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Effects of bio-control agents with medical compound (sodium docusate) on the grape mealybug, *Planococcus flcus*, its parasitoid and predator on grape vines

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ABSTRACT

The effect of bio-control agents alone (Biofly, *Beauveria bassiana* and Egyptian nematode, *Steinernema carpocapsae*) or with medical compound (Sodium docusate) comparing with Super Misrona oil were studied on the grape mealybug, *Planococcus ficus* (Signoret) and its parasitoides *Leptomastix dactylopii* Howard (Hymenoptera : Encyrtidae) and predator, *Scymnus syriacus* Kirsch (Coleoptera : Coccinellidae) before and after pruning. In the first season (2008), the treatments with different bio-control agents (Biofly and Egyptian nematode) alone gave moderate reduction percent on the population of adult females and nymphs of *P. ficus* when comparing with Super Misrona oil, which gave also moderate or highly reduction percent after 1st, 2nd and 3rd weeks before and after pruning. Also, these bio-control agent compounds gave also moderate toxic effect on parasitoides *L. dactylopii* and the predator, *S. syriacus* before and after pruning when comparing with Super Misrona oil, which gave also moderate toxicity after the 1st, 2nd and 3rd weeks. The data in the second season (2009) gave similar results to those obtained in the first year (2008). When mixing Biofly and Egyptian nematode with Sodium docusate gave highly reduction percent on the population of adult females and nymphs of *P. ficus* comparing with mixture of Super Misrona oil + Sodium docusate also gave highly reduction percent after the 1st, 2nd and 3rd weeks before and after pruning. Also, these bio-control agent compounds + Sodium docusate gave moderate or highly toxic effect on its parasitoides and the predator before and after pruning comparing with Super Misrona oil + Sodium docusate , which gave highly toxicity after the 1st, 2nd and 3rd weeks. The data in the second season (2009) gave similar results to those obtained in the first year (2008). It can be concluded that mixing the bio-control agents and mineral oils with medical compound (Sodium docusate) increasing the effectiveness against the mealybug and could be using in integrated pest management programs "IPM" on the grape mealybug, *Planococcus ficus*, which becoming very dangerous pest on grape vine plants, especially in organic farms that exporting fruits to Europe and America.

INTRODUCTION

The grape mealybug, *Planococcus ficus* (Signoret) (Homoptera: Pseudococcidae) is one of the most common mealybugs. This pest has a pan tropical distribution and subtropical regions. The grape mealybug attacks grape vine, citrus, cotton, mango and banana. This insect has two forms, a root form that attacks the roots of its host and an aerial form that attacks the leaves, twigs and the base of fruits (Martin and Mau, 1999). The grape mealybug is usually found at the base of stems (or petioles of plants with long petioles). After the first batch of eggs hatch, the infestation becomes very noticeable. As their numbers increase, mealybugs of all sizes can be found crawling around or feeding on all surfaces of the plant (Baker, 1998). Mealybugs cause damage for plants by inserting their threadlike mouth parts into any part of the host plants and sucking out sap. Mealybugs can excrete honeydew, sweet and sticky liquid. Sooty moulds often grow in the honeydew causing infesting plants to turn black. The grape mealybug has a toxin in its saliva, which causes its toxin in its salvia, which causes its host plants to drop leaves and buds. The mealybugs, their oviscas, honeydew and sooty moulds. They further disfigure plants by secreting cottony wax. Infested plants usually die unless the pest is controlled (Baker, 1998 and Anonymous, 2001). Large infestations cause fruit drop and reduce yields, but the greatest damage is caused by honeydew on fruit and leaves. Build up of honeydew and associated sooty mould fungus leads to reduce fruit quality

and lower trees vitality (Cartwirth and Browning, 1999). The ladybird beetle, *Cryptolaemus montrouzieri* (Mulsant) (Coleoptera : Coccinellidae) is a excellent predator of several mealybug (Mani *et al.*, 1997). Adult female beetles lay their eggs among the cottony egg sac of mealybug adult female. Adult beetles and young larvae feed on mealybug eggs and nymphs, while large larvae feed on all stages (Anonymous 2001). Etomopathogenic nematodes (EPN) from the Heterorhabditidae and Steinernematidae families are widely distributed throughout the world and are considered to be one of the best non-chemical alternatives for insect pest control (Hominick, 2002 and Kaya *et al.*, 2006).

