J. Agric. Sci. Mansoura Univ., 25 (6): 3661 - 3675, 2000.

INSECTICIDAL EFFICIENCY OF SOME NATURAL PRODUCTS AND BIOCIDES ON COTTON SUCKING PESTS AND THEIR ASSOCIATED NATURAL ENEMIES

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ABSTRACT

Two experiments were conducted at Sakha Agricultural Research Station during 1999 cotton growing season to evaluate the initial and residual effect of three natural materials in addition to five biocides on some cotton sucking pests and their associated natural enemies. Summarized results showed the following:

Kz-oil and Milbeknock induced the highest initial and residual activity on aphids 71.62 and 77.61% reduction after 2 days and 56.89 & 53.74% reduction after 14 days for Kz-oil and milbecknock, respectively. Supermisrona, naturalis, MVP II and bankol had a moderate effect in this respect. Vapcomic at the higher two rates induced a moderate initial kill, biofly by 3 rates and vapcomic at 208.25 cm^3/Fed. had a least effect, while vapcomic at 833.3 cm^3/Fed. caused the best results to residual activity. On the other hand, all tested products caused no satisfactory effect on jassids as initial and residual activity.

For the effect on immature stages of whitefly, milbecknock and supermisrona induced the moderate initial and residual effect, while Kz-oil, naturalis, MVP II and bankol induced a slight initial and residual activity, all tested products (2^{nd} experiment) caused weak initial kill (ranged from 0 to 38.41%). The residual effect of the tested treatments data proved that vapcomic at the higher rate induced the best results in population of immature stages followed closely by the highest rate of biofly, then vapcomic and biofly, at the two lower rates.

On the other hand, all the tested products in two experiments caused no satisfactory effect on mature stages as initial and residual activity. Their initial kill ranged between (14.92 to 28.20% reduction), while they caused residual activity ranged between (0.89% to 17.81% reduction).

As for the side effect on the associated natural enemies, all the tested compounds had no effect on *Coccinella undecimpunctata* except the higher rates from biofly and vapcomic. Also all tested treatments in the first experiment and biofly at 200 cm^3/fed. had no effect on *Scymnus syriacus*, while other treatments caused slight effect except vapcomic 833.3 cm^3 that induced most effect. All tested compounds also differently decreased population density of *Sc. punctillum*, which ranged between about (1.18 to 34.12% reduction) in the two experiments.

On the other hand, milbeknock, bankol, supermisrona, biofly at the higher rates Kz-oil and vapcomic at the lower rates have decreasing effect on the population density of *Orius* sp. than the untreated check. While, naturalise, MVP II, biofly at the two lower rates and vapcomic at the two higher rates had no effect on *Orius* sp. All tested treatments had no effect on *Chrysoperla carnea* except naturalis and MVP II. While *Paederus alfierii* and true spiders were affected only with high rates of bankol and vapcomic.

INTRODUCTION

Aphis gossypii (Clov.), *Empoasca lybica* (De Berg) *Bemisia tabaci* (Genn.) and *Thrips tabaci* are considered among the economic pests of cotton plants in the present. In the last years, Jassid and Whitefly were not

considered economic pests, as well as the infestation with aphid in the late season was not economic also.

In the official programmes, the control of thrips and aphids is done roughly during early season, then the whole problem is neglected. Therefore, it was necessary to follow up the situation of the three main sucking pests during the major part of the season. Chemical control is still considered one of the most important methods for controlling these pests. Many authors have studied the activities of many different products against cotton sucking pests such as Radwan *et al.* (1985), Darwish and Farghal (1990), Halawa *et al.* (1992), Butler *et al.* (1993) and Korkor *et al.* (1996)

Several problems in controlling pests such as pollution of the environment, resistance and harmful the natural enemies has been risen from the intensive use of insecticides. The present work aimed to study the effect of some natural materials, Kz-oil, supermisrona, naturalis in addition to some biocides which were MVP II, bankol, milbeknock, biofly and vapcomic against some cotton sucking pests and the side effect on natural enemies to avoid the problems of insecticides used.

MATERIALS AND METHODS

This work was carried out during 1999 cotton growing season at Sakha Agricultural Research Station. Two cotton fields of about 1/2 Fed. were used for studying the initial and residual effect of certain compounds treatments against sucking pests, *Aphis gossypii*, cotton Jassid, *Empoasca decipiens* and cotton whitefly *Bemisia tabaci*, and their side effect on natural enemies, *Coccinella undecimpunctata, Scymnus syriacus, Scymnus punctillum, Paederus alfierii, Orius* sp., *Chrysoperla carnea* and true spiders.

