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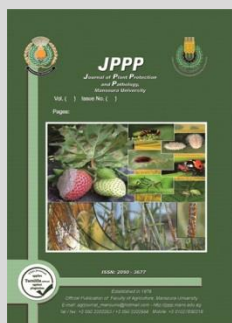
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Efficiency of Trimedlure Diluted with Oleic Acid As Sex Attractant for Mediterranean Fruit Fly, *Ceratitis capitata* Males under Filed Conditions

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ABSTRACT

The efficacy of the sex attractant, trimedlure diluted with oleic acid was estimated against the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) on guava and mandarin orchards. Four concentrations (25, 50, 75 and 98 %) were tested by using yellow Jackson traps. The current results illustrated that the highest general mean of *C. capitata* males was attracted by trimedlure at a concentration of 75% followed by 50, 98 then 25%, represented by 5.48, 3.74, 3.48 and 1.8 respectively as FTD in the first 5 weeks. Also in the second 5 weeks of study concentration 75% recorded the highest FTD (5.62) compared with concentrations of 50%, 98% and 25%. With respect to the general FTD all over the 10 weeks, concentration 75% was recorded the highest FTD (5.55) followed by 50% (2.29), 98% (2.73) and 25% (1.82 flies per trap per day) respectively. Also, in mandarin concentration 98% recorded the highest FTD in the first 5 weeks of the study (1.83) on contrary other concentrations (75%, 50% and 25%) were (FTD= 1.39, 0.75 and 0.78 males per trap/day) respectively. The regression of the attractiveness of each tested concentration to PFF males, all over the 10 weeks, the efficiency of all of the tested concentrations did not affected by the elapsed time. However R^2 -values were 0.040, 0.000, 0.011 and 0.001 in the case of 98, 75, 50 and 25% concentrations, respectively in guava orchards, while in mandarin orchards all over the 10 weeks were relatively affected by elapsed time.

Keywords: *Ceratitis capitata*; trimedlure; oleic acid and sex attractant for MFF.

INTRODUCTION

The Mediterranean fruit fly (MFF), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) is one of the most important pests destructing fruits of over 350 species of fruits, nuts and vegetables round the world (Liquido *et al.*, 1991 and Papadopoulos, 2014). MFF population is recorded all over the year in Egypt. This is due to the existence of its hosts all over the year. The maximum population was recorded during the fruiting seasons of the orchards (Hashem *et al.*, 2001; Ghanim and Moustafa, 2009; Ghanim, 2012; Moutafa *et al.*, 2014 and Ghanim, 2017). Fruit production is negatively affected by Medfly; whereas, the females lay their eggs inside the fruits and the hatching maggots devour into the pulp. Moreover, the secondary infestations with bacterial and fungal diseases mostly occurred leading to fruits drop down and loss marketing value of fruits (White and Elson-Harris, 1994 and Borge and Basedow, 1997). Medfly seasonal population activity is highly affected by two factors, presence of host fruit ripening in addition to climatic conditions especially temperature degrees. Ghanim (2012), Moustafa *et al.* (2014) and Ghanim (2017) reported that the fruit fly's population positively correlated with presence of host fruit ripening. Also, Saafan *et al.* (2005), Saafan *et al.* (2006), Ghanim and Moustafa (2009) and Moustafa *et al.* (2014) illustrated that Medfly population is significantly affected by weather factors especially temperature degrees. Also, it was found that relative humidity plays a minor effect on Medfly

population Ghanim and Moustafa (2009) and Ghanim (2017).

The threat of MFF establishment has always been a high priority for countries engaged in international trade due to the fly quarantine importance, and an ongoing search for new and improved semiochemical based control and detection methods remain a high priority (Jang 2006 and El-Metwally, 2016). Fruit fly detection and control programs typically rely on traps baited with male sex attractant lures. Trimedlure is widely used as the "standard" synthetic male MFF attractant (Beroza, 1964). It is a sex-specific attractant that widely used in detection, monitoring and control programs around the world. Trimedlure is deployed in solid dispensers that are placed in Jackson traps (IAEA, 2003). Two grams of trimedlure is formulated in a polymeric plug-type dispenser that provides controlled release of the attractant for about eight weeks in Jackson traps [Leonhard *et al.*, 1987, Gilbert and Bingham 2013, El-Metwally 2017 and El-Metwally, 2019]. The disruption effect of MFF males was examined with different emission levels of trimedlure (Navarro *et al.*, 2011). Previous studies had been done to evaluate the efficiency of diluted sex attractants of fruit flies [Drilling and Dettner (2009), El-Abbassi, El-Metwally (2013), Ghanim (2013), El-Metwally (2017), and El-Metwally (2019)]. Oleic acid is an unsaturated fatty acid that is the most widely distributed and abundant fatty acid in nature. It is used in manufacturing of surfactants, soaps, plasticizers. Emulsifying agent in foods and pharmaceuticals. Also, it used as male annihilation technique (lure and kill) for fruit fly (Zaheeruddin, 2007).

