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THE LEVEL OF INSECTICIDE RESISTANCE OF THE FIELD STRAINS OF *CERATITIS CAPITATA* (WIEDEMANN) AND *BACTROCERA ZONATA* (SAUNDERS) (DIPTERA: TEPHRITIDAE) BY BAIT BIOASSAY

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ABSTRACT

The level of insecticide resistance of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and the peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) to seven insecticides was assessed by bait bioassay technique under laboratory conditions. The tested insecticides were chlorpyrifos-methyl (organophosphates), α-cypermethrin, lambda-cyhalothrin, deltamethrin (pyrethorids), emamectin benzoate, spinosad (microbial) and imidacloprid (neonicotinoids). The results showed that emamectin benzoate and deltamerthin insecticides had the highest toxicity for the laboratory strain of *C. capitata* and *B. zonzta*, respectively. While Chlorpyrifos -methyl was the least toxic to both species. *C. capitata* was more susceptible to tested insecticides than *B. zonata*. The females of *C. capitata* as well as *B. zonata* of the laboratory and field population were less sensitive than the males. The toxicity of the tested insecticides was increased with the increase of exposure time. Moreover, each of chlorpyrifos, lambda-cyhalothrin, deltamethrin and α-cypermethrin showed moderate to high levels of resistance. No to moderate resistance were found for the spinosad, imidacloprid and emamectin benzoate pesticides.

Key words: Insecticides resistance, *Ceratitis capitata*, *Bactrocera zonata*, insecticides toxicity.
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INTRODUCTION

The family Tephritidae (superfamily: Tephritoidea; suborder: Brachycera) is one of the largest and most abundant Diptera families with about 500 genera and more than 4.400 species worldwide. This family (commonly known as fruit flies) are very important, polyphagous pests and the majority of their larvae develop in fruits (Merz, 2001; Norrbom and Condon, 2010; Soltanizadeh, *et al.*, 2015; Darwish, 2016). The fruit flies cause significant damage to important crops leading to losses of 40% to 80%, depending on the fruit variety, season and locality (Kibira *et al.*, 2010). Both Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera, Tephritidae) are sever pests of a wide variety of horticultural crops due to their ability for adaptation in various environmental condition, high polyphagia and rapid reproduction (Sarwar, 2015). These pests cause direct damage to fruits by the puncture of the fruits for oviposition by the female. The larval development occurs inside the fruit; subsequently the infested fruits drop down (Aluja, 1994; White & Elson-Harris, 1994).

The current control strategies of fruit flies are limited and rely mainly on insecticides as coverage or partial-bait spray (Darwish and Attia, 2021), soil-drench (Stark *et al.*, 2014), male annihilation technique (Ghanim, 2013) and poisoned mass trapping methods. Therefore, various insecticides from different groups with different mode of action were used to control these pests in the field. The intensive use of insecticides and their mixtures against these pests which has destructive habits and has not hibernation period (Darwish, 2014; Darwish, and Attia, 2021) encourage them to develop resistant to most of the conventional insecticides (Rossi & Rainaldi, 2000 and Magana *et al.*, 2007; Couso-Ferrer, *et al.* 2011). Hence, it is important to evaluate the efficacy of some insecticides for effective fruit flies management. The objective of this study was therefore to determine the susceptibility levels of *C. capitata* and *B. zonata* to seven commonly used commercial insecticides.

MATERIALS AND METHODS

The present experiments were conducted under the laboratory conditions (27±2C, 65±5% RH), Faculty of Agricultre, Damanhour

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University to determine the susceptibility and the level of resistance of two Tephritidae species, *C. capitata* and *B. zonata* to seven of the recommended insecticides.

Insects

Field populations of *C. capitata* and *B. zonata* were collected from infested and fallen fruits of apricot and peach from different orchards at Nubaria district, Beheira Governorate, Egypt. The collected fruits were separately incubated in large plastic pans containing a sterile fine sand to allow jumping larvae to pupate. The pupae were introduced into cages for the adult emergence and the adults of each species were dealt as a field strain. The susceptible strains of *C. capitata* and *B. zonata* were obtained from the plant protection research institute (Agricultural Research Center, Dokki, Giza, Egypt) which has been reared for more than ten years without exposure to any insecticides.