Every compound treatment comprised 3 replicates of 1/100 of a Fed. each. A check of 3 replicates was left for each field. For each treatment, samples of 75 cotton leaves were picked up at random before spray and after 2, 5, 8, 11 and 14 days for Aphids and Jassids and 2, 5, 10 and 15 days of application for population counts of whitefly. Population densities of the following major natural enemies, lady bird, *Coccinella undecimpunctate, Scymnus syriacus* and *Scymnus punctillum*, aphid lion, *Chryosperla carnea*¸ rove beetle, *Paederus alfierii*, anthocorid bug, *Orius* sp. and true spiders, prevailing in cotton fields were studies. Samples of 25 plants for each plot (75 plants for each treatment) were examined and the weekly number of predators found were recorded. Samples were chosen at random from both diagonals of the inner square area of each plot. Reduction in population was computed according to the equation of Henderson and Tilton (1955). Chi-square method was used at 5% probability to evaluate significant differences of the efficacy between treatments.

The compounds used were the following:

1. **First experiment:**

1. **Kz-oil:** A mineral oil.
2. **Supermisrona:** A mineral oil .

3. **Naturalis-L:** A liquid of formulated biocide which contains spores of the fungi *Beauveria bassiana*.
4. **MVP II** 20% EC: delta endotoxin of *Bacillus thuringiensis* variety Kurstaki encapsulated in killed *Pseudomonas fluorescens*.
5. **Bankol 50% WP (Benultap):** A natural product-produced by the microorganism *Lumberis* sp.
6. **Milbeknock** 7% EC: (milbemectin) is a natural product produced by the soil microorganism *Streptomyces hygroscopicus*.

II. Second experiment:

1. **Biofly**: A liquid of formulated biocide which contains spores of the fungi, *Beauveria bassiana*.
2. **Vapcomic 1.8% Ec (Abametctin):** A natural product, produced by the soil microorganism, *Streptomyces avermitilis*.

The formulated compounds were diluted with water (150 liters/Fed.) and were sprayed on cotton by using solo motor.

RESULTS AND DISCUSSION

1. Effect of tested compounds on aphids, *Aphis gossypii*:

For the first experiment data in table (1) show the aphicidal activity of compounds treatment against *Aphis gossypii*. Summarized results show that, Kz-oil and Milbeknock induced the highest initial and residual activity among the tested compounds. In term of Figures, the percent reduction were 71.62 and 77.61% after 2 days of spraying (initial kill) and 56.89 & 53.74% reduction during 14 days (residual activity) for Kz-oil and milbeknock, respectively. On the other hand, supermisrona, naturalis, MVP II and bankol had a moderate effect in this respect.

With the second set of experiment, data in the same table show that, vapcomic at the rates of 833.3 and 416.50 cm^3/Fed. induced a moderate initial kill where they showed 52.65 and 42.15% reduction after two days of spraying, respectively. Also, biofly at the three rates and vapcomic at the rate of 208.25 cm^3 per Fed. had a least effect in this respect.

With respect to residual activity, vapcomic at the rate of 833.3 cm^3/Fed. induced the best result, recording 45.66% reduction in residual activity. On the other hand, biofly at 800, 400 and 200 cm^3/fed and vapcomic at 416.5 and 208.25 cm^3/fed. induced a slight residual activity, where they reduced the population density of aphids from 4.67 to 19.00% and from 7 to 20%, respectively.

Green and Dybas (1984) reported that, Avermectin had a good contact activity against aphids (including *Neomyzus circumflexus* and *Myzus persicae*), but had a short residual contact effect on leaf surfaces. El-Hamady (1997) found that, abamectin applied at rates 100-300 ml/f may be efficient and adequate for controlling aphids, *Aphis gossypii* (Glover) on squash and eggplant.

Effect of tested compounds on Jassids:

Data presented in tables (2) show that, all tested compounds in two experiments caused no satisfactory effect on Jassids as initial and residual activity. Their initial kill ranged between from 13.28 to 41.59% reduction, while they caused residual activity ranged between from 0.67 to 65.58% reduction.

