		Crimson		Thompson	
Zero time	dormancy stage and buds swelling	leaves	fruits	leaves	fruits	leaves	fruits
		16.5	0	22	0	22	0
Calcium Silicates	once/week	65	50	70	55	70	55
Calcium Chloride	once/week	70	55	70	55	70	66
Potassium Chloride	once/week	60	55	70	66	70	70
Chitosan	once/week	60	45	70	55	75	60
Potassium phosphate	once/week	60	50	70	66	70	60
Control		77	60	90	75	90	85
LSD 0.05		4.721	4.332	4.613	6.108	5.595	4.958

Table 12: Effect of fertilizers alone on three varieties of grapes to reduce the percentage of disease severity of Downey mildew at Alkhatatba on season2022

Treatments	ALKHATATBA						
	Time	Flame		Crimson		Thompson	
Zero time	dormancy stage and buds swelling	leaves	fruits	leaves	fruits	leaves	fruits
		5	0	5	0	4	0
Calcium Silicates	once/week	33	17	30	20	44	25
Calcium Chloride	once/week	44	30	48	25	55	27
Potassium Chloride	once/week	40	25	45	25	55	25
Chitosan	once/week	30	20	45	20	55	25
Potassium phosphate	once/week	50	30	55	35	65	40
Control		65	45	65	50	68	55
LSD 0.05		5.741	3.499	3.057	4.462	4.359	4.933

Tables (13, 14 and15) showed the results of the third season 2023 applying the integrated control program for plant diseases that affect three varieties of grape in each of Almansoura, South of Tahrir and Alkhatatba. Where we found that all the plants were sprayed in the dormancy stage in November once every 7 days, Hence, the efficiency of the program was in reducing the number of fungicides sprays, as well as the introduction of biofungicides in the program to reduce toxicity and increase safety on fruits, especially in the case of export. The program was designed on the basis of the beginning of spraying in November, when the buds swell, to eliminate any fungal or insect infection from the previous season, and then spraying with fungicides such as Ridomil gold sl and Ridomil gold plus , Equation pro and Antracol at the beginning of flowering, settling and ripening of fruits, biocides are sprayed i.e. Plantagaurd and RizoN in order to preserve the flowers from falling, protect the fruits and reduce fungicide residues in them.The results showed significant differences at the end of the season compared to the control, where we found that with regard to grapes, the percentage of disease severity in fruits were 1, 5, 5% and in Almansoura in flame, crimson and Thompson respectively, compared to the control,which reached 45%,55 and 95% .The results of south of tahreer and alkhatatba followed the same pattern.

Table 13: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at Almansoura on season 2023

Treatments	ALMANSOURA						
		Flame		Crimson		Thompson	
	Time	leaves	fruits	leaves	fruits	leaves	fruits
zero time	1/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	1/11 DORNANCY	0	0	0	0	0	0
CONTROL	7/11 DORNANCY	0	0	0	0	0	0
CINAMON OIL	10/11 DORNANCY	0	0	0	0	0	0
CONTROL	10/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	18/11 DORNANCY	0	0	0	0	0	0
CONTROL	18/11 DORNANCY	0	0	0	0	0	0

Cont. Table 13: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at Almansoura on season 2023

