Egypt. Acad. J. biolog. Sci., 2 (1): 13- 19 (2010) F. Toxicology &Pest control
Email: egyptianacademic@yahoo.com ISSN: 2090 - 0791
Received: 2/8/2009 www.eajbs.eg.net

Efficiency of some insecticides in male annihilation technique of peach fruit fly, *Bactrocera zonata* (Saunders) under Egyptian conditions

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ABSTRACT

The effectiveness of technical products of Naled, Lambada, Fenthion (Lebaycid), Fenitrothion (Sumithion), Malathion and Dimethoate (mixed with methyl eugenol in the ratio of 1:4), in addition to commercial Malathion (57% EC mixed with methyl eugenol in two ratios of 1:2 and 2:3) were evaluated under field conditions as male annihilation technique (lure and kill) of *Bactrocera zonata* (Saunders) (Diptera: Tiphritidae). Plant fiber blocks saturated with mentioned mixtures were used at four governorates of Egypt (Damietta, Dakahlia, Ismailia and Fayoum) over 12 successive weeks. Efficiency (as lured and killed populations per block per day) of all tested mixtures degraded over time regardless the area. The obtained results revealed that Naled mixture was significantly superior to all other mixtures regard less area or inspection. Naled mixture blocks were relatively effective for up to 8 weeks while others efficiency did not exceed 4 weeks. Commercial Malathion (1:2), technical Malation, Dimethoate were the worth. It was recommended that Naled mixture can be used successfully in *B. zonata* male annihilation technique and renewed every two months. Lambada, Lebaycid, Sumithion, commercial Malathion (2:3) mixtures could be used with monthly renewal.

Keywords: *Bactrocera zonata*, male annihilation technique, methyl eugenol, plant fibers blocks, insecticides.

INTRODUCTION

Peach fruit fly (PFF), *Bactrocera zonata* (Saunders) (Diptera : Tephritidae) is considered one of the most economic important pests for several kinds of fruits in temperate, tropical and subtropical countries (Fletcher, 1987 and Younes *et al.*, 2009).

In Egypt, *B. zonata* became a serious pest since 90's of the last century attacking a wide range of fruits that differ in their ripening time stage all over the year (El-Minshawy *et al.*, 1999 and Hashem *et al.*, 2007).

Male annihilation technique (MAT) (lure and kill) is a fruit fly control method removes male insects, thus reducing male population. This disturbs the male: female ratio and reduces the insect's chances of mating and females produce very few progeny. As a result, the wild population in the target area declines and the insects are eradicated in the end (Cunningham, 1989 and Zaheeruddin, 2007).

The insecticides used in MAT are generally organophosphorus compounds, such as Naled, Malathion, and Dichlorvos (DDVP) (Vargas *et. al.,* 2003). This method is applied as spot treatments by using many dispensers as carriers of methyl eugenol and toxicant (such as cotton cord, neutral gel, plant fibers blocks and felt blocks). The use of lure-and-kill stations (*i.e.* plant fibers and felt blocks impregnated with the methyl eugenol-insecticide mixture) is often preferred (Afia, 2007; Abd El-Kareim

et al., 2009 and Ghanim, 2009). Male flies are attracted to the blocks, feed from their surfaces and killed (Stonehouse *et al.*, 2002).

Fiberboard blocks impregnated with methyl eugenol and various insecticides (e.g., Naled, Malathion and Fipronil) were used successfully to eradicate oriental fruit fly, *Bactrocera dorsalis* (Hendel) in Rota (Steiner *et al.*, 1965), Saipan (Steiner *et al.*, 1970) & Okinawa (Koyama *et al.*, 1984); Asian papaya fruit fly, *Bactrocera papayae* (Drew & Hancock) in Australia (Cantrell *et al.*, 2002) and *Bactrocera* species in Nauru (Allwood *et al.*, 2002).

In Egypt, there is a necessity for improving the system of "lure and kill" under the local conditions; therefore, the present work concerned to evaluate the efficiency of some insecticides in this technique for *B. zonata* at different regions of Egypt.

MATERIAL AND METHODS

1. Experimental areas:

The experiments of the present work were conducted during the period from October 2009 till January 2010 in four governorates of Egypt; Damietta (at the north of Egypt), Dakahlia (at the delta region), Ismailia (at the canal region) and Fayoum (at the north of Upper Egypt). The cultivated host plants at these locations were guava, citrus, and mango, respectively.

