LATENT EFFECT OF SOME PESTICIDES ON CERTAIN BIOLOGICAL ASPECTS OF *CERATITIS CAPITATA* (WIED.) AND ITS CHEMICAL CONTROL

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Abstract

The latent effect of some pesticides belonging to different chemical groups on certain biological aspects of *Ceratitis capitata* adults emergeing from treated pupae was studied under laboratory conditions. All the tested toxicants affected significantly fecundity of females and egg hatchability. The tested compounds induced female sterility of 62.07, 72.07, 77.69, 50.25, 28.43 and 54.94% for chlorfluazuron, fenamiphos, fenobucarb, oxamyl, pirimiphos-methyl and pyriproxyfen, respectively. The longevity of both males and females was affected significantly. The mean longevity of males and females emerging from treated pupae were 4.80-10.13 and 6.12-16.18 days compared with 11.50 and 16.84 days for the control, respectively.

Field chemical control trials were conducted in citrus orchard by applying partial bait-spray. All treatments achieved good control for the pest. Treatment of one branch in all rows was more efficient compared with the other treatments. Dimethoate reduced the population of files by 84.89 and 79.56%, and the reduction of fruit infestation was 71.47 and 81.51% in 1990 and 1991, respectively. Pirimiphos-methyl caused reduction of population by 82.46 and 70.84% and the infestation was reduced by 59.11 and 70.94% in 1990 and 1991, respectively.

INTRODUCTION

The Mediterranean fruit fly, *Ceratitis capitata* (Wied.) is a major pest attacking over 250 species of fruits, nuts and vegetables. In Egypt, it invades many kinds of fruits causing a serious decline in both quantity and quality of fruit yield. The latent effect of pesticides on *C. capitata* was studied by only few authors (Arambourg *et al.*, 1977; Abdel-Mageed *et al.*, 1981). The chemical control by applying partial bait-spray treatment was investigated by Harris *et al.* (1971) and Hashem *et al.* (1987).

The present study aimed at revealing the latent effect of some pesticides on certain biological aspects of the adults emerging from treated pupae under laboratory conditions. Moreover, a field attempt to control the insect in citrus orchards using partial bait-spray was carried out.

MATERIALS AND METHODS

One-day old pupae were obtained from a strain continuously reared in the laboratory of the Plant Protection Department, Faculty of Agriculture, Zagazig University. Four hundred individuals were treated topically on the mid-region with a single sublethal dose (ED_{25} or ED_{50}) by a Hamilton microsyringe. The used doses were 21.25, 5.13, 8.31, 5.31, 0.10 and 2.58 ug/pupae for chlorfluazuron 5 % EC, fenamiphos 40% EC, fenobucarb 50% EC, oxamyl 24% L, pirimiphosmethyl 50% EC and pyriproxyfen 10% EC, respectively. Each pupae received 1 ul of pesticide dilution in acetone. The control individuals were treated with acetone only. The treated pupae were kept in large glass till adult emergence. Immediately after emergence, complete normal adults were transferred to small plastic cages using glass aspirator. In each cage 3-5 pairs of adults were confined. Five replicates were used for each treatment. The cages were kept under laboratory conditions of 25 ± 3°C and 60 ± 5% R. H. These adults were supplied with water and sugar solution (20%) in small spongy pieces. The number of deposited eggs was counted daily and the adult longevity was recorded. The hatchability percentage of 100 eggs laid by emerged females in five replicates for each treatment was inspected twice daily. The sterilizing effect of the tested toxicants was calculated according to Toppozada

et al. (1964).

Partial bait-spray was used to control the insect during the two successive seasons 1990 and 1991 in an orchard of about 25 feddans of navel orange at El-Kassasein region, Ismailia Governorate. The trees were over 20 years-old and their average height was about 3 metres. Two organophosphorus insecticides; pirimiphos - methyl 50% EC and dimethoate 40% EC were used as poison baits at the rate of 250 ml of the commercial product plus 250 ml of the feeding attractant buminal per 20 litres of water. Spraying was carried out every two weeks by using a knapsack sprayer of 20 litres capacity. Every tree required 200 ml of the insecticidal dilution. The partial spray with poison baits were carried out as follows:

I) One branch of the tree toward the north direction was sprayed in all trees for each row.

