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EFFICIENCY OF WOODEN BLOCKS AND COTTON WICKS AS DISPENSERS OF METHYL EUGENOL FOR ATTRACTING AND KILL THE PEACH FRUIT FLY MALES

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ABSTRACT

The peach fruit fly, *Bactrocera zonata* (Saunders) is one of the most harmful tephritid insects that infest many commercial fruits causing a significant economic damage. The objective of this study was to evaluate the field performance of wooden blocks of fiber plant comparing cotton wicks as an alternative dispenser of methyl eugenol either in internally plastic bottles or directly exposed to weather factors as in sticky-double sheet boards. Two experimental trails were carried out extending for 8 weeks in two locations of Fayoum orchards.

During the 8 weeks of experimentation, the grand weekly means of attracted males of *B. zonata* for the blocks, plastic bottle traps and the sticky-double sheets were 189.96, 43.81 and 62.77 males / week, respectively with a weekly relative attractancy means of 60.49, 21.24 and 18.27%, respectively of the total captured males. On the 2nd trail the residues and lost amounts of methyl eugenol and Sumithion mixture for the fiber blocks and cotton wicks were assessed. After 4 weeks of field exposure, the residues mean % of mixture of fiber blocks, cotton wicks that were internally in the plastic traps and the cotton wick that directly exposed fixing in the sticky-double sheets were 77.19, 71.87 and 53.29%, respectively, while after eight weeks of exposure, the residues percentages were 49.80, 6.72, 2.36%, respectively. The results ensured the continuously applications of plant fiber blocks as an element of peach fruit fly integrated control according to its high performance for males attracting, long time durational of lure residence and the easily application of field procedures.

The tagged words :
*Bactrcera zonat*a – methyl eugenol – fiber block – cotton wick - dispenser.

INTRODUCTION

The peach fruit fly, *Bactrocera zonata* (Saunders) is one of the most harmful tephritid insects that infest several commercial fruits including mango, guava, apricot, peach, apple and citrus causing a considerable and significant economic damage (Hashem *et al.*, 2001). Methyl eugenol (4-allyl-1,2-dimethoxybenzene-carboxylate) is a kairomone (Metcalf and Metcalf 1992) that is attractive to the males of *B. zonata* and has been tested to suppress the fly population through male annihilation technique (MAT) concept of insect control (Qureshi *et al.,* 1981).

Male annihilation technique (MAT) is a control method removes males of insect thus reducing male population causing disturbance of male: female ratio, reducing 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). In Egypt, the National Area Eradication Program was applied for *B. zonata* control depending upon MAT by using plant fiber blocks

as carriers of methyl eugenol and toxicant. Male flies are attracted to the blocks, feed from their surfaces and killed (Stonehouse *et al.,* 2002).

The use of lure-and- kill stations (i.e. plant fibers and felt blocks impregnated with the methyl eugenol-insecticide mixture) is often preferred (Afzal *et al.,* 2001; Afzal and Javed 2001; Ghanim *et al.,* 2010). Sumithion as a kill agent was recommended to be used in *B. zonata* male annihilation technique and monthly renewed, (Ghanim *et. al.,* 2010). Fiberboard blocks impregnated with methyl eugenol and various insecticides were used successfully to eradicate oriental fruit fly, *B. dorsalis* (Hendel) in Okinawa (Koyama *et al.,* 1984); Asian papaya fruit fly, *B. papayae* (Drew & Hancock) in Australia (Cantrell *et al.,* 2002) and *Bactrocera* species in Nauru (Allwood *et al.,* 2002).

On the other side, the cotton wick as a dispenser for methyl eugenol proved most efficient in attracting the flies for longer duration and thus had a potential usefulness for monitoring and control of *B. zonata* (Qureshi *et al.,* 1992 and Afia, 2007). The enclosing wicks inside bucket traps not only provided protection from the weather but also made the device visible, retrievable, and reusable with limited environmental contamination and exposure to humans and pests (Cunningham and Suda 1986 and Vargas *et al.*, 2000). Similarly bucket traps with cotton dispensers containing methyl eugenol and malathion were effective up to 16 week (Vargas *et al.*, 2000).