2. The tested insecticides:

In the present study, technical products of Naled 90% (Naled), Lambada 92% (Lambada), Fenthion 90% (Lebaycid), Fenitrothion 95% (Sumithion), Malathion 96% (T. Mal.), Dimethoate 90% (Dimethoate) and commercial Malathion (Malathion 57% EC) (C. Mal.) were used. All of the mentioned insecticides were mixed with methyl eugenol in ratio of 1:4 (insecticide : methyl eugenol); except that of commercial Malathion which mixed in two ratios of 1:2 and 2:3.

3. Field bioassay:

To evaluate the efficiency of tested insecticides against *B. zonata* males, field bioassay was carried out by using plant fibers blocks (measuring 5x5x1.1 cm).

Blocks were impregnated with the solution of tested insecticide and methyl eugenol according to the mentioned ratios of mixture for about four hours in the laboratory. The impregnated blocks were transferred to the field on plastic bags. The blocks were hanged on the trees by metallic wire on regular distance at height of about two meters in shady and airy place. Blocks were distributed at 50 meters intervals along all of each area study.

In each location, each treatment was replicated seven times and distributed in a completely randomized design.

To collect the dead insects, plastic containers (measuring 20 cm in height and 10 cm in diameter) were fixed under the treated blocks by metallic wire for receiving the dead male flies. The lured and killed *B. zonata* males in the plastic containers were counted and recorded weekly without renewal the treatments.

Statistical analysis was conducted as Analysis of variance (three ways) for each 4 weeks using Proc ANOVA in SAS (SAS Institute, 1998).

RESULTS

The obtained results are summarized in Tables (1 to 4) as mean values of weekly collected male flies per block per day for different tested mixtures at the four tested sites.

1. Effect of time on the efficiency:

As shown in Tables (1 to 4), all of the tested methyl eugenol-insecticides mixtures exhibited their highest efficiency (as lure and kill) over the first 3 to 5 weeks. After that, this efficiency degraded as time progressed regardless site or mixture.

Table (1): Mean lured and killed male flies per block per day over time at Damietta using different methyl eugenol-insecticides mixtures.

Insecticide mixture	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Naled	37.71	17.55	27.02	24.02	30.57	7.61	6.35	3.47	2.55	1.31	1.88	1.51
Lambada	6.36	3.76	5.41	4.22	5.45	2.12	1.37	1.31	0.45	0.45	0.45	0.41
Lebaycid	7.95	3.41	5.00	3.43	4.41	2.12	1.23	1.18	0.61	0.47	0.69	0.61
Sumithion	4.88	2.82	3.98	3.14	3.77	1.96	1.55	0.73	1.08	0.64	0.49	0.49
C.Mal. (2:3)	8.64	1.51	3.45	2.61	5.61	3.69	2.27	1.65	0.76	0.55	0.43	0.12
C.Mal. (1:2)	5.41	0.82	1.71	2.10	1.73	1.49	1.31	0.86	0.41	0.41	0.33	0.02
T. Mal.	2.41	0.33	0.90	0.29	0.88	1.31	0.69	0.53	0.22	0.22	0.16	0.12
Dimethoate	1.33	0.06	0.20	1.06	0.08	0.89	0.92	0.10	0.53	0.10	0.08	0.00

Table (2): Mean lured and killed male flies per block per day over time at Dakahlia using different methyl eugenol-insecticides mixtures.

Insecticide mixture	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Naled	31.39	20.45	18.39	8.67	8.12	4.32	2.41	0.96	1.63	0.83	0.96	0.65
Lambada	11.72	4.67	5.04	1.96	1.38	1.08	0.79	0.90	0.94	0.25	0.16	0.31
Lebaycid	6.92	4.47	4.90	2.55	2.40	1.61	1.05	1.59	0.63	0.27	1.14	0.75
Sumithion	3.81	1.92	3.51	2.63	2.48	0.91	0.59	0.63	0.65	0.39	0.37	0.53
C.Mal. (2:3)	3.10	4.61	3.65	1.29	1.21	1.02	0.38	0.21	0.12	0.12	0.29	0.27
C.Mal. (1:2)	1.77	4.18	1.69	1.22	0.90	0.98	0.48	0.29	0.08	0.25	0.43	0.27
T. Mal.	0.33	2.02	0.27	0.27	0.19	0.18	0.17	0.20	0.16	0.06	0.12	0.06
Dimethoate	0.12	0.75	0.00	0.04	0.21	0.04	0.07	0.02	0.00	0.00	0.04	0.00

Table (3): Mean lured and killed male flies per block per day over time at Ismailia using different methyl eugenol-insecticides mixtures.

