J. Plant Prot. and Path., Mansoura Univ., Vol.8 (12): 667 – 676, 2017

Efficiency of Wooden Blocks for Attracting Peach Fruit Fly Males in Relation with Weather Conditions Effect on Loss of Methyl Eugenol under Field Conditions

Amin, A. A.
Plant Protection Research Institute, ARC, Giza, Egypt

ABSTRACT

The peach fruit fly, *Bactrocera zonata* (Saunders) is one of the most harmful tephtitid flies that infesting many commercial fruits causing a significant economic damage. The current study aims to evaluate the performance of open air blocks, plastic traps and cylindrical net traps for attracting and killing *B. zonata* males. Also, the study extends to assess the loss rate of methyl eugenol and Sumithion mixture(MES) under different weather conditions. The study was carried out in orchards at Fayoum governorate under different weather conditions throughout 4 successive climatic seasons including autumn (2016), winter (2016/2017), spring (2017), and summer (2017). Throughout autumn season, the net traps were significantly the most attracting with mean of 70.69 flies/trap/day followed by open air blocks, and plastic traps with respective means of 43.49 and 36.18 flies/trap/week. While, during summer season, the fresh blocks captured significantly the highest numbers of males followed by weathered open air blocks, plastic traps and net traps with the respective means of 194.87, 59.90, 38.20 and 29.26 flies / trap /week . The blocks were impregnated with a mean quantity of 10.34 cm^3/ block during successive seasons, the MES loss rate of open air blocks during summer season was the highest and fastest averaging 55.13,67.51 and 71.67 % of its initial impregnated quantities after 4, 8 and 12 weeks of exposure respectively. While, during winter season, the loss rate % was the lowest and slowest averaging 8.49, 15.22 and 22.42 % of its initial impregnated quantities after 4, 8 and 12 weeks of exposure, respectively. The blocks of plastic traps were the lowest for losing MES followed by that fixed internally in cylindrical net traps during successive climatic seasons. Temperature correlated significantly with the loss rate for all tested blocks and was the significant variable factor that affecting the linear regression during autumn, winter and spring seasons, while, R.H. % was effective during summer season. Results indicated that the open air blocks are still the best for *B.zonata* males attraction up to 4 weeks for male annihilation technique (MAT) applications, however, there is a necessity for saving an alternative dispenser has the ability to lose its content of MES in regular release.

Keywords : *Bactrcera zonat*a – methyl eugenol – fiber block –- dispenser–- loss rate – male annihilation technique

INTRODUCTION

The peach fruit fly, *Bactrocera zonata* (Saunders) is one of the most harmful tephrtitid flies that infesting many 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). MAT is a fruit fly control method removes male insects thus reducing male population. The disturbance male: female ratio and 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).

Dispensers for MAT vary, use of lure and kill stations as plant fibers and felt blocks impregnated with the methyl eugenol-insecticide mixture is often preferred (Lloyd *et. al.,* 1998Afzal, *et. al.,* 2001, Ghanim *et. al.,* 2010). Sumithion as a killing agent was recommended to be used in *B. zonata* male annihilation technique and monthly be renewed (Ghanim *et. al.* 2010*,* and Gazia *et. al.,* 2013).While, Vargas *et. al.,* (2000) tested simple bucket traps with cotton dispensers containing methyl eugenol and malathion for detection, monitoring and male annihilation of oriental fruit fly, *B. dorsails* populations, the traps were effective up to 16 wk.

In Egypt, a National Area Wide Eradication Program was applied for *B. zonata* controlling depending upon using MAT applications which is carried out by using plant fibers blocks (as carriers of methyl eugenol and toxicant) installed directly to weather factors effects.

The current study is a trail to evaluate the plant fibers blocks performance that are directly exposed to open air, enclosing blocks inside plastic traps and blocks that fixed internally cylindrical net traps. Also, the study extended to assess the loss rate of methyl eugenol and Sumthion mixture (MES) content under different weather conditions particularly temperature and relative humidity during successive climatic seasons.

MATERIALS AND METHODS

This experiments were carried out in orchards at Fayoum governorate under different weather conditions throughout 4 successive climatic seasons including autumn (the period from 28/9/2016 to 20/12/2016), winter (the period from 22/12/2016 to 14/3/2017), spring (23/3to 15/6/2017), and summer (2/7 to 17/9/2017).

The experimental trails:

The first trail:

This trail aimed to evaluate the attraction efficiency of impregnated fiber blocks through 3 types of block applications during seasons of autumn, winter and spring. Firstly, the open air blocks that were exposed directly to air stream where the attracted and killed males were received in plastic containers (measuring 20 cm in height and 10 cm in diameter) fixed under the blocks by metallic wire(Fig. 1a). Secondly, the blocks were put inside plastic traps (25 cm height and 10 cm diameter) where 16 holes of 8 mm diameter were induced to allow entrance of the attracted male flies (Fig. 1b). These traps were used to avoid direct exposure to sunlight and reduce the loss rate of methyl eugenol. The impregnated blocks were fixed centrally on the bottle top. The plastic traps were supplied with a removable cover for obtaining the attracted flies weekly. Thirdly, the net enclosed traps; cylindrical traps supplied with 8 holes (8 mm diameter) made from net green opaque plastic (0.025 cm thick). The impregnated blocks were fixed inside traps (Fig. 1c). Attracted and killed males were counted and recorded weekly.

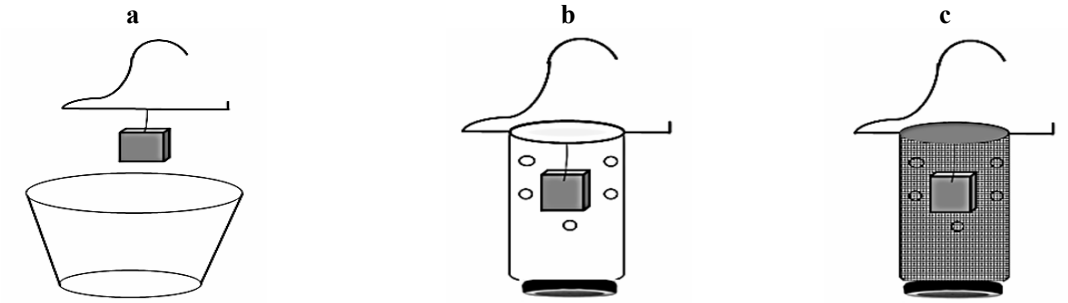

Fig. 1 . a- Open air blocks supplied with a plastic container for dead male attracted receiving, b- Plastic traps containing wooden block (fixed centerally) impregnated by MES mixture, and C- Net cylinderical traps containing wooden block (fixed centerally) impregnated by MES mixture.

The second trail:

Beside the above mentioned applications of blocks, a new treatment containing open air weathered blocks which was added during summer season. These blocks were impregnated as mentioned above and exposed directly to air streams under field weather conditions during 1st week of June 2017 for a period of 4 weeks previously to beginning of summer season starting trail.

B- The experimental orchards:

The autumn, winter and summer season trails were carried out in orchards at Fedmin village, Senours district, Fayoum governorate. The cultivated host plants included mango, citrus and guava trees. The spring season trail was carried in the orchards of Dekm village, Senours district, Fayoum governorate, the orchards cultivated with mango, apricot, lemon and mandarin. The distance between each replicate (7 replicates) in every treatment was not less than 65 meters distributed in a complete randomized block design.

C- Assessment of weekly loss rate percentage of methyl eugenol:

To assess the weekly gradual loss of MES, the fiber blocks 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 6 hours, left for 6 hours to drain and then secondly weighted to assess the absorbent quantities. The density of MES was assessed on the laboratory (1.0472 gm/ cm^3) under laboratory temperature (24°C, these quantities in weight were inverted to equivalent volume quantities depending on MES density. These blocks were transferred to the field in plastic bags. The mentioned blocks were hung on trees at the same time coinciding with that of the above trail in the 2nd location of the experiment. Every week, six blocks of each treatment were pulled out from the field location, brought to the laboratory, exposed to gentle air stream to remove dusts and weighted to assess the lost amounts percentages of MES.