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In Egypt, the price of trimedlure is high and the used quantity of it in monitoring and control methods of MFF is large. So, the present study was conducted to dilute trimedlure with oleic acid to find out best effective concentration which reduces the quantity of the used trimedlure and hence less costs with high effective attractance to the pest.

MATERIALS AND METHODS

All experiments of the current study were carried out on guava and mandarin orchards at Mansoura district, Dakahlia governorate to demonstrate the efficacy of olfactory attraction of trimedlure diluted with oleic acid to the Mediterranean fruit fly (MFF), *Ceratitis capitata* (Wiedemann).

Tested orchards:

For evaluating the efficacy of trimedlure different concentrations as olfactory attractants for MFF adults, two experiments were carried out. The first experiment, was carried out from the 3rd of August till the 6th of November 2020 on eight feddans of a seven-year-old guava, *Psidium guajava* L. orchard. The other experiment was conducted from the 19th November 2020 till the 23rd of January 2021 on ten feddans of a ten-year-old mandarin, *Citrus reticulata* orchard. Irrigation in both experiments was carried out through overwhelming system.

Experimental design:

Four concentrations (98, 75, 50 and 25 %) were prepared from trimedlure (98% purity, manufactured in the USA) diluted with oleic acid (LobaChemie Mie Pvt. LTD).

The field bioassay was carried out by using Jackson traps to evaluate the attractiveness and residual effectiveness of each concentration of trimedlure as attractants for males of *C. capitata*. The cotton wick of each trap was mounted with 2 ml of the tested concentration. Each concentration was replicated six times. Traps were hung in a shady site within the canopy of the guava or mandarin trees at height of 1.5 – 2 meters from the ground. The distance between every two adjacent traps was not less than 50 meters to avoid the interaction between lures. All the prepared traps were randomly distributed in the field without the renewal of the attractants. Captured males were collected weekly for ten successive weeks and were counted and recorded (as number of flies per trap per day " FTD").with renewing the sticky cardboards.

Statistical analysis:

Data were subjected to analysis of variance (ANOVA) followed by least significant difference (LSD) at the probability of 0.05 (as considered significant). In addition, the regression was demonstrated. All statistical analysis was carried out by using CoHort Software (2004).

RESULTS AND DISCUSSION

Results

1- The attraction of *C. capitata* males to the tested concentrations of trimedlure:

On guava orchards:

Data illustrated in Figure (1) showed that the FTD of MFF adult males, attracted to different concentrations of trimedlure diluted with oleic acid in guava orchard. *C. capitata* adults showed different degrees of attractancy for the different tested concentrations. However, at 75%

concentration, exhibited the highest attractiveness for MFF males followed by the concentrations of 50%, 98% and 25%, respectively. Statistical analysis showed that were significant differences between the tested concentrations at the weeks of tested (first 5 weeks , second 5 weeks and allover 10 weeks) LSD (4.98, 4.62 and 3.09) respectively (Fig 2).

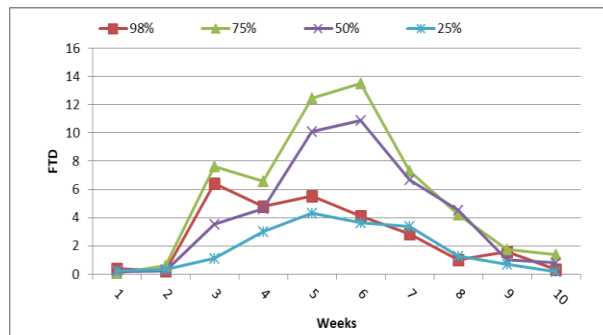


Fig. 1. Response of MFF males to different concentrations of trimedlure diluted with oleic acid under field conditions in guava orchards.

