

Response of Mediterranean Fruit Fly, *Ceratitis capitata* (Wied.) Males to Different Amounts of Trimedlure under Field Conditions

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ABSTRACT

The Mediterranean fruit fly *Ceratitis capitata* (Wied), is ranked as the most economically important fruit fly worldwide. The trials were carried out at Dakahlia Governorate (Aga district) in navel and Valencia orange orchards. Evaluation periods extended to eight weeks in two experimental sites. This study was carried out to evaluate the field efficiency of five amounts of trimedlure (TML) (1, 1.5, 2, 2.5 and 3 cm³) mounted inside traps to determine the optimal one that could be used for detection, survey and monitoring the *C. capitata* male flies in integrated pest control programs. The obtained results pointed out that the TML could be used successfully by 1.5 or 2.0 cm³ and consequently reduce the economic costs of the pest control.

Keywords: Mediterranean Fruit Fly, Trimedlure, *Ceratitis capitata*, male lure.

INTRODUCTION

Mediterranean fruit fly (MFF), *Ceratitis capitata* Wiedemann is an invasive pest that effects on fruit production and export worldwide. *C. capitata* attacks approximately 250 different hosts around the world (Duyck, and Quilici, 2002). It has a high dispersive and adaptation ability, over a comparatively wide temperature range. It has successfully established in many parts of the world, often as a result of multiple introductions (Malacrida *et al.*, 2007).

Fruit fly detection programs typically rely on traps baited with male sex attractant lures. Trimedlure (TML) was described as a sex attractant for Mediterranean fruit fly (Beroza *et al.*, 1964). TML is a sex-specific attractant that widely used in detection and monitoring programs around the world. Currently, it is the standard male MFF attractant in USA detection programs. Its deployed in solid dispensers (polymeric plugs) containing 2 g of the lure (and no toxicant) that are placed in Jackson traps, which in turn are suspended in a shady place at the canopy of host trees (IAEA 2003). Jackson traps used with male-specific attractants and catch the released sterile males, and their use should be limited to programmers with an SIT component. For commercial use, 2 g of trimedlure is formulated in a polymeric plug-type dispenser that provides controlled release of the attractant for up to eight weeks when applied in Jackson traps (Leonhardt *et al.*, 1987, 1989; Gilbert and Bingham, 1999).

The disruption effect of *C. capitata* males was not observed when different emission levels were examined for the para pheromone TML. The highest catches were obtained when the rate of TML release was around 2 mg/day. However, fly catches did not significantly increase with the increase TML release rate up to 6 times. This lack of saturation in response to higher pheromone concentrations could explain why TML do not produce flight disruption in *C. capitata* (Navarro Llopis *et al.*, 2011)

Due to the use of large amounts of TML in the Egyptian National area wide Program for Extermination of Fruit Flies for detection, survey and monitoring and its high economic cost, this study aimed to determine the optimal amount of TML that minimizes the economic costs of pest control without affecting the attraction efficiency.

MATERIALS AND METHODS

Locations of experiment:

The present experiments were carried out in two sites at Aga district, (Dakahlia Governorate). The first site (A) was about 25 feddans cultivated with navel orange *Citrus sinensis* (L.) while the second one (B) was about 20 feddans cultivated with Valencia orange (*C. sinensis* var. Valencia).

Experimental design and TML application:

Dispensers constructed from cotton wicks (4 cm long x 1 cm diameter) were injected with amounts 1, 1.5, 2, 2.5 and 3 cm³ of commercial trimedlure C (98% purity, manufactured in the USA) These dispensers were installed in Jackson traps (Harris *et al.*, 1971). Five traps (as replicates) for each amount of TML were hanged randomly in shaded sites in fruit trees at a height of 1.5 -2.0 meters where the distance between every two traps was about 40 meter to avoid interaction among tested TML amounts. Sticky cardboards inserts in traps were weekly inspected and replaced with new cardboards since the number of attracted males was recorded per each trap. Evaluation of traps baited with different amounts of trimedlure in site A started from November 8th, 2015 till January 4th, 2016 and from January 1st till February 26th, 2017, While, in site B, the examination started from February 2nd till April 8th, 2016 and from February 26th till April 23th, 2017).

Statistical analysis :

The statistical analysis was performed by using one way ANOVA; (CoStat, 1990).

RESULTS AND DISCUSSION

Data represented in Tables 1, 2, 3 and 4 shows the mean attracted numbers of MFF males inside traps saturated with different amounts of TML (1, 1.5, 2, 2.5 and 3 cm³) in different citrus crops at the two experimental sites (A & B) at Aga district, Dakahlia Governorate.

A- Navel orange orchards :

As shown in Table (1), data obtained from navel orange orchards in site (A) at Aga district at the period from 8th November, 2015 till 4th January, 2016. Non significant differences in numbers of attracted MFF males are found among all tested amounts of TML throughout 1st, 4th and 5th weeks of the trial. Mean number of MFF males attracted into traps were 29.6, 37.4, 30.5 33.5 and 27.1 males / trap at 1, 1.5, 2, 2.5 and

3 cm³ of TML, respectively. The traps that were supplied by 1.5 cm³ of TML were superior in attracting MFF males in comparison with other tested amounts throughout the 1st, 2nd, 4th and 5th weeks, while, those that were supplied by 3.0 cm³ were superior during the 7th and 8th weeks.