Adults of the two species were reared in cages containing one side covered with muslin clothes for oviposition (Abu al-Futuh, *et al.*, 2019). Flies in rearing cages were fed with sugar mixed with protein hydrolysate at ratio of 4:1 and cotton plug on a plastic bottle as a source of water. Eggs were collected and transferred to artificial diet in plastic trays to increase the number of flies. The flies from the 2nd generation used in the bioassay.

Insecticides and its used concentrations:

- **Emamectin benzoate** (Proclaim® 19% EC**,** Syngenta chemical**),** (20, 40, 60 and 100 ppm).
- **Imidacloprid** (Ecomida® 30.5 % SC, Bharat Insecticides Ltd., India)**,** (20, 50, 75 and 100 ppm).
- **Chlorpyrifos-methyl** (Reldan® 40% EC, Dow Agrosciences, USA), (25, 50, 100 and 200 ppm).
- **Deltamethrin** (Decis® 2.5 % EC, Bayer Crop Science, Germany) (20, 40, 60 and 100 ppm).
- α-**Cypermethrin** (Fastac® 5 % EC, Jiangsu Yangnong Chemical Co., Ltd., China), (10, 25, 50 and 100 ppm).
- **Lambda-cyhalothrin** (Lambada® 5% EC, Barighat, India)**.** (10, 20, 40 and 80 ppm).
- **Spinosad** (Tracer®, 24% SC., Dow Agroscience Co.). (25, 50, 75 and 100 ppm).

Bioassay:

Ten pairs (males and females) of known age (4-5 days) of the two species were transferred to plastic jars contain petri dishes lined with Tissue paper. The Tissue paper dipped in solution consisted of insecticide solution + 10 % feeding attractive protein materials (Buminal). Each concentration was repeated four times. Tissue paper dipped in water + 10 % feeding attractive materials (Buminal) to used as a control. The plastic jar was covered with a muslin cloth held with a rubber band. Mortality was noted after regular intervals up to 24 h and 48 h and they were corrected by Abbott's formula (1925). The fifty lethal concentration (LC_{50}) values and 95% confidence limits were calculated according to Finney (1971) by using LdP-line, Ehab Software (http://www.ehabsoft.com/ldpline/). The resistance ratios (RR) for the seven tested insecticides were calculated by following formula (Torres-Vila, *et al*., 2002):

Resistance Ratio (RR) = LC_{50} values of field strain/ LC_{50} of laboratory strain

Where: (RR = 1) when the tested strain was susceptibility

(RR = 2-10) when the tested strain was low resistance,

(RR= 11-30) when the tested strain was moderate resistance,

(RR = 31-100) when the tested strain was high resistance

and (RR>100) when the tested strain was very high resistance.

RESULTS AND DISCUSSION

The field and laboratory strains of *Ceratitis capitata* and *Bactrocera zonata* responded differently when they were exposed to emamectin benzoate, α-cypermethrin, imidacloprid, spinosad, deltamethrin, lambda-cyhalothrin and chlorpyriphos-methyl.

The Mediterranean fruit fly, *Ceratitis capitata:*

The effectiveness of the seven insecticides on the adults of *C. capitata* after 24 and 48 h exposure time was shown in Tables (1 and 2). The results revealed that emamectin benzoate was the most toxic insecticide, while chlorpyrifos-methyl was the lowest toxic one. The tested insecticides could be arranged in descending order according to their toxicity for the males of the laboratory strain of *C. capitata* as follows emamectin benzoate, α-cypermethrin, imidacloprid, spinosad, deltamethrin, lambda-cyhalothrin and chlorpyrifos-methyl with a fifty lethal concentration values of 6.73, 12.02, 16.81, 18.57, 26.16, 33.08 and 41.11 ppm, respectively. The results also showed that in the most cases of the tested insecticides, females were less sensitive than males, where the lC_{50} values of females were 8.84, 14.23, 15.93, 21.27, 33.5, 40.5 and 41.12 ppm, respectively.

This arrangement differed slightly in the field strain, whereas the lC_{50} values were 38.37, 71.05, 133.18, 216.84, 381.07, 738.18 and 1174.16 ppm for emamectin benzoate, imidacloprid, spinosad, α-cypermethrin, deltamethrin, lambda-cyhalothrin and chlorpyrifos-methyl, respectively. The females of the field strain were remained more resistant than the males, as the values of the LC_{50} recorded 47.07, 83.82, 115.41, 187.7, 620.22 798.9 and 933.6 ppm for emamectin benzoate, imidacloprid, spinosad, α-cypermethrin, deltamethrin, lambda-cyhalothrin and chlorpyrifos-methyl, respectively. The resistance ratio ranged between 4.23 fold (low resistance) for imidacloprid to 28.56 fold (moderate resistance) for lambda-cyhalothrin in the males of med-fly, while in the females ranged between 5.26 in case of imidacloprid insecticide (low resistance) and 23.84 fold in lambda-cyhalothrin insecticide (moderate resistance).

