EFFECT OF DIFFERENT BIO-CONTROL AGENTS ON THE BAMBOO PIT SCALE, *BAMBUSASPIS BAMBUSAE* AND THE SEYCHELLARUM MEALYBUG, *ICERYA SEYCHELLARUM* UNDER LABORATORY CONDITIONS

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Abstract

The relative toxicity of different natural control agents against the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) and the seychellarum mealybug, *Icerya seychellarum* (Westwood) were studied under laboratory conditions. The potency of three natural compounds namely (Biovar, Bio-Ranza and Super Mesrona oil) compared with OP, Sumithion against the nymphs, non-gravid and gravid females of the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) was carried out using direct exposure technique. The obtained data indicated that the bamboo pit scale, *Bambusaspis bambusae* (under laboratory conditions) showed less susceptibility to the tested compounds as compared with the seychellarum mealybug, *Icerya seychellarum*.

INTRODUCTION

The bamboo pit scale, *Bambusaspis (Asterolecanium) bambusae* (Boisduval) (Homoptera : Asterolecaniidae) form clusters on all parts of the bamboo plant, feeds on the sap from sheath and forms clusters on the stems of bamboo, *Dendrocalamus giganteus.* This infestation leading to defoliation, dryness, disfigured and reduction of the bamboo plants (Mohammad *et al.,* 1997 and Abdel-Atty 2004). *Bambusaspis* sp. n. is described from females taken from bamboo (Phyllostachys edulis) in Anhui, China, in 1979 (Wu, 1983). While, *Bambusaspis bambusae* is one specific pest of some species of bamboo in Spain, and spread from the Asiatic region throughout many other world regions where bamboo is used for ornamental plantings. Scale has been found for the first time in Spain on *Bambusa* sp. (Soria *et al.,* 1998) and in France (Germain *et al.,* 2003). Very rare data about this insect was found in Egypt or around the world. The mealybug, *Icerya seychellarum* (Westwood) (Homoptera : Margarodidae) infests branches and leaves of ornamental plants. The female lays a large number of eggs (600-800 eggs/female) in an ovisac made of wax secreted from wax gland lays on the lower side of *I. seychellarum*. The mealybug is usually found in clusters on branches and leaves, it also feeds on the sap sucked from the host plant tissues. As this sap contains only a very low concentration of protein, the insect sucks a great amount of

sap from which it obtains the amount of protein sufficient for its growth and egg development. The high number of insects, attacking leaves and branches of the tree results in a great loss of sap, thus leading to defoliation, dryness and reduction of the tree vitality. In addition, the mealybugs secrete honeydew, which offers a suitable medium for the growth of fungus (Dreistadt *et al.*, 1994).

The present work aimed to study the relative toxicity of different control agents against the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) on bamboo plants and the seychellarum mealybug, *Icerya seychellarum* (Westwood) on Washingtonia palms under laboratory conditions.

MATERIALS AND METHODS

1. Relative toxicity of different natural control agents against the bamboo pit scale, *Bambusaspis (Asterolecanium) bambusae* (Boisduval) under laboratory conditions

The experimental insects of bamboo pit scale, *Bambusaspis (Asterolecanium) bambusae* (Boisduval) (Homoptera: Asteroleacaniidae) used in the present investigation were the, nymphs, non-gravid and gravid females. The infested bamboo leaves were collected from the field (Giza Governorate) and kept in polyethylene bags and transferred to the laboratory few hours before treatment. The laboratory experiments were carried out in the Laboratory of Scale Insects and Mealybugs Research Department, Plant Protection Research Institute, ARC, Dokki, Giza, Egypt. The method of direct exposure was used throughout the present investigation. Five concentrations of each natural control agent were used, twenty leaves infested with pit scale insects were dipped in each concentration for five seconds. Leaves were divided into five replicates. Five leaves were dipped in clean water as untreated check (control). The leaves were transferred to clean wide plastic dishes which then covered with muslin cloth held in position by rubber bands. The culture were maintained at room temperature about 25±1°C and 65±1% relative humidity in polyethylene bags according to Zidan *et al.* (1982). After one week, the dead nymphs, non-gravid and gravid females were counted.