Treatments	Time	ALMANSOURA					
		Flame		Crimson		Thompson	
		leaves	fruits	leaves	fruits	leaves	fruits
COLVE OIL	21/11 DORNANCY	0	0	0	0	0	0
CONTROL	21/11 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	29/11 DORNANCY	0	0	0	0	0	0
CONTROL	29/11 DORNANCY	0	0	0	0	0	0
CHITOSAN	7/12 DORNANCY	0	0	0	0	0	0
CONTROL	7/12 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	14/12 DORNANCY	0	0	0	0	0	0
CONTROL	14/12 DORNANCY	0	0	0	0	0	0
POTASSIUM PHOSPHATE	21/12 DORNANCY	0	0	0	0	0	0
CONTROL	21/12 DORNANCY	0	0	0	0	0	0
MANCOZIB	28/12 DORNANCY	0	0	0	0	0	0
CONTROL	28/12 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	4/1 DORNANCY	0	0	0	0	0	0
CONTROL	4/1 DORNANCY	0	0	0	0	0	0
MANCOZIB	11/1 DORNANCY	0	0	0	0	0	0
CONTROL	11/1 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	19/1 buds swelling	0	0	0	0	0	0
CONTROL	19/1 buds swelling	0	0	0	0	0	0
RIDOMIL GOLD PLUS	26/1buds reveal	0	0	0	0	0	0
CONTROL	26/1 buds reveal	0	0	0	0	0	0
ROSEMARY OIL	31/1 leaves appear	0	0	0	0	0	0
CONTROL	31/1 leaves appear	0	0	0	0	0	0
RIDOMIL GOLD PLUS	7/2	0	0	0	0	0	0
CONTROL	7/2	0	0	0	0	0	0
POTASSIUM CHLORIDE	15/2 appear 4:6 leaves	0	0	0	0	0	0
CONTROL	15/2 appear 4:6 leaves	5	0	5	0	5	0
RIDOMIL GOLD SL	22/2flowering	0	0	0	0	0	0
CONTROL	22/2flowering	5	3	6	1	7	5
CHITOSAN	1/3 ,30% flowering	0	0	0	0	0	0
CONTROL	1/3 ,30% flowering	11	1	12	5	17	7
RIDOMIL GOLD SL	8/3	0-	0	0	0	0	0
CONTROL	8/3	18	5	25	7	25	7
POTASSIUM PHOSPHATE	16/3	0	0	0	0	0	0
CONTROL	16/3	25	7	35	10	35	10
RHIZO N	23/3	7	1	8	10	14	5
CONTROL	23/3	35	10	35	10	35	12
AQUAGENE PRO	30/3, 80% flowering	5	0	5	1	15	5
CONTROL	30/3, 80% flowering	45	15	55	15	50	15
POTASSIUM SILICATE	6/4 fruiting	3.5	1	0	5	12	7.5
CONTROL	6/4 fruiting	60	25	65	25	65	25
AQUAGENE PRO	13/4	3	5	7	3	5	5
CONTROL	13/4	74	25	70	25	70	35
PLANTAGARD	21/4	7	3	4	3	6	5
CONTROL	21/4	70	35	75	55	85	55
ANTRACOL	30/4	3	1	6	5	5	5
CONTROL	30/4	80	45	85	55	95	95

Table 14: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at South of tahreer on season 2023

Treatments		SOUTH OF TAHREER					
		Flame		Crimson		Thompson	
	Time	leaves	fruits	leaves	fruits	leaves	fruits
zero time	1/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	1/11 DORNANCY	0	0	0	0	0	0
CONTROL	7/11 DORNANCY	0	0	0	0	0	0
CINAMON OIL	10/11 DORNANCY	0	0	0	0	0	0
CONTROL	10/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	18/11 DORNANCY	0	0	0	0	0	0
CONTROL	18/11 DORNANCY	0	0	0	0	0	0
COLVE OIL	21/11 DORNANCY	0	0	0	0	0	0
CONTROL	21/11 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	29/11 DORNANCY	0	0	0	0	0	0
CONTROL	29/11 DORNANCY	0	0	0	0	0	0
CHITOSAN	7/12 DORNANCY	0	0	0	0	0	0
CONTROL	7/12 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	14/12 DORNANCY	0	0	0	0	0	0
CONTROL	14/12 DORNANCY	0	0	0	0	0	0
POTASSIUM PHOSPHATE	21/12 DORNANCY	0	0	0	0	0	0
CONTROL	21/12 DORNANCY	0	0	0	0	0	0
MANCOZIB	28/12 DORNANCY	0	0	0	0	0	0
CONTROL	28/12 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	4/1 DORNANCY	0	0	0	0	0	0
CONTROL	4/1 DORNANCY	0	0	0	0	0	0
MANCOZIB	11/1 DORNANCY	0	0	0	0	0	0
CONTROL	11/1 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	19/1 buds swelling	0	0	0	0	0	0
CONTROL	19/1 buds swelling	0	0	0	0	0	0
RIDOMIL GOLD PLUS	26/1buds reveal	0	0	0	0	0	0
CONTROL	26/1 buds reveal	0	0	0	0	0	0
ROSEMARY OIL	31/1 leaves appear	0	0	0	0	0	0
CONTROL	31/1 leaves appear	0	0	0	0	0	0
RIDOMIL GOLD PLUS	7/2	0	0	0	0	0	0
CONTROL	7/2	0	0	0	0	0	0
POTASSIUM CHLORIDE	15/2 appear 4:6 leaves	0	0	0	0	0	0
CONTROL	15/2 appear 4:6 leaves	8	0	15	0	17	0
RIDOMIL GOLD SL	22/2flowering	7	0	11	5	15	5
CONTROL	22/2flowering	14	7	17	5	18	5
CHITOSAN	1/3, 30% flowering	8	5	15	5	20	15
CONTROL	1/3, 30% flowering	20	7	25	7	25	10
RIDOMIL GOLD SL	8/3	15	5	22	7	25	7
CONTROL	8/3	35	12	35	15	37	17
POTASSIUM PHOSPHATE	16/3	25	8	25	17	33	12
CONTROL	16/3	35	12	45	13	45	20
RHIZO N	23/3	35	10	40	10	35	17
CONTROL	23/3	48	17	50	17	40	15
AQUAGENE PRO	30/3, 80% flowering	25	25	42	25	42	25
CONTROL	30/3, 80% flowering	65	35	75	35	65	35
POTASSIUM SILICATE	6/4 fruiting	34	25	35	25	35	35