Effect of tested compounds on whitefly *Bemisia tabaci*:

a. Immature stages:

Data in table (3) show that, milbeknock and supermisrona induced a moderate initial and residual activity among the tested compounds. In term of figures, the percent reduction where 55.49 and 41.10% after 2 days of spray (initial kill) and 61.33 & 47.83% reduction during 14 days (residual activity) for milbeknock and supermisrona, respectively. On the other hand, Kz-oil, naturalis, MVP II and bankol induced a slight initial and residual activity where it ranged from 13.24 to 23.23% and from 0.00 to 15.66% reduction for the initial and residual effect, respectively. With the second set of experiment data in the same table show that, a weak initial kill was observed after two days from all treatments where they recorded a percent reduction from 0 to 38.41%.

Considering the residual activity of the tested compounds in cotton fields, data proved that, vapcomic at the rate of 833.2 cm^3/Fed. induced the best result, recording 63.60% reduction in population of immature stages of whitefly followed closely by biofly at the rate of 800 cm^3 (42.74%), vapcomic at the rate of 416.50 cm^3 (38.66%), vapcomic at the rate of 208.25 cm^3 (31.00%), biofly at the rate of 400 cm^3 (30.30%) and biofly at the rate of 200 cm^3 (10.28%) reduction.

Data presented in table (3) showed that, insignificant differences in the efficiency of the two higher rates of biofly and the two lower rates of vapcomic against immature stages of whitefly. In term of figures the initial kill were 17.47, 24.16%, and 12.05, 11.76% reduction, while the residual effect were 30.30, 42.74% and 38.66, 31.00% reduction for the two higher rates of biofly and the two lower rates of vapcomic, respectively.

b. Mature stage:

Data presented in table (4) show that, all tested compounds in two experiments caused no satisfactory effect on mature stage of whitefly as initial and residual activity. Their initial kill ranged between 14.92 to 28.20% reduction while they caused residual activity ranged between 0.89 to 17.81% reduction.

These results are in harmony with those of Price and Schuster (1991) who found that abamectin reduced the number of nymphs and adults of *B. tabaci* infesting poinsettias by the largest amount. On the other hand, El-Hamady (1997) reported that, abamectin applied at rates 100-300 ml/Fed. may be efficient and adequate for controlling mite, *Tetranychus* spp. and aphids, *Aphis gossypii* on squash and eggplant, while failed to show effective control against whitefly *Bemisia tabaci* even at higher rates (i.e. 500 and 700 ml/f.). El-Bessomy *et al*. (1996) reported that, the fungal insecticide, biofly can be used successfully to reduce the three whitefly stages using half the

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recommended rates (50 ml/100 liters water) after five sprays on tomato, plants.

Hamid and Korkor (1998) found that, hopa-oil, M-Pede, natrilo, naturalis and biofly can have an important role in controlling whitefly, as being effective against immature stages of the whitefly, where they showed 55.61, 48.72, 47.87, 46.16 and 44.96% and 44.96% reduction, respectively, while milbeknock and vertimec were the least effective recording 31.91 and 29.70% reduction, respectively. On the other hand, all tested compounds exerted unsatisfactory control results against the mature stage of whitefly where the percent reduction ranged between 8.70 to 27.95%.

El-Bessomy (1998) found that, natural oils (Jojoba oil 96%) efficiency was 88.86% comparing with the other three recommended chemical insecticides 89.18, 88.42, and 86.99% for Admire, Nextar and Reldan, respectively) without significant difference on the different stages of the whitefly *Bemisia tabaci* infesting tomato plant.

Korkor *et al*. (1996), reported that, insignificant differences was observed between cotton seed oil 5% plus soap 5% (64.91%), mineral oil Kz 1.75% (57.58%) and the IGR's pyriphoxyfen at the half recommended rate 150 cm^3/Fed. at the (69.63%) and at the recommended rate (75.07%) reduction in the number of immature stages of whitefly after 3 sprays at two weeks interval. They also found that, seed cotton oil plus soap and mineral oil had a considerable effect on whitefly adult, where they caused 35.71% and 41.34% reduction after two days of spray as compared with 22.41% and 12.39% reduction for pyriproxyfen of 300 and 150 cm^3/Fed., respectively.

Effect of tested compounds on natural enemies:

Data presented in Tables (5, 6 and 7) elucidate the side effect of some bio-insecticides and natural products when sprayed on cotton plants for control of sucking pests and their associated natural enemies, *Coccinella undecimpunctata, Scymnus syriacus, Scymnus punctillum, Orius* sp., *Chrysoperla carnea, Paederus alfierii* and true spiders.