2. Relative toxicity of different natural control agents against the seychellarum mealybug, *Icerya seychellarum* (Westwood)

The experimental insects of the seychellarum mealybug, *Icerya seychellarum* (Westwood) used in the present investigation were the, nymphs, non-ovipositing and ovipositing females. The infested Washingtonian leaves were collected from the field and kept in polyethylene bags and transferred to the laboratory few hours before treatment. The laboratory experiments were carried as mentioned above. The method

of direct exposure was used throughout the present investigation. Five concentrations of each natural control agent were used, four leaves infested with mealybugs were dipped in each concentration for five seconds. Leaves were divided into four replicates. Also, four leaves were dipped on clean water and used as untreated check (control). The leaves were transferred to clean wide plastic dishes which then covered with muslin cloth held in position by rubber bands. They were maintained at laboratory temperature about 25±1°C and 65±1% relative humidity in polyethylene bags according to Zidan *et al.* (1982). After 24 hours, the dead nymphs, non-oviposition and ovipositing females were counted.

3. The following materials were tested

a. Sumithion 57% EC was applied at a rate of 2 ml/litre of water.
b. Biovar, an entomopathogenic fungi (3200 viable spore/mg), containing the fungus *Beauveria bassiana*. applied at a rate of 2 ml/litre of water.
c. Bio-Ranza, an entomopathogenic fungi (32 x 10^6 viable spore/ml), containing the fungus *Metarrihizium anisoplae*. applied at a rate of 2 ml/litre of water.
d. Super Mesrona oil 95% EC, a local mineral oil, containing 95% paraffinic oil w/w and 5% inert ingredients, unsulfonated residue content reached 92%. applied at a rate of 20 ml/litre of water.

4. Statistical analysis

In laboratory tests, the mortality percentages were calculated and corrected for natural mortalities by Abbott's formula (1925).

The corrected percent mortalities were statistically computed according Finney (1971) and plotted on probit analysis paper. The tested compounds were compared for their efficiency on the mealybugs and pit scale insect according to their LC_{50}, LC_{90} and slopes of the toxicity lines.

RESULTS AND DISCUSSION

1. Relative toxicity of different control agents against the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) on bamboo leaves under laboratory conditions

Data presented in Table (1) and graphically illustrated as toxicity lines in Fig. (1) showed the potency of three natural compounds namely (Biovar, Bio-Ranza and Super Mesrona oil) compared with Sumithion against the nymphs, non-gravid and gravid females of the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) using direct exposure technique.

Tabulated data indicated that, the potency of the tested compounds was varied tremendously due to the nature of the tested compounds, the used concentration and the tested stage. As a general trend, data proved that at any of the tested compound the higher the concentration, the higher was the rate of mortality and vice versa.

1.1. Effect on nymphs

Data in Table (1) show that, Super Mesrona oil proved the inferior against nymphs of pit scale insect (LC_{50} 5171.33 ppm). Biovar ranked next showing LC_{50} 2527.23 /viable spore/mg), while Bio-Ranza gave (LC_{50} 3240100 viable spore/mg). On the other hand, Sumithion gave highly efficient against nymphs (LC_{50} 302.09 ppm).

On base of the LC_{90} values, the tested compounds showed the same trend, where Super Mesrona oil gave (LC_{90} 31887.51 ppm). Biovar come in the second category (LC_{90} 100360 viable spore/mg), while Bio-Ranza gave (LC_{90} 20078E+6 viable spore/mg). On the other hand, Sumithion gave highly effect against nymphs (LC_{90} 809.79 ppm).

According to the LC_{50} and LC_{90}, Sumithion proved to be the most effective compound, followed by Super Mesrona oil, Biovar while Bio-Ranza came in the last category.

1.2. Effect on non-gravid females

Regarding the non-gravid female of the bamboo pit scale insect, Sumithion proved to be the most effective compound (LC_{50} 388.53 ppm) followed by Biovar (LC_{50} 2710.26 viable spore/mg), Super Mesrona oil (LC_{50} 8089.12 ppm). However, Bio-Ranza was the least effective representing (LC_{50} 9265400 viable spore/mg).