Insecticide mixture	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Naled	12.10	28.83	16.59	7.06	7.45	4.02	2.44	1.55	2.10	1.65	1.45	1.02
Lambada	4.06	13.30	2.14	2.00	2.28	1.38	1.06	1.20	0.45	1.00	0.77	0.63
Lebaycid	1.00	4.03	3.08	0.89	0.57	0.28	0.18	0.61	0.79	1.32	0.38	0.39
Sumithion	1.77	3.36	1.85	0.79	0.75	0.22	0.14	0.14	0.26	0.20	0.41	0.34
C.Mal. (2:3)	0.40	2.08	1.06	0.79	1.81	0.79	0.40	0.73	0.81	0.40	0.14	0.41
C.Mal. (1:2)	0.24	1.00	0.83	0.34	0.57	0.26	0.18	0.36	0.61	0.43	0.45	0.41
T. Mal.	0.18	0.47	0.36	0.07	0.08	0.10	0.04	0.02	0.16	0.16	0.06	0.12
Dimethoate	0.20	0.00	0.00	0.04	0.08	0.06	0.02	0.08	0.02	0.00	0.02	0.12

Table (4): Mean lured and killed male flies per block per day over time at Fayoum using different methyl eugenol-insecticides mixtures.

Insecticide mixture	Weeks											
	1	2	3	4	5	6	7	8	9	10	11	12
Naled	22.26	26.38	10.59	5.93	10.28	4.88	3.21	3.21	3.40	1.45	0.78	1.26
Lambada	2.64	5.43	2.52	1.28	2.62	0.57	0.21	0.85	0.90	0.57	0.48	0.28
Lebaycid	2.49	3.57	1.55	0.76	1.59	0.57	1.31	0.81	0.50	0.67	0.55	0.26
Sumithion	2.21	2.59	1.54	0.93	1.52	0.59	0.64	0.40	0.50	0.38	0.19	0.17
C.Mal. (2:3)	1.75	1.74	1.69	1.43	0.66	1.16	0.28	0.50	0.55	0.23	0.31	0.14
C.Mal. (1:2)	1.85	1.78	0.95	0.86	1.86	0.69	0.76	0.43	0.33	1.02	0.38	0.26
T. Mal.	1.83	1.50	1.64	0.78	1.28	0.85	0.45	0.38	0.35	0.50	0.28	0.28
Dimethoate	0.28	0.24	0.05	0.07	0.02	0.26	0.07	0.12	0.00	0.00	0.19	0.07

2. Effect of different tested mixture:
Statistical analysis of obtained data are presented in Table 5.

The obtained results revealed that Naled mixture was significantly superior to all other mixtures regardless of site or inspection. Naled mixture blocks were effective for up to 8 weeks while others efficiency did not exceed 4 weeks. Lured and killed males per block per day for Naled mixture blocks were 19.68 and 6.30 for the first and second 4 weeks, respectively regardless of site. These values were higher than those obtained by all other mixtures other the first 4 weeks (Table 5). At the last 4 weeks it was still significantly higher than all others. Commercial Malathion (1:2), technical Malathion, Dimethoate mixtures were the worth (Table 5).

3. Effect of site:

The presented results over different governorates revealed significant differences on lured and killed PFF males per block per day. Over the first 4 weeks, Damietta was the highest site followed by Dakahlia, Ismailia and Fayoum, respectively. Over the 5 to 8 weeks, Damietta was significantly higher than other sites. Over the last 4 weeks differences were not significant between all sites (Table5).

Table (5): Statistical analysis of obtained results.

Variable		Intervals		
		1st – 4th week	5th – 8th week	9th – 12th week
Treatment	Naled	19.68 a	6.30 a	1.53 a
	Lambada	4.78 b	1.52 b	0.53 bc
	Lebaycid	3.50 bc	1.34 b	0.63 b
	Sumithion	2.67 bcd	1.06 b	0.49 bc
	C.Mal. (2:3)	2.49 bcd	1.40 b	0.44 cd
	C.Mal. (1:2)	1.67 cd	0.82 b	0.38 cd
	T. Mal.	0.85 d	0.46 b	0.19 de
	Dimethoate	0.28 d	0.16 b	0.07 e
	F-value	56.150	11.210	35.960
	P	0.0001	0.0001	0.0001
Site	Damietta	6.05 a	3.09 a	0.58 a
	Dakahlia	4.98 ab	1.17 b	0.40 a
	Ismailia	3.47 b	0.93 b	0.55 a
	Fayoum	3.47 b	1.35 b	0.40 a
	F-value	4.480	5.710	2.350
	P	0.0052	0.0011	0.0760
Inspection	1st week	5.91 a	3.12 a	0.71 a
	2nd week	5.33 ab	1.48 b	0.51 b
	3rd week	4.11 bc	1.03 b	0.46 b
	4th week	2.61 c	0.81 b	0.38 b
	F-value	6.040	7.020	6.750
	P	0.0007	0.0002	0.0003

DISCUSSION

Naled-methyl eugenol mixture exhibited the highest efficiency against *B. zonata* males in comparison with the mixtures of the other tested insecticides. Naled-lure mixture is the most popular used in MAT for *B. dorsalis* in California, Florida and Los Angeles (Chambers *et al.*, 1974 and Sanderson, 2009). EPPO (2002) reported that the insecticides used in MAT for *B. zonata* are generally organophosphorus compounds such as Malathion or Naled. Vargas *et al.* (2003) reported that Naled is one of the most effective insecticides against *B. dorsalis* and *B. cucurbutae* in Hawaii.