II) One branch of the tree toward the north direction was sprayed in all trees every other row.

III) One branch of the tree toward the north direction was sprayed in all trees every third row.

IV) The trunk of the tree was sprayed in all trees every third row.

All treatments of partial bait-spray and control (check) were designed in randomized plots of 35 trees each. The experiments started in mid-October and lasted for 2.5 months. Three Jackson's traps were hung in the middle of each treatment to monitor the number of captured males weekly. Trimedlure (sex attractant) and the sticky paper sheets were changed in traps twice monthly. Fifty fruits from each of five trees on the mid-row of each treatment were externally inspected periodically every two weeks (one week after treatment)and the number of infested fruits were recorded.

Results were statistically analyzed according to a completely randomized design and the appropriate methods were used for the analysis of data. The proper "F" test and Duncan's multiple range test were followed (Snedecor, 1957).

RESULTS AND DISCUSSION

A. Latent effect of some pesticides on certain biological aspects of *Ceratitis capitata*.

1- Effect on female fecundity and sterility

The results tabulated in Table 1 indicate that the tested pesticides reduced significantly the total number of eggs deposited by adult female. Fenobucarb caused the highest reduction in egg production (76.25%). The other compounds could be arranged descendingly according to the reduction of female fecundity as follows : fenamiphos, pyriproxyfen, chlorfluazuron, oxamyl and pirimiphos-methyl. The corresponding reductions in egg production were 70.47, 50.27, 48.72, 28.72 and 28.28 %.

Considering the effect on egg hatch, the insecticides decreased significantly hatchability percentages. Among the six tested pesticides, oxamyl gave the lowest hatchability percent (67.00) and pirimiphos-methyl induced the highest (95.80) which was almost similar to that of the control. The other compounds could be arranged descendingly according to their efficiency on egg hatchability as follows : chlorfluazuron (71.00%), pyriproxyfen (87.00%), fenobucarb (90.20%) and fenamiphos (90.80%). The reduction in hatchability ranged between 0.21 and 30.21%.

In general, the tested compounds had sterilizing effects on the emerged females. Fenobucarb was the most effective recording 77.69% sterility, followed by fenamiphos (72.07), chlorfluazuron (62.07), pyriproxyfen (54.94), oxamyl (50.25) and pirimiphos-methyl (28.43%).

2- Effect on adult longevity

data presented in Table 2 show that pre-oviposition, oviposition and post-oviposition periods together with the longevity of both adult males and females had been significantly shortened when the pupae were topically treated with sublethal doses of the tested toxicants.

Table 1. Effect of pupal treatment with sublethal doses of certain pesticides on fecundity and sterility of the emerged adults of *C. capitata* (Wied.).

Pesticide	Dose ug/pupa	Mean No. of eggs/ female	% Reduction in egg production	% Egg hatchability	% Reduction in hatchability	% Sterility
Chlorfluazuron	21.25	46.82 c	48.72	71.00 b	26.04	62.07 a
Fenamiphos	5.13	26.96 d	70.47	90.80 a	5.42	72.07 a
Fenobucarb	8.31	21.68 d	76.25	90.20 a	6.04	77.69 a
Oxamyl	5.31	65.08 b	28.72	67.00 b	30.21	50.25 b
Pirimiphos-methyl	0.10	65.48 b	28.28	95.80 a	0.21	28.43 c
Pyriproxyfen	2.58	45.40 c	50.27	87.00 a	9.38	54.94 b
Control	0.00	91.30 a		96.00 a		

Table 2. Effect of pupal treatment with sublethal doses of certain pesticides on the longevity of adult females and males of *C. capitata* (in days).

Pesticide	Dose ug/pupa	Mean pre-oviposition period	Mean oviposition period	Mean post-oviposition period	Mean longevity of adult	
					Female	Male
Chlorfluazuron	21.25	2.24 bc	5.04 bc	1.16 ab	8.44 bc	5.12 b
Fenamiphos	5.13	2.80 a	3.14 c	0.26 c	6.12 c	4.80 b
Fenobucarb	8.31	1.80 c	4.22 c	0.20 c	6.36 c	4.80 b
Oxamyl	5.31	2.40 ab	6.92 b	0.72 bc	10.04 b	6.24 b
Pirimiphos-methyl	0.10	2.00 bc	13.50 a	0.74 bc	16.18 a	10.13 a
Pyriproxyfen	2.58	2.00 bc	5.16 bc	1.20 ab	8.36 bc	4.76 b
Control	0.00	2.40 ab	12.90 a	1.58 a	16.84 a	11.50 a

The differences between means followed by similar letters are statistically insignificant.