D- Effect of weather factors:

The daily means of temperature and relative humidity were obtained from the Central Laboratory of Climatic Research. The daily records of each weather factor were grouped into weakly means according to the date of traps inspection. The accumulative means of temperature and R.H.% were calculated by dividing the total of recorded temperature degree and R.H.% by the period of expose weeks.

E-The statistical analysis:

The statistical analysis was done as one way ANOVA, Least Significant Difference (LSD), correlation and multiple regression analysis were conducted by using Costat Software, Version 6.4 (Costat. 1990).

RESULTS

A- Autumn season(2016) :

1-The attracted population of *B. zonata* male flies

Data represented in Fig. (2) showed the weekly attracted means of B. zonata that coincided with presence of some host fruits during their maturity ripening stages like guava and novel orange during autumn season (2016). During the 1st fourth weeks of trail, the net traps captured insignificantly the highest numbers of B. zonata males with a mean of 159.46 flies / trap / week followed by the open air impregnated blocks and plastic traps with respective means of 101.57 and 81.64 males / trap / week(df= 2.81, F=3.27, P=0.0431 and LSD_{05}= 62.91). It could be noted that the highest mean capture of male flies was recorded during the 3rd week (206.43 flies / trap / week) by blocks of cylindrical net traps.

All the mean numbers of males attracted to different blocks declined sharply affected by temperature decrease during this period of the year. During the 2nd fourth weeks, insignificant differences is shown among the three treatments (df= 2.81, F=2.20, p=0.1169 and LSD_{05}= 26.07).The net traps were insignificantly the highest one (104.52 males / trap), followed by open air blocks and plastic traps averaging 63.96 and 53.42 flies / trap / week, respectively (n= 96, f=5.532, and p=0.027). Temperature reduction during the 3rd fourth weeks affected negatively the mean numbers of attracted males when compared with the previous 8 weeks of experimentation whereas the lowest means were insignificantly recorded (df= 2.81, F=0.856, p=0.4318 and LSD_{05}= 2.04).Generally, the net traps were significantly the most attracting during the autumn season,with mean of 70.69 flies/trap/day followed by open air blocks and plastic traps with respective means of 43.49 and 36.18 flies/trap/week (df=2,249, F=3.57, P=0.0295 and LSD_{05}=26.79).

2-The loss rate of ME :

Data illustrated in Fig. (3) showed the gradual reduction % of the impregnated quantity of MES throughout the experimentation period of autumn season of 2016. The open air blocks, plastic traps and net traps started to lose insignificantly the impregnated solution with mean % of 5.82, 4.39 and 4.85%, respectively, of its initial impregnated quantities. Hence, the tested treatments continued to lose or release significantly the solutions with means of 22.64, 9.86 and 15.73% after 4 weeks (df=2,15, F=11.06, P=0.0011 and LSD_{05}=5.80). Also, after 8 weeks of blocks exposure, the

open air blocks lose significantly the highest content of the impregnated solutions with mean percentage of 34.50% compared to that lost by other treatments (15.26 and 19.26% after 8 weeks) (df=2,15, F=52.26, P=0.0000 and LSD_{05}=4.23). Meanwhile, the loss rate for all the tested treatments appears to slowly increase recording 38.47, 26.17 and 31.63, respectively after 12 weeks of exposure (df=2,15, F=3.57, P=0.0540 and LSD_{05}=9.83).

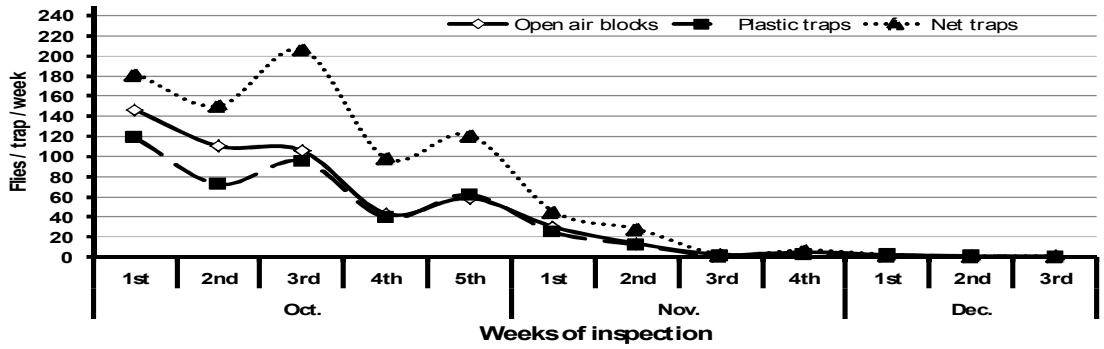

Fig. (2) : The weekly attracted males of *B. zonata* to open air blocks, plastic traps and net cynderical trap during autumn season 2016 at Fayoum governorate.

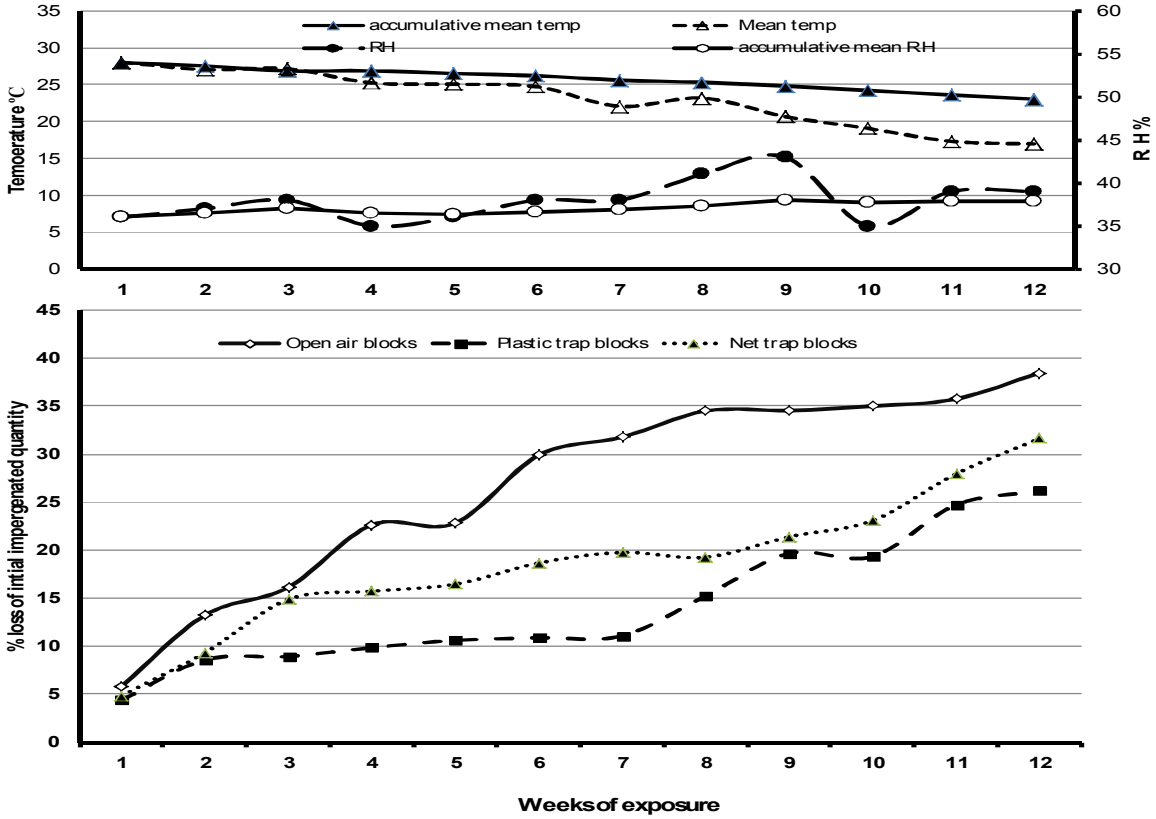

Fig. (3) : The weekly loss rate (%) of of MES mixture impergenated quantities of open air blocks , fixed blocks internally plastic traps and fixed blocks fixed internally net cynderical trap in relation with weekly means of mean temp. and mean RR.H.% during autumn season 2016 at Fayoum governorate.