On base of the LC_{90} values, the tested compounds showed the same trend where Super Mesrona oil gave (LC_{90} 36182.98 ppm). Biovar come in the second category (LC_{90} 1284000 viable spore/mg), while Bio-Ranza gave (LC_{90} 13094E+7 viable spore/mg). On the other hand, Sumithion gave highly effect against non-gravid females (LC_{90} 1182.57 ppm).

Based on LC_{50} and LC_{90}, it could be arrange the tested compounds potency against non-gravid females in descending order as follows, Sumithion, Super Mesrona oil, Biovar and Bio-Ranza.

1.3. Effect on gravid females:

Considering the effects of natural control agents against gravid female of the bambo pit scale insect, it was found that Super Mesrona oil proved the inferior showing (LC_{50} 15168.68 ppm). Biovar came in the second category (LC_{50} 4396.93 viable spore/mg), while Bio-Ranza gave (LC_{50} 39417000 viable spore/mg). On the

other hand, Sumithion proved to be the most effective against gravid females (LC_{50} 314.57 ppm).

On base of the LC_{90} values, the tested compounds showed the same trend as Super Mesrona oil gave (LC_{90} 154710 ppm). Biovar came in the second category (LC_{90} 15023800 viable spore/mg), while Bio-Ranza gave (LC_{90} 60692E+7 viable spore/mg). On the other hand, Sumithion proved to be the most effective one against gravid females (LC_{90} 2037.09 ppm).

1.4. Slope of line

The slope of regression line of any pesticide is useful to clarify the homogeneity of different stages, (nymphs, non-gravid and gravid females) of the bambo pit scale insect population, which collected from the field. When the population of bambo pit scale insect is similar in homogeneity the slope value proved high value.

Data in Table (1) showed that the slope values against stages, (nymphs, non-gravid and gravid females) of *A. bambusae* population with Biovar and Bio-Ranza gave (0.31-0.802). But with Mesrona oil and Sumithion, the slope of all stages, (nymphs, non-gravid and gravid females) of *A. bambusae* population gave (1.58-2.993) this meaning that it could be expect to appear the resistance in insect population against the two compounds.

The obtained data is harmony with those obtained by Mangoud (1994), who found that primiphos-methyl was the most potent than (malathion + Shecrona oil, Shecrona oil alone, malathion, diazinon, fenitrothion, and prothiophos) against all stages (nymphs, non-gravid and gravid females) of the fig scale insect, *Russellaspis pustulans* (Cockerell) on apple branches under laboratory conditions.

2. Relative toxicity of different control agents against the seychellarum mealybug, *Icerya seychellarum* (Westwood) on Washingtonian leaves under laboratory conditions

Data in Table (2) and Fig. (2) showed the potency of three natural compounds (Biovar, Bio-Ranza and Super Mesrona oil) compared with Sumithion against the nymphs, non-ovipositing and ovipositing females of the seychellarum mealybug, *Icerya seychellarum* using direct exposure technique.

2.1. Effect on nymphs

Considering the nymphal stages of the seychellarum mealybug, *Icerya seychellarum* the organophosphorous insecticide, Sumithion proved to be the most effective (LC_{50} 163.76 ppm) followed by Super Mesrona oil (LC_{50} 110.14 ppm). Biovar

(LC_{50} 1295.53 viable spore/mg), while Bio-Ranza (LC_{50} 25373000 viable spore/mg) was the least effective on nymphal stages.

Table 1. LC values of the tested compounds against different stages of the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) on bamboo leaves under laboratory conditions.

Stages	Compound	LC_{50} ppm	LC_{90} ppm	Slope
Nymphs	Super Mesrona oil	5171.33	31887.51	1.62
	Sumithion	302.09	809.79	2.993
	Biovar	2527.23	100360	0.802
	Bio-Ranza	3204100	20078E+6	0.34
Non- gravid females	Super Mesrona oil	8089.12	36182.98	1.97
	Sumithion	388.53	1182.57	2.65
	Biovar	2710.26	1284000	0.48
	Bio-Ranza	9265400	13094E+7	0.309
Gravid females	Super Mesrona oil	15168.68	154710	1.27
	Sumithion	314.57	2037.09	1.58
	Biovar	4396.93	5023800	0.42
	Bio-Ranza	39417000	60692E+7	0.31