Regarding the pre-oviposition period, the longest period (2.80 days) was recorded with fenamiphos, while the shortest (1.80 days) was obtained with fenobucarb.

The oviposition period was significantly shortened following the application of fenamiphos, fenobucarb, chlorfluazuron, pyriproxyfen and oxamyl recording 3.14, 4.22, 5.04, 5.16 and 6.92 days, respectively. Pirimiphos - methyl induced insignificant increase in the oviposition period (13.5 days) compared with the control (12.9 days).

Considering the post-oviposition period, it is clear that all the tested compounds had shortened it compared with the control. The post-oviposition period in treated insects ranged between 0.20 and 1.20 days compared with 1.58 days for the untreated control.

With regard to female longevity (life-span), all the tested toxicants shortened significantly the mean longevity of adult female i.e. 8.44, 6.12, 6.36, 10.04, 16.18, 8.36 and 16.84 days for chlorfluazuron, fenamiphos, fenobucarb, oxamyl, pirimiphos-methyl, pyriproxyfen and the control, respectively.

The male life-span was significantly affected by pesticidal treatments. The mean longevity of male flies emerging from treated pupae with the six tested toxicants ranged between 4.80 and 10.13 days, while in the control this period was 11.50 days.

3. Chemical control of *Ceratitis capitata* in citrus orchard :

The results given in Table 3 show the effect of partial bait-spray with binary mixtures of two organophosphorus compounds and buminal on the insect population. Applying four spray regimes with either dimethoate or pirimiphos-methyl through one branch of all trees toward the north on each row recorded the lowest number of captured males, whereas the highest number was recorded when the trunk of all trees every third row was sprayed. The number of captured males in the other treatments was between those recorded with the aforementioned two treatments. This result holds true with dimethoate and pirimiphos-methyl bait-sprays in both 1990 and 1991 years. The efficiency of dimethoate bait-spray was insignificantly

Table 3. Efficiency of dimethoate and pirimiphos-methyl mixed with buminal and applied as partial bait-spray against the population of *C. capitata* adults infesting navel orange trees during 1990 and 1991.

Treatment	Dimethoate				Pirimiphos-methyl			
	1990		1991		1990		1991	
	Mean No. of flies/trap	% Reduction in population	Mean No. of flies/trap	% Reduction in population	Mean No. of flies/trap	% Reduction in population	Mean No. of flies/trap	% Reduction in population
I	1.13 d	90.99	1.32 b	87.52	1.25 d	90.03	2.00 b	81.10
II	1.33 cd	89.39	1.58 b	85.07	1.88 cd	85.01	2.42 b	77.13
III	2.33 bc	81.42	2.83 b	73.25	2.63 bc	79.03	3.79 b	64.18
IV	2.79 b	77.75	2.92 b	72.40	3.04 b	75.76	4.13 b	60.96
Control	12.54 a		10.58 a		12.54 a		10.58 a	
Average	4.02	84.89	3.85	79.56	4.27	82.46	4.58	70.84

Table 4. Efficiency of dimethoate and pirimiphos-methyl mixed with buminal and applied as partial bait-spray against *C. capitata* infestation in navel orange fruits during 1990 and 1991.

Treatment	Dimethoate				Pirimiphos-methyl			
	1990		1991		1990		1991	
	% infestation	% Reduction in infestation	% infestation	% Reduction in infestation	% infestation	% Reduction in infestation	% infestation	% Reduction in infestation
I	3.20 c	82.61	1.80 b	85.37	5.80 c	68.49	2.40 b	80.49
II	4.80 c	73.91	2.20 b	82.11	6.60 c	64.13	3.20 b	73.98
III	5.90 b	67.93	2.40 b	80.49	8.40 b	54.35	4.40 b	64.23
IV	7.10 b	61.41	2.70 b	78.05	9.30 b	49.46	4.30 b	65.04
Control	18.40 a		12.30 a		18.40 a		12.30 a	
Average	7.88	71.47	4.28	81.51	9.70	59.11	5.32	70.94