These nematodes are commercially produced and used in biological control insect pests especially in soil and cryptic foliage (Georgis, 2002).

The main purposes of this work are:

1. Studying the efficiency of different bio-control agents (Biofly, *Beauveria bassiana* and entomopathogenic nematodes, *Steinernema carpocapsae*) and mineral oil on *Planococcus ficus*, its parasitoides on grape vines before and after pruning.
2. Studying the effect of adding a human laxative and ear wax remover (Sodium docusate) to these bio-control agents and to the mineral oil on *Planococcus ficus*, its parasitoides on grape vines before and after pruning.

MATERIALS AND METHODS

1. Tested bio-control agents:

Two bio-control agents with different mode of actions were used against the grape mealybug, *P. ficus* before and after pruning under field conditions.

a. **Biofly**, an entomopathogenic fungi ($3X10^7$ c.f.u./1ml), formulated by BioAgro International, Egypt containing the fungus *Beauveria bassiana.*

b. **Entomopathogenic nematode, *Steinernema carpocapsae* (Weiser)** reared on the last instar of the wax moth, *Galleria mellonella* according to (Woodring and Kaya, 1988).

2.Tested compounds:

Two compounds were used against the grape mealybug, *P. ficus* before and after pruning under field conditions.

a. **Docusate Sodium** belongs to the family of medications known as stool softeners. It is used to treat and prevent occasional constipation due to hard stools. Docusate sodium works by increasing the amount of water in the stool, making stools softer and easier to pass. It usually starts to work within 1 to 3 days, but may take up to 5 days to work. Also, found it kill different pests without any harms for plants (Abdel-Rahman, 2009).

b. **Super Misrona oil 95% EC,** a local mineral oil, formulated by Masrona Co., containing 94% praffinic oil w/w and 6% inert ingredients, unslufonated residue content reached 94%.

3.Experimental design:

This study was conducted on grape, *Vitis vinifera* in Alexandria during June and December 2008 season and repeated in the same times in 2009 season. Spraying trail contained four replicates (four plants) in each compound and used four plants as untreated check (control). Samples were randomly taken weekly and counting started from 15th June and 5th December 2008 and 2009. The sample consists of 30 leaves with leaf petioles were randomly

collected during summer (June) and 30 inches (2.5X2.5 cm each) were selected during winter (December). The trees were 2-2.5m height and were heavily infesting with *P. ficus*.

In these trails, the whole tree was sprayed before and after pruning. Spraying was accomplished by a knapsack sprayer CP-3 of 20 L capacity. Seven and four liters of spraying liquid were sufficient to insure complete coverage of the whole tree before and after pruning. The leaves samples (summer spray) with leaf petioles were kept in fine perforated paper bags and transferred to the laboratory for careful examination also, samples (winter spraying) were kept separately in plastic cups 5X9 cm, covered with muslin cloth and held in position by rubber bands to prevent the insect from escaping, then transferred to the laboratory for counting by the aid of a stereomicroscope. Nymphs, adults of the mealybug and predators stages were counted under a stereomicroscope. Each leaf with petiole was stored for seven days in glass emergence tube and monitored daily for parasitoid emergence. Both surfaces of the leaf and a leaf petiole were inspected.

3. Sanitation:

Pruning was carried out in beginning-December; it was practiced to remove most of the infested shoots and branches. All pruned parts of the grape vine plants were collected and burned directly after pruning. Also the dropped leaves in winter were buried in holes deep enough then covered with sand or clay to enrich the soil with organic matter and to eliminate a source of infestation. Removal of weeds, which may harbour major pests, was of prime importance.

4. The insecticidal efficacy:

The percent infestation reduction was calculated according to the equation of (Hendrson and Tilton 1955).

RESULTS AND DISCUSSION:

1. During 2008 season:

1.1. Before pruning:

Pre-spraying: the counts of adults and nymphs of *P. ficus* were 483-527 and 1421-1618/30 leaves, respectively. The counts of the parasitoid (*L. dactylopii*) were 94-109/30 leaves and for predator (*Scymnus* sp.) were 35-41/30 leaves, respectively (Table, 1).