After 48 h exposure time (Table 2), the toxicity of the tested insecticides was increased. The values of LC_{50} for the males of laboratory strain were recorded 1.95, 2.86, 6.87, 7.59, 8.53, 9.26 and 20.96 ppm for emamectin benzoate, imidacloprid, spinosad, deltamethrin, α-cypermethrin, lambda-cyhalothrin and chlorpyrifos-methyl, respectively. These values for females were 2.39, 3.82, 6.38, 7.71, 8.68, 13.37 and 17.27 ppm for emamectin benzoate, imidacloprid, spinosad, lambda-cyhalothrin, α-cypermethrin, deltamethrin and chlorpyrifos-methyl, respectively. Concerning the field strain, the values of LC_{50} recorded 20.72, 36.24, 90.56, 190.82, 262.94, 413.38 and 634.05 ppm for emamectin benzoate, imidacloprid, spinosad, α-cypermethrin, deltamethrin, lambda-cyhalothrin and chlorpyrifos-methyl, in the males of *C. captata*, respectively. While these values in females of *C. capitata* for emamectin benzoate, imidacloprid, spinosad, α-cypermethrin, lambda-cyhalothrin, deltamethrin and chlorpyrifos-methyl were 28.71, 47.78, 73.86, 168.93, 249.45, 345.1 and 653.52 ppm, respectively.

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Table (1): Toxicity and resistance ratio of seven insecticides against laboratory and field strains of *Ceratitis capitata* at 24 h post treatment:

	Insecticides	Laboratory strain					Field strain					RR	Class
		LC_{50}	Confidence limits		Slope	X^2	LC_{50}	Confidence limits		Slope	X^2		
			Lower	Upper				Lower	Upper				
Males	Spinosad	18.57	10.51	43.56	1.19	0.98	133.18	48.46	978.77	4.99	0.023	7.17	low
	Emamectin benzoate	6.73	4.06	14.42	1.17	0.611	38.37	12.91	148.56	2.23	0.24	5.7	Low
	α-Cypermethrin	12.02	7.24	28.55	1.15	0.34	216.84	137.37	517.54	2.54	0.71	18.04	Moderate
	Imidacloprid	16.81	8.18	30.1	1.34	0.921	71.05	32.17	208.06	2.25	0.09	4.23	Low
	Lambda-cyhalothrin	33.08	25.21	58.82	1.21	0.045	738.18	285.01	1412.65	1.83	0.26	22.31	Moderate
	Deltamethrin	26.16	14.72	60.15	1.44	0.92	381.07	108.76	917.44	1.77	1.75	14.57	Moderate
	Chlorpyrifos	41.11	29.34	86.96	1.77	0.18	1174.16	751.88	2090.66	1.63	0.06	28.56	Moderate
Females	Spinosad	21.27	12.03	32.94	1.44	1.23	115.41	41.3	517.29	4.24	0.122	5.43	Low
	Emamectin benzoate	8.84	3.58	14.79	1.26	0.23	47.07	16.57	181.83	3.55	0.16	5.32	Low
	α-Cypermethrin	14.23	8.74	44.36	2.19	0.89	187.7	59.09	512.93	2.06	0.651	13.19	Moderate
	Imidacloprid	15.93	10.18	47.56	2.67	0.334	83.82	32.21	508.87	4.66	0.45	5.26	Low
	Lambda-cyhalothrin	33.5	14.9	72.86	1.77	0.95	798.9	142.28	1219.28	1.57	0.05	23.85	Moderate
	Deltamethrin	40.5	24.44	71.81	1.55	1.23	620.22	312.35	1072.08	1.86	0.73	15.31	Moderate
	Chlorpyrifos	41.12	20.36	70.1	1.12	0.28	933.6	412.32	1628.34	1.58	0.23	22.7	Moderate

RR: Resistance Ratio = LC_{50} of field strain/ LC_{50} of laboratory strain; X^2 = calculated Chi square