As part of a mission to develop area wide integrated pest management methods for *B. zonata*, the objective of this study was to evaluate the performance of wooden blocks of fiber plant comparing to cotton wicks as an alternative dispenser of methyl eugenol either in internally plastic bottles or directly exposed to weather factors as in sticky-double sheet boards.

MATERIALS AND METHODS

The experimental trails were carried out during the period from15th of October till December 2012 extending for 8 weeks in two separated locations for each trail with an adjacent distance of > 1km. The two selected orchards were located at Beni-Saleh, Fayoum district, Fayoum governorate. The cultivated host plants at these locations were mango, citrus and guava.

A- The 1st trail :

The trail was designed to evaluate the efficiency of fiber wooden blocks as dispenser of methyl eugenol compared to cotton wicks either fixing internally in plastic bottles to reduce the gradual loss or directly exposed to weather factors as in sticky-double sheet boards.

1-The plant fiber blocks :

Plant fiber blocks (5x5x1.1 cm) were impregnated with the solution of methyl eugenol and technical Sumithion as a toxicant at ratio of 4:1 for about four hours in the laboratory. These blocks were transferred to the field in plastic bags. 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 to collect the dead males of *B. zonata* males which were counted and recorded weekly for 8 weeks.

2- The plastic bottles:

Plastic bottles (25 cm height and 10 cm diameter) had 4 entrance holes of 8 mm diameter in the 1st upper third were used. A cotton wick was fixed and supplied with the mixture of methyl eugenol and the technical Sumithion. The bottles were supplied with a removable cover for obtaining and counting the weekly attracted male flies.

3- The sticky-double sheets:

Cartoon sheets (21.5 X 21.5 cm) of sticky-double surfaces were applied with fixing the impregnated cotton wicks on circular holes (1cm diameter) in the center of the sheet. The attracted and killed insects were weekly counted and removed.

The evaluated dispensers were distributed at 65 meters intervals along all of each area study. Each treatment was replicated 8 times and distributed in a completely randomized design. Relative attractancy of each dispenser was expressed as the ratio of its weekly total number of flies caught to the total number of fruit caught flies for each week**.**

B- The 2nd trail :

To assess the weekly gradual release of methyl eugenol as lure, the fiber blocks and cotton wicks were firstly numbered and weighted in a dry state, hence they were impregnated with the mixture of methyl eugenol and Sumithion at ratio of 4:1, for 4 hours, and then secondly weighted to assess the absorbent quantities. The mentioned blocks and cotton wicks were hung on trees at the same time of the above trail in the 2nd location of the experiment. Every week, six of each were pulled out from the field location and brought to the laboratory and weighted to assess the percentages resident and lost amounts of methyl eugenol-insecticide mixture. These quantities in weight were inverted to equivalent volume quantities depending on methyl eugenol density (1.0356 gm/ cm^3) (Lewis 2001)

C-The statistical analysis :

The statistical analysis was done as one way ANOVA and means separated were conducted by using Duncan' test at the probability of 5% by using Costat Software, Version 4.2. (Costat, 1990).

RESULTS

The 1st trail :

The weekly means of attracted males of *B. zonata* for the tested dispensers are shown in Table (1). During the 1st period (1-4 wk), the wooden blocks captured significantly the highest mean numbers of *B. zonata* males followed by the sticky-double sheet boards and the plastic traps with the respective means of 353.16, 119.00 and 75.47 males / trap. While, during the 2nd period of investigation (5-8 wk), the aforementioned three tested methods had insignificantly low mean numbers of males (26.77, 6.53 and 12.16 males / trap, respectively).

Generally, during the period of investigation (8weeks), the mean numbers of males attracted to wooden blocks was significantly the highest (189.96 males / trap), whereas an insignificantly difference was shown

between the captured males in both plastic bottles (43.81 males / trap) the sticky-double boards(62.77 males / trap).