Table 1. Mean number of MFF males attracted to different amounts of TML throughout a period of eight weeks in navel orange at site A (November 8th 2015 till January 4th 2016).

	TML amounts					LSD .05
	1.0 cm ³	1.5 cm ³	2.0 cm ³	2.5 cm ³	3.0 cm ³	
1 st	95.4 a	136.2 a	85.6 a	120.0 a	87.0 a	NS
2 nd	63.2 ab	87.4 a	47.4 ab	47.8 ab	36.0 b	30.34
3 rd	25.6 ab	15.0 b	22.2 ab	34.8 a	12.0 b	16.79
4 th	20.0 a	22.4 a	13.6 a	15.6 a	17.4 a	NS
5 th	18.8 a	20.0 a	19.0 a	17.4 a	18.32 a	NS
6 th	8.4 b	18.6 a	20.0 a	17.2 a	17.6 a	6.93
7 th	3.2 d	12.6 bc	15.2 ab	8.4 c	19.4 a	4.92
8 th	11.6 b	32.0 a	28.8 a	25.0 a	35.2 a	12.42
Mean	29.6 ab	37.4 a	30.5 ab	33.5 ab	27.1 b	9.10

Means followed by the same letters in a rows are not significantly different at 5% level.

Data presented in (Table 2) showed that, at Aga district, in site A, when same amounts of TML were evaluated in the second period for MFF male attraction in navel orange orchards, the amount of 2.0 cm³ was the superior when compared with other tested amounts. However, non significant differences were observed in the mean number of attracted males after 8 weeks among different tested amounts of TML (1.0, 1.5, 2.5 and 3.0 cm³). Mean number of attracted MFF males after 8 weeks were 2.7, 2.9, 5.1, 3.4 and 3.1 males / trap for TML amounts of 1, 1.5, 2, 2.5 and 3 cm³, respectively. In general, MFF population in site A, the second tested period was much less when compared with the first tested period. It could be concluded that performance of TML in areas of relatively lower population of MFF is better than areas where population is high.

Table 2. Mean number of MFF males attracted to different amounts of Trimedlure throughout a period of eight weeks in navel orange at site A (January 1st till February 26th 2017).

	TML amounts					LSD .05
	1.0 cm ³	1.5 cm ³	2.0 cm ³	2.5 cm ³	3.0 cm ³	
1 st	7.0 c	11.6 b	19.6 a	9.2 bc	11.4 b	3.44
2 nd	1.4 c	2.8 bc	5.0 a	3.4 ab	2.8 bc	1.70
3 rd	3.8 ab	2.4 b	6.6 a	3.8 ab	1.2 b	2.81
4 th	2.6 a	1.8 a	3.6 a	0.0 b	1.8 a	1.66
5 th	1.4 b	0.8b	1.0 b	4.0 a	0.8 b	2.18
6 th	3.4 a	1.6 a	2.4 a	3.6 a	3.4 a	NS
7 th	0.0 a	0.8 a	0.8 a	1.4 a	1.6 a	NS
8 th	2.4 a	1.6 a	1.6 a	1.8 a	1.4 a	NS
Mean	2.7 b	2.9 b	5.1 a	3.4 b	3.1 b	1.34

Means followed by the same letters in a rows are not significantly different at 5% level.

B-Valencia orange

Data arranged in Table (3) showed non significant differences on attraction efficiency of MFF

males inside traps mounted with different amounts of TML throughout the first four weeks of the test, except the traps that baited with 2.0 cm³ of TML on the 1st week which was significantly varied. The general mean number of males over the tested period of test (8 weeks) were 77.3, 78.2, 76.7, 83.1 and 90.3 males / trap for amounts of TML 1, 1.5, 2, 2.5 and 3 cm³, respectively.

Table 3. Mean number of MFF males attracted to different amounts of TML throughout a period of eight weeks in Valencia orange at the site B (February 2nd till April 8th 2016).

	TML amounts					LSD .05
	1.0 cm ³	1.5 cm ³	2.0 cm ³	2.5 cm ³	3.0 cm ³	
1 st	94.6 a	94.8 a	71.4 b	92.2 ab	102.2 a	21.59
2 nd	110.2 a	94.6 a	90.4 a	104.0 a	116.4 a	NS
3 rd	70.4 a	85.8 a	68.4 a	79.0 a	98.4 a	NS
4 th	87.0 a	86.0 a	94.4 a	101.2 a	95.5 a	NS
5 th	82.4 b	101.8 ab	118.0 a	121.2 a	119.2 a	27.83
6 th	83.0 a	106.6 a	86.8 a	86.2 a	89.6 a	NS
7 th	69.0 ab	46.0 b	73.0 ab	87.2 a	71.8 ab	27.32
8 th	69.6 a	59.8 a	49.0 a	51.0 a	72.4 a	NS
Mean	77.3 a	78.2 a	76.7 a	83.1 a	90.3 a	NS

Means followed by the same letters in a rows are not significantly different at 5% level.