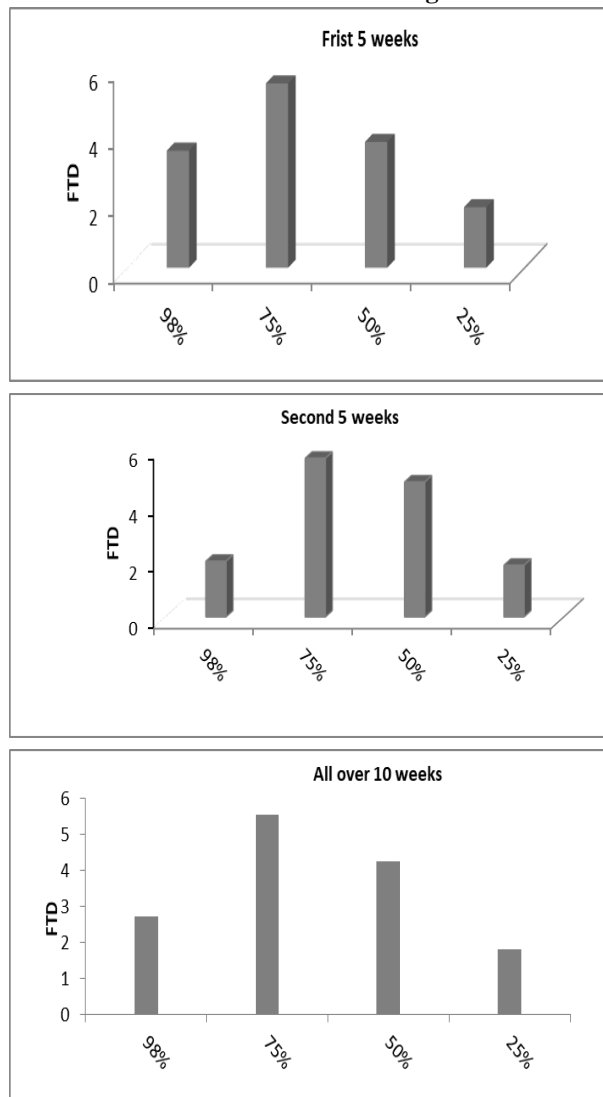


Fig.2. Mean captured male files of MFF per trap per day (FTD) in first 5 weeks (LSD= 4.98), second 5 weeks (LSD= 4.62) and general FTD (LSD=3.09) in guava orchards.

Data illustrated in Figure (2) indicated that trimedlure attracted the highest general mean of *C. capitata* males at a concentration of 75% followed by 50, 98 and 25%, represented by 5.48, 3.74, 3.48 and 1.8 respectively as FTD in the first 5 weeks. Also in the second 5 weeks of study concentration 75% recorded the highest FTD (5.62) compared with concentrations of 50%, 98% and 25%. With respect to the general FTD allover the 10 weeks , concentration 75% was recorded the highest FTD(5.55) followed by 50%(2.29) , 98%(2.73) and 25% (1.82 flies per trap per day) respectively.

On mandarin orchards:

As shown as in Figure (3) concentration 89 % recorded the highest FTD of MFF in the first (FTD = 4.0) and second (FTD= 1.5 flies) weeks. The other weeks of the study concentration of 75% recorded the highest FTD compared with concentrations of 98%, 50% and 25% respectively.

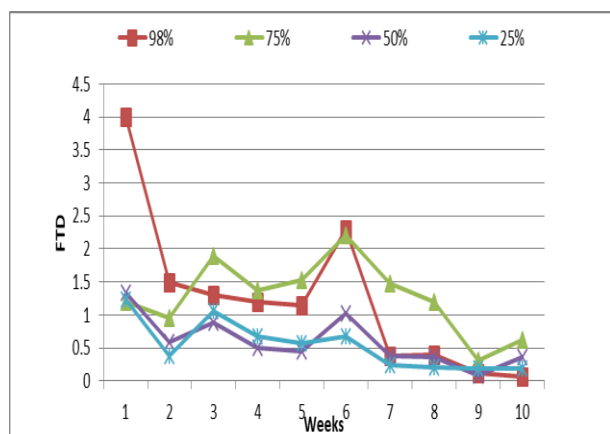


Fig. 3. Response of MFF males to different concentrations of trimedlure diluted with oleic acide under field conditions in mandarin orchards.