3-Effect of weather factors on MES treated blocks loss:

Data represented in Table (1) indicated that the means of accumulated temperature correlated positively with high significance with means of loss rate % in open air, plastic trap and net trap blocks (P <0.05) (*r=0.911, 0.975 and 0.966*). Also, the mean of accumulated R.H % correlated positively with high significance with means of loss rate % of the tested blocks (*0.745, 0.860, and 0.789, respectively*).

On the other side, the multi regression analysis indicated a positive and strong linear regression between the effect of accumulative means of temperature and loss rate % of all tested blocks, while, R.H. % affected insignificantly on the loss rate (P <0.05) (Table 1). Depending upon regression coefficient (R2) values, the blocks of plastic traps were the most effecting followed by the blocks of the cylindrical net trap and open air blocks with respect R2 values of 0.958, 0.934 and 0.830.

B- Winter season (2016/17):

1- The attracted population of *B. zonata* male flies:

Data illustrated in Fig. (4) showed absence of male flies during the first three weeks, whereas no male flies were attracted to the different tested blocks as a result of temperature reduction. Gradually, the male flies started to be attracted insignificantly at low numbers responding to temperature rise during the 2nd week of Jan. with means of 0.57, 0.14 and 0.43 fly / trap / week, for open air blocks, plastic traps and net traps, respectively.

Table 1. Multiple regression analysis between open air blocks (A treatment), fixed blocks internally plastic traps (B treatment) and fixed blocks fixed internally net cylindrical trap (C treatment) in relation with accumulative means of temperature and mean R.H. % during autumn season (2016) at Fayoum governorate.

Treatment	Regression ANOFA			Statistics of the regression coefficients			R^2
	Source	*F*	*P*	Variable	Coefficient	*P*	
A	Regression	22.03	0.0003 ***	Constant	207.34	0.2546 ns	0.830
	Temperature	44.05	0.0001 ***	Temperature	-6.27	0.0041 **	
	R.H.%	0.01	0.8871 ns	R.H.%	-0.53	0.8871 ns	
B	Regression	102.89	0.0000 ***	Constant	50.15	0.3902 ns	0.958
	Temperature	203.92	0.0000 ***	Temperature	-3.66	0.0001 ***	
	R.H.%	1.78	0.2149 ns	R.H.%	1.56	0.2149 ns	
C	Regression	64.04	0.0000 ***	Constant	154.57	0.0664 ns	0.934
	Temperature	128.00	0.0000 ***	Temperature	-4.66	0.0001 ***	
	R.H.%	0.08	0.7862 ns	R.H.%	-0.44	0.7862 ns	

The attracted males recorded the highest means of capturing during the 3rd week of February averaging 7.43, 6.86 and 9.43 flies / trap / week for open air blocks, plastic traps and net traps, respectively. Statistically, insignificant differences were observed among the tested treatments throughout the first and second fourth weeks, while, during the 3rd fourth weeks, the open air blocks attracted significantly the highest numbers of males with a mean of 7.07 flies/trap / week followed by the other type of block treatments recording 6.07 and 3.67 flies /trap / week (*df, 2,81, F= 3.099, P=0.050 and* LSD_{05} *=2.78*). Throughout the entire evaluation period, the tested treatments could be arranged according to their means of attraction with insignificant difference as follow, open air blocks (3.39), the net traps (3.08) and the plastic traps (2.60) (*df, 2,81, F= 2.40, P =0.0925 and* LSD_{05}*= 1.25*), respectively.

2- The loss rate of MES:

As shown in Fig. (5), the treated blocks started to lose or release the MES mixture slowly affecting by temperature reduction during this period of the year with mean percentages of 2.61, 0.30 and 0.53% for open air blocks, plastic traps and net traps, respectively. After 4 weeks of blocks exposure under filed conditions, the loss rate of MES averaging 8.49, 0.88 and 4.50% of the initial impregnated quantities for blocks of open air, plastic traps and net traps, respectively. The blocks loss rate of open air, plastic traps and net traps increased gradually to reach 15.22, 4.89 and 8.69 %, respectively, of the initial impregnated quantities after 8 weeks of exposure. However, after 12 weeks of exposure under temperature reduction conditions, the loss rate of the treated blocks was insignificantly differed with means of 22.42, 16.79 and 19.91% for the blocks of open air, plastic traps and net traps, respectively.

3- Effect of weather factors on MES treated blocks loss:

Results represented in Table (2), the loss rate of the blocks that fixed internally in the plastic traps correlated significantly with the accumulative mean temperature (*r=0.625*), while the other two treatments correlated insignificantly, in same time, all the treatments correlated significantly with the weekly mean temperature. Concerning effect of accumulative mean R. H.%, insignificant negative correlation is shown between the mentioned factor and each type of tested blocks except the correlation between the rate of loss for the blocks that fixed internally in the plastic traps and the accumulative mean R.H.% (*r=0.072*). Multi regression analysis reveals a strong linear relationship between both of accumulative means of temperature and R.H.% as variable factors and loss rate % of all tested blocks (Table 2). The combined effects of temperature and R. H. % indicting by regression coefficient (R^2) were 0.780, 0.782 and 0.845.

Table 2. Multiple regression analysis between open air blocks (A treatment), fixed blocks internally plastic traps (B treatment) and fixed blocks fixed internally net cylindrical trap (C treatment) in relation with accumulative means of temperature and mean R.H. % during winter season (2016/2017) at Fayoum governorate.

Treatment	Regression ANOFA			Statistics of the regression coefficients			R^2
	Source	*F*	*P*	Variable	Coefficient	*P*	
A	Regression	15.99	0.0011 **	Constant	363.67	0.0061 **	0.780
	Temperature	8.25	0.0184 *	Temperature	14.85	0.0009 ***	
	R.H.%	23.72	0.0009 ***	R.H.%	-13.45	0.0009 ***	
B	Regression	16.16	0.0011 **	Constant	218.67	0.0472 *	0.782
	Temperature	16.13	0.0030 **	Temperature	15.52	0.0004 ***	
	R.H.%	16.18	0.0030 **	R.H.%	-10.37	0.0030 **	
C	Regression	24.53	0.0002 ***	Constant	283.22	0.0062 **	0.845
	Temperature	19.03	0.0018 **	Temperature	15.40	0.0001 ***	
	R.H.%	30.04	0.0004 ***	R.H.%	-11.83	0.0004 ***	

C- Spring season (2017):

1-**The attracted population of *B. zonata* male flies:**

Data represented in Fig. (6) showed the relative disappearance of *B. zonata* males or their availability in low numbers during the first weeks of the season (March and April), this reduction of population may be attributed to the effect of low temperatures during winter season. Meanwhile, the male flies were variably attracted to different types of tested treatments. After the 1st fourth weeks, insignificant variations were observed among the treatments (*df= 2,81, F=2.650, p =0.076 and* LSD_{05} *= 0.490*). During the period of 2nd fourth weeks, the attracted male flies in the blocks that were fixed internal net cylindrical traps or that fixed internal plastic traps were significantly higher with respective means no. of 2.64 and 1.85 flies / trap / week (*df=2,81, F=7.869, p=0.0008 and* LSD_{05} *= 1.11*). Hence, the apricot fruits

begun to complete their ripening stage during May weeks, the 3rd fourth weeks recorded a slight increase of *B. zonata* males with insignificant differences among the evaluated treatments (*df=2,79, F=1.52, p=0.2247 and* LSD_{05} *= 2.20*). Similarly to the obtained results of autumn season, net traps were significantly the highest one in capturing *B. zonata* males followed by open air blocks and plastic traps during spring season with respective means 2.48, 1.48 and 1.11 flies / trap / week(*df=2,84, F=5.01, p=0.0073 and* LSD_{05} *= 0.89*)

