

**INVESTIGATIONS ON ECONOMIC INJURY LEVEL AND
RELATIONSHIP BETWEEN TRAP CATCH AND CROP
LOSS IN MANDARIN ORCHARDS BY INFESTATION OF
THE MEDITERRANEAN FRUIT-FLY *Ceratitis capitata*
(WIED.) (DIPTERA: TEPHRITIDAE)
IN EGYPT**

AIDA M. EL-HAKIM, T.S. EL-ABBASSI AND A.M.Z. MOSALLAM

Plant Protection Research Institute, ARC, Dokki, Giza

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Abstract

Two experimental designs were carried out at Fayoum Governorate during mature fruit seasons of 2006 and 2007 to establish different levels of infestation on the economic injury level of the Mediterranean fruit-fly (Medfly) *Ceratitis capitata* (Wied.). In the first trial, four mandarin trees at different levels of infestation were surrounded by muslin cages constructed by wooden frames. Sticky traps baited with trimedlure were hung on each tree for evaluating adult fly density and the relationship between trap catch and infestation percent, total of living stages and crop loss. The second trial was carried out to establish a range of infestation levels across experimental field plots of mandarin using different insecticide treatments to evaluate the relationship between *C. capitata* density and the abovementioned parameters. High levels of *C. capitata* adults in trap catch were associated with significant reductions in fruit yield. The loss in mandarin yield was evaluated at different levels of infestation. High yield loss was obtained (903\$/feddan) in mandarin plots when no control practices were applied.

INTRODUCTION

The Mediterranean fruit-fly *Ceratitis capitata* (Wied.) (Diptera: Tephritidae) is considered one of the most serious pest worldwide infesting fruits of >300 plant species (Liquido *et al.*, 1991). It has also an expanding geographical distribution. In Egypt, this pest was early recorded in 1904 (Compere, 1912). It causes considerable damage and inflicts significant economic losses in fruit orchards (Hafez & Fares, 1967).

For controlling Medfly, growers rely use insecticide applications on a regular bases regardless to the adult density. This technique often results in improper time or unnecessary insecticide applications.

Economic thresholds and economic injury levels are important components in an integrated pest management programmes and are useful for determining the application timing of pesticides.

The objective of this study was to find out an easy and not time consuming method to determine the economic injury level caused by Medfly in mandarin orchards and to establish a relationship between trapped adult density and fruit damage.

MATERIALS AND METHODS

During mature fruit seasons of 2006 and 2007, trials to evaluate the economic injury level of Medfly infestation in mandarin orchards and relationship between density of adult fly and fruit injury were conducted at Fayoum Governorate. Two experimental designs were evaluated:

1. Levels of Medfly Infestation in Field Cages

The first trial was conducted during fruit maturity (November, December, 2006 and January, 2007). Four mandarin trees naturally infested by *C. capitata* at different degrees (low, medium, high and very high) were chosen. Each selected tree was covered by unexpensive and easy to construct muslin cages using suitable wooden frames.

A sticky trap (Harris *et al.*, 1971) baited with trimedlure (tetra-butyl-4- [and 5] chloro-2-methyl-cyclohexane-1-carboxylate) was hung on each tree at the beginning of mature fruit season, and checked weekly where flies were counted and recorded (catch/trap/week).

Samples of mandarin fruits (20 from each tree) were collected weekly at random and checked in the laboratory for estimating infestation percent and counting the living forms i.e. eggs and larvae. Fallen fruits under the tree were collected weekly and inspected also in the laboratory.

2. Insecticide Treatments to Estimate Different Levels of Medfly Infestation in the Open Orchard

A range of infestation levels of the Mediterranean fruit-fly were established across experimental field plots of mandarin by varying insecticide treatments to evaluate the relationship between Medfly density (catch/trap/day) and crop production during mature fruit season of 2007 (October – November). Malathion 57% EC [O,O-dimethyl-S-(1,2-biscarboxy ethyl) phosphordithioate] bait-spray was used to obtain complete sound fruits, very low, low, medium, high and very high infestation.