The recorded results in Table (2) showed that Super Misrona oil alone gave moderate reduction percent against adults (62.13%), and good effect against nymphs (82.21%). Mineral oil gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 67.32 and 72.80%, respectively.

Mineral oil was the most effective when applied in the suitable time. When crawlers were treated, they were prevented from developing. Nymphs not able to moult and grow normally. Mineral oil interferes with both respiration and membrane function and disrupts feeding activities. For oil to be effective the material must coat the pest, thus complete coverage is essential for optimum results (Sieburth *et al.*, 1998).

The obtained data indicated that, the mineral oil as contact insecticides must be sprays during of nymphs presence.

These results are agreed with those obtained by Grafton-Cardwell (2000) they used highest dosage of oil for controlling mealybugs in July or August.

Table (1): Effect of different bio-control agents with medical additive (Sodium docusate) on the grape mealybug, *Planococcus ficus*, its parasitoid and predator on grape vines during 2008 (before pruning).

Treatment	Rate of application (L.W.)	Pre-spraying counts (individuals)				Post-spraying counts (individuals)															
						1st week				2nd week				3rd week				Average numbers			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	494	1421	99	38	256	649	56	29	277	611	51	31	281	626	50	31	271	629	52	30
Biofly + Sodium docusate	3 ml +15 ml	501	1618	101	41	112	229	51	29	109	235	47	31	123	243	44	36	115	236	47	32
Nematode	3ml	522	1523	117	36	304	754	67	27	321	762	70	29	339	841	71	33	321	786	69	30
Nematode + Sodium docusate	3 ml+ 15ml	498	1601	94	40	83	163	19	26	84	171	52	30	91	188	51	34	86	174	41	30
Super Misrona Oil	20 ml	483	1588	109	35	212	321	36	13	219	326	39	15	228	360	41	17	220	336	39	15
Super Misrona + Sodium docusate	20 ml+ 15 ml	511	1499	96	39	43	94	28	13	47	112	30	15	53	153	32	17	48	120	30	15
Control	-	527	1609	102	40	615	1811	105	55	633	1903	111	63	651	2021	116	71	633	1912	111	63

A = Adults N = Nymphs
Pa = Parasitoid (*Leptomastix dactylopii*)
Pr = Predator *Scymnus syriacus*
Nematode = *Steinernema carpocapsae*
Oil = Super Misrona oil
L.W. = Liters of Water

Table (2): Reduction percentages of the grape mealybug, *Planococcus ficus*, its parasitoid and predator when subjected to different bio-control agents with medical additive (Sodium docusate) on the grape vines during 2008 (before pruning).

Treatment	Rate of application	Reduction% of insect, predators and parasitoides at different intervals															
		1st week				2nd week				3rd week				Average % reduction			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	55.59	59.42	45.05	44.49	53.32	63.64	52.66	48.20	53.94	64.92	55.59	48.20	**54.28**	**62.66**	**51.10**	**46.96**
Biofly + Sodium docusate	3 ml +15 ml	80.84	87.42	50.94	48.55	81.88	87.72	57.24	51.99	80.12	88.04	61.69	50.52	**80.95**	**87.73**	**56.62**	**50.35**
Nematode	3ml	50.09	56.01	44.37	45.45	48.80	57.69	45.02	48.85	47.42	56.07	46.64.	48.35	**48.77**	**56.59**	**45.34**	**47.55**
Nematode + Sodium docusate	3 ml+ 15ml	85.71	90.95	49.34	52.73	85.95	90.96	86.31	49.17	52.38	90.65	52.29	52.11	**74.68**	**90.85**	**62.65**	**51.34**
Super Mis-rona Oil	20 ml	62.38	82.04	67.91	72.98	62.25	82.64	67.12	72.78	61.77	81.95	66.92	72.63	**62.13**	**82.21**	**67.32**	**72.80**
Super Mis-rona + So-dium docu-sate	20 ml+ 15 ml	92.78	94.42	71.67	75.75	92.34	93.68	81.81	82.09	75.57	91.87	83.57	75.44	**86.90**	**93.32**	**79.02**	**77.76**

The mixture of Sodium docusate with Super Misrona oil gave highly efficacy against adults and nymphs (86.90 and 93.32%, respectively, Table 2). Also, it gave toxicity against parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) 79.02 and 77.76%, respectively.