I = One branch of the tree was sprayed in all trees for each row.
II = One branch of the tree was sprayed in all trees for every other row.
III = One branch of the tree was sprayed in all trees for every third row.
IV = Trunk of the tree was sprayed in all trees every third row.

higher than that of pirimiphos-methyl in all spray regimes. The present results indicate also that the partial bait-spray treatments with either dimethoate or pirimiphos-methyl gave a significant reduction in population density compared with the untreated plots for both years. The efficiency of the tested insecticides in 1991 was slightly lower than that in 1990. Partial bait-spray with dimethoate gave an average percent reduction in the population of 84.89 and 79.56 in 1990 and 1991, respectively. Pirimiphos-methyl showed an average of 82.46 and 70.84%.

The data presented in Table 4 indicated that all treatments recorded lower percentages of infestation compared with the untreated plots in both years. Among four spray regimes applied, spraying one branch of all trees towards the north direction of each row gave the lowest percentage of infestation. The highest infestation was obtained when the trunk of all trees every third row was treated. The infestation rate in the other treatments was between those of the previously mentioned two treatments. This result holds true with dimethoate and pirimiphos-methyl bait-spray in 1990 and 1991. Also, the efficiency of dimethoate bait-spray was significantly higher than that of pirimiphos-methyl in the first year, while it differed significantly in the second one.

The partial bait-spray treatments with either dimethoate or pirimiphos-methyl caused a significant reduction of *C. capitata* infestation in fruits for both years. The efficiency of the tested insecticides for 1990 was slightly lower than that for 1991. Partial bait-spray treatment with dimethoate gave an average reduction in infestation reaching 71.47 and 81.51 in 1990 and 1991, respectively. Pirimiphos-methyl gave an average of 59.11 and 70.94 % reduction.

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التأثير المتأخر لبعض مبيدات الآفات على بعض المظاهر البيولوجيه لذبابة فاكهة البحر المتوسط ومكافحتها الكيماويه

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تمت دراسة التأثير المتأخر لبعض مبيدات الآفات التى تنتمى لمجموعات مختلفه على بعض المظاهر البيولوجيه للأطوار الكامله لذبابة فاكهة البحر المتوسط الخارجه من عذارى معامله تحت الظروف المعمليه. وقد أظهرت كل المبيدات المختبره تأثيراً معنوياً على خصوبة الإناث الخارجه وكذلك على فقس البيض. ولقد كانت نسبة عقم الإناث ٧٢ر٠٧ ، ٧٧ر٦٩ ، ٥٠ر٢٥ ، ٢٨ر٤٣ ، ٥٤ر٩٤ لمركبات الكلورفلوآزيورون ، الفيناميفوس ، الفينوبيوكارب ، الأوكساميل ، البيريميفوس - ميثيل والبيريبوكسيفين على التوالى.

كذلك تأثرت فترة حياه كل من الذكور والإناث فقد تراوح متوسط عمر الذكور الخارجة من العذارى المعامله بين ٨٠ر٤ - ١٣ر١٠ يوماً بينما كان متوسط عمر الإناث فى حدود ١٢ر٦ - ١٨ر١٦ يوماً وكان متوسط عمر أفراد المقارنه ٥٠ر١١ ، ٨٤ر١٦ يوماً لكل من الذكور والإناث على التوالى.

هذا وقد أجريت دراسات مكافحة كيماويه فى بستان موالح باستخدام معاملات الرش الجزئى وقد أظهرت كل المعاملات كفاءه فى مكافحة ذبابة الفاكهه وكان أفضلها رش فرع فى كل الخطوط وقد أدى الدايمثويت إلى تخفيض التعداد بنسبة ٨٩ر٨٤ ، ٥٦ر٧٩٪ كما أدى إلى خفض الإصابه بنسبة ٤٧ر٧١ ، ٥١ر٨١٪ وذلك خلال موسمى ١٩٩٠ و ١٩٩١ على التوالى. أما مركب البيريميفوس - ميثيل فقد أدى إلى خفض التعداد بنسبة ٤٦ر٨٢ ، ٨٤ر٧٠ وقلل الإصابه بنسبة ١١ر٥٩ ، ٩٤ر٧٠٪ خلال موسمى الدراسه.