The results obtained in Fig. (4) concentration 98% recorded the highest FTD in the first 5 weeks of the study (1.83) on contrary other concentrations (75%, 50% and 25%) were (FTD= 1.39, 0.75 and 0.78) respectively . Data in fig(4), indicated that in the second 5 weeks of study concentration 75% was recorded the highest FTD (1.16) followed by the other concentrations (89% (0.65), 50%(0.44) and 25% (0.3)). According to the previously data , it revealed that concentration 75% approved to be best concentration it recorded the mean FTD allover the10 weeks was higher in the case of 75% concentration (1.28) and other concentrations(98%, 50% and 25%) were recorded (FTD= 1.24, 0.59 and 0.54) respectively.

2- Residual activity of different concentrations of trimedlure against *C. capitata* males .

To evaluate the potentiality of the tested concentrations (as lures for MFF) against time, regression analysis was done between the FTD of captured males and time (in weeks).

As shown in Fig (5), the efficiency of all the tested concentrations increased by elapsed time during the first 5 weeks in guava orchard.

However, the attracted flies (as FTD) increased weekly by 3.07, 2.42, 1.48 and 1.09 individuals in case of concentrations 75%, 98%, 50% and 25% respectively. In contrary, the efficiency of the tested concentrations decreased by elapsed time during the second 5 weeks. However every week FTDs reduced by 2.98, 2.58, 0.97 and 0.88 individuals when the concentrations of 75%, 50%, 25% and 98% respectively.

Generally, all over the 10 weeks, the efficiency of all of the tested concentrations did not affected by the elapsed time. However R² -values were 0.040, 0.000, 0.011 and 0.001in the case of 98, 75, 50 and 25% concentrations, respectively (Fig. 5).

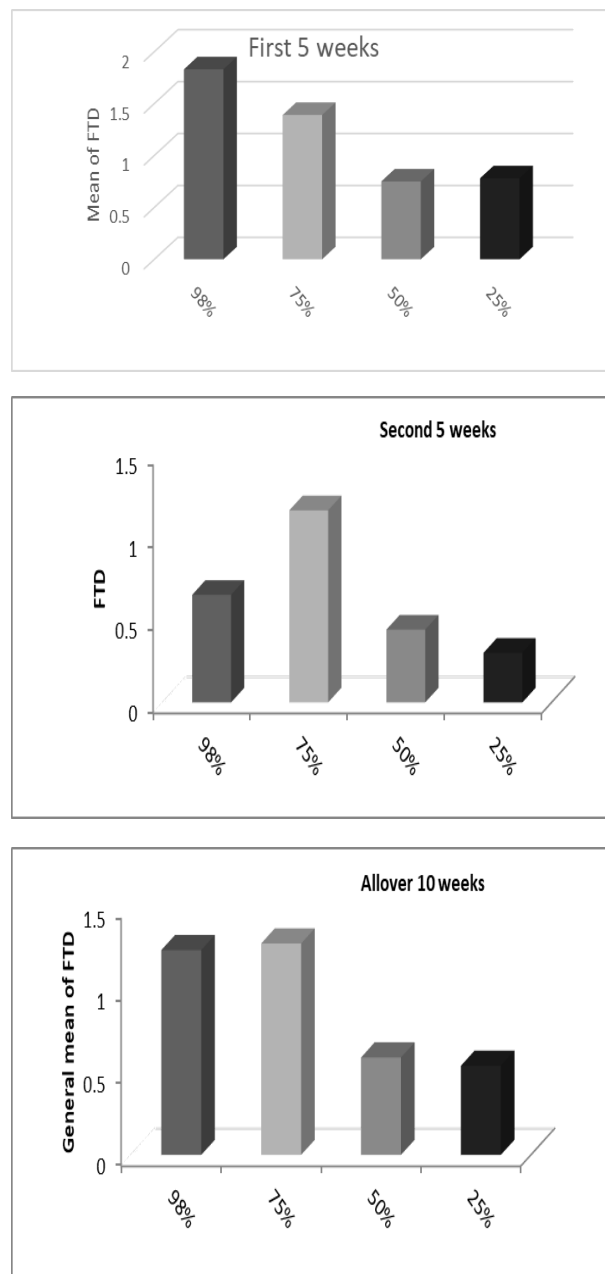


Fig. 4. Mean captured male files of MFF per trap per day (FTD) in first 5 weeks (LSD=0.91), second 5 weeks (LSD=0.84) and general FTD (LSD= 0.64) in mandarin orchards.