The oil serves a carrier to facilitate foliar absorption of pesticides. Moreover, the evaporation from a falling emulsion droplet is slower than that from a water droplet and this is useful in increasing foliar retention and reducing drift (Omar *et al.*, 1987).

On the other hand, the recorded results in Table (2) showed that the entomopathogenic fungi (Biofly) and beneficial nematode (*Steinernema carpocapsae*) alone gave moderate reduction percent against adults and nymphs of *P. ficus* (54.28 & 48.77% and 62.66 &56.59% respectively), while they gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 51.10 & 45.34 and 46.96 & 47.55%, respectively.

Mangoud *et al.* (2009) studied the effect of Biofly, NeemAzal and Super Misrona oil comparing with entomopathogenic nematodes on the grape mealybug, *Planococcus ficus* and its predator *Cryptolaemus montrouzieri* under laboratory conditions. They found the potency of the tested compounds and nematodes were varied tremendously due to the nature of the tested compounds. Super Misrona oil gave highly mortality while, Biofly came in the second order, whereas, NeemAzal gave lowest percent mortality against nymphs and adult females of *P. ficus* and low toxicity effects against immature and mature stages of *C. montrouzieri*. Comparison of the two entomopathogenic nematodes. *Steinernema carpocapsae* and *Heterorhabditis indica* showed that *S. carpocapsae* scored medium effect against nymphs and adult females of *P. ficus* and higher effects against immature and mature stages of *C. montrouzieri* than *H. indica*.

Mixing of Sodium docusate with Biofly and *S. carpocapsae* gave highly reduction percent against adults and nymphs of *P. ficus* (80.95 & 87.73% and 74.68 &90.85% respectively), while the two mixtures gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 56.62 & 50.35 and 62.65 & 51.34%, respectively.

1.2. After pruning:

Pre-spraying: the counts of adults and nymphs of *P. ficus* were 250-353 and 681-730/30 leaves, respectively. Also, the counts of the parasitoid (*L. dactylopii*) were 60-73/30 leaves and for predator (*Scymnus* sp.) were 23-35/30 leaves, respectively (Table, 3).

The recorded data in Table (4) showed that Super Misrona oil alone gave moderate reduction percent against adults (65.54%), and good reduction percent against nymphs (83.92%). Also, Mineral oil gave 61.42% reduction against its parasitoid (*L. dactylopii*) and 61.83% against the predator (*Scymnus* sp.).

These results agreed with those obtained by Abd-Rabou and Mangoud (2002). They found Super-Misrona oil gave moderate effect against adults of the hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (Homoptera : Pseudococcidae) and gave low toxicity against parasitoids.

Whereas, when added Sodium docusate to Super Misrona oil, the mixture gave highly efficacy against adults and nymphs (89.50 and 92.22%, respectively) (Table 4). The mixture of Super Misrona oil and Sodium docusate gave 65.28% reduction against parasitoid (*L. dactylopii*) and gave reduction percent (66.37%) against the predator (*Scymnus* sp.).

Table (3): **Effect of different bio-control agents with medical additive (Sodium docusate) on the grape mealybug, *Planococcus ficus*, its parasitoid and predator on grape vines during 2008 (after pruning).**

Treatment	Rate of application (L.W.)	Pre-spraying counts (individuals)				Post-spraying counts (individuals)															
						1st week				2nd week				3rd week				Average numbers			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	332	728	61	23	192	369	39	15	167	331	42	17	161	322	45	19	173	341	42	17
Biofly + Sodium docusate	3 ml +15 ml	311	699	72	34	88	147	39	20	74	141	39	23	71	133	41	23	78	140	40	22
Nematode	3ml	250	718	68	29	108	234	39	19	98	218	41	22	89	197	45	25	98	216	42	22
Nematode + Sodium docusate	3 ml+ 15ml	347	681	70	27	72	114	40	17	67	99	37	18	59	91	44	19	66	101	40	18
Super Misrona Oil	20 ml	300	690	59	31	121	144	23	14	109	121	26	16	86	98	29	18	105	121	26	16
Super Misrona + Sodium docusate	20 ml+ 15 ml	321	702	60	30	41	65	22	12	33	56	25	15	29	58	24	14	34	60	24	14
Control	-	353	730	73	35	357	781	76	41	360	801	81	49	363	815	93	52	360	799	83	47

A = Adults N = Nymphs
Pa = Parasitoid (*Leptomastix dactylopii*)
Pr = Predator *Scymnus syriacus*
Nematode = *Steinernema carpocapsae*
Oil = Super Misrona oil
L.W. = Liters of Water

Table (4): Reduction percentages of the grape mealybug, *Planococcus ficus*, its parasitoid and predator when subjected to different bio-control agents with medical additive (Sodium docusate) on the grape vines during 2008 (after pruning)..