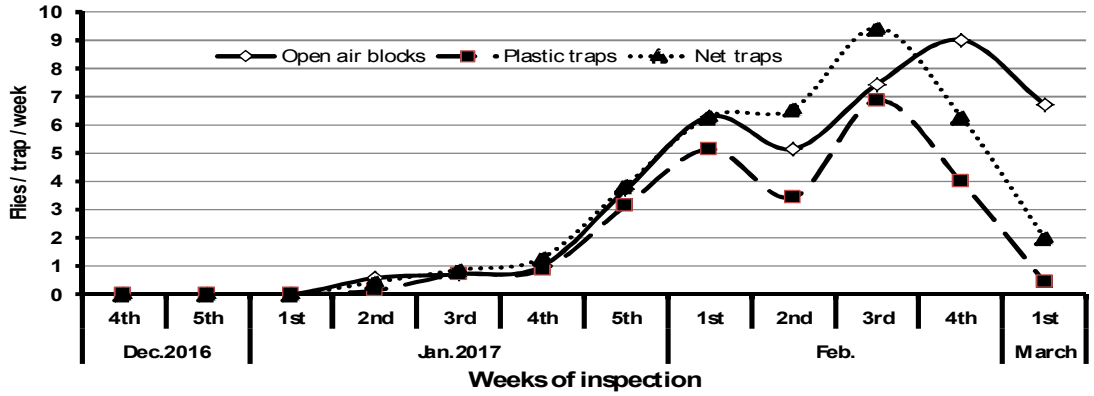

Fig. (4) : The weekly attracted males of *B. zonata* to open air blocks, plastic traps and net cynderical trap during winter season 2016/2017 at Fayoum governorate.

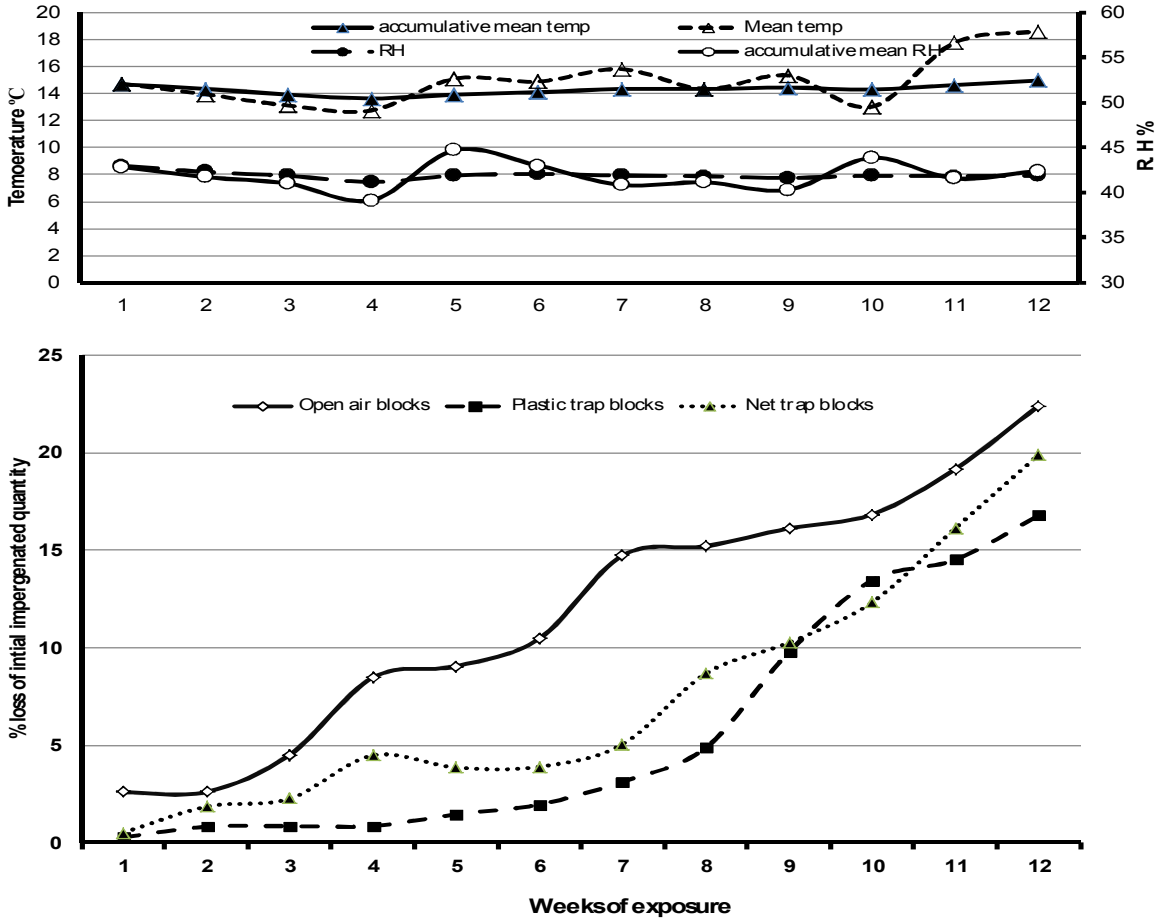

Fig. (5) : The weekly loss rate (%) of of MES mixture impergenated quantities of open air blocks, fixed blocks internally plastic traps and fixed blocks fixed internally net cynderical trap in relation with weekly means of mean temp. and mean R.H. %during winter season 2016/2017 at Fayoum governorate.

2- The loss rate of MES mixture:

Illustrated data of Fig. (7) showed the MES loss rate % under spring season conditions. The open air, plastic trap and cylindrical net trap blocks started to insignificantly lose 6.67, 5.67 and 6.51%, of its initial impregnated quantities, respectively after one week of exposure (*df=2,15 F=0.091and p= 0.9064*). After 4 weeks of field conditions, the exposed blocks lost significantly 28.72, 14.16 and 21.50% of its initial impregnated quantities (*df, 2,15, F=7.841, p=0.0047 and* LSD_{05}*= 7.84*). Meanwhile, the treated blocks that were exposed for 8 weeks continued to lose significantly their contents of methyl eugenol with mean % of 58.47, 32.66 and 43.15 % of its initial impregnated quantities (*df=2,15 F=6.686, p=0.0084, and* LSD_{05}*= 15.13*). After 12 weeks of blocks exposure, the open air blocks were significantly the most one for losing MES

mixture with a mean of 69.89% followed by that blocks installed internal the cylindrical net traps (62.66%), while the blocks of plastic traps lost 54.79% of their impregnated quantities (*df=2,15, F=7.954, p=0.0044 and* LSD_{05}*=8.07*).