With respective the relative attractancy of the three tested methods(Fig., 1), the wooden blocks seemed to be the most attractable, such results is indicated by the rate of relative attractancy mean pecentages(Fig. 1). With careful view, the wooden blocks trend had the top rated with a mean of 60.49% ranging 51.50 and 68.00 % during the 8 weeks of the experimentation period. Concerning the trend of the plastic bottles, a gradual increase was observed with a range of 9.46- 28.40% with a mean of 21.42%. Contrary to above, the trend of the sticky-double sheets, the curve was in a gradual decrease with a range of 9.33-33.12% with a mean of 18.27%. Conspicuously, the trend of the plastic traps was the only one that was in relative increase comparing with others.

Table (1): Weekly means of attracted *B. zonata* males to wooden blocks, plastic bottles and sticky-double sheets in Fayoum governorate during 2012 season.

Week no.	Mean number (±S.D)of attracted flies		
	Blocks	Plastic bottles	Sticky-double sheets
1	258.75±83.18	42.63±15.46	149.25±54.82
2	617.13±148.33	113.75±63.74	193.88±56.69
3	394.63±74.39	98.13±43.19	113.38±39.68
4	142.13±81.17	47.38±22.17	19.50±9.35
1-4 weeks*	353.16±203.99 **a**	75.47± 35.81**b**	119.00±74.06 **b**
5	55.50±26.63	22.88±15.37	10.38±5.53
6	25.63±15.85	12.13±6.66	5.25±2.05
7	20.57±3.12	10.75±4.65	8.63±1.85
8	5.38±1.77	2.88±0.83	1.88±1.25
5-8 Weeks**	26.77±20.99 **a**	12.16±8.23 **a**	6.53±3.76 **a**
Mean	189.96±220.14 **a**	43.81±41.52 **b**	62.77±77.27 **b**

Values in each row followed by the same letter are similarly insignificant, *1-4 weeks (n= 96, f=5.532, *p*=0.027), **5-8 Weeks (n= 96, f=2.504, *p*=0.137), 1-8 Week(n= 192, f=2.699, *p*=0.091).

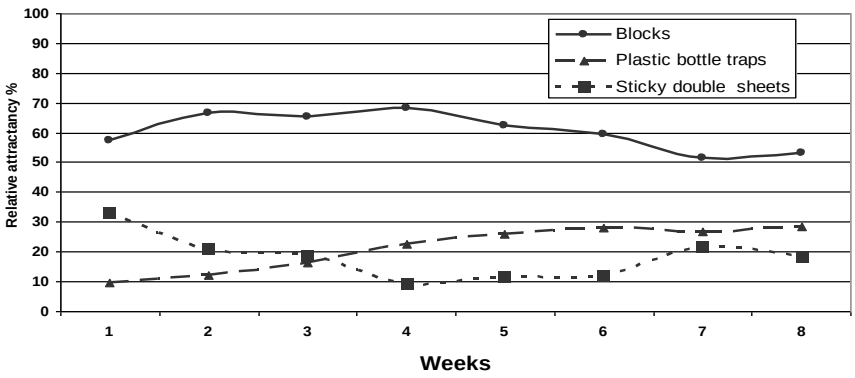

Fig. (1) : Relative attractancy mean percentages of the blocks, plastic bottles and sticky-double sheets in Fayoum governorate during 2012 season.

B- The 2nd trail :

In order to understand the efficient role of the tested dispensers as a carrier of methyl eugenol, this trail was designed to assess the residues of methyl eugenol and Sumithion in blocks or in cotton wicks either that was enclosed inside the plastic traps or that was directly exposed to weather factors via sticky-double sheets. No doubt that the quantity of impregnated mixture would affect the efficiency as "lure and kill" of evaluated dispensers.

For blocks as shown in Table (2), throughout eight weeks of evaluation, the impregnated quantity of the mixture was gradually reduced from 92.49% after the first week to 49.80% after 8 weeks. Significant difference was shown among the mean percentage throughout the experimentation period of the exposure.

Table (2) : The impregnated quantity before exposure, residues quantity after exposure , lost quantity after exposure of the fiber blocks and cotton wicks.