1. Effect of tested compounds on Coccinella undecimpunctata:

Data in table (5) indicated that, all tested compounds had no effect on *Coccinella undecimpunctata* except Biofly at the rate of 800 cm^3/Fed. and Vapcomic at the rates of 416.5 and 208.25 cm^2/Fed. which caused from 18.18 to 41.82% reduction.

2. Effect of tested compounds on Scymnus syriacus:

Data in table (5) show that, Kz-oil, supermisrona naturalis, bankol, milbeknock and biofly at the rate of 200 cm^3/Fed. had no effect on *Scymnus syriacus* during the period of experiment, while biofly at the rates of 400 & 800 cm^3 and vapcomic at the rates of 208.25 & 416.5 cm^2/Fed. caused slight effect. On the other hand, vapcomic at the rate of 833.3 cm^3/Fed. induced the most relatively effect.

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3. Effect of tested compounds on Scymnus punctillum:

Data in Tables (5) indicated that, all tested treatments decreased population density of *Scymnus punctillum* in comparison with the untreated check. Treatment could be arranged descendingly according to reduction percentage as follows: Kz-oil (33.33%), MVP II (33.33) supermisrona (25.00%), bankol (16.67%), naturalis (11.11%) and milbeknock (4.17%) as for the first experiment, while the second experiment vapcomic at the rate of 833.3 cm^3/fed. (34.12%), vapcomic at the rate of 208.25 cm^2 (13.07%), biofly at the rate of 800 (13.07%), vapcomic at the rate of 416.5 cm^3 (7.35%), biofly at the rate of 400 cm^3 (5.88%) and biofly at the rate of 200 cm^3/Fed. (1.18%) reduction.

4. Effect of tested compounds on Orius sp.:

The data presented in table (6) show that, milbeknock, bankol, supermisrona, biofly at the rate of 800 cm^3, Kz-oil and vapcomic at the rate of 208.25 cm^3 per Fed. have decreasing effect on the population density of *Orius* sp. compared with the untreated check. The reduction percentages reached 48.42, 15.79, 15.26, 15.15, 7.89 and 2.36%, respectively. The contrary was obtained in the case of naturalis, MVP II, biofly at the rates of 200 & 400 cm^3 and vapcomic at the rates of 833.3 & 416.50 which had no effect on *Orius* sp.

5. Effect of tested compounds on Chrysoperla carnea:

The data presented in table (6) show that, all tested compounds had no effect on *Chrysoperla carnea* during the period of experiment except naturalis and MVP II which caused 12.47 and 15.14% reduction, respectively.

6. Effect of tested compounds on *Paederus alfierii*:

Data in table (7) indicated that, all tested compounds had no effect on *Paederus alfierii* except bankol, and vapcomic at the rates of 833.3 & 416.5 cm^3/Fed. they caused a slight effect (10.51, 9.05 and 5.09% reduction, respectively).

7. Effect of tested compounds on true spiders:

The data presented in Tables (7) show that, all tested compounds had no effect on true spiders during the periods of two experiments except bankol and vapcomic at the rate of 833.3 cm^3/fed. which caused a slight effect (10.29 and 4.14% reduction, respectively).

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J. Agric. Sci. Mansoura Univ., 25 (6), June, 2000.

التاثير الإبادى لبعض المركبات الطبيعية والحيوية على بعض الآفات الثاقبة الماصة للقطن والأعداء الحيوية المشاركه لها

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تم تنفيذ تجربتين لاختبار كفاءة بعض المركبات الحيوية والطبيعية على بعض الآفات الثاقبة الماصة للقطن وكذا دراسة التأثيرات الجانبية لهذه المركبات على الأعداء الحيوية لهذه الآفات. تم إجراء البحث بمحطة البحوث الزراعية بسخا موسم 1999.

