COMPARISON BETWEEN ORIENTED AND WHOLE TREE SPRAYING FOR CONTROLLING *BAMBUSASPIS BAMBUSAE* (BOISDUVAL) ON BAMBOO PLANTS

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Abstract

The distribution of *B. bambusae* on different parts of bamboo plants as indicated by half monthly count, showed that branches of bamboo plants harboured by the highest level of *Bambusaspis bambusae* populations, whereas, 28.6% of the total population were found on trunk and 20.9% were recorded on lower side of leaves. The upper side of leaves and both of lower and upper sides of midrib harboured the lowest number of bamboo pit scale. The counted stages on these parts were 1.4, 0.6 and 0.12%, respectively.

In general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) gave moderate reduction on nymphs and low reduction on non-gravid and gravid females. On the other hand, Sumithion gave a high average reduction for all stages, on branches, trunks and on leaves. The whole tree spraying trail gave similar results to those obtained from the oriented trail (spraying of trunk and main branches).

INTRODUCTION

The bamboo pit scale, *Asterolecanium bambusae* (Boisduval) (Homoptera : Asterolecaniidae) form clusters on all parts of bamboo plant, feeds on the sap from sheath. The immature and mature stages of insects, suck the plant sap and occur beneath the outer near the base of twigs or branches and causes shedding of the leaves, thus leading to defoliation, dryness, disfigured and reduction of the bamboo plants (Mohammad *et al.,* 1997 and Abdel-Atty, 2004). Very rare data about this insect was found in Egypt or around the world.

The main purpose of this study was directed to compare between oriented and whole tree spraying methods for controlling the bamboo bit scale, *Bambusaspis bambusae* (Boisduval) on bamboo plants under field conditions by using natural control agents.

MATERIALS AND METHODS

1. Distribution study of *B. bambusae* on bamboo plants

The distribution of *B. bambusae* scale was carried out in the farm of Agricultural Research Center located in Giza Governorate, Egypt. Twenty infested bamboo trees, nearly of the same age (ca. 15 years) and size (height 10-15 m) were used. Samples randomly taken at biweekly interval. Methods of sampling were developed by (El-Kifl *et al.,* 1978) and as adopted by Mangoud (1994 & 2000). Counting was started from January 15th till December 1st, twenty new branches (20-25 cm long) and twenty leaves from the new branches were examined. Twenty old branches and twenty of leaves were selected random from all parts of the tree, both surfaces of the leaf were inspected. The samples were kept separately in polyethylene bags and transferred to laboratory for counting the scale insect by the aid of a stereomicroscope. Twenty trunks were selected and take one sample, each was represented by one square inch examined by hand lens (X10) under field conditions (Mangoud, 2000). The immature stages (first, second and third nymphal instars) and females (gravid and non-gravid females) were counted.

2. Whole tree spraying

In this experiment, the whole tree was sprayed. About 7 litres at winter time of spraying liquid per tree were sufficient to insure complete coverage.

3.Oriented spraying (spraying the infested branches)

In this experiment, only the trunk and main branches were sprayed. About 2 litres of spraying volume per tree were sufficient to cover the infested trunk and main branches.

Each spraying trial containing 16 trees (4 replicates) was applied. Other 16 trees were left as untreated check (control). A knapsack sprayer CP-20 of 20L was employed. Counts were made biweekly just before and after spraying.

4. Samples

Twenty twigs each 20-25 cm long, twenty leaves and twenty trunks were selected at random. Samples of twigs and leaves were kept in paper bags and transferred to the laboratory for examination. The tree trunks were examined under field conditions by hand lens (X10). The alive nymphs, adult females (gravid and non-gravid females), were counted under a stereomicroscope. Counts were made before spraying and 6, 12 and 21 days after spraying.

The following materials were tested:

a. Sumithion 57% EC was applied at a rate of 2 ml/ liter of water.

b. Biovar, an entomopathogenic fungi (3200 viable spore/mg), containing the fungus *Beauveria bassiana* applied at a rate of 2 ml/liter 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/liter of water.

d. Micronized sulphur 85%, applied at a rate of 2.5 g/ liter of water.

e. Super Misrona 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/ liter of water.

5. Statistical analysis

The percent reduction of infestation was statistically calculated according to the equation of (Henderson and Tilton 1955), the data were subjected to analysis of variance (ANOVA) and the means were compared by LSD test at 0.05 level, using SAS programme (SAS Institute, 1988).