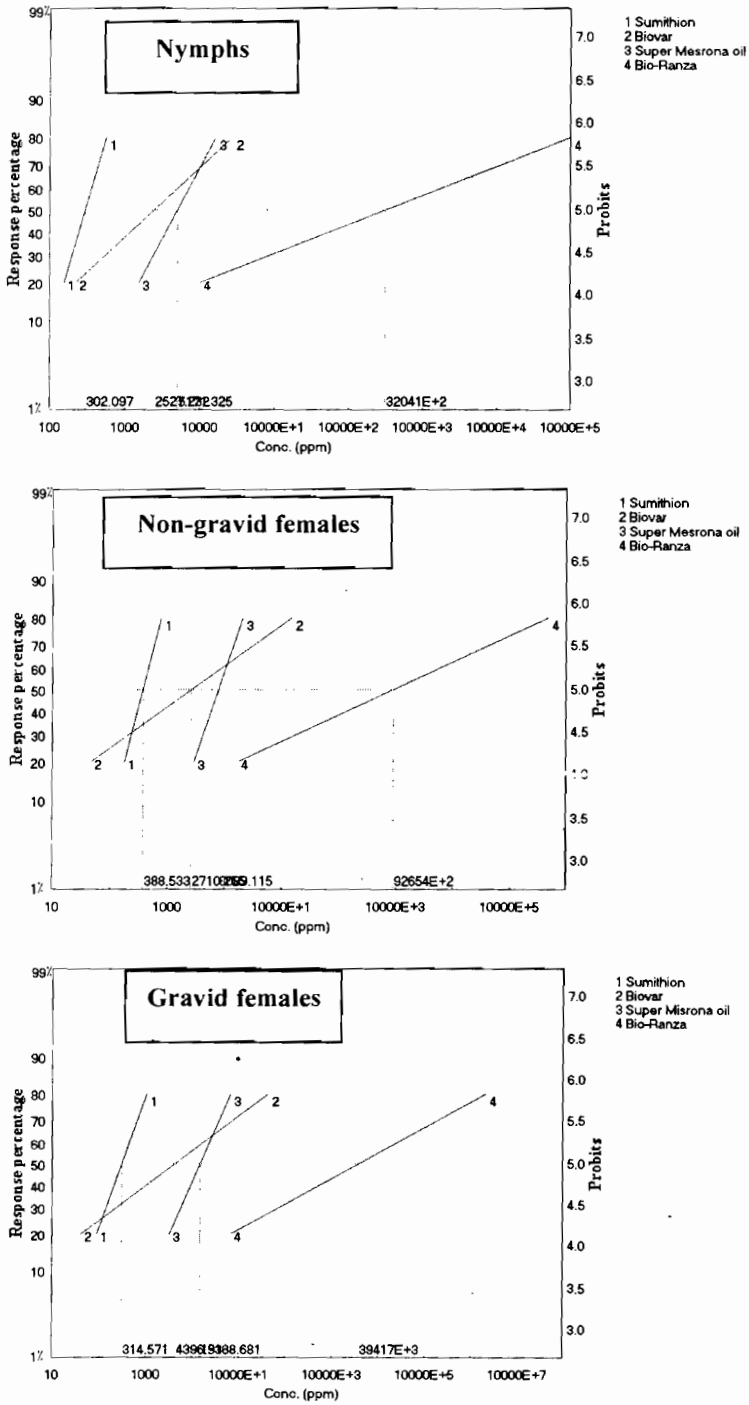

Fig. 1. Toxicity lines of the tested compounds against nymphs, non-gravid and gravid females on the bamboo pit scale, *Bambusaspis bambusae* (Boisduval) on bamboo leaves under laboratory conditions.

On the base of the LC_{90} values, the tested compounds showed the same trend, as Super Mesrona oil gave (LC_{90} 8085.59 ppm). Biovar came in the second category (LC_{90} 30163.33 viable spore/mg), while Bio-Ranza gave (LC_{90} 2128E+5 viable spore/mg). On the other hand, Sumithion gave highly effect against nymphs (LC_{90} 2118.47 ppm).