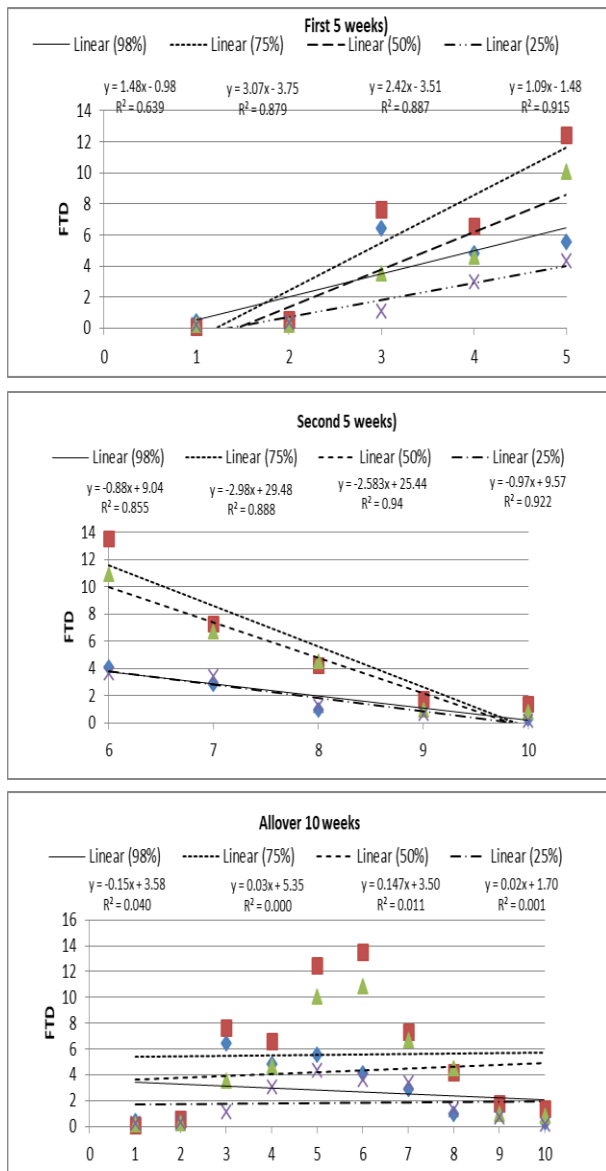


Fig. 5. The relationships between attractiveness of trimedlure concentrations (as FTD) and the elapsed time (in weeks) on guava orchard.

In mandarin orchard, the elapsed time showed a relatively higher effect on the efficiency of the tested concentrations (Fig., 6). However, the efficiency of all the concentrations decreased by elapsed time except that of 75% concentration during the first 5 weeks (where, FTD increased weekly by 0.11 individuals). With respect to FTDs for the concentrations 98%, 50% and 25% reduced by 0.66, 0.18 and 0.10 individuals, respectively during first 5 weeks. During the second 5 weeks FTD of 98,75, 50 and 25% concentrations reduced by 0.47, 0.43, 0.16 and 0.10 individuals, respectively during the second 5 weeks (Fig., 6).

The efficiency of the tested concentrations (as FTDs) all over respectively the 10 weeks were relatively affected by elapsed time, however R^2 – values were relatively high in comparison with guava orchard. On the other hand, FTDs of 98, 75, and 25% concentrations decreased weekly by elapsed time by 0.31, 0.07, 0.09 and 0.10 individuals, respectively (Fig., 6).