RESULTS AND DISCUSSION

1. Distribution study of *B. bambusae* on bamboo plants

Data in Table (1) show the distribution of *B. bambusae* on different parts of bamboo plants as indicated by half monthly count, the careful examination of the data revealed that branches of bamboo plants harboured the highest level of *B. bambusae* populations, whereas, 28.6% of the total population were aggregated on trunk and 20.9% were recorded on lower side of leaves. The upper side of leaves and both of lower side and upper side of midrib harboured the lowest number of bamboo pit scale, showing 1.4, 0.6 and 0.12%, respectively.

Statistical analysis yielded high significant differences between different stages aggregated on the various parts of bamboo plants (F value = 788, LSD = 228.4). It could be arrange the different parts descendingly according to the mean number of insect counted as follow, branch, trunk, lower leaves, upper leaves, lower midrib and upper midrib.

These results are in agreement with those obtained by Nestel *et. al.,* (1995), who stated that the citrus mealybug was more abundant especially on the stems. Also, Mangoud (2000) found that some branches of apple trees attached by the mealybug, *Icerya seychellarum.*

Table 1. Half monthly count of *Bambusaspis bambusae* on different parts of bamboo plants during 2005 at (Agricultural Research Station, ARC Giza Governorate).

Inspection date	Trunk	Branch	Lower side of leaves	Upper side of leaves	Lower side of midrib	Upper side of midrib
	Indivd. No./20 inch^2	Indivd. No./ 20 branches	Indivd. No./100 leaves	Indivd. No./100 leaves	Indivd. No./100 leaves	Indivd. No./100 leaves
15/1/2005	2766	4740	2126	160	67	16.0
1/2	3180	4413	2206	146	58	21.0
15/2	3180	4160	2100	126	51	18.0
1/3	3020	5393	2248	140	74	13.7
15/3	2960	5513	2256	120	69	13.0
1/4	3106	5606	2420	130	78	13.0
15/4	3200	5634	2235	160	78	9.7
1/5	3300	5726	2208	156	79	10.9
15/5	3206	5760	2253	173	80	10.0
1/6	3014	5326	2274	181	87	9.7
15/6	2973	5254	2286	193	88	10.0
1/7	2933	4686	2186	153	58	14.7
15/7	3186	4426	2093	120	50	17.0
1/8	2944	4860	2153	166	59	12.0
15/8	2886	5530	2230	166	73	10.0
1/9	3000	4933	2226	170	89	7.0
15/9	2946	4846	2113	127	63	13.7
1/10	2926	4574	2048	100	38	16.0
15/10	2753	4160	2020	72	40	18.0
1/11	2773	5146	2100	113	54	15.7
15/11	2586	5360	2201	123	60	12.0
1/12	3096	5426	2206	166	68	9.0
Total	65941	111481	48194	3168	1466	293.0
Mean	29977	5067	2190	144	66	13.0

Also, Mangoud & Abd El-Gawad (2003), found that *Icerya seychellarum* exist on some branches (from 5-7 branches) of apple trees and also aggregated towards water pipes in newly reclaimed lands during larval development and the non-ovipositing and ovipositing females were more abundant on branches than on leaves.

2. Comparison between oriented and whole tree spraying methods for controlling *B. bambusae* on bamboo plants

2.1. Oriented spraying (spraying the trunk and main branches)

Table (2) showed that the pre-treatment average numbers of nymphs reached (11.4-11.8 individuals/leaf), non-gravid females (5.4-5.8 individuals/leaf) and gravid females (9.1-9.7 individuals/leaf), respectively on leaves of bamboo palms. While, the average number of nymphs reached (37.8-38.5 individuals/branch), non-gravid females reached (16.1-16.9 individuals/branch) and gravid females (20.8-21.8 individuals/branch), respectively on branches of bamboo plant. On the other hand, the average number of nymphs (16.9-17.7 individuals/square inch), non-gravid females (10.8-11.8 individuals/square inch) and gravid females (11.5-11.9 individuals/ square inch), respectively on trunks of bamboo plants (Table 2).

Only trunk and main branches of bamboo plants were spraying, therefore the direct effect of different compounds were calculated.

On branches: in general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) and Sumithion gave moderate reduction on nymphs and then on non-gravid and gravid females.

Biovar gave moderate average reduction 73 and 65% against nymphs and non-gravid after 21 days while, gave poor reduction 47% against gravid females, respectively. Also, Bio-Ranza gave moderate average reduction 70, 62 and 50%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur gave moderate average reduction 71 and 60%, against nymphs and non-gravid and gave poor average reduction 43% to gravid females, respectively. Also, Super Misrona oil gave moderate average reduction 67 and 56%, against nymphs and non-gravid and gave poor average reduction 40% against gravid females, respectively. On the other hand, Sumithion gave high average reduction 96, 94 and 81% against nymphs, non-gravid and gravid females, respectively (Table, 3).