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Table (2): Toxicity and resistance ratio of seven insecticides against laboratory and field strains of *Ceratitis capitata* at 48 h post treatment:

	Insecticides	Laboratory strain					Field strain					**RR**	class
		LC_{50}	Confidence limits		Slope	X^2	**LC_{50}**	Confidence limits		Slope	X^2		
			Lower	Upper				Lower	Upper				
Males	**Spinosad**	6.87	2.2	9.96	1.12	**1.21**	90.56	31.34	258.59	2.51	0.04	13.18	Moderate
	Emamectin benzoate	1.95	1.08	5.07	1.62	**0.84**	20.72	6.78	50.1	1.81	0.3	10.62	Moderate
	α-Cypermethrin	8.53	4.66	11.4	1.02	**0.27**	190.82	73.7	1054.47	3.46	1.1	22.36	Moderate
	Lmidacloprid	2.86	1.08	4.37	1.09	**0.65**	36.24	15.61	150.51	3.49	0.31	12.68	Moderate
	lambda-cyhalothrin	9.26	4.88	13.99	1.19	**2.18**	413.38	232.9	934.38	1.42	1.2	44.63	High
	Deltamethrin	7.59	2.49	12.29	1.28	**0.73**	262.94	153.47	739.94	1.79	0.09	34.66	High
	Chlorpyrifos	20.96	11.56	120.03	4.24	**0.44**	634.05	279.17	1526.11	1.75	0.025	30.24	High
Females	**Spinosad**	6.38	3.86	14.34	1.09	**1.61**	73.86	42.59	306.31	2.39	0.85	11.58	Moderate
	Emamectin benzoate	2.39	1.25	3.72	1.01	**0.62**	28.71	16.71	81.54	1.87	0.25	12.03	Moderate
	α-Cypermethrin	8.68	5.14	14.79	1.12	**0.5**	168.93	58.99	423.51	1.79	1.65	19.46	Moderate
	Imidacloprid	3.82	2.19	8.016	1.49	**1.62**	47.78	21.99	108.79	1.63	0.76	12.5	Moderate
	Lambda-cyhalothrin	7.71	4.09	28.14	2.36	**0.44**	249.45	127.86	1951.76	4.86	0.085	32.38	High
	Deltamethrin	13.36	6.1	62.92	3.39	**0.84**	345.1	186.06	877.08	1.98	1.63	25.82	Moderate
	Chlorpyrifos	17.27	9.12	27.32	1.29	0.17	653.52	416.33	1635.11	1.74	1.05	37.84	High

RR: Resistance Ratio = LC_{50} of field strain/ LC_{50} of laboratory strain; X^2 = calculated Chi square

The resistance ratio ranged between 10.62 in emamectin benzoate insecticide (moderate resistance) to 44.63-fold in lambda-cyhalothrin (high resistance) in the males and from 11.58-fold in spinosad (moderate resistance) to 37.84-fold (high resistance) in chlorpyrifos-methyl in the females. Raga and Sato, (2006) Studied the Time-mortality for *C. capitata* exposed to insecticides in laboratory. They found that chlorpyriphos presented the highest fifty lethal time, LT_{50} (less effective) and fenpropathrin and trichlorfon showed the lowest LT_{50} (more effective). Raga and Sato (2005) studied the effect of Tracer (spinosad) bait compared with fenthion and trichlorfon against *C. capitata* (Wied.) in laboratory and found that fenthion and trichlorfon showed L_{T50} values lower than spinosad for different ages of medfly. The results of current study agree with those found by Abu al-Futuh *et al*. (2019) who studied the toxic actions of lambda-cyhalothrin and spinosad on the adults of laboratory strain of *C. capitata* and three field populations (collected from different governorates). They found that the males of laboratory and field strains were more susceptible than the females. The field strains exhibited highest resistance level to lambda-cyhalothrin. Akl (2016) also found that the males of *C. capitata* of laboratory and field strains were more susceptible than females to Malatox insecticide. On the other hand, El-Gendy 2018, studied insecticide resistance of a field Strain of *C. capitata*. The author assayed four insecticides *viz.*, malatox, malathion, fenitrothion and spinosad after 24 and 48h. the level of resistance ranged from 24.24-115.56 fold in females and from 18.79-112.81 fold in males after 24 h and from 89.19-100.8 fold in males and from 29.34-99.45 fold in females after 48 h post-treatment.