Cont. Table 14: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at South of tahreer on season 2023

Treatments	Time	SOUTH OF TAHREER					
		Flame		Crimson		Thompson	
		leaves	fruits	leaves	fruits	leaves	fruits
CONTROL	6/4 fruiting	60	25	60	20	65	25
AQUAGENE PRO	13/4	37	25	50	35	65	35
CONTROL	13/4	75	45	85	65	85	60
PLANTAGARD	21/4	55	25	60	50	75	45
CONTROL	21/4	85	50	80	50	90	60
ANTRACOL	30/4	60	40	65	45	70	45
CONTROL	30/4	90	55	95	70	98	95

Table 15: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at Alkhatatba on season 2023

Treatments	Time	ALKHATATBA					
		Flame		Crimson		Thompson	
		leaves	fruits	leaves	fruits	leaves	fruits
zero time	1/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	1/11 DORNANCY	0	0	0	0	0	0
CONTROL	7/11 DORNANCY	0	0	0	0	0	0
CINAMON OIL	10/11 DORNANCY	0	0	0	0	0	0
CONTROL	10/11 DORNANCY	0	0	0	0	0	0
MICRON SULPHER	18/11 DORNANCY	0	0	0	0	0	0
CONTROL	18/11 DORNANCY	0	0	0	0	0	0
COLVE OIL	21/11 DORNANCY	0	0	0	0	0	0
CONTROL	21/11 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	29/11 DORNANCY	0	0	0	0	0	0
CONTROL	29/11 DORNANCY	0	0	0	0	0	0
CHITOSAN	7/12 DORNANCY	0	0	0	0	0	0
CONTROL	7/12 DORNANCY	0	0	0	0	0	0
COPPEROXYCHLORIDE	14/12 DORNANCY	0	0	0	0	0	0
CONTROL	14/12 DORNANCY	0	0	0	0	0	0
POTASSIUM PHOSPHATE	21/12 DORNANCY	0	0	0	0	0	0
CONTROL	21/12 DORNANCY	0	0	0	0	0	0
MANCOZIB	28/12 DORNANCY	0	0	0	0	0	0
CONTROL	28/12 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	4/1 DORNANCY	0	0	0	0	0	0
CONTROL	4/1 DORNANCY	0	0	0	0	0	0
MANCOZIB	11/1 DORNANCY	0	0	0	0	0	0
CONTROL	11/1 DORNANCY	0	0	0	0	0	0
POTASSIUM CHLORIDE	19/1 buds swelling	0	0	0	0	0	0
CONTROL	19/1 buds swelling	0	0	0	0	0	0
RIDOMIL GOLD PLUS	26/1buds reveal	0	0	0	0	0	0
CONTROL	26/1 buds reveal	0	0	0	0	0	0
ROSEMARY OIL	31/1 leaves appear	0	0	0	0	0	0
CONTROL	31/1 leaves appear	0	0	0	0	0	0
RIDOMIL GOLD PLUS	7/2	0	0	0	0	0	0
CONTROL	7/2	0	0	0	0	0	0
POTASSIUM CHLORIDE	15/2 appear 4:6 leaves	0	0	0	0	0	0
CONTROL	15/2 appear 4:6 leaves	2	0	3	0	7	0
RIDOMIL GOLD SL	22/2flowering	0	0	0	0	0	0
CONTROL	22/2flowering	3	0	3	3	5	4
CHITOSAN	1/3 ,30% flowering	0	0	0	0	0	0

Table 15: Applying the integrated control program to reducing the percentage of disease severity of Downey mildew in three verities of grapes at Alkhatatba on season 2023

Treatments		ALKHATATBA					
		Flame		Crimson		Thompson	
	Time	leaves	fruits	leaves	fruits	leaves	fruits
CONTROL	1/3 ,30% flowering	3	2	5	3	4	4
RIDOMIL GOLD SL	8/3	0	0	0	0	0	0
CONTROL	8/3	5	3	5	3	5	5
POTASSIUM PHOSPHATE	16/3	0	0	0	0	0	0
CONTROL	16/3	5	7	5	7	10	8
RHIZO IN	23/3	0	0	0	0	0	0
CONTROL	23/3	12	8	12	8	13	15
Equation PRO	30/3, 80% flowering	0	0	0	0	0	0
CONTROL	30/3, 80% flowering	17	12	22	12	25	13
POTASSIUM SILICATE	6/4 fruiting	7	7	12	5	12	12
CONTROL	6/4 fruiting	35	15	40	20	35	25
Equation PRO	13/4	4	2	4	2	5	5
CONTROL	13/4	40	20	45	30	45	30
PLANTAGARD	21/4	3	1	3	1	2	2
CONTROL	21/4	50	25	66	45	65	40
ANTRACOL	30/4	0	0	0	0	0	0
CONTROL	30/4	66	35	75	50	75	55

DISCUSSION

In this research were been evaluated the effectiveness of fungicides, essential oils, biocides and fertilizers separately in two seasons. The third season we designed an integrated control program included all the previous treatments. Datashowed that a successive program to control the downy mildew disease of grape depended on the time ofapplication spray. Addition, involves a combination of fungicide, essential oils, biocides and fertilizers, the benefit of this program is decreasing the numbers of spraying fungicides so that is eco-environmental and decreasing the residual effect on fresh fruits.