On trunks : in general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) and Sumithion gave high reduction on nymphs and then on non-gravid and gravid females.

Biovar gave moderate average reduction 75 and 67% against nymphs and non-gravid after 21 days while, gave poor reduction 51% against gravid females, respectively. Also, Bio-Ranza gave moderate average reduction 79, 63 and 56%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur gave moderate average reduction 75 and 59%, against nymphs and non-gravid and gave poor average reduction 46% to gravid females, respectively. Also, Super Misrona oil showed moderate average reduction 66 and 59%, against nymphs and non-gravid and proved poor average reduction 43% against gravid females, respectively.

On the other hand, Sumithion induced high average reduction 94, 93 and 95% against nymphs, non-gravid and gravid females, respectively (Table, 3).

Table (2): Average number of different stages of the bamboo bit scale, *Bambusaspis bambusae* (Boisduval) before and after application of various control agents under field conditions (oriented spraying method).

Treatment	Rate of applic. ml/L.	Pre-treatment count									Post-treatment count after 21 days								
		Leaves			Branch			Trunk			Leaves			Branch			Trunk		
		N	NG	G	N	NG	G	N	NG	G	N	NG	G	N	NG	G	N	NG	G
Biovar	2 ml	11.6	5.8	9.7	37.9	16.1	21.2	16.9	10.8	11.9	11.1	10.2	15.6	20.1	13.1	23.2	7.8	8.2	13.5
Bio-Ranza	2 ml	11.8	5.7	9.1	37.8	16.3	20.8	17.6	10.9	11.8	11.9	9.8	14.2	22.5	13.5	21.3	6.8	9.5	11.9
Micronized sulphur	2.5 g	11.5	5.7	9.3	38.4	16.5	20.9	17.2	11.3	11.6	10.3	10.1	15.1	21.9	16.2	24.3	8.1	10.8	14.5
Super Misrona oil	20 ml	11.3	5.6	9.4	38.5	16.8	21.3	17.4	11.8	11.7	9.7	9.8	16.3	24.5	16.9	26.1	11.1	11.4	15.4
Sumithion	2 ml	11.4	5.4	9.5	38.2	16.9	21.8	17.7	11.4	11.5	8.5	8.6	13.3	3.2	4.5	8.7	2.1	1.8	1.3
Control	-	11.4	5.7	9.6	38.2	16.7	21.7	17.5	11.1	11.6	20.8	14.2	21.4	75.2	32.8	44.5	32.7	25.9	26.8

N= Nymphs, G = Gravid females and NG = Non-gravid females

Table (3): reduction percent induced by application of various control agents for controlling the bamboo bit scale, *Bambusaspis bambusae* (Boisduval) and under field conditions during 2004 season (oriented spraying method).

Treatment	Rate of applic. l/L.	Average reduction% after 21 days								
		Leaves			Branch			Trunk		
		N	NG	G	N	NG	G	N	NG	G
Biovar	2 ml	48	29	28	73	65	47	75	67	51
Bio-Ranza	2 ml	45	31	30	70	62	50	79	63	56
Micronized sulphur	2.5 g	51	29	27	71	60	43	75	59	46
Super Misrona oil	20 ml	53	30	22	67	56	40	66	59	43
Sumithion	2 ml	59	36	37	96	94	81	94	93	95
Control	-	-	-	-	-	-	-	-	-	-

N= Nymphs, G = Gravid females and NG = Non-gravid females

The indirect spraying liquid "drift" gave some reduction on leaves, as Biovar gave poor average reduction 48, 29 and 28% against nymphs, non-gravid and gravid females after 21 days, respectively. Also, Bio-Ranza showed poor average reduction 45, 31 and 30%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur induced poor average reduction 51, 29 and 59%, against nymphs, non-gravid and gravid females, respectively. Also, Super Misrona oil gave poor average reduction 53, 30 and 22%, against nymphs, non-gravid and gravid females, respectively. On the other hand, Sumithion gave moderate or low average reduction 59, 36 and 37% against nymphs, non-gravid and gravid females, respectively (Table3).

In this respect, Sieburth *et al.,* (1998), reported that mineral oil must coat the pest and its eggs, since complete coverage was essential for optimum results. Mineral oil was the most effective when applied against eggs, and treated first instars stopped development. Nymphs were not able to moult and to grow normally. Mineral oil interferes with both respiration and membrane function and disrupts feeding activities. Oil must coat the pest and its eggs, since complete coverage is essential for optimum results (Sieburth *et al.,* 1998).