2.2. Effect on non- ovipositing females

Considering the potency of the natural control agents against non-ovipositing female of the mealybug, it was found that Super Mesrona oil was the most effective (LC_{50} 355.69 ppm). Biovar came in the second category (LC_{50} 3231.94 viable spore/mg), while Bio-Ranza gave (LC_{50} 14795E+3 viable spore/mg). On the other hand the, Sumithion gave highly effect against non-ovipositing (LC_{50} 0.291 ppm).

On the base of the LC_{90} values, the tested compounds showed the same trend as Super Mesrona oil gave (LC_{90} 26884.77 ppm). Biovar came in the second category (LC_{90} 162760 viable spore/mg), while Bio-Ranza gave (LC_{90} 11755E+6 viable spore/mg). On the other hand, Sumithion gave highly effect against non- ovipositing (LC_{90} 2118.47 ppm).

2.3. Effect on ovipositing females

Considering the effects of natural control agents against ovipositing females of the mealybug, it was found that Super Mesrona oil showed (LC_{50} 175.56 ppm). Biovar came in the second category (LC_{50} 5238.26 viable spore/mg), while Bio-Ranza gave (LC_{50} 78116E+3 viable spore/mg). On the other hand, Sumithion gave highly effiiciency against ovipositing females (LC_{50} 131.07 ppm).

On the base of the LC_{90} values, the tested compounds show the same trend as Super Mesrona oil gave (LC_{90} 12284E+1 ppm). Biovar came in the second category (LC_{90} 377310 viable spore/mg), while Bio-Ranza gave (LC_{90} 9036E+7 viable spore/mg). On the other hand, Sumithion gave highly effective against ovipositing females (LC_{90} 1267.34 ppm).

Table 2. LC values of the tested compounds against the different stages of the mealybug, *Icerya seychellarum* (Westwood) on Washingetonia leaves using leaf-dipping technique under laboratory conditions

Stages	Compound	LC_{50}	LC_{90}	Slope
Nymphs	Super Mesrona oil	110.14	8085.59	0.687
	Sumithion	163.76	700.07	2.03
	Biovar	1295.53	30163.33	0.938
	Bio-Ranza	25373000	212800000	1.388
Non- ovipositing females	Super Mesrona oil	355.69	26884.77	0.682
	Sumithion	0.291	2118.47	0.33
	Biovar	3231.94	162760	0.752
	Bio-Ranza	14795E+3	11755E+6	0.442
Ovipositing females	Super Mesrona oil	175.56	12284E+1	0.45
	Sumithion	131.07	1267.34	1.30
	Biovar	5238.26	377310	0.69
	Bio-Ranza	78116000	9036E+7	0.418