Four feddans of mandarin orchard were divided into 8 plots, nearly half feddan each. The first plot was partially sprayed by malathion 57% EC (½ litre) + buminal (protein hydrolyzate) (one litre) and 18.5 litre water (250ml solution for each tree). The second plot was treated as one row sprayed with the same concentration and leaving the other row. The third was sprayed at every third row. The fourth was

sprayed at every fourth row. The fifth at every fifth row. The sixth at every sixth row. The seventh was left untreated.

At the beginning of the experiment, sticky traps baited with trimedlure were hung in each plot and attracted flies were counted weekly.

Samples of 20 fruits were randomly picked from different directions of three selected trees at each plot (level of infestation) and taken to the laboratory to determine percent of infestation, number of living stages of Medfly (eggs, first, second and third larval instars).

Fallen fruits under trees were collected, transferred to laboratory and checked for Medfly infestation to estimate crop loss.

Analysis of data was statistically calculated according to Snedecor (1991).

RESULTS AND DISCUSSION

1. Levels of Medfly Infestation in Field Cages:

Population density of Medfly in field cages was classified to low, medium, high and very high (Table, 1). Number of flies at the beginning of the season was considered a good predictor for the expected population density in the whole season to establish a relationship between mean catch per trap per week (CTW), mean infestation percent, total number of living stages and total of fruit loss. Statistical analysis between abovementioned parameters against density of Medfly calculated according to Snedecor, 1991 proved that the relationship between mean number of captured flies per trap per week and infestation percent during the season was positive and significant ($r = + 0.97$), between mean catch per trap per week and total of living stages was positive and not significant ($r = + 0.55$), between mean catch per trap per week and crop loss was positive and significant ($r = + 0.99$).

The same Table shows positive and insignificant relationship between fly density at the beginning of mature fruit season and both mean percent of infestation ($r = + 0.93$) and total number of living stages ($r = + 0.66$). While, the relationship was positive and significant with total crop loss ($r = + 0.99$). In general, the higher and population density of adult fly, the increment of the abovementioned parameters, and during the second half of mature fruit season reverses was true, where the tested parameters increased as the density decreased (Fig., 1). These unsatisfactory results were because of the removal of the fallen infested fruits from the isolated field cages, and this did not allow reinfestation and building up a second generation inside cage.

2. Insecticide Treatments to Estimate Different Levels of Medfly Infestation:

In an open mandarin orchard of which was divided into 8 plots, each ½ feddan; levels of infestation was established through an insecticide treatment of malathion bait-spray. It was clear that as the density of adult fly of *C. capitata*

increased, the other parameters (mean infestation percent, total of living stages and total of crop loss) increased too (Fig., 2). The relationship between density of adult fly assessed as captured flies/trap/day (CTD) during mature fruit season and mean infestation percent, total of living forms and total of crop loss per tree was positive and not significant ($r = + 0.72, + 0.62$ and $+ 0.66$, respectively) (Table, 2). This could be attributed to emigration of adult fly from one plot to another and because of the distance between plots was at the range of the flight ability of the fly.

The same Table also shows that the relationship between catch/trap/day at the beginning of the mature fruit season and the abovementioned parameters were highly significant and positive ($r = + 0.904, + 0.896$ and $+ 0.903$, respectively).

Total crop loss per feddan (200 trees) increased gradually with the increase of infestation at medium, high and very high levels of infestation (considering 1 Kg = 1.5 L.E.), 743 Kg (1115 L.E.), 933 Kg (1399.5 L.E.), 900 Kg (1350 L.E.), respectively. The crop loss in untreated orchard of mandarin by Mediterranean fruit-fly infestation at Fayoum Governorate was 3310 Kg (4965 L.E. approximately equal 903 \$, 1 \$ = 5.50 L.E.).

Table 1. Relationship between catch/trap/week and mean infestation percent, total of living stages and total of fruit loss in mandarin orchard due to infestation by *Ceratitis capitata* in field cage experiment during 2006/2007 season.