At Frist, we applied integrated best management program atdormancy period .In this respect, we started fungicides applications sprayer with MICRON SULPHER (non-systemic), then, the second fungicide treated was COPPEROXYCHLORIDE (non-systemic), then the third fungicide treated wasmancozeb, (non-systemic), then, RIDOMIL GOLD PLUS (the frist systemic fungicide)which was more decreased the disease severity % of grape downy mildew, (Thouvenin ,*et al* 2017), then Equation PRO (the second systemic fungicide). While, the last one of the program application, wasAntracol fungicide, which is non-systemic, so we avoided the residual effect on fruits. Baldi, (2012) and (Grillet, 2004). Addtion all the pervious application were been done individual with essential oils, biocides and fertilizers to decrease fungicides sprayers application and the time keep the downy mildew disease infection under controlling.

On the Other hand, the genus *Trichoderma*spp (Plantaguard) and *Bacillus subtilis* (RhizoN) were been tested for their efficient to control downy mildew under field conditions (Olalde, 2013). However, *Trichoderma* spp. has been reported increasing the plant's ability to tolerate disease andresist the pathogen

Shoresh and Harman, (2008). Biological control has shown many effects on the pathogenic fungus, whether by competing for food, secreting decomposing substances from the cell walls of the pathogenic fungus, or secreting toxic substances into the food environment itself. (Heydari and Pessarakli. 2010) and Perazzolli, *et.al* (2012). Chitosan plays a very important role in the plant's resistance to stress resulting from injury, as well as stress resulting from salinity or climate change. Rhazi*et al*., 2000; Dahiya*et al*., 2006. In addition, It is one of the best non-toxic natural nutrients for plants. It also stimulates resistance genes in the plant to withstand against fungal and bacterial attacks as well.Aziz, *et.al* (2006). It also is increasingthe antioxidant potential in different tissues of *V. vinifera.*

Results of this investigation showed that, the individual application of plantoilsgavesignificant reduction in grape downy mildewdisease severity. The cinnamon and rosemary essential oils were more efficient in inhibiting the *P. viticola*, after the application in grapevine leaves and fruits, in the field. Its effect on the decreasing of disease among

those working with oils is due to its interference in the opening and closing of the stomata, as well as its effect on the germination of spores. Klinkenberg *etal*.,(1998) indicated that induced resistance can be anadditional tool inthe integratedcontrol ofdisease of diseases caused by Oomycetes. Ammar, *et.al* (2018). They found an increase in the number of clusters and their lengths that were treated with oils.

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الملخص العربي

تقييم برنامج مكافحه متكامله لمرض البياض الزغبي في العنب بمصر

سحرشرقاوي عبد الله، دعاء عبد المقصود قفشير

هدفت هذه الدراسة إلى تقييم تأثير المبيدات الفطرية والزيوت العطرية والمبيدات الحيوية والأسمدة على فطر *Plasmopara viticola* المسبب لمرض البياض الزغبي في ثلاثة أصناف من العنب في ثلاث محافظات (الدقهلية، البحيرة، المنوفية) على ثلاثة مواسم، تم تقييم تأثير الموسم الأول للمبيدات الفطرية في تقليل شدة المرض، ريدوميل جولد بلس، إيكويشن برو وأنتراكول أعطت تأثيراً عالياً في تقليل المرض، في الموسم الثاني تم اختبار الزيوت العطرية والمبيدات الحيوية والأسمدة بشكل منفردعلى المرض؛ كانت القرفة وإكليل الجبل هي الأفضل في السيطرة على المرض إلا أن كل من Plantaguard وRhizo N وChitosan قللوا المرض، وفي الموسم الثالث تم تقييم برنامج المكافحة المتكامله الذي احتوى على جميع المركبات المختبرة مجتمعة ولكن بترتيب معين حسب مرحلة السكون والتزهير والإثمار لتقليل عددرشات المبيدات الفطرية واستخدام المركبات الصديقه للبيئية على أوراق وثمار العنب في الظروف الحقلية، أعطى البرنامج تأثيراً عالياً جداً في تقليل شدة مرض البياض الزغبي في العنب لجميع المحافظات في ثلاثة أصناف من العنب (فليم، كريمسون، طومسون).