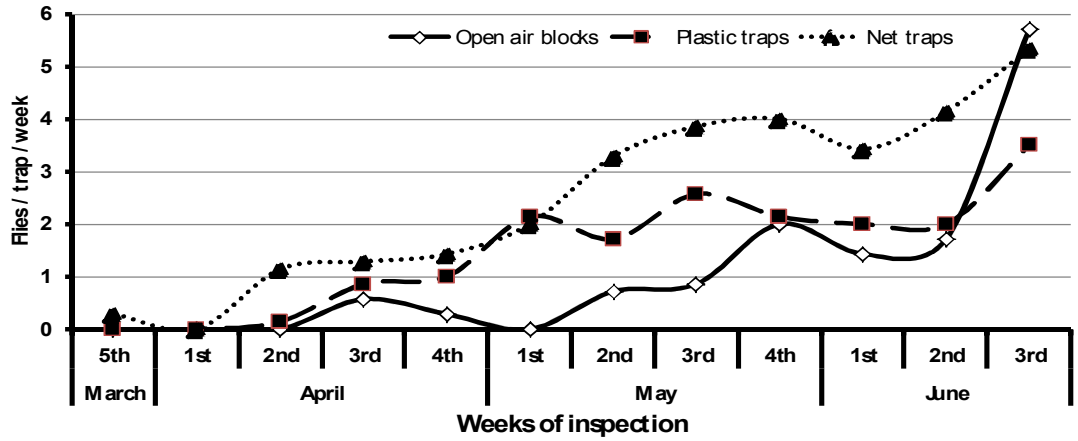

Fig. (6) : The weekly attracted males of *B. zonata* to open air blocks, plastic traps and net cynderical trap during spring season 22017 at Fayoum governorate.

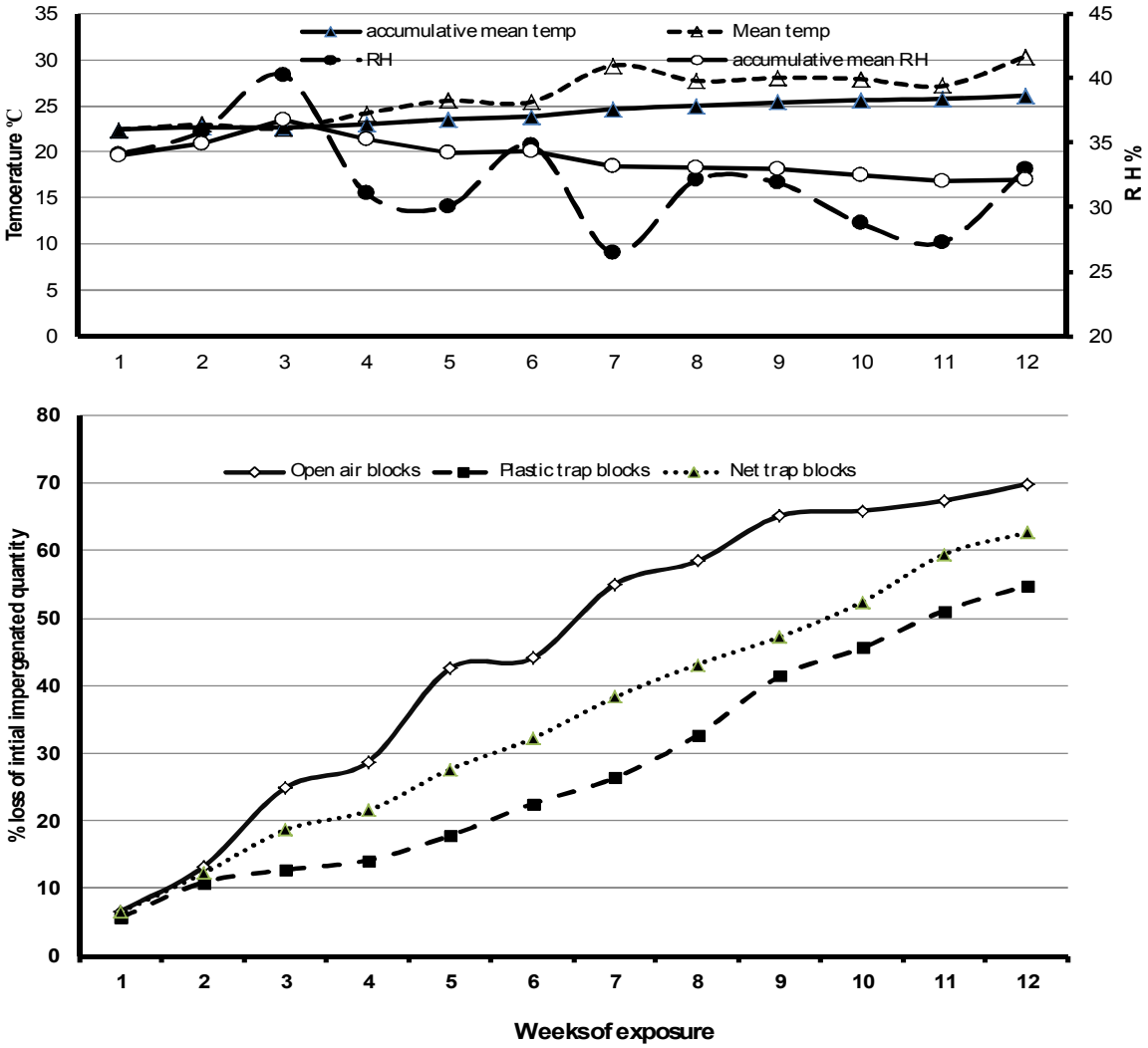

Fig. (7) : The weekly loss rate (%) of of MES mixture impergenated quantities of open air blocks, fixed blocks internally plastic traps and fixed blocks fixed internally net cynderical trap in relation with weekly means of mean temp. and mean R.H. %during spring season 2017 at Fayoum governorate.

3- Effect of weather factors on MES treated blocks loss:

The loss percentage of MES in all tested blocks correlated with high significance with both of accumulative means of temperature and R.H%. The multi regression analysis indicated that the mean of accumulative temperature is significantly the responsible factor for the linear regression, while, the mean of accumulative R.H.% was not effective on such relationship for loss rates % of MES in all tested blocks (Fig.7). The regression coefficient (R^2) values revealed that temperature affected similarly on open air,

plastic traps, the cylindrical net trap blocks whereas the respect R^2 values were 0.947, 0.964 and 0.977.

D: Summer season (2017):

1-**The attracted population of *B. zonata* male flies:**

Data represented in Fig. (8) indicated availability of *B. zonata* population in higher numbers when compared with the previous seasons where male flies responded strongly to fresh open air blocks than other traps or weathered open air blocks, this tendency was significantly indicated by data obtained for the 1st , 2nd, and 3rd fourth weeks. During the 1st fourth weeks, the fresh open air blocks attracted significantly the highest numbers of males with mean of 134.71 flies / trap / week, while the other treatments could be arranged as follow; plastic traps, weathered open air and net traps with respective means; 40.78, 29.14 and 15.75 flies / trap / week, respectively (*df= 3,108, F=21.17, P=0.0000 and* LSD_{05}*= 32.90*). Similarly, the fresh blocks continued its superiority during the period of 2nd and 3rd fourth weeks, the freshly block attracted with means of 178.82 and 271.18 flies / trap / week, respectively, while, the weathered open air blocks, plastic traps and net cylindrical traps attracted 54.89, 81.57, 44.64 flies/ trap /week for the 3rd four weeks, respectively(*df=3,108, F=7.49, P=0.0001 and* LSD_{05}*= 62.71*), and 30.57, 57.36 and 27.39 flies / trap / week, respectively, for the 4th four weeks (*df=3,108, F=16.37, P=0.0000 and* LSD_{05}*= 81.15*).Generally, during summer seasons, the fresh blocks captured significantly the highest numbers of males with mean of 194.87, 59.90, 38.20 and 29.26 flies / trap /week (*df=3,332, F=34.82, P=0.0000 and* LSD_{05}*= 36.43*).