Also, the population of MFF in site B at second period test was lower than its respective in same site at the first period test. Data presented in table (4) show response of MFF males to different amounts of TML in Valencia orange orchards at Aga district site B in second examined period February 26th till April 23th 2017. Mean number of weakly captured males throughout 8 weeks were 33.4, 39.6, 33.6, 30.2 and 35.6 males / trap for the respective TML amounts of 1, 1.5, 2, 2.5 and 3 cm³.

Table 4. Mean number of MFF males attracted to different amounts of TML throughout a period of eight weeks in Valencia orange at the site B (February 26th till April 23th 2017).

	TML amounts					LSD .05
	1.0 cm ³	1.5 cm ³	2.0 cm ³	2.5 cm ³	3.0 cm ³	
1 st	14.0 ab	19.4 ab	14.0 ab	10.0 b	23.0 a	8.73
2 nd	25.8 a	21.4 a	23.4 a	19.0 a	24.6 a	NS
3 rd	41.4 a	39.8 a	36.6 a	36.34 a	37.0 a	NS
4 th	67.8 a	68.4 a	66.6 a	44.4 b	57.6 b	13.84
5 th	64.6 b	79.0 a	73.8 ab	71.4 ab	62.4 b	11.87
6 th	32.6 bc	50.4 a	27.0 c	35.6 b	44.8 a	6.17
7 th	16.6 b	30.0 a	18.4 b	18.2 b	19.0 b	7.16
8 th	4.4 b	8.6 b	8.8 b	8.6 b	16.6 a	5.14
Mean	33.4 b	39.6 a	33.6 b	30.2 b	35.6 ab	5.49

Means followed by the same letters in a rows are not significantly different at 5% level.

Careful review above mentioned data reveals that efficiency of MFF male attraction in traps supplied with amounts of TML 1.5, 2.0 and 2.5 cm³ were non significantly varied with that of the standard treatment (3 cm³). The attraction efficiency was not affected by MFF population density, whereas the experimental sites varied in the MFF populations. These variations could be attributed to variability of hosts and/or weather factors.

Generally, the obtained data indicated that MFF captured males declined by lapse of time. Lower amount of TML in dispensers may attract more males when compared with higher amounts especially at relatively lower populations of MFF. This data is in agreement with the findings of El-Abbassi and El-Metwally (2013) who tested efficiency of different concentrations of TML diluted with paraffin oil, the 75% concentrations of TML was superior than 98% concentration throughout 8 weeks of investigations especially in guava orchards. Furthermore, under outdoor olfactometer cage and in field tests, non significant differences captures of MFF males traps loaded with 10.0 µg and 1.0 µg of TML (Jang *et al.* 2001) were noticed. The current data are in agreement with results reported by Jang *et al.* (2005) who found that doses of (-) ceralure B1 of 87.5% and 75% were as effective as the 98% concentration in attracting med fly males. Navarro Llopis *et al.*, 2011 stated that dispensers releasing TML around 2 mg/day attracted the highest catches of *C. capitata* males, however, male catches did not significantly decrease with the TML release rate increasing more than 6 times. This lack of saturation in response to higher pheromone concentrations could explain why TML do not produce flight disruption in *C. capitata*. This can explain the presence of ideal amounts of pheromones, as high amounts saturate the receptors, while the emission rate can be increased with para pheromone without saturation that affect male attraction. Minimizing the amounts of TML from 3 cm³ to 2 cm³ could save 33% of the total proposed costs for TML.

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استجابة ذكور ذبابة فاكهة البحر المتوسط لكميات مختلفة من الترايملور تحت الظروف الحقلية مصطفى مهران المتولي

معهد بحوث وقاية النباتات - مركز البحوث الزراعية

تعتبر ذبابة فاكهة البحر المتوسط عالمياً واحدة من أهم أنواع ذباب الفاكهة اقتصادياً. وقد تم تنفيذ التجارب الحقلية في بساتين البرتقال ابو صرة والبرتقال الصيفي بمحافظة الدقهلية (مركز أجا). وقد استمرت التجارب لمدة ثماني أسابيع في موقعين تجريبيين. وقد أجريت هذه الدراسة لتقييم الكفاءة الحقلية لخمس كميات مختلفة من الترايملور شاملة 1.0 و 1.5 و 2.0 و 2.50 و 3.0 سم³ وذلك لتقدير الكمية المثلى والتي يمكن استعمالها في أعمال الكشف والحصر والرصد لذكور ذبابة فاكهة البحر المتوسط من خلال برامج المكافحة المتكاملة لها. وقد خلصت النتائج الى أن كميات الترايملور 1.5 و 2.0 سم³ يمكن استخدامها بنجاح وهو الامر الذي يقلل من التكلفة الاقتصادية لتطبيقات مكافحة الآفة.