These results agree also with the idea of oriented spraying by Mangoud (1994 & 2000), and with those obtained by (Mangoud & Abd El-Gawad, 2003), who found that light oil alone gave poor average reduction of infestation of adult *Icerya seychellarum* (oriented spraying), while, malathion alone gave moderate effect, whereas light oil + malathion gave good reduction of both adults and nymphs. The light oil + malathion and malathion alone had toxic effect against the mature and immature stages of *R. cardinalis* in the apple farm, while light oil alone gave moderate toxicity.

Whole trees spraying:

This trail gave similar results to those obtained from the oriented trail (spraying of trunk and main branches).

The pre-treatment average numbers of nymphs reached (12.4-13.7 individuals/leaf), non-gravid females (7.9-8.5 individuals/leaf) and gravid females (10.5-11.8 individuals/leaf), respectively on leaves of bamboo palms. While, the average number of nymphs reached (39.8-42.7 individuals/branch), non-gravid females (17.8-18.9 individuals/branch) and gravid females (16.9-17.7 individuals/branch), respectively on branches of bamboo palms. On the other hand, the average number of nymphs reached (18.5-21.5 individuals/square inch), non-gravid females (13.4-15.4 individuals/square inch) and gravid females (12.9-14.2 individuals/ square inch), respectively on trunks of bamboo palms (Table, 4).

On branches: in general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) and Sumithion gave moderate reduction on nymphs and then on non-gravid and gravid females.

Biovar gave moderate average reduction 76 and 64% against nymphs and non-gravid while, gave poor reduction 55% against gravid females after 21 days, respectively. Also, Bio-Ranza induced moderate average reduction 72, 62 and 51%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur gave moderate average reduction 74 and 61%, against nymphs and non-gravid and gave poor average reduction 45% to gravid females, respectively. Also, Super Misrona oil showed moderate average reduction 68 and 57%, against nymphs and non-gravid and gave poor average reduction 40% against gravid females, respectively. On the other hand, Sumithion gave high average reduction 95, 83 and 95% against nymphs, non-gravid and gravid females, respectively (Table, 5).

On trunks : in general, the four control agents (Biovar, Bio-Ranza, Micronized sulphur and Super Misrona oil) and Sumithion gave moderate reduction on nymphs and then on non-gravid and gravid females.

Biovar gave moderate average reduction 76 and 71% against nymphs and non-gravid and while, gave poor reduction 52% against gravid females after 21 days, respectively. Also, Bio-Ranza showed moderate average reduction 80, 65 and 58%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur induced moderate average reduction 76 and 61%, against nymphs and non-gravid and gave poor average reduction 46% to gravid females, respectively. Also, Super Misrona oil recorded moderate average reduction 68 and 61%, against nymphs and non-gravid and gave poor average reduction 47% against gravid females, respectively. On the other hand, Sumithion gave high average reduction 95, 94 and 95% against nymphs, non-gravid and gravid females, respectively (Table, 5).

On leaves: Biovar recorded moderate average reduction 78, 67 and 57% against nymphs, non-gravid and gravid females after 21 days, respectively. Also, Bio-Ranza gave moderate average reduction 73, 65 and 53%, against nymphs, non-gravid and gravid females, respectively. While, Micronized sulphur gave moderate average reduction 76, 62 and 46%, against nymphs, non-gravid and gravid females, respectively. Also, Super Misrona oil showed moderate average reduction 70, 60 and 44%, against nymphs, non-gravid and gravid females, respectively. On the other hand, Sumithion gave highly average reduction 96, 95 and 86% against nymphs, non-gravid and gravid females, respectively (Table, 5).

Table (4): Average number of different stages of the bamboo bit scale, *Bambusaspis bambusae* (Boisduval) before and after application of various control agents under field conditions (whole tree spraying)..

Treatment	Rate of applic. ml/L.	Pre-treatment count									Post-treatment count after 21 days								
		Leaves			Branch			Trunk			Leaves			Branch			Trunk		
		N	NG	G	N	NG	G	N	NG	G	N	NG	G	N	NG	G	N	NG	G
Biovar	2 ml	12.4	8.5	10.5	41.5	18.9	25.4	19.7	13.4	13.1	4.9	7.2	11.3	20.2	12.8	24.1	9.8	10.2	19.2
Bio-Ranza	2 ml	13.1	8.4	11.1	42.7	17.8	26.2	19.1	14.8	14.2	6.4	7.5	13.2	24.3	12.5	27.1	7.9	13.5	18.1
Micronized sulphur	2.5 g	12.8	7.9	11.2	41.5	18.7	24.9	18.5	14.2	13.8	5.6	7.5	15.1	21.5	13.4	28.4	9.2	14.2	22.9
Super Misrona oil	20 ml	12.7	8.2	10.8	39.8	18.6	26.7	20.1	15.1	13.7	6.8	8.3	15.2	25.4	14.8	29.4	13.2	15.2	22.1
Sumithion	2 ml	13.2	7.9	11.5	42.2	18.2	25.1	21.4	14.9	12.9	1.0	1.0	3.3	2.8	1.8	8.8	2.1	2.3	1.8
Control	-	13.7	8.1	11.8	42.3	18.4	24.9	21.5	15.4	13.7	24.5	20.5	29.7	84.7	34.2	52.1	44.6	39.8	41.8