Infestation level		Catch/trap at the beginning of the season	Mean catch/trap/week	Mean fruit infestation (%)	Total of living forms	Total of fruit loss/tree
Low	(Cage I)	2	10.7	12.1	107	48
Medium	(Cage II)	30	18.5	11.4	121	48
High	(Cage III)	52	23.5	11.4	131	50
Very high	(Cage IV)	171	91.1	18.1	129	58

Table 2. Relationship between catch/trap/day and mean of infestation percent, living stages and fruit loss in mandarin orchard due to infestation by *Ceratitis capitata* in open orchard during 2007 season.

Infestation level	Catch/trap/ day at the beginning of the season	Mean catch/trap/day	Mean infestation %	Mean of living forms/tree	Mean of fruit-loss tree	Loss/ feddan (Kg)
Sound fruits	4.6	22.7	0.0	0.0	0.0	0.0
Very low	14.7	24.0	1.57	21.4	18.7	62.3
Low	21.7	28.0	2.65	36.7	14.3	476.0
Medium	19.4	30.5	3.37	54.0	22.3	743.3
High	34.6	36.1	6.15	67.3	28.0	933.3
Very high	16.1	37.0	6.18	56.0	27.0	900.0
Untreated	51.4	37.2	21.74	315.7	99.3	3310.0

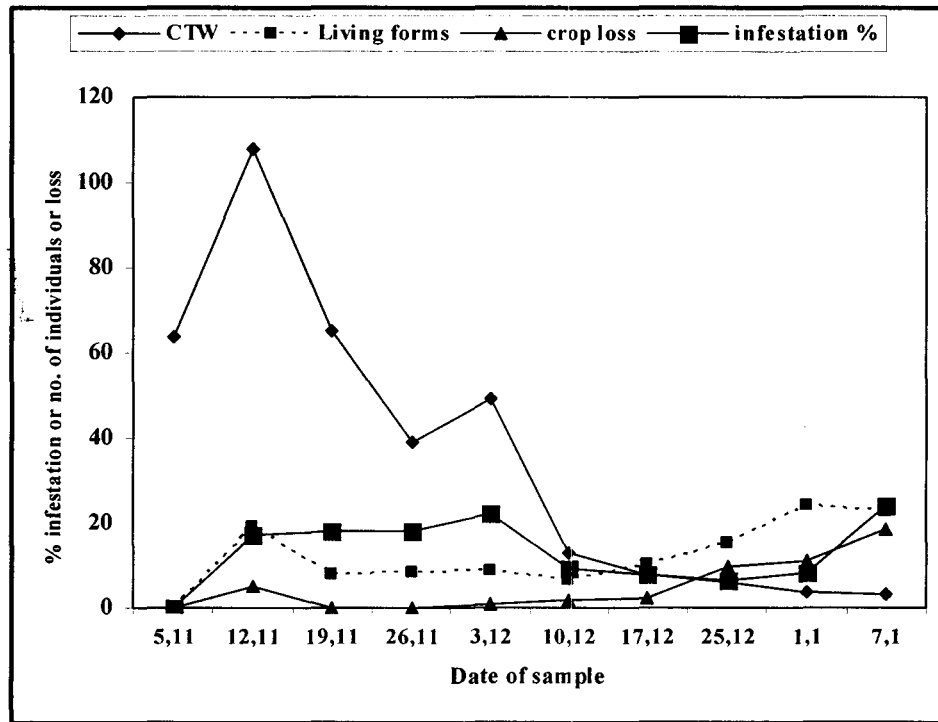


Fig. 1. Catch/trap/week, living stages, infestation percent and fruit loss in mandarin orchard infested by *Ceratitidis capitata* in field cages experiment during 2006/2007 season.