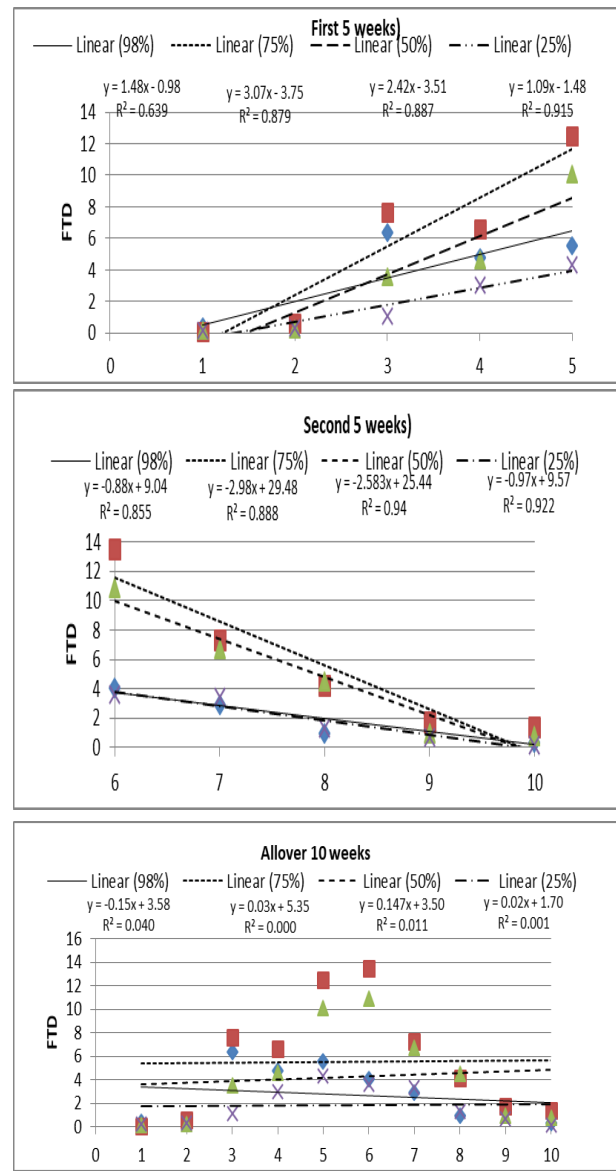


Fig. 6. The relationships between attractiveness of trimedlure concentrations (as FTD) and the elapsed time (in weeks) in mandarin orchard.

Discussion

Trimedlure is widely used as the “standard” synthetic male MFF attractant (Beroza *et al.*, 1964). The cost of monitoring and controlling of MFF, dilution of trimedlure with olic acid four different concentrations of had been evaluated to reduce the quantity of trimedlure compared with un-diluted trimedlure. The obtained data showed that adding olic acid to trimedlure with a concentration of 75% of trimedlure attracted significantly higher numbers of MFF adult males all over ten weeks in comparison with the other concentrations in guava and mandarin orchards. These findings are in agreement with those obtained by El-Abbassi and El-Metwally (2013) and El-Metwally (2017) They stated that adding paraffin oil to trimedlure with a concentration of 25% was effective as the 98% concentration (un-diluted trimedlure) in attracting MFF males under field conditions. Also agree with (El-Metwally *et. el* 2019) reported that adding paraffin or castor oils to trimedlure with a concentration of 25% attracted significantly higher numbers of MFF adult males

all over eight weeks in comparison with un-diluted trimedlure under field conditions; while, the lowest treatments were those of adding 50% of soya bean or castor oils to trimedlure. Also, the present findings are in agreement with results reported by Jang *et al.* (2005) who reported that doses of (-) ceralure B1 of 87.5% and 75% were as effective as the 98% concentration in attracting MFF males. In the same trend, El-Metwally and Amin (2015) and Ghanim (2013) reported that dilution of methyl eugenol (the sex attractant of peach fruit fly, *Bactrocera zonata* (Saunders)) in paraffin oil till 50% did not significantly affect the captured males.

The present study revealed that the most stable treatments all over ten passed weeks were those of diluted with olic acid in concentration 75%; while, concentrations 89%, 50% and 25% were affected by passed time these data agree with (El-Metwally and Salma 2020) they reported that the efficiency of methyl eugenol at 75% concentration slightly decreased by the time in guava in comparison with mandarin orchards. Also El-Metwally (2017) and El-Metwally *et al.* (2017) they reported that captured males of MFF to trimedlure declined by lapse of time. Also, El-Metwally and Amin (2015) reported that by the time passed under field conditions, the effectiveness of methyl eugenol for *B. zonata* was decreased. Also, they found that paraffin oil gave more stability than sunflower oil to methyl eugenol with passed time. According to (El-Adly, *et al.* 2018 and El-metwally 2017), the efficacy of a novel composite as a dispenser for methyl eugenol to attract the peach fruit fly did not significantly affected by the time passed after hanging traps; while, methyl eugenol released from cotton wick dispenser significantly decreased gradually by the time.

The current study revealed that trimedlure diluted with oleic acid was the most stable treatment all over ten weeks where at a concentration of 75% exhibited approximately similar potentiality towards *C. capitata* adult males with time. This may be attributed to the degree of trimedlure dilution by oleic acid. So, it could be concluded that diluting trimedlure by oleic acid at a concentration of 75% is the ideal concentration for attraction high numbers of *C. capitata* males and stability of trimedlure under field conditions.