ولقد وضح من خلال النتائج المتحصل عليها أن كل من مركب كذد ـ أويل ، ميلبيكنوك ، قد أعطيا أعلى تأثير مبدأى بعد 2 يوم (71.62% ، 77.61%) وتأثير متبقى بعد 14 يوم من المعاملة وقدره (56.89% ، 53.74% انخفاض) لكل منهم على الترتيب. بينما أعطى كل من سوبر مصرونا ، ناتيورالز ، MVPII ثم مركب بانكول تأثير متوسط فى هذا الاتجاه. كما وضح من النتائج أن مركب فايكومك بأعلى تركيزين. قد أظهر تأثير متوسط مبدأى. كما وضح أن مركب بيوفلاى (ثلاث معدلات) ومركب فابكوك بأقل معدل تطبيق كان لهما أقل تأثير. بينما أعطى أعلى معدل لمركب فايكومك أعلى تأثير متبقى.

ومن ناحية أخرى لم تظهر كل المركبات المختبرة أى تأثير مقنع على الجاسيد وبالنسبة للتأثير على الذبابة البيضاء (الطور غير الكامل) فقد أظهر كل من مركب ميلبيكنوك ، وسوبر مصرونا تأثير أولى وكذا متبقى متوسط الفعالية ، بينما أعطى كل من كذد ـ أويل ، ناتيورالز ، MVPII ثم بانكول تأثير أولى ومتبقى قليل الفعالية ، كما أن كل المركبات المختبرة قد أعطت تأثير أولى ضعيف (بين صفر إلى 38.41% انخفاض). كما أعطى مركب فايكومك باستخدام أعلى معدل له أعلى تأثير على تعداد الأطوار غير الكاملة وذلك بالنسبة للتأثير المتبقى يليه فى التاثير أعلى معدل مستخدم لمركب بيوفلاى ثم مركب فايكومك بالتركيزين المتوسط والمنخفض ثم كان أخرهم كل من التركيز المتوسط والأقل لمركب بيوفلاى.

كذلك فقد أوضحت النتائج أن كل المركبات المختبرة فى كلا التجربتين لم تعطى تأثير مرضى على الأطوار الكاملة للذبابة البيضاء سواء كان أولى أو متبقى حيث كان يتراوح التأثير الأولى بين (14.92 إلى 28.8% انخفاض) بينما كان التأثير المتبقى يتراوح بين (0.89 إلى 17.81%).

وبالنسبة للتأثير الجانبى على الأعداء الحيوية المشاركة للآفات الثاقبة الماصة فإن كل المركبات والمعاملات المختبرة لم يكن لها تأثير على أبو العيد المنقط ما عدا التركيزات العالية لكل من مركبي البيوفلاى والفايكومك. كما أن كل المركبات فى التجربة الأولى ومركب بيوفلاى بمعدل 200سم3/فدان لم يكن لها تأثير على أبو العيد الأسود ، بينما أحدثت بقية المعاملات الأخرى تأثير قليل ما عدا مركب فايكومك بأعلى تركيز مستخدم حيث كان له أكبر تأثير على نفس الحشرة. كما أوضحت النتائج أيضا أن كل المركبات المختبرة قد أحدثت تأثير مختلف على خفض تعداد أبو العيد السمنى حيث تراوح الانخفاض بين (1.18% إلى 34.12%) فى كلا التجربتين.

ومن ناحية أخرى فقد وضح من النتائج أن مركبات ميلبيكنوك ، بانكول ، سوبر مصرونا وبيوفلاى بأعلى تركيز مستخدم وكذ ـ أويل ثم فايكوك بالتركيز المنخفض قد كان لها تأثير على خفض تعداد حشرة الأوريس ، وذلك عن المقارنة. كما لم يكن لكل المعاملات المختبرة فى التجربة أى تأثير على خفض تعداد أسد المن ما عدا مركبى نايتورالز ، MVPII كما لم يكن للمركبات المختبرة تأثير على خفض تعداد العناكب الحقيقية والرواغة ما عدا كل من مركب بانكول وفايكومك بأعلى تركيز مستخدم.

Table (1): Number of aphids (per 75 leaves) and percent-reduction following the application of tested compounds.