2-**The loss rate of MES:**

Data illustrated in Fig. (9) indicated that the blocks of open air, plastic traps and net traps lost insignificantly16.73, 11.62 and 13.43%, of its initial impregnated MES quantities, respectively after one week of exposure under summer conditions(*df= 2,15, F=1.23, P=0.319 and* LSD_{05}*= 7.03*). Afterward, both blocks of open air and cylindrical net traps sharply lost significantly 55.14 and 49.07 while the plastic traps lost 37.22% after 4 weeks of exposure(*df= 2,15, F=13.99, P=0.0004 and* LSD_{05}*= 7.34*). After 8 weeks of field exposure, the open air and cylindrical net trap blocks were significantly the highest of MES loss (67.41and 60.89%, respectively) followed by that of plastic traps (55.41%) (*df= 2,15, F=4.53, P=0.0288 and* LSD_{05}*= 8.58*). However, the loss rate slightly increased from the 6th week of exposure to the last week of the trail to record 71.67, 62.78 and 66.53 of its initial impregnated quantities (*df= 2,15, F=4.51, P=0.0292 and* LSD_{05}*= 6.33*).

Table 3. Multiple regression analysis between open air blocks (A treatment), fixed blocks internally plastic traps (B treatment) and fixed blocks fixed internally net cylindrical trap (C treatment) in relation with accumulative means of temperature and mean R.H. % during spring seasons (2017) at Fayoum governorate.

Treatment	Regression ANOFA			Statistics of the regression coefficients			R^2
	Source	*F*	*P*	Variable	Coefficient	*P*	
A	Regression	80.11	0.0000 ***	Constant	-522.29	0.0033 **	0.947
	Temperature	158.21	0.0000 ***	Temperature	18.87	0.0000 ***	
	R.H.%	2.02	0.1889 ns	R.H.%	1.42	0.1889 ns	
B	Regression	120.92	0.0000 ***	Constant	-359.04	0.0018 **	0.964
	Temperature	240.54	0.0000 ***	Temperature	9.01	0.0000 ***	
	R.H.%	1.29	0.2852 ns	R.H.%	1.14	0.2852 ns	
C	Regression	193.13	0.0000 ***	Constant	-408.26	0.0003 ***	0.977
	Temperature	383.44	0.0000 ***	Temperature	15.38	0.0000 ***	
	R.H.%	2.83	0.1270 ns	R.H.%	2.11	0.1270 ns	

1-Effect of weather factors on MES loss treated blocks:

Data represented in Table (4) showed that the accumulative mean temperature during summer trail related negatively significantly with mean loss % of MES in all tested blocks whereas r values were -0.619, -0.635 and -0.608($P<0.05$), respectively, while accumulative mean R.H.% related positively with high significance with mean loss% for the same treatments, r=0.987, 0.934 and 0.962 ($P<0.01$). Regardless the significant negative effect of temperature, the multi regression indicated the efficient role of R.H% .The regression coefficient (R^2) values revealed that R.H% affected similarly on open air, plastic traps, the cylindrical net trap blocks whereas the respect R^2 values were 0.978, 0.888 and 0.931.

Generally, with a careful view, population density could be considered and be available in suitable levels, the lowest levels of *B. zonata* males were observed during the last weeks of autumn season, the first weeks of winter season and its extended effect during spring season in spite of apricot fruits availability in suitable status for infestation. No doubt, lower density data may be conclude to misleading or miss understanding, therefore, such data could be avoided.

Net traps were the highest for *B. zonata* flies attraction during activity periods of autumn seasons (1-8 weeks) under moderate levels of temperature. While during summer season, the fresh open air blocks with its high content concentration of MES were significantly the highest for *B. zonata* males attraction, under availability of *B. zonata* populations in high densities coinciding with maturity and ripening of many host fruits. However, data obtained ensured during certain weeks the performance of plastic or net traps was similar if not higher than open air blocks.

Such variation maybe attributed to the variation of MES concentrations of tested blocks effecting by exposure longevity under field conditions. Blocks protection inside closed traps may be reduce its loss rate of MES, also, condensation of MES released on the internal plastic and net sides of traps may increase its efficiency for attracting when compared with the direct exposure of open air blocks, particularly with periods of low or moderate temperature. In contrary to that, the high levels of temperature during summer season may support the continuous release or loss of MES mixture through air streams in short times compared with other seasons.

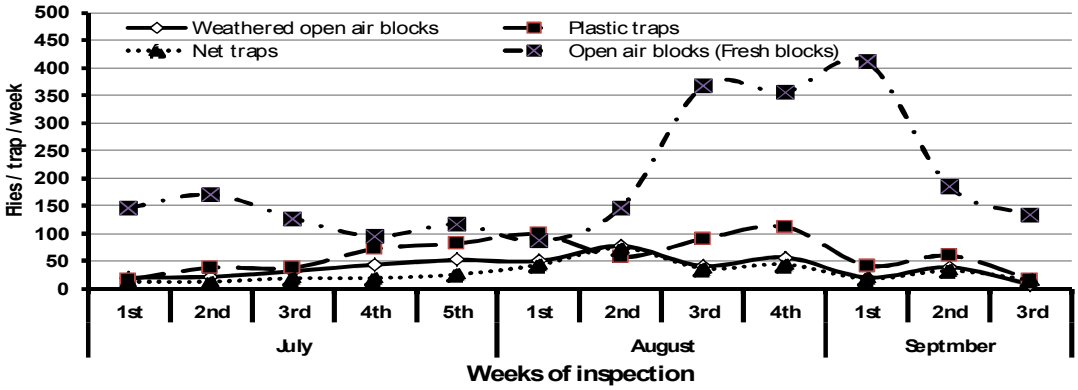

Fig. (8) : The weekly attracted males of *B. zonata* to weathered open air blocks , plastic traps , net cynderical traps and fresh open air blocks during summer season 22017 at Fayoum governorate.