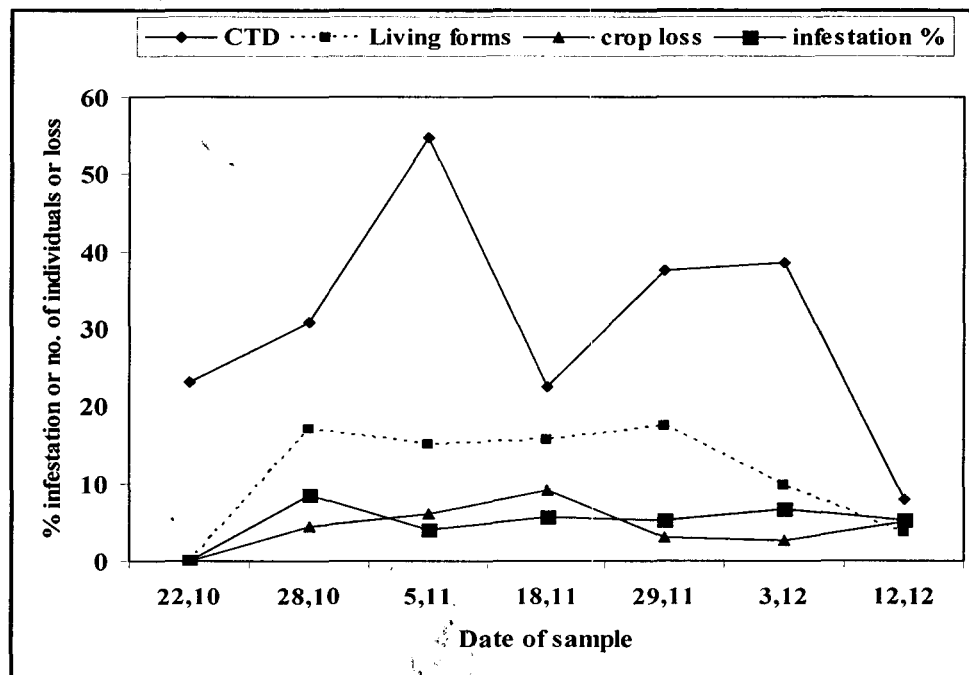


Fig. 2. Catch/trap/day, living stages, infestation percent and fruit loss in mandarin orchard infested by *Ceratitidis capitata* in open orchard during 2007 season.

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تأثير الإصابة بذبابة فاكهة البحر المتوسط على مستوى الضرر الاقتصادي والفقد في المحصول في بساتين اليوسفي في مصر

عايدة مصطفى الحكيم ، طلال صلاح الدين العباسي ، أحمد محمود زكي مسلم

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة

تم إجراء تجربتين في موسمي إثمار ٢٠٠٦، ٢٠٠٧ عند معدلات مختلفة للإصابة بذبابة فاكهة البحر المتوسط لتقدير مستوى الضرر الاقتصادي لهذه الآفة. استخدمت في التجربة الأولى الخيام حيث تم تغطية أربعة أشجار يوسفي ذات معدلات مختلفة للإصابة بخيام من القماش الخفيف مع استخدام دعائم خشبية. وتم تعليق مصيدة ورقية تحتوى على مادة لاصقة والجاذب الجنسي (تراى ميدلور) على كل شجرة لتقدير عدد الذباب الناتج ومدى علاقته بنسبة الإصابة وإجمالى الأطوار غير الكاملة إضافة إلى الفقد في المحصول. اعتمدت التجربة الثانية على تكوين معدلات مختلفة للإصابة بذبابة الفاكهة في أشجار اليوسفي باستخدام الرش الجزئى في قطاعات متساوية من البستان وتقدير العلاقة بين كثافة الذباب في المصائد والعوامل السابقة. وقد ثبت أن المستويات المرتفعة من تعداد الذباب في المصائد تؤدي معنوياً إلى انخفاض المحصول إذ ظهر أعلى معدل لانخفاض في المحصول الناتج من ثمار اليوسفي (٩٠٣ دولار/فدان) في الجزء من البستان الذى لم تجرى به وسيلة مكافحة لذبابة فاكهة البحر المتوسط.