Treatments	Rate/ fedd.	No. aphids/75 leaves						% reduction					Residual effect
		Before spray	48 hours	5 days	8 days	11 days	14 days	48 hours	5 days	8 days	11 days	14 days	
Kz-oil	3 L.	1148	706	1206	1063	2420	2807	71.62 a	52.79	60.34	61.44	52.98	56.89 **a**
Supermisrona	3 L.	810	855	1105	1118	2799	3514	51.28 b	38.69	40.88	36.79	16.58	33.24 **bc**
Naturalis	1 L.	1052	994	929	14888	3882	3571	56.39 b	60.31	39.42	32.49	34.73	41.74 **ab**
MVP II	1 L.	783	770	1045	1424	3325	3110	54.61 b	40.02	22.11	22.32	23.62	27.02 **bc**
Bankol	1 k.g	730	921	902	1304	3288	3870	41.77 b	44.47	23.49	17.60	0	21.39 **c**
Milbeknock	1.5 L.	901	437	731	937	2047	2927	77.61 a	63.54	55.46	58.44	37.53	53.74 **a**
Untreated	-	684	1482	1522	1597	3739	3557						
Biofly	200 cm^3	282	248	382	507	651	730	23.54 c	7.94	6.45	2.81	1.48	4.67 **c**
Biofly	400 cm^3	281	246	360	489	628	700	23.88 c	12.93	9.45	5.91	5.20	8.037 **c**
Biofly	800 cm^3	314	260	367	498	584	691	28.01 bc	20.57	17.48	21.70	16.25	19.00 **b**
Vapcomic 100 ppm	833.3 cm^3	303	165	180	326	354	572	52.65 a	59.63	44.02	20.82	28.16	45.66 **a**
Vapcomic 50 ppm	416.5 cm^3	257	171	239	369	517	654	42.15 ab	36.80	25.29	15.31	3.15	20.14 **b**
Vapcomic 25 ppm	208.25 cm^3	244	189	296	420	647	673	32.65 bc	17.56	10.44	0	0	7.00 **c**
Untreated	-	333	383	490	640	791	875						

Table (2): Number of Jassids (per 75 leaves) and percent reduction following the application of tested compounds.

Treatments	Rate/ fedd.	No. of Jassids/75 leaves						% reduction					Residual effect
		Before spray	48 hours	5 days	8 days	11 days	14 days	48 hours	5 days	8 days	11 days	14 days	
Kz-oil	3 L.	129	82	103	172	102	85	41.46 a	23.73	9.70	6.29	0	11.76 ab
Supermisrona	3 L.	125	104	97	158	103	106	23.38 b	25.87	14.40	2.34	0	10.65 ab
Naturalis	1 L.	135	123	99	145	107	96	16.10 b	29.95	27.26	6.06	0	15.82 a
MVP II	1 L.	124	101	120	171	108	99	24.99 b	7.56	6.61	0	0	3.54 b
Bankol	1 k.g	128	113	109	178	106	93	18.71 b	18.66	5.82	1.85	0.28	65.58 ab
Milbeknock	1.5 L.	134	85	102	140	100	95	41.59 a	27.29	29.24	11.55		17.09 a
Untreated	-	128	139	134	189	108	91						
Biofly	200 cm^3	211	115	134	120	172	222	22.09 ab	2.68	0	0	0	0.67
Biofly	400 cm^3	213	113	121	111	164	221	24.16 ab	12.95	3.48	4.65	0	5.27 bc
Biofly	800 cm^3	220	105	119	102	156	213	31.77 a	17.11	14.13	10.50	5.83	11.89 ab
Vapcomic 100 ppm	833.3 cm^3	221	103	112	93	149	211	33.37 a	22.34	22.06	16.51	7.14	17.0 a
Vapcomic 50 ppm	416.5 cm^3	218	114	123	116	183	227	21.97 ab	13.54	1.44	0	0	3.75 bc
Vapcomic 25 ppm	208.25 cm^3	211	128	128	117	179	232	13.28 b	7.04	0	0	0	1.76 c
Control	-	213	149	139	115	172	219						

Table (3): Number of immature stages of whitefly (per 75 leaves) and percent reduction following the application of tested compounds.