Treatment	Rate of application	Reduction% of insect, predators and parasitoides at different intervals															
		1st week				2nd week				3rd week				Average % reduction			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	**1.5 ml/l.**	42.81	52.62	38.58	44.32	50.67	58.56	39.94	47.20	52.28	60.38	42.09	44.39	**48.59**	**57.19**	**40.20**	**45.30**
Biofly + Sodium docusate	**3 ml +15 ml**	72.02	80.34	47.97	49.73	76.66	81.61	51.18	51.68	77.79	82.95	54.30	54.46	75.49	**81.63**	**51.15**	**51.96**
Nematode	**3ml**	57.28	69.53	44.91	44.07	61.56	72.33	45.66	45.81	65.38	75.42	48.06	41.97	61.41	**72.43**	**46.21**	**43.95**
Nematode + Sodium docusate	**3 ml+ 15ml**	79.48	84.35	45.11	46.25	81.06	86.75	52.36	52.38	83.46	88.03	50.66	52.64	81.33	**86.38**	**49.38**	**50.42**
Super Misrona Oil	**20 ml**	60.12	80.49	62.55	61.44	64.37	84.01	60.28	63.13	72.12	87.27	61.42	60.91	**65.54**	**83.92**	**61.42**	**61.83**
Super Misrona + Sodium docusate	**20 ml+ 15 ml**	87.37	91.34	64.78	65.85	89.92	92.73	62.45	64.29	91.21	92.59	68.60	68.98	**89.50**	**92.22**	**65.28**	**66.37**

On the other hand, the recorded results in Table (4) showed that, the entomopathogenic fungi (Biofly) and beneficial nematode (*Steinernema carpocapsae*) gave moderate reduction percent against adults and nymphs of *P. ficus* (48.59 & 61.41% and 57.19 &72.43% respectively), while they gave moderate toxicity against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 40.20 & 46.2 and 45.30 & 43.95%, respectively.

Whereas, addition of Sodium docusate to Biofly and *S. carpocapsae* caused highly reduction percent against adults and nymphs of *P. ficus* (75.49 & 81.33% and 81.63 &86.38% respectively), while the two mixtures gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.), 51.15& 51.96 and 49.38&50.42%, respectively.

2. During 2009 season:

2.1. Before pruning:

Pre-spraying: the counts of adults and nymphs of *P. ficus* were 399-491 and 1121-1415/30 leaves, respectively. The counts of the parasitoid (*L. dactylopii*) were 81-96/30 leaves and for predator (*Scymnus* sp.) were 47-55/30 leaves, respectively (Table, 5).

The recorded data in Table (6) showed that, Super Misrona oil alone gave moderate reduction percent against adults (66.05%), and good reduction percent against nymphs (83.44%). Mineral oil gave 64.9% reduction against its parasitoid (*L. dactylopii*) and 59.34% reduction against the predator (*Scymnus* sp.).

Whereas, addition of Sodium docusate to Super Misrona oil, gave highly efficacy against adults and nymphs (90.91 and 93.80%, respectively, Table 6). The mixture of Super Misrona oil and Sodium docusate gave moderate reduction percent against parasitoid (*L. dactylopii*) and against the predator (*Scymnus* sp.), 70.56 and 69.63%, respectively.

On the other hand, the results in Table (6) showed that, the entomopathogenic fungi (Biofly) and beneficial nematode (*Steinernema carpocapsae*) caused moderate reduction percent against adults and nymphs of *P. ficus* (57.16 & 55.17% and 62.31 &56.34% respectively), while they gave moderate toxicity against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) (47.85 & 47.00 and 45.11& 52.94%, respectively).