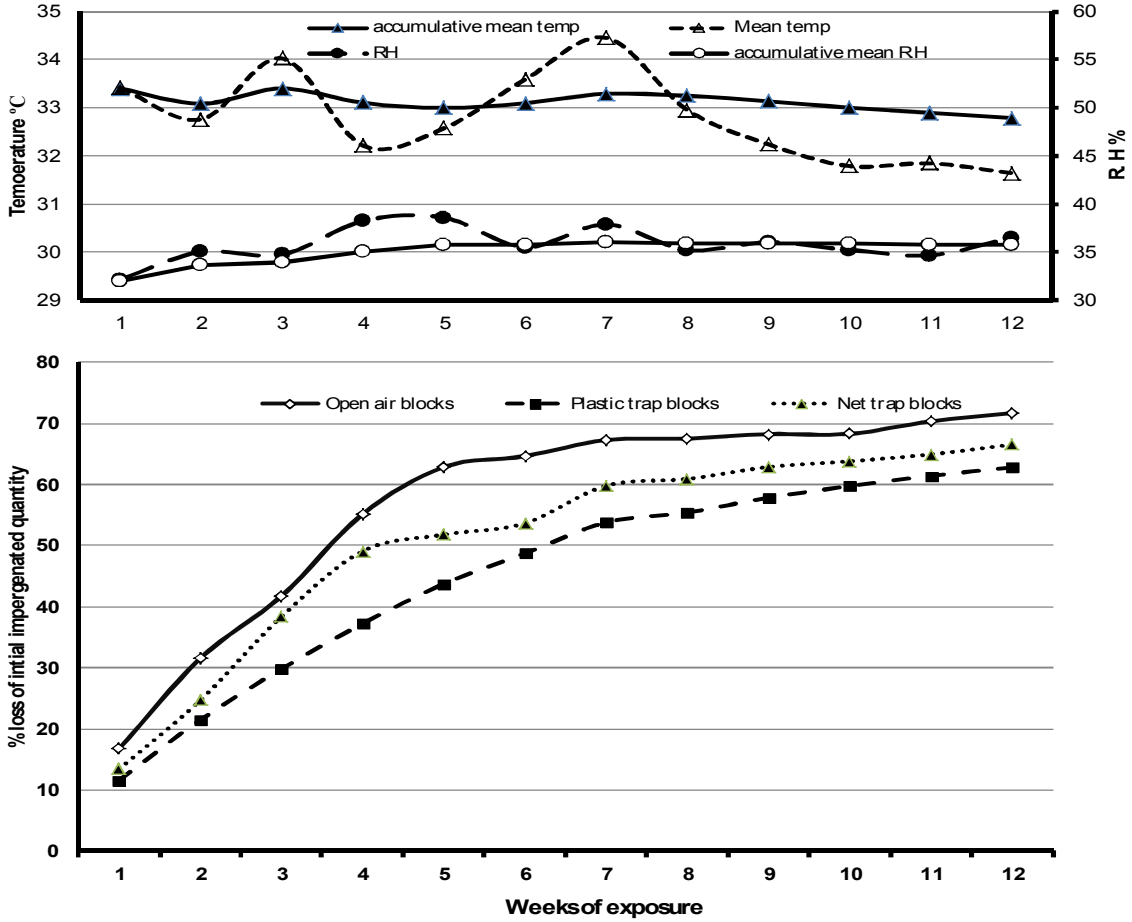

Fig. (9) : The weekly loss rate (%) of of MES mixture impergenated quantities of open air blocks, fixed blocks internally plastic traps and fixed blocks fixed internally net cynderical trap in relation with weekly means of mean temp. and mean R.H. % during summer season 2017 at Fayoum governorate.

Table 4. Multiple regression analysis between open air blocks (A treatment), fixed blocks internally plastic traps (B treatment) and fixed blocks fixed internally net cylindrical trap (C treatment) in relation with accumulative means of temperature and mean R.H. % during summer seasons (2017) at Fayoum governorate.

Treatment	Regression ANOFA			Statistics of the regression coefficients			R^2
	Source	*F*	*P*	Variable	Coefficient	*P*	
A	Regression	197.04	0.0000 ***	Constant	-151.99	0.4908 ns	0.978
	Temperature	154.68	0.0000 ***	Temperature	-7.80	0.2132 ns	
	R.H.%	239.41	0.0000 ***	R.H.%	13.32	0.0000 ***	
B	Regression	35.73	0.0001 ***	Constant	94.40	0.8386 ns	0.888
	Temperature	32.47	0.0003 ***	Temperature	-13.60	0.3007 ns	
	R.H.%	38.98	0.0002 ***	R.H.%	11.44	0.0002 ***	
C	Regression	60.64	0.0000 ***	Constant	-125.42	0.7337 ns	0.931
	Temperature	48.19	0.0001 ***	Temperature	-7.85	0.4453 ns	
	R.H.%	73.08	0.0000 ***	R.H.%	12.43	0.0000 ***	

The study indicated that all blocks impregnated with a mean quantity of 10.34 cm3/ block during successive seasons. During period activity of summer season, only 5.70 cm3 of MES were sufficient for achieving the maximum catch of male flies as possible during 4 weeks, thus meaning about 4.64 of MES cm3 was economically useless.

It could be noted that all loss rates of tested treatments were increasable gradually during autumn, winter and spring, however, the loss rate during summer season was increasable till 5th week of exposure, hence that, the blocks slowly released MES in low rate, thus may reduce the blocks efficacy for *B. zonata* males attraction compared the fresh blocks. In same time, the males attracted strongly to the fresh blocks of open air treatment.

Concerning effect of weather factors, temperature is playing the major role that affecting the loss rate of methyl eugenol, the highest loss rate was observed during summer followed by autumn season, while, the lowest loss rate was observed during winter season coinciding with recording the lower levels of temperature. Temperature was the significant variable factor that affected the linear regression during autumn, winter and spring seasons, while, R.H.% was effective during summer season, such result could be accepted as result of temperature fluctuation around high degrees during this period of the year.

DISCUSSION

Efficiency of freshly open air wooden blocks in attracting *B. zonata* males under high levels of population was the best when compared with the other blocks either that were weathered or that were fixed internal plastic or net traps. Wooden blocks are the optimal option of MAT applications and have been used successfully throughout the Pacific for 40 year (Lloyd *et. al.,* 1998). The most characteristic operational of the wooden blocks which may be used for MAT that they emitting their loads of methyl eugenol relatively slowly comparing with cotton wicks (Amin, 2013). The obtained results are in agreement with those reported by Reji Rani *et. al.,* 2012 and Singh *et. al.,* 2015 who reported that the freshly blocks were higher than that of closed traps. Also, the application of plywood blocks with methyl eugenol and malathion is suitable to be applied in MAT against *B. invadens* in Sudan (Sidahmed *et. al.,* 2014).

Contrary to them, 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 pets (Cunningham and Suda 1986 and Vargas *et. al.,* 2000). Performance of bucket traps and canec disks was similar for attracting of *B. dorsails* males, however, bucket traps were slightly more attractive during winter (Vargas *et. al.,* 2000).

The loss rate of open air blocks during summer season was increasable till 5th week of exposure achieving the maximum catch of male flies as possible coinciding with release of about 55.12% of the initial impregnated MES quantity. This duration of efficiency is similar to that reported by Ghanim *et. al.*, 2010 and Amin, 2013. While, Lloyd *et. al*., 1998 revealed that the efficacy of blocks was reduced by 50% in comparison to a new block and the methyl eugenol content was reduced by 73 % after eight weeks exposure. Moreover, bucket traps with cotton dispensers containing methyl eugenol and malathion were effective up to 16 weeks (Vargas *et. al.,* 2000).

In order to understand the attraction variations among different types of treated blocks, the reduced concentration of methyl eugenol of block content affecting by heat exposing periods may play an important role. This assumption could be acceptable, diluted methyl eugenol by paraffin oil till 50% had a high effect against *B. zonata* population (Ghanim, 2013). The blocks that impregnated with 8 cm3 as the maximum and standard quantity of methyl eugenol captured significantly the highest number of *B. zonata* males in comparison with other quantities 6, 4 and 2 cm3 (El-Mettwaly and Amin 2015). Also, *B. dorsails* males were attracted to 8 cm3 of methyl eugenol than other quantities(6, 4 and 2 cm3) by using enclosed cotton wicks fixed internally plastic bucket traps (Vargas *et al*., 2000). Also, Ravikumar, 2006 found positive responses of fly. *B. zonata* to methyl eugenol-insecticide as the quantity increased. However, the high concentration maybe not the preferable, among 0.8, 0.6, 0.4 and 0.2 cm3 of methyl eugenol, The traps charged with 0.4 ml methyl eugenol was superior in attracting highest number of *B. dorsalis* and *B. correcta*, while, the highest number of *B. zonata* was recorded in the traps charged with 0.6 ml methyl eugenol (Nagaraj *et. al.*, 2014).

It could be concluded that the open air blocks are still the best for *B.zonata* males attraction up to 4 weeks for MAT applications under our Egyptian conditions, however, there is a necessity for saving an alternative dispenser has the ability to lose its content of MES in regular release or in slower manner without affecting the attracted numbers of particularly during the time periods of high levels of temperature (summer and autumn seasons) coinciding with availability of *B. zonata* males in highest populations.

REFERENCES

Afzal, M. and Javed H. , (2001): Evaluation of Soaked Wooden Killer Blocks for Male Annihilation (MA) on Fruit Fly *Bactrocera* spp. (Diptera: Tephritidae). Journal of Biological Sciences, 1: 577-579.

Amin, A. A.(2013): Efficiency of wooden blocks and cotton wicks as dispensers of methyl eugenol for attracting and kill the peach fruit fly males. J. Plant Prot. and Path., Mansoura Univ., Vol. 4 (3): 245 - 252.

CoStat Software (1990). Microcomputer program analysis Version 4.2, CoHort Sofware, Berkeley, CA.