Treatments	Rate/ fedd.	No. of Witefly immature stages/75 leaves					% reduction				Residual effect
		Before spray	48 hours	5 days	10 days	15 days	48 hours	5 days	10 days	15 days	
Kz-oil	3 L.	476	574	692	941	703	23.23 c	19.02	15.11	12.86	15.66 **b**
Supermisrona	3 L.	482	446	509	463	461	41.10 b	41.18	58.75	43.57	47.83 **a**
Naturalis	1 L.	452	616	671	793	788	13.24 c	17.31	24.66	0	13.99 **b**
MVP II	1 L.	422	518	804	1316	805	21.86 c	0	0	0	0.00 **c**
Bankol	1 k.g	512	646	558	1184	879	19.68 c	39.29	0.70	0	13.33 **b**
Milbeknock	1.5 L.	472	330	189	457	417	55.49 a	77.70	58.42	47.87	61.33 **a**
Untreated	-	508	798	912	1183	861	-				
Biofly	200 cm^3	167	259	248	277	406	0 c	4.76	13.66	12.43	10.28 **c**
Biofly	400 cm^3	182	168	200	230	368	17.47 b	29.52	34.22	27.17	30.30 **b**
Biofly	800 cm^3	191	162	207	194	262	24.16 b	30.49	47.13	50.59	42.74 **b**
Vapcomic 100 ppm	833.3 cm^3	135	93	107	67	122	38.41 a	49.17	74.17	67.45	63.60 **a**
Vapcomic 50 ppm	416.5 cm^3	122	120	125	132	210	12.05 b	34.29	43.68	38.00	38.66 **b**
Vapcomic 25 ppm	208.25 cm^3	153	151	178	194	282	11.76 b	25.39	34.00	33.61	31.00 **b**
Untreated	-	152	170	237	292	422					

Table (4): Number of mature stages of whitefly (per 75 leaves) and percent reduction following the application of tested compounds.

Treatments	Rate/ fedd.	No. of Whitefly mature stages/75 leaves					% reduction				Residual effect
		Before spray	48 hours	5 days	10 days	15 days	48 hours	5 days	10 days	15 days	
Kz-oil	3 L.	221	194	176	281	271	14.92 a	12.83	5.82	0	6.22 **ab**
Supermisrona	3 L.	244	200	192	284	234	20.56 a	13.87	13.78	10.60	12.75 **a**
Naturalis	1 L.	226	170	169	287	234	27.10 a	18.15	5.93	3.48	9.19 **ab**
MVP II	1 L.	210	174	168	289	227	19.70 a	12.44	0	0	4.15 **b**
Bankol	1 k.g	247	183	150	273	275	28.20 a	33.53	0	0	11.18 **ab**
Milbeknock	1.5 L.	231	178	144	252	236	25.32 a	31.77	19.91	1.76	17.81 **ab**
Untreated	-	220	227	201	297	236	--				
Biofly	200 cm^3	193	160	180	175	248	18.82 a	15.26	10.28	1.68	9.07 **a**
Biofly	400 cm^3	189	149	171	169	238	22.80 a	17.79	11.52	3.64	10.98 **a**
Biofly	800 cm^3	197	156	172	171	252	22.45 a	20.67	14.11	2.12	12.30 **a**
Vapcomic 100 ppm	833.3 cm^3	183	149	168	158	256	20.27 a	16.58	14.57	0	10.38 **a**
Vapcomic 50 ppm	416.5 cm^3	173	150	165	161	265	15.09 a	13.34	7.91	0	7.08 **a**
Vapcomic 25 ppm	208.25 cm^3	174	149	175	174	250	16.14 a	1.61	1.05	0	0.89 **b**
Untreated	-	189	193	208	191	247					

Table (5): Number of coccinellidae/75 plant and the percent reduction.

Treatments	Rate/ fedd.	No. of individuals/75 plant														
		Coccinella undecimpunctata					*Scymnus syriacus*					*Scymnus punctillum*				
		Before spray	1 week	2 weeks	Mean	% red.	Before spray	1 week	2 weeks	Mean	% red.	Before spray	1 week	2 weeks	mean	% red.
Kz-oil	3 L.	6	18	28	23	0 a	41	38	69	53.5	0 b	5	7	13	10	33.33 a
Supermisrona	3 L.	6	14	26	20	2.44 a	45	40	78	59	0 b	6	7	20	13.5	25.00 ab
Naturalis	1 L.	4	14	30	22	0 a	30	33	71	52	0 b	6	10	22	16	11.11 cd
MVP II	1 L.	5	15	20	17.5	0 a	52	34	79	56.5	12.24 a	5	7	13	10	33.33 a
Bankol	1 k.g	6	17	30	23.5	0 a	47	44	104	74	0 b	5	10	15	12.5	16.67 bc
Milbeknock	1.5 L.	6	17	27	22	0 a	50	39	103	71	0 b	4	10	13	11.5	4.17 d
Untreated	-	6	16	25	20.5		42	28	76	52		4	10	14	12	
Biofly	200 cm^3	4	5	5	5	9.09 cd	27	40	34	37	0 d	5	7	5	6	1.18 c
Biofly	400 cm^3	4	7	5	6	0.00 e	30	42	23	32.5	13.97 bc	7	8	8	8	5.88 bc
Biofly	800 cm^3	5	5	3	4	41.82 a	32	42	25	33.5	16.87 bc	9	14	5	9.5	13.07 b
Vapcomic 100 ppm	833.3 cm^3	5	10	3	6.50	5.45 d	34	34	24	29	32.27 a	10	13	3	8	34.12 a
Vapcomic 50 ppm	416.5 cm^3	4	7	2	4.50	18.18 bc	34	43	35	39	8.91 bc	8	11	7	9	7.35 bc
Vapcomic 25 ppm	208.25 cm^3	4	6	2	4	27.27 ab	32	46	30	38	5.70 bc	9	12	7	9.50	13.07 b
Untreated	-	4	8	3	5.50		27	43	25	34		7	11	6	8.50	