N= Nymphs, G = Gravid females and NG = Non-gravid females

Table (5): Reduction percent induced by application of various control agents for controlling the bamboo bit scale, *Bambusaspis bambusae* (Boisduval) and under field conditions (whole tree spraying)..

Treatment	Rate of applic. l/L.	Average reduction% after 21 days								
		Leaves			Branch			Trunk		
		N	NG	G	N	NG	G	N	NG	G
Biovar	2 ml	78	67	57	76	64	55	76	71	52
Bio-Ranza	2 ml	73	65	53	72	62	51	80	65	58
Micronized sulphur	2.5 g	76	62	46	74	61	45	76	61	46
Super Misrona oil	20 ml	70	60	44	68	57	40	68	61	47
Sumithion	2 ml	96	95	89	97	95	83	95	94	95
Control	-	-	-	-	-	-	-	-	-	-

N= Nymphs, G = Gravid females and NG = Non-gravid females

These results also agree with those obtained by Saad (1974) who found that Volck oil 2% and Volck oil 2% + malathion 0.15 % gave satisfactory results in controlling *Icerya seychellarum.* Assem (1990) found that Sumithion gave good results against *Icerya seychellarum.* Also, the results are in agreement with those obtained by Flint (1998), who found that adult females with their white, ridged egg sacs are the most obvious stage. Adults are not controlled well by contact insecticides but through spraying the foliage when the tiny crawlers are active. However such applications kill natural enemies (*Rodalia cardinalis*). Mangoud (1994), found that profenphos, fenitrothion, malathion, pirimiphos-methyl and diazinon gave 89.7, 85.1, 85.0, 83.9 and 81.7% average reduction in infestation against the mealybug, *Icerya seychellarum.*

As mentioned before, about 15 litres of spraying liquid was sufficient to insure complete coverage of all parts of the bamboo palm (whole tree spraying) while, 5 litres (oriented spraying) per palm were sufficient. In other words, the treatment of infested branches is more economic (about 3.5 times less), and safer to environment than the spraying of the whole tree.

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مقارنة بين الرش الموجه الجزئي والرش الكلي لمكافحة حشرة البامبو القشرية علي نباتات البامبو

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تم دراسة توزيع حشرة البامبو القشرية علي الأجزاء المختلفة لنباتات البامبو. وقد وجد أن حوالي ٢٥% من مختلف الأعمار تصيب جذع نباتات البامبو كذلك وجد أيضا أن حوالي ٢٥% من مختلف الأعمار تصيب أوراق نباتات البامبو كذلك وجد أن حوالي ٥٠% من مختلف الأعمار تصيب الأفرع الرئيسية.

عند مقارنة الرش الموجة الجزئي (رش الجذع والأفرع الرئيسية) والرش الكلي ضد حشرة البامبو القشرية علي نباتات البامبو وجد أن المركبات الأربع (بيوفار – بيورانزا – كبريت ميكروني – زيت مصرونا المعدني) أعطت نتائج متوسطة ضد الأعمار غير الكاملة لحشرة البامبو القشرية في حين أعطت نتائج ضعيفة ضد الإناث غير الحاملة والحاملة للبيض بينما أعطي مبيد السومثيون نتائج عالية ضد جميع الأعمار علي كلا من الأفرع والجذع والأوراق في حالة الرش الموجة الجزئي (رش الجذع والأفرع الرئيسية).

كما وجد أن المركبات الأربع (بيوفار – بيورانزا – كبريت ميكروني – زيت مصرونا المعدني) أعطت نتائج قريبة من المتحصل عليها مع الرش الجزئي كذلك أعطي مبيد السومثيون نفس النتائج في حالة الرش الكلي ضد حشرة البامبو القشرية علي نباتات البامبو.

من جهة أخري عند المعايرة لكمية محلول الرش المستخدم وجد أنه في الرش الكلي احتاجت الشجرة لـ ١٥ لتر للتغطية الكاملة بينما احتاجت الشجرة لـ ٥ لتر لتغطية الجذع والأفرع الرئيسية.