Whereas, addition of Sodium docusate to Biofly and *S. carpocapsae* gave highly reduction percent against adults and nymphs of *P. ficus* (83.25 & 85.33% and 84.80 &89.77% respectively), while the two mixtures gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) (51.10& 54.23 and 51.71& 54.65%, respectively).

These results agreed with those obtained by Mangoud and Abd El-Gawad (2003). They found that, the four natural control agents (Biofly, NeemAzal, oil and Sulphur) gave moderate reduction percent in infestation against nymphs of the mealybug.

Table (5): Effect of different bio-control agents with medical additive (Sodium docusate) on the grape mealybug, *Planococcus ficus*, its parasitoid and predator on grape vines during 2009 (before pruning).

Treatment	Rate of application (L.W.)	Pre-spraying counts (individuals)				Post-spraying counts (individuals)															
						1st week				2nd week				3rd week				Average numbers			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	399	1311	88	47	207	392	58	31	207	392	58	31	207	392	58	31	207	392	58	31
Biofly + Sodium docusate	3 ml + 15 ml	481	1404	81	53	98	167	54	29	98	167	49	29	98	167	48	28	98	167	50	29
Nematode	3ml	471	1121	92	50	256	382	62	28	256	382	62	28	256	382	62	28	256	382	62	28
Nematode + Sodium docusate	3 ml+ 15ml	405	1209	88	51	72	95	57	28	72	95	52	27	72	95	53	27	72	95	54	27
Super Misrona Oil	20 ml	418	1316	94	49	172	169	42	24	172	169	42	24	172	169	42	24	172	169	42	24
Super Misrona + Sodium docusate	20 ml+ 15 ml	433	1217	90	52	48	60	31	17	48	60	36	20	48	60	34	19	48	60	34	19
Control	-	491	1415	96	55	596	1103	122	65	596	1103	122	65	596	1103	122	65	596	1103	122	65

A = Adults N = Nymphs
Pa = Parasitoid (*Leptomastix dactylopii*)
Pr = Predator *Scymnus syriacus*
Nematode = *Steinernema carpocapsae*
Oil = Super Misrona oil
L.W. = Liters of Water

Table (6): Reduction percentages of the grape mealybug, *Planococcus ficus*, its parasitoid and predator when subjected to different bio-control agents with medical additive (Sodium docusate) on the grape vines during 2009 (before pruning).

Treatment	Rate of application	% reduction of insect, predators and parasitoides at different intervals															
		1st week				2nd week				3rd week				Average % reduction			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	57.93	57.30	44.96	46.28	55.85	63.69	49.38	45.03	57.69	65.95	49.20	44.03	**57.16**	**62.31**	**47.85**	**45.11**
Biofly + Sodium docusate	3 ml +15 ml	82.46	84.55	47.54	53.70	83.07	84.32	52.39	53.70	84.22	85.53	53.36	55.29	**83.25**	**84.80**	**51.10**	**54.23**
Nematode	3ml	53.37	55.45	44.53	54.91	54.32	57.21	48.24	53.33	57.82	56.35	48.22	50.57	**55.17**	**56.34**	**47.00**	**52.94**
Nematode + Sodium docusate	3 ml+ 15ml	83.71	90.99	49.03	53.54	85.44	89.79	53.50	55.20	86.84	88.52	52.61	55.20	**85.33**	**89.77**	**51.71**	**54.65**
Super Mis-rona Oil	20 ml	63.24	83.93	64.12	59.51	66.80	83.91	65.68	59.18	68.12	82.49	64.91	59.33	**66.05**	**83.44**	**64.90**	**59.34**
Super Mis-rona + So-dium docu-sate	20 ml+ 15 ml	90.16	92.82	72.89	72.34	90.79	94.35	68.52	67.46	91.79	94.23	70.27	69.08	**90.91**	**93.80**	**70.56**	**69.63**

2.2. After pruning:

Pre-spraying: The counts of adults and nymphs of *P. ficus* were 277-334 and 498-594/30 leaves, respectively. The counts of the parasitoid (*L. dactylopii*) were 76-86/30 leaves and for predator (*Scymnus* sp.) were 41-55/30 leaves, respectively (Table, 7).

The recorded data in Table (8) showed that, Super Misrona oil alone gave moderate reduction percent against adults (64.0%), and good effect against nymphs (83.6%). Mineral oil gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 52.3 and 59.5%, respectively.