Treatments	Week no.	The impregnated quantity before exposure		The residues quantity after exposure		The lost quantity after exposure		The mean % of the mixture	
		Weight (gm)	Volume (cm^3)	Weight (gm)	Volume (cm^3)	Weight (gm)	Volume (cm^3)	Residues	Loss
Blocks	1	8.15	7.86	7.51	7.25	0.63	0.61	92.49**A**	7.51**g**
	2	9.05	8.73	7.91	7.63	1.14	1.10	87.42**B**	12.58**f**
	3	8.27	7.98	6.63	6.40	1.64	1.59	80.15**C**	19.85**e**
	4	8.51	8.21	6.57	6.34	1.94	1.87	77.19**D**	22.81**e**
	5	8.28	7.99	5.56	5.37	2.72	2.62	67.17**E**	32.83**d**
	6	7.57	7.30	4.69	4.52	2.88	2.78	62.04**E**	37.96**c**
	7	7.18	6.93	4.10	3.96	3.08	2.97	57.22**F**	42.78**b**
	8	7.83	7.56	3.97	3.83	3.86	3.73	49.80**G**	50.20**a**
Plastic bottle traps	1	2.71	2.61	2.51	2.42	0.20	0.19	92.67**A**	7.33**f**
	2	2.76	2.66	2.48	2.39	0.28	0.27	89.87**A**	10.13**f**
	3	2.74	2.64	2.20	2.13	0.53	0.52	80.48**B**	19.52**e**
	4	2.72	2.63	1.96	1.89	0.77	0.74	71.87**C**	28.13**d**
	5	2.72	2.62	1.54	1.49	1.17	1.13	56.83**D**	43.17**c**
	6	2.73	2.64	0.76	0.74	1.97	1.90	27.85**E**	72.15**b**
	7	2.72	2.62	0.24	0.23	2.48	2.39	8.68 **F**	91.32 **a**
	8	2.72	2.62	0.18	0.18	2.53	2.45	6.72 **F**	93.28**a**
Sticky-double sheets	1	2.72	2.63	2.43	2.34	0.29	0.28	89.31**A**	10.69**g**
	2	2.72	2.63	2.20	2.12	0.52	0.50	80.86**B**	19.14**g**
	3	2.72	2.63	1.69	1.63	1.03	1.00	62.11**C**	37.89**f**
	4	2.73	2.63	1.45	1.40	1.27	1.23	53.29**D**	46.71**e**
	5	2.73	2.63	0.97	0.93	1.76	1.70	35.53**E**	64.47**d**
	6	2.72	2.62	0.47	0.45	2.25	2.17	17.23**F**	82.77**c**
	7	2.71	2.62	0.17	0.16	2.54	2.45	6.24**G**	93.76**b**
	8	2.73	2.63	0.06	0.06	2.66	2.57	2.36**G**	97.64**a**

Methyl eugenol density = 1.0356 gm/ cm^3 (Lewis 2001)

For each treatment only, the means followed by the same letter are similarly insignificant

Concerning the plastic bottle traps, after 1 week of exposure, the mean % of residual amount was 92.67 which decreased gradually to record

6.72% after 8 weeks of exposure. Also, the residual mean percentages were significantly varied (Table 2).

Concerning the sticky-double sheets, after 1 week of exposure, the mean % of residual amount was 89.31% which decreased gradually to record 2.36% after 8 weeks of exposure. The residual mean percentage were significantly varied (Table 2).

Regardless the variation of the saturated amount of mixture of each dispenser, the plant fiber blocks have the ability to maintain the highest percentage of the methyl eugenol comparing to cotton wicks. In addition, after 4 weeks of exposure, the cotton wicks of plastic traps lost 28.13 % comparing with 46.71% for that were airy-exposed on the sticky-double sheets, thus indicating the mixture of methyl eugenol and Sumithion declined faster.

DISCUSSION

In the current study, fibered blocks that were treated by methyl eugenol and Suumithion as a toxicant were the highest efficient for attracting and kill the highest numbers of *B. zonata* males for up to 4 weeks. Meanwhile, the fibred block and cotton wick that either were protected inside plastic bottle traps or that were directly exposed to the air were insignificantly varied during the 2nd four weeks of exposure under field conditions.