REFERENCES

- Beroza M, MCGovern TP, Miyashita DH, Steiner LF. Tert-butyl + Tert-pentyl esters of 6-methyl-3-cyclohexene-1-carboxylic acid as attractants for Mediterranean fruit fly. *Journal of Agricultural and Food Chemistry*. 1964; 12:258-259.
- Borge, M.N. and T. Basedow, 1997. A survey on the occurrence and flight period of fruit fly species (Diptera: Tephritidae) in a fruit growing area in southwest Nicaragua. *Bull. Ent. Res.*, 87: 405-412.
- CoHort Software (2004). CoStat. www.cohort.com Monterey, California, USA.
- Drilling K, Dettner K. Electrophysiological responses of four fungivorous coleoptera to volatiles of *Trametes versicolor*: implications for host selection. *Chemoecology*. 2009; 19:109-115.
- Egypt. J. Appl. Sci., 16 (2): 303-
- El-Abbassi TS, El-Metwally MM.(2013). Response of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) males to different concentrations of trimedlure under field conditions in Egypt. *Bulletin of the Entomological Society of Egypt, Economic Series*. 2013; 39:169-179.
- El-Adly, R. A.; M.M. El- Metwally and N.M. Dhanim. (2018). A Novel Composite as a Dispenser for Methyl Eugunol to Attract the PeachFruit Fly, *Bactrocera zonata* (Saunders) Males under Field Conditions. *J. Plant Prot. And Path., Mans Univ.*, 9 (2): 57-63, 2018.
- El-Metwally MM, Amin AA, Youssef EA, El-Ghaffar MA. (2017). Coating effect of trimedlure and methyl eugenol by some polymers on male attraction of the Mediterranean fruit fly and peach fruit fly under field conditions. *Egyptian Journal of Chemistry*. 2017; 60(6):985-993.
- El-Metwally MM, Amin AA.(2015). Efficiency of methyl eugenol diluted with certain oils on field attraction of the peach fruit fly, *Bactrocera zonata*. *Egyptian journal of agricultural research*. 2015; 93(3):759-770.
- El-Metwally MM. (2017). Response of Mediterranean fruit fly, *Ceratitis capitata* (Wied.) males to different amounts of trimedlure under field conditions. *Journal of Plant Protection and Pathology Mansoura University*. 2017; 8(8):385-387.
- El-Metwally MM. (2018). Enhancing the attraction efficiency of GF-120 for the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) by adding some ammonium compounds. *Journal of Plant Protection and Pathology Mansoura University*. 2018; 9(2):51-56.
- El-Metwally, M. M. and Salma Kh. Ragab. (2020). Influence of Methyl Eugenol Diluted with Oleic Acid as Lure for the Peach Fruit Fly (PFF) Males, *Bactrocera zonata* (Saunders) under Filed Conditions. *J. of Plant Protection and Pathology, Mansoura Univ., Vol. 11 (11):543-547, 2020*
- El-Metwally., M. M. Mostafa., M. E and Ghanim., N. M.(2019). Effect of trimedlure diluted with certain oils against Mediterranean fruit fly, *Ceratitis capitata* males under filed conditions. *Journ.Entomol,d Zool*. 2019; 7(2): 326-332.
- Ghanim NM. (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*. 2013; 2:3. doi.org/10.4172/2161-093.1000114.
- Ghanim, N.M. and S.A. Moustafa, 2009. Flight activity of Mediterranean fruit fly, *Ceratitis capitata* Wiedemann in response to temperature degrees and relative humidity at Dakahlia governorate. *Bull. ent. Soc. Egypt*, 86: 209-221.
- Ghanim, N.M., (2012). Responses of *Ceratitis capitata* Wiedemann and *Bactrocera zonata* (Saunders) to some weather factors and fruit ripening in persimmon orchards. *Bull. Entom. Soc. Egypt*, 89: 201-214.