Cunningham, R. T., and D. Y. Suda.(1986): Male annihilation through mass-trapping of male flies with methyl eugenol to reduce infestation of oriental fruit fly (Diptera:Tephritidae) larvae in papaya. J. Econ. Entomol. 79: 1580-1582.

Cunningham, R.T. (1989): Male annihilation. In: Robinson, A.S., Cooper, G. (Eds.), Fruit flies: their biology, natural enemies and control. Elsevier World Crop Pest 3B, pp. 345-351.

El-Metwally, M. M. and Amin, A. A.(2015): Efficiency of methyl eugenol diluted with certain oils on field attraction of the peach fruit fly, *Bactrocera zonata. Egypt. J. Agric. Res., 93 (3), 2015.*

Gazia, E. F; El-Hosary, R. A. and Abd El-Zaher, T. R.(2013): Studies on the Control of *Bactrocera zonata* (Saunders) by Male Annihilation Techniques in Two Locations. American-Eurasian Journal of Toxicological Sciences, 5 (2): 48-54.

Ghanim, N. M. (2013).Influence of methyl eugenol diluted with paraffin oil on male annihilation technique of peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae). Entomol. Ornithol. Herpetol., 2: 114.

Ghanim, N. M.; Moustafa S. A.; El-Metwally M. M.; Afia Y. E.; Salman M. S. and Mostafa M. E. (2010) : Efficiency of some insecticides in male annihilation technique of peach fruit fly, *Bactrocera zonata* (Saunders) under Egyptian conditions . *Egypt. Acad. J. biolog. Sci., 2 (1): 13- 19.*

Hashem, A. G.; Mohammed, M. S. and El-Wakkad, M. F.(2001): Diversity and abundance of the Mediterranean and peach fruit flies (Diptera : Tephritidae) in different horticultural orchards. *Egyptian J. Appl. Sci., 16(2): 303-314.*

Lloyd, A; Leach, P and Kopittke, R. (1998): Effects of exposure on chemical content and efficacy of male annihilation blocks used in the eradication of 'Bactrocera papayae' in north Queensland. *Gen. Appl. Entomol. 28: 1-8.*

Metcalf, R. L. and E. R. Metcalf (1992): Fruit flies of the family Tephritidae, pp. 109–152. In Metcalf R. L. and E. R. Metcalf, Plant kairomones in insect ecology and control. Chapman and Hall, New York, 168 pp.

Nagaraj, K.S., Jaganath, S., Srikanth, L. and Mahamadtoufeeq, H. (2014): Attraction of fruit Fly to different quantities of methyl eugenol in mango orchard. *Trends in Biosciences, 7(11);1113-1115.*

Qureshi, Z.A.; Bughio A.R.; and Siddiqui Q.H. (1981): Population suppression of fruit fly, *Dacus zonatus* (Sand) (Dipt. Teph) by male annihilation technique and its impact on fruit infestation. *Z. ang. Ent. 91, 521-524.*

Ravikumar, P. (2006): Studies on fruit fly trapping systems by using methyl eugenol and protein food baits in guava and mango orchards. M. Sc. Thesis, fac. Agric. Sci., Dharwad Univ., India.

Reji Rani, O. P.; Paul A. and Jiji T. (2012) :Field evaluation of methyl eugenol trap for the management of Oriental fruit fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae) infesting mango. *Pest Management in Horticultural Ecosystems, 18(1), 19-23.*

Sidahmed O. A. A.; Taha A. K.; Hassan G. A. and Abdalla I. F. (2014): Evaluation of pheromone dispenser units in methyl eugenol trap against *Bactrocera invadens* Drew, Tsuruta and White (Diptera: Tephritidae) in Sudan. *Sky Journal of Agricultural Research, 3(8), 148 – 151.*

Singh M.; Gupta D. and Gupta P. R. (2015): Evaluation of wooden block lure traps for mass trapping of fruit flies, *Bactrocera* spp in mango orchards. *International Journal of Farm Sciences,* 5(4) : 236-240.

Vargas, R. I.; Stark J. D.; Kido M. H.; Ketter H. M. and Whitehand L. C.. (2000). Methyl eugenol and cue-lure traps for suppression of male oriental fruit flies and melon flies (Diptera: Tephritidae) in Hawaii: effects of luremixtures and weathering. *J. Econ. Entomol. 93: 81-87.*

Zaheeruddin, M. (2007): Study of diffusion and adoption of Male Annihilation Technique. International J. Education and Development using Information and Communication Technology (IJEDICT), 3 (2): 89-99.

كفاءة البلوكات الخشبية في جذب ذكور ذبابة ثمار الخوخ بالارتباط مع تأثير الظروف الجوية على فقد الميثيل ايوجينول

علي أحمد أمين

معهد بحوث وقاية النباتات – مركز البحوث الزراعية - الدقي – الجيزة

تعتبر ذبابة ثمار الخوخ والتي تهاجم العديد من محاصيل الفاكهة مسببة لها أضرار جسيمة وقد أجريت هذه الدراسة لتقييم كفاءة البلوكات المكشوفة وكذلك المصائد البلاستيكية والمصائد الشبكية الاسطوانية وبلوكات مكشوفة قديمة سبق تعريضها للظروف الجوية لمدة 4 اسابيع، وامتدت الدراسة لتقدير معدل فقد البلوكات الخشبية (المصنعة من الياف نباتية) لمحتواها من مخلوط الميثيل ايوجينول والسومثيون. وقد أجريت هذه الدراسة في بساتين الفاكهة بمحافظة الفيوم تحت ظروف مناخية متباينة خلال 4 مواسم مناخية متعاقبة شملت موسم الخريف (2016) و موسم الشتاء (2016-2017) و موسم الربيع (2017) وموسم الصيف (2017).وخلال موسم الخريف كانت المصائد الشبكية الأكثر جذباً وبدرجة معنوية بمتوسط 70.69 ذبابة / مصيدة /أسبوع متبوعة بالبلوكات المكشوفة والمصائد البلاستيكية بمتوسطي 43.49 و 36.18 ذبابة / مصيدة /أسبوع على الترتيب. وخلال موسم الصيف كانت البلوكات المكشوفة الحديثة الاكثر جذبا وبدرجة معنوية بمتوسط 194.87 ذبابة / مصيدة /أسبوع متبوعة بالبلوكات القديمة والتي سبق تعريضها لظروف جوية والمصائد الشبكية بمتوسطات 59.90 و 38.20 و 29.26 ذبابة / مصيدة /أسبوع على الترتيب . وكان متوسط تشبع البلوكات بمخلوط الميثيل ايوجينول والسومثيون 10.34 سم3/ بلوك وكان معدل الفقد للبلوكات الخشبية المكشوفة خلال موسم الصيف هو الأكثر الاسرع حيث فقدت 55.13 و 67.51 و71.67 % كمتوسط من الكمية الأولية المشبعة وذلك بعد 4 و 8 و 12 اسبوع من تعرض البلوكات على الترتيب. وعلى النقيض كان معدل فقد البلوكات لمحتواها من المخلوط خلال فصل الشتاء هو الأقل والابطأ حيث فقدت 8.49 و 15.22 و 22.42 % كمتوسط من الكمية الأولية المشبعة وذلك بعد 4 و 8 و 12 اسبوع من تعرض البلوكات على الترتيب. وكانت درجة الحرارة العامل المتغير المؤثر وبدرجة معنوية على علاقة الانحدار المتعدد خلال مواسم الخريف والشتاء والربيع فحين كان متوسط الرطوبة النسبية هو المؤثر وبدرجة معنوية خلال فصل الصيف. وتؤكد النتائج على أن البلوكات الخشبية المكشوفة هي الافضل لتطبيقات تكنيك افناء الذكور وذلك حتى اربعة أسابيع ومع ذلك فأن هناك ضرورة لتوفير بدائل لها لديها القدرة على فقد محتواها من الميثيل ايوجينول بطريقة اطلاق منتظمة.