Table (6): Number of *Chrysopa carnia* and *Orius* sp. on 75 plant and percent reduction.

Treatments	Rate/ fedd.	No. of individuals/75 plants									
		Chrysopa carnia					*Orius* sp.				
		Before spray	1 week	2 weeks	Mean	% red.	Before spray	1 week	2 weeks	Mean	% red.
Kz-oil	3 L.	25	26	32	29	0 b	8	9	11	10	7.89 b
Supermisrona	3 L.	28	30	40	35	0 b	10	11	12	11.5	15.26 b
Naturalis	1 L.	29	25	30	27.5	12.47 a	7	12	9	10.5	0 c
MVP II	1 L.	31	29	28	28.5	15.14 a	6	12	7	9.0	0 c
Bankol	1 k.g	27	28	33	30.5	0 b	7	6	10	8	15.79 b
Milbeknock	1.5 L.	28	26	36	31	0 b	10	9	5	7	48.42 a
Untreated	-	24	25	27	26		7	11	8	9.5	
Biofly	200 cm^3	11	18	27	25.50	0 a	8	19	16	17.50	0 b
Biofly	400 cm^3	9	23	22	22.50	0 a	9	25	13	19	0 b
Biofly	800 cm^3	10	16	26	21	0 a	10	14	14	14	15.15 a
Vapcomic 100 ppm	833.3 cm^3	12	25	21	23	2.29 a	10	19	14	16.50	0 b
Vapcomic 50 ppm	416.5 cm^3	12	19	30	24.50	0 a	9	25	16	20.50	0 b
Vapcomic 25 ppm	208.25 cm^3	13	19	32	25.50	0 a	9	19	10	14.50	2.36 b
Untreated	-	13	21	30	25.50		10	21	12	16.50	

Table (7): Number of *Paederus alfierii* and true spiders 75 plant and percent reduction.

Treatments	Rate/ fedd.	No. of *Paederus alfierii* on 75 plant					No. of true spiders on 75 plant				
		Before spray	1 week	2 weeks	Mean	% red.	Before spray	1 week	2 weeks	Mean	% red.
Kz-oil	3 L.	112	115	86	100.5	0 b	64	70	79	74.5	0 b
Supermisrona	3 L.	104	100	91	95.5	0 b	62	75	75	75	0 b
Naturalis	1 L.	96	101	90	95.5	0 b	56	66	72	69	0 b
MVP II	1 L.	101	95	102	98.5	0 b	60	70	93	81.5	0 b
Bankol	1 k.g	128	85	101	93	10.51 a	72	64	80	72	10.29 a
Milbeknock	1.5 L.	99	94	94	94	0 b	64	70	82	76	0 b
Untreated	-	101	74	90	82		61	55	81	68	
Biofly	200 cm^3	92	82	62	72	0 b	73	73	58	65.5	0 b
Biofly	400 cm^3	100	86	67	76.5	0 b	70	85	55	70	0 b
Biofly	800 cm^3	102	85	58	71.5	0 b	73	81	53	67	0 b
Vapcomic 100 ppm	833.3 cm^3	123	80	56	68	9.05 a	86	79	52	65.5	4.14 a
Vapcomic 50 ppm	416.5 cm^3	130	85	65	75	5.09 a	85	79	60	69.5	0 b
Vapcomic 25 ppm	208.25 cm^3	121	83	66	74.5	0 b	80	88	54	71	0 b
Untreated	-	102	70	54	62		73	67	49	58	