The efficiency success of impregnated fiberboard blocks with methyl eugenol were previously reported to eradicate oriental fruit fly, *B. dorsalis* in Okinawa (Koyama *et al.,* 1984); Asian papaya fruit fly, *B. papayae* in Australia (Cantrell *et al.,* 2002) and *Bactrocera* species in Nauru (Allwood *et al.,* 2002). MAT applications using blocks offers considerable advantages over all traps in terms of durability, efficiency. The most characteristic operational of the wooden blocks which may be used for MAT that they emitting their loads relatively slowly comparing the cotton wicks.

The obtained results are in agreement with those previously reported by Afzal and Javed (2001) Ghanim *et al.*, (2010), while, they are in disagreement with Qureshi *et al.*, (1992), and Afia, (2007) who reported that the cotton wick as a dispenser for methyl eugenol proved most efficient in attracting the flies. Also, the obtained results are in disagreement with that reported of Cunningham and Suda (1986) and Vargas *et al.* (2000) who indicated the impact role of the enclosing wicks inside bucket traps for providing protection from the weather.

In summary, depending upon its high performance of attracting and kill male flies, the obtained results support using the fibered blocks as a dispenser of methyl eugenol for suppression *B. zonata* males by MAT applications. In the same time, performance development of alternatives is a necessity to improve the trapping quality.

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كفاءة المكعبات الخشبية وفتائل القطن كموزعات لمادة الميثيل ايوجينول لجذب وقتل ذكور ذبابة ثمار الخوخ

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تعتبر ذبابة ثمار الخوخ من أهم لآفات التي تهاجم العديد من محاصيل الفاكهة مسببة لها أضرار جسيمة وقد أجريت هذه الدراسة للتعرف على الكفاءة الحقلية لبعض الموزعات الحاملة لمادة الميثيل ايوجينول والجاذبة لذكور هذه الذبابة ومن خلال تجربتين متلازمتين في محافظة الفيوم. ففى التجربة الاولى تم تقييم كفاءة الجذب والقتل لكل من المكعبات الخشبية المعاملة بمخلوط الميثيل ايوجينول ومبيد السومثيون والمصائد البلاستيكية المحتوية بداخلها على فتيل قطن مشبع بنفس المخلوط والمطويات الورقية المزدوجة والمجهزة بالمادة اللاصقة والمثبت بها فتيل قطن معرض ومشبع بنفس المخلوط مباشرة للظروف الجوية وقد أختلفت متوسطات الجذب الاسبوعية معنوياً خلال الاسابيع الثماني الاولى كالاتي 189.96 و 43.81 و 62.77 ذكر / اسبوع على الترتيب وكان معدل الجذب النسبي 60.49 و 21.24و18.27 ٪ من اجمالي التعداد الكلي للذباب المنجذب اسبوعياً. وفي التجربة الثانية تم تقدير المتبقي والمفقود من مخلوط الميثيل ايوجينول ومبيد السومثيون كنسبة مئوية للكعبات الخشبية وفتائل القطن وأظهرت النتائج أن البلوكات الخشبية كانت الاكثر احتفاظاً بالمخلوط حيث كانت نسبة المتبقي 77.19 ٪ و 49.80٪ بعد اربعة اسابيع وثمانية اسابيع على الترتيب فحين كانت النسبة المئوية للمتبقى بفتائل القطن المثبتة داخل المصائد البلاستيكية 71.87 ٪ و 6.72 ٪ و لفتائل القطن المثبتة على المطويات الورقة المزدوجة والمجهزة بالمادة اللاصقة 53.29٪ و 2.36 ٪ على نفس الترتيب وذلك نسبة الى ما تم تشبيعه من بداية التجربة، وتوصي النتائج باستمرارية الاعتماد على البلوكات الخشبية والمشبعة بمخلوط الميثيل ايوجينول والسوميثيون مدة لا تزيد عن 4 اسابيع في إطار برنامج المكافحة المتكاملة لذبابة الخوخ وذلك نظراً لكفاءة الجذب ولطول الفترة الزمنية للاحتفاظ بالجاذب ولسهولة العمل عند التطبيق الحقلي.

قام بتحكيم البحث

أ.د / عبد الستار عبد الكريم	**كلية الزراعة – جامعة المنصورة**
أ.د / احمد زكى مسلم	**مركز البحوث الزراعيه**