The present study revealed that Lambada, Lebaycid, Sumithion, commercial Malathion (2:3) had the second rank of efficiency against *B. zonata* males. Afia (2007) reported that Malathion and Lebaycid had a moderate effect on *B. zonata* males (in comparison with DDVP). In Mauritius, Seewooruthun *et al.* (1997) reported that use of plywood blocks impregnated with methyl eugenol and Malathion 57% (with a ratio of 6:1) gave positive results in controlling of *B. dorsalis*.

On the other hand, Dimethoate had the lowest effect on *B. zonata* males. Afia (2007) mentioned that Dimethoate was one of the least effective insecticides on *B. zonata*.

In Hawaii, bucket traps with cotton dispensers containing methyl eugenol and either Naled, Malathion, or DDVP proved effective against *B. dorsalis* or *B. cucurbitae* for 20 weeks without replacement of the lure or toxicant. The efficiency of blocks reduced by 50% after 8 weeks (Vargas *et al.*, 2003). In Nauru, methyl eugenol or cue-lure and the insecticide Fipronil were used in MAT of *Bactrocera* species and the blocking campaigns

and repeated every eight weeks (Allwood *et al.*, 2002).

It is recommended that Naled mix is the most effective against *B. zonata* males especially during the first two months of hanging. So, it can be used in MAT of *B. zonata* and renewed every two months. Lambada, Lebaycid, Sumithion, commercial Malathion (2:3), respectively, could be used in MAT of *B. zonata* with monthly renewal.

ACKNOWLEDGEMENT

The authors are grateful to Prof. Dr. Fawzy N. Mahrous, Chairman of the Steering Committee, and Director of Peach Fruit Fly Eradication Program for his support to research. The authors are also thankful to Prof. Dr. Abdel Fattah G. Hashem, Deputy Director and Technical Advisor of Peach Fruit Fly Eradication Program for providing the requirements and technical support to this study.

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ARABIC SUMMARY

كفاءة بعض المبيدات الحشرية في طريقة إفناء الذكور لذبابة ثمار الخوخ تحت الظروف المصرية

نبيل محمد غانم - سامح أحمد مصطفى - مصطفى مهران المتولي - يسري إسماعيل عافية - محمد سلمي سلمان - محمد الحسيني مصطفى

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – وزارة الزراعة

في هذه الدراسة تم تقييم المنتج الخام من مبيدات نالد ، لمبادا ، ليباسيد ، سومثيون ، ملاثيون ودايمثويت (مخلوطة بالميثيل ايوجينول بنسبة ١ : ٤) بالإضافة إلى مبيد ملاثيون ٥٧%EC (مخلوطاً بالميثيل ايوجينول بنسبتين هما ١ : ٢ ، ٢ : ٣) وذلك تحت الظروف الحقلية باستخدام مكعبات الألياف النباتية (المستخدمة في طريقة إفناء الذكور لذبابة ثمار الخوخ) وذلك بأربع مناطق مصرية هي دمياط ، الدقهلية ، الإسماعيلية ، الفيوم على مدار ١٢ أسبوع متتالية وقد ظهرأعلى تأثير لكل المبيدات المدروسة خلال الأسبوع الأول أو الثاني من التقييم بجميع مناطق الدراسة. كما أوضحت النتائج أن مخلوط مبيد نالد هو الأعلى تأثيراً على ذكور هذه الآفة يليه مخاليط مبيدات لمبادا ، ليباسيد ، سومثيون ، ملاثيون ٥٧% ، ملاثيون خام ودايموثيت على التوالي وذلك بجميع مناطق الدراسة. ونستخلص من هذه الدراسة أن مبيد نالد يمكن أن يستخدم بنجاح في طريقة إفناء ذكور ذبابة ثمار الخوخ ويعاد تغيير المكعبات المشبعة به كل شهرين ، كما يمكن أيضاً استخدام مبيدات لمبادا ، ليباسيد ، سومثيون وملاثيون ٥٧% (٢ : ٣) مع تغيير المكعبات شهرياً .