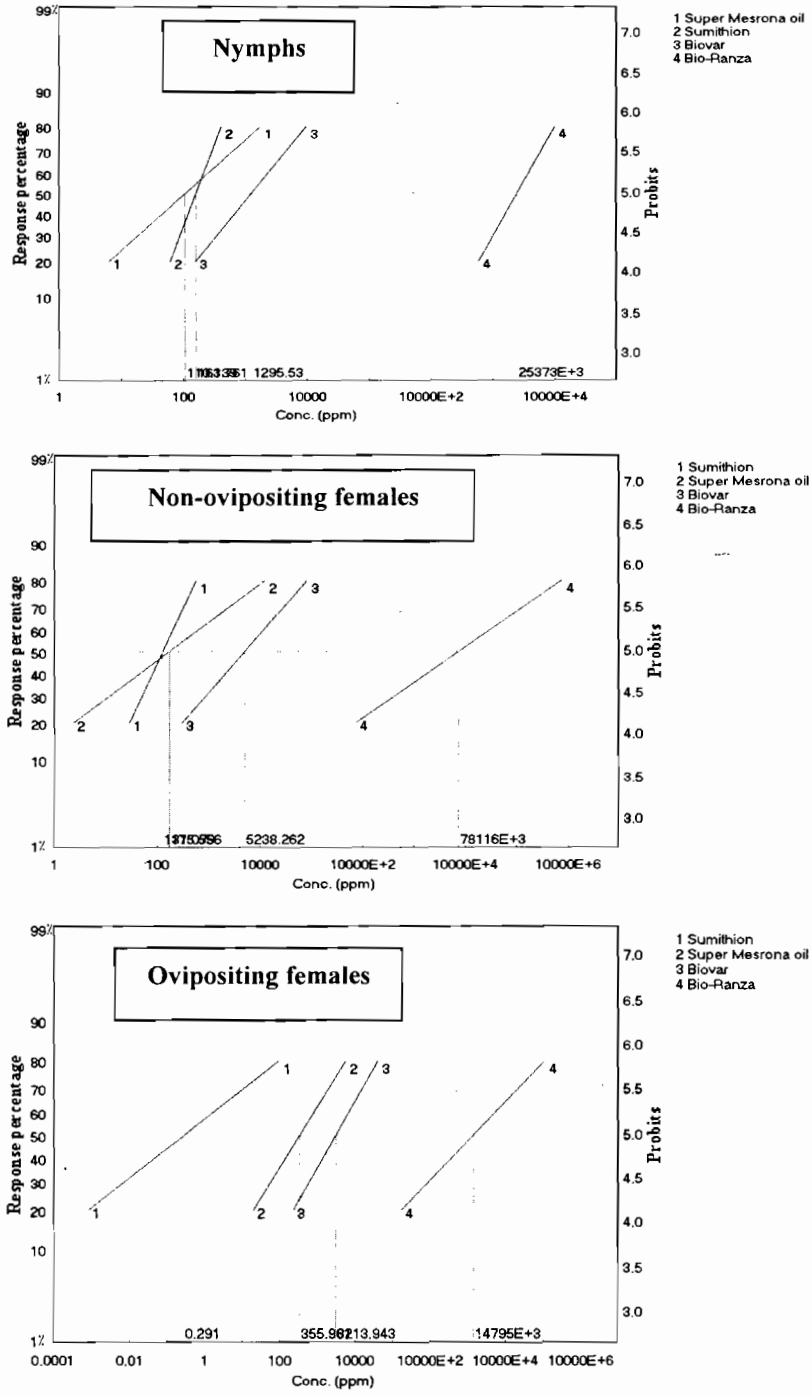

Fig. (2): Toxicity lines of the tested compounds against nymphs, non-ovipositing and non-ovipositing females of the mealybug, *Icerya seychellarum* (Westwood) on Washingetonia leaves under laboratory conditions.

2.4. Slope of line

Data in Table (2) showed that the slope of all stages, (nymphs, non-ovipositing and ovipositing females) of *I. seychellarum* population was relatively small (0.33-938) meaning the homogeneity of insect population in response to the compounds. some exception, was revealed in case of ovipositing females to Sumithion (1.30) and nymphs to Bio – Ranza(10,388)

The obtained data are harmony with those obtained by Mangoud (1994) who stated that profenophos is the most potent insecticide as compared to (diazinon, fenitrothion, formthion, malathion, primiphos-methyl and prothiophos) against all stages, (nymphs, non-ovipositing and ovipositing females) of the seychellarum mealybug, *Icerya seychellarum* using direct exposure technique.

Generally, the bamboo pit scale, *Bambusaspis bambusae* (under laboratory conditions) showed less susceptibility to the tested compounds as compared with the seychellarum mealybug, *Icerya seychellarum*.

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تاثير بعض المركبات ذات الاصل الطبيعى ضد حشرة البامبو القشرية وبق السيشيلارم الدقيقي تحت الظروف المعملية

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تم دراسة التاثير السام لبعض المركبات من اصل طبيعي ضد الاعمار المختلفة لحشرة البامبو القشرية وبق السيشيلارم الدقيقي تحت الظروف المعملية باستخدام طريقة التعريض المباشر .اوضحت النتائج ان فعالية مركبات (بيوفار ، بيورانزا ، زيت سوبر مصرونا المعدنى) مقارنة بمبيد السومثيون ضد الأعمار غير الكاملة والإناث غير الواضعة للبيض لحشرة البامبو القشرية اقل تأثيرا عن الأعمار غير الكاملة والإناث غير الواضعة والواضعة للبيض لبق السيشيلارم الدقيقي .