- Ghanim, N.M., 2017. Population fluctuations of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) with respect to some ecological factors in peach orchards. J. Plant Prot. and Path., Mansoura Univ., 8 (11): 555-559.
- Gilbert J, Bingham RR. Insect trapping guide. California department of food and agriculture. Edn.13, Sacramento, California, US, 2013, 1-9.
- Hashem, A.G., M.S.A. Mohamed and M.F. El-Wakkad, 2001. Diversity and abundance of IAEA (International Atomic Energy Agency). Trapping guidelines for area-wide fruit fly programmes. IAEA, Vienna, Austria, 2003, 12-17.
- Jang EB, Khrimian AT, Holler V, Casana-Giner SL, Carvalho L.(2005) Field response of Mediterranean fruit fly (Diptera: Tephritidae) to ceralure B1: evaluations of enantiomeric B1 ratios on fly captures. Journal of Economic Entomology. 2005; 98:1139-1143.
- Leonhardt BA, Cunningham RT, Rice RE, Harte EM, McGovern TP. Performance of controlled-release formulations of trimedlure to attract the Mediterranean fruit fly, *Ceratitis capitata*. Entomologia Experimentalis et Applicata. 1987; 44:45-51.
- Liquido NJ, Shinoda LA, Cunningham RT. Host plants of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae): An annotated world review. Entomol. Soc. Amer., Lanham. MD., 1991, 77.
- Mediterranean and peach fruit flies (Diptera: Tephritidae) in different horticultural orchards.
- Moustafa, S.A., N.M. Ghanim and D.M. Shower, 2014. Presence of *Ceratitis capitata* Wiedemann and *Bactrocera zonata* (Saunders) in apple orchards at Dakahlia governorate, Egypt. Bull. Ent. Soc.Egypt, 91: 149-161.
- Navarro Llopis V, Alfaro Canamas C, Primo Millo J, Vacas Gonzalez S. Response of two tephritid species, *Bactrocera oleae* and *Ceratitis capitata*, to different emission levels of pheromone and para pheromone. Crop Protection. 2011; 30(7):913-918.
- Papadopoulos NT. Fruit fly invasion: historical, biological, economic aspects and management, Springer, Netherlands 2014, 219-252.
- Saafan, M.H., S.M. Foda and A.A. Amin, 2006. Ecological studies on fruit flies on different hosts atFayoum governorate, Egypt. Egyptian J. Agric. Res., 84 (2): 323-336.
- Saafan, M.H., S.M. Foda and T.A. Abdel-Hafez, 2005. Ecological studies on Mediterranean fruit fly, *Ceratitis capitata* (Wied.) and peach fruit fly, *Bactrocera zonata* (Saund.) in mango orchards at Fayoum governorate. Egyptian J. Agric. Res., 83 (2): 625-637.
- White, I.M. and M.M. Elson-Harris, 1994. Fruit flies of economic significance: their identification and bionomics. CAB International with ACIAR. P 601 + addendum.
- Zaheeruddin, M. (2007). Study of diffusion and adoption of Mal Annihilation Technique. International J. Edu and Devvelop using Information and Communi Technology (IJEDICT), 3(2): 89-99.

مدى تأثير الترای ميدلور المخفف بحامض الاوليك كجاذب جنسى لذكور ذبابة فاكهة البحر الابيض المتوسط تحت ظروف الحقل.

سالمة خيرى رجب و ميرفت قاسم جبر الشربيني
معهد بحوث وقاية النباتات- الدقى- الجيزة

تعتبر ذبابة فاكهة البحر الابيض المتوسط من الافات الخطيرة فى مصر . حيث انها تهاجم العديد من الحاصلات البستانية . وبالتالي كان الهدف من الدراسة هو تقييم تأثير وكفاءة الجاذب الجنسى (تراى ميدلور) المخفف بحامض الاوليك بتركيزات مختلفة 98 , 75 , 50 و 25% تحت الظروف الحقلية فى كلا من بستان الجوافة واليوسفى وذلك باستخدام مصائد جاكسون . اوضحت النتائج ان تركيز 75% افطى اعلى نسبة جذب بالمقارنة بالتركيزات الاخرى (98, 50 و 25%) حيث كان متوسط الجذب اليومى (5.48, 3.74, 3.48 و 1.8) على الترتيب فى الخمس اسابيع الاولى من الدراسة وكذلك فى الخمس اسابيع الثانية من الدراسة وذلك فى بستان الجوافة. اما بالنسبة لبستان اليوسفى ابدى تركيز 98% اعلى نسبة جذب فى الخمس اسابيع الاولى من الدراسة مقارنة بالتركيزات الاخرى. كما اوضح التحليل الاحصائى انه خلال 10 اسابيع الدراسة لم تتأثر التركيزات بمرور الوقت فى بستان الجوافة اما فى بستان اليوسفى تأثرت كل التركيزات بمرور الوقت.