Whereas, when added Sodium docusate to Super Misrona oil, the mixture gave high efficacy against adults and nymphs (88.6 and 91.8%, respectively) (Table 8). The mixture of Super Misrona oil with Sodium docusate gave reduction percent against parasitoid (*L. dactylopii*) and against the predator (*Scymnus* sp.) were gave 58.0 and 62.7%, respectively.

On the other hand, the recorded results in Table (8) showed that, the entomopathogenic fungi (Biofly) and beneficial nematode (*Steinernema carpocapsae*) alone gave moderate reduction percent against adults and nymphs of *P. ficus* (48.0 & 61.5% and 58.5&69.5% respectively), while they gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 43.9& 51.2 and 42.8& 58.4%, respectively. Whereas, addition of Sodium docusate to Biofly and *S. carpocapsae* gave high reduction percent against adults and nymphs of *P. ficus* (75.2 & 82.5% and 83.3&84.92% respectively), while the two mixtures gave moderate reduction percent against its parasitoid (*L. dactylopii*) and the predator (*Scymnus* sp.) were 52.0& 56.30 and 58.6&54.49%, respectively.

These results are harmony with those obtained by Abdel-Rahman (2010) she studied the effect of medical substance, Sodium Docusate as insecticide alone or mixture with Malathion against adults of *Icerya aegyptiaca*. She obtained good mortality percentages under laboratory conditions.

In general, the grape mealybug is not easy to control because the eggs are enmeshed in the waxy fluff, it is difficult to get a pesticide through to kill them (Baker, 1998).

Complete control of the mealybug by the use of insecticides is extremely difficult. Pesticides cannot easily penetrate the heavy wax layers on the female body or the ovisac, also, the water repellency of the waxy covering prevents insecticides from making contact with the insect (Hamlen, 1975 and Cloyed, 1998). Also the adults are firmly even after their death. This may gave a false impression of the pest status and eggs are protected by the waxy covering of their mother and are shielded from chemical sprays (Copland and Ibrahim, 1985).

Table (7): Effect of different bio-control agents with medical additive (Sodium docusate) on the grape mealybug, *Planococcus ficus*, its parasitoid and predator on grape vines during 2009 (after pruning).

Treatment	Rate of application (L.W.)	Pre-spraying counts (individuals)				Post-spraying counts (individuals)												Average numbers			
						1st week				2nd week				3rd week							
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	298	544	80	53	177	243	45	28	168	232	42	30	159	246	45	31	168	240	44	30
Biofly + Sodium docusate	3 ml +15 ml	301	581	85	55	86	115	39	21	81	109	40	22	76	95	41	24	81	106	40	22
Nematode	3ml	277	509	78	49	121	167	35	19	119	175	38	20	107	169	39	21	116	170	37	20
Nematode + Sodium docusate	3 ml+ 15ml	311	499	81	50	62	87	35	20	60	82	34	23	55	78	35	24	59	82	35	22
Super Misrona Oil	20 ml	325	581	77	47	133	118	34	17	128	104	36	19	119	89	38	20	127	104	36	19
Super Misrona + Sodium docusate	20 ml+ 15 ml	299	498	76	41	41	47	31	14	38	41	30	15	32	56	33	16	37	48	31	15
Control	-	334	594	86	54	364	615	83	49	371	662	81	52	385	680	89	58	373	652	84	53

A = Adults **N = Nymphs**
Pa = Parasitoid (*Leptomastix dactylopii*)
Pr = Predator *Scymnus syriacus*
Nematode = *Steinernema carpocapsae*
Oil = Super Misrona oil
L.W. = Liters of Water

Table (8): **Reduction percentages of the grape mealybug, *Planococcus ficus*, its parasitoid and predator when subjected to different bio-control agents with medical additive (Sodium docusate) on the grape vines during 2009** (after pruning)..

Treatment	Rate of application	Reduction% of insect, predators and parasitoides at different intervals															
		1st week				2nd week				3rd week				Average % reduction			
		A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr	A	N	Pa	Pr
Biofly	1.5 ml/l.	43.86	56.85	41.71	41.77	47.73	61.73	44.25	41.22	52.32	56.84	45.64	45.54	48.0	58.5	43.9	42.8
Biofly + Sodium docusate	3 ml +15 ml	72.99	80.88	52.45	57.92	75.05	83.16	50.03	58.46	77.43	85.72	53.39	59.37	75.2	83.3	52.0	58.6
Nematode	3ml	58.71	68.31	53.51	57.36	60.18	69.15	48.27	57.61	65.48	70.99	51.68	60.09	61.5	69.5	51.2	58.4
Nematode + Sodium docusate	3 ml+ 15ml	81.19	83.16	55.23	55.92	82.11	85.25	55.43	52.23	84.19	86.34	58.25	55.31	82.50	84.92	56.30	54.49
Super Mis-rona Oil	20 ml	61.33	80.38	54.24	60.13	63.48	83.93	50.36	58.01	67.28	86.61	52.31	60.38	64.0	83.6	52.3	59.5
Super Mis-rona + So-dium docu-sate	20 ml+ 15 ml	87.04	90.88	57.73	62.36	88.21	92.61	58.08	62.01	90.44	91.76	58.25	63.66	88.6	91.8	58.0	62.7

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الملخص العربى

تأثير بعض المركبات الحيوية خلطا مع المركب الطبي صوديوم دوكاسييت علي بق العنب الدقيقي والطفيليات والمفترسات المرتبطه به علي العنب

رائدا محمد عبد الرحمن و أشرف عبد السلام هندي منجود
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تم دارسة فعالية بعض المركبات الحيوية (البيوفلاي، فطر *Beauveria bassiana* والنيماتودا *Steinernema carpocapsae*) منفردة أو خلطا بالمركب الطبي صوديوم دوكاسييت مقارنة بفعالية الزيت المعدني الخفيف منفردا أو خلطا بالصوديوم دوكاسييت علي بق العنب الدقيقي ودراسة تأثير هذه المركبات علي الطفيل *Leptomastix dactylopii* والمفترس *Scymnus syriacus* المرتبطة بالبق الدقيقي قبل وبعد التأقليم.

خلال الموسم الأول (2008) أعطت المركبات الحيوية (البيوفلاي والنيماتودا) منفردة فعالية متوسطة ضد الحشرات الكاملة وغير الكاملة لبق العنب الدقيقي مقارنة بالزيت المعدني الخفيف (سوبر مصرونا) حيث أعطي نسبة إبادة متوسطة أو عالية بعد أسبوع،أسبوعين وثلاثة أسابيع قبل وبعد التأقليم. كذلك أعطت كل من البيوفلاي والنيماتودا منفردة سمية متوسطة ضد الطفيل والمفترس المرتبطان ببق العنب الدقيقي مقارنة بزيت سوبر مصرونا حيث أعطي نسبة سمية متوسطة أو عالية بعد أسبوع،أسبوعين وثلاثة أسابيع قبل وبعد التقليم. أتضح من نتائج الموسم الثاني (2009) تقاربها مع نتائج الموسم الأول (2008). عند خلط المركب الطبي صوديوم دوكاسييت مع البيوفلاي والنيماتودا زادت الفعالية ضد الحشرات الكاملة وغير الكاملة لبق العنب الدقيقي كما زادت فعالية زيت سوبر مصرونا عند خلطه خلطا بالمركب الطبي صوديوم دوكاسييت بعد أسبوع،أسبوعين وثلاثة أسابيع قبل وبعد التأقليم. كذلك عند خلط المركب الطبي صوديوم دوكاسييت مع البيوفلاي والنيماتودا كانت السمية متوسطة أوعالية ضد الطفيل والمفترس المرتبطة ببق العنب الدقيقي مقارنة بزيت سوبر مصرونا حيث أعطي نسبة سمية عالية بعد أسبوع،أسبوعين وثلاثة أسابيع قبل وبعد التأقليم. أتضح من نتائج الموسم الثاني (2009) تقاربها مع نتائج الموسم الأول (2008).

من النتائج السابقة نستنتج أنه عند خلط المركب الطبي صوديوم دوكاسييت مع المركبات الحيوية (البيوفلاي والنيماتودا) زادت الفعالية البق العنب الدقيقي كذلك يمكن استخدام هذه المخاليط في برامج المكافحة المتكاملة لهذا النوع من البق الدقيقي والذي أصبح من أهم وأخطر آفات العنب خاصة في مزارع التصدير.