The peach fruit fly, *Bactrocera zonata*

The results presented in Tables 3 and 4 showed that the males of field strain of *B. zonata* exhibited varying resistance ratios with highest resistance against chlorpyrifos-methyl, followed by deltamethrin, lambda-cyhalothrin, α-cypermethrin, imidacloprid, spinosad and emamectin benzoate in descending order at 24 h. the resistant ratio of females ranged between 3.6 fold as in imidacloprid (low resistance) to 25.55 fold in chlorpyrifos-methyl (moderate resistance). After 48 h exposure time, the highest resistance ratios for males and females of *B. zonata* were recorded for chlorpyrifos-methyl (26.84 fold) and deltamethrin (18.08 fold), respectively. Generally, the females of *B. zonata* are more resistant than the males

The males of the laboratory population was observed to be susceptible to deltamethrin (LC_{50} of 5.31 ppm) followed by α-cypermethrin (8.19 ppm), emamectin benzoate (10.42 ppm), imidacloprid (22.3 ppm), spinosad (30.33 ppm), lambda-cyhalothrin (63.45 ppm) and Chlorpyrifos-methyl (66 ppm), respectively. The highly toxic insecticide with lowest LC_{50} were emamectin benzoate (54.45 ppm) and spinosad (181.54 ppm), respectively to field strain after 24 h showing low level of resistance. The low toxic insecticides for the females with highest LC_{50} was Chlorpyrifos-methyl (67.73 ppm in the laboratory strain and 1730 ppm in the field strain).

After 48 h, the most effective insecticides against *B. zonata* was α-cypermethrin insecticide followed by deltamethrin, emamectin benzoate, imidacloprid, spinosad, lambda-cyhalothrin and chlorpyrifos-methyl. While in the males the α-cypermethrin insecticide was more toxic than deltamethrin. Our results are in agreement with the results of Ahmad et al. (2010), who determine the level of insecticide resistance in malathion, trichlorfon, lambda-cyhalothrin, spinosad and bifenthrin, against two field strains of *B. zonata*. They found that the field strain of *B. zonata* were resistant to trichlorfon, malathion, lambda-cyhalothrin and bifenthrin ranging 3-19 fold. The two tested population were susceptibility to spinosad while cyhalothrin insecticide registered resistances ratio (4-9 fold). The current results also are in the same line with the results of Haider, *et al*. (2011) who determined the level of insecticide resistance of the peach fruit fly, *B. zonata*. They found that the field strain of *B. zonata* exhibited varying ratios of resistance as follows; Diptrex (65.32) followed by Curacron (13.20), Confidor (7.12), Talstar (5.97), Karate (5.73), Malathion

(5.54) and Deltamethrin (2.35) at 24 h. Our results also confirm the results of Nadeem, *et al*. (2014) assayed six insecticides viz., bifenthrin, lambda-cyhalothrin, trichlorfon, malathion, methomyl and spinosad against fourteen field populations of *B. zonata*. Lambda-cyhalothrin and spinosad insecticides were showed susceptible to low resistance (1.00-fold to 9.57- fold and 1.20 -fold to 9.95-fold). In agreement with the results of Gazit, and Akiva, (2017), the current results revealed that *B. zonata* (males and females) was more tolerant to the tested insecticides than *C. capitata*.

From the above-mentioned results, it could be concluded that: first, the low slope values of the log dose-probit line in laboratory strain of *C. capitata* and *B. zonata* compared with the field strain indicated the homogeneity of the laboratory strains towards the seven tested insecticides. Second, the calculated Chi square (x^2) values were less than the tabulated ones at 0.05 probability level (tabulated Chi square =5.99) for the seven tested insecticides on both males and females of the two species.

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Table (3): Toxicity and resistance ratio of seven insecticides against laboratory and field strains of *Bactrocera zonata* at 24 h post treatment:

	Insecticides	Laboratory strain					Field strain					RR	Class
		LC_{50}	Confidence limits		Slope	X^2	LC_{50}	Confidence limits		Slope	X^2		
			Lower	Upper				Lower	Upper				
Males	**Spinosad**	30.33	17.82	70.63	1.56	1.78	181.54	67.74	548.52	2.18	1.45	5.99	Low
	Emamectin benzoate	10.42	6.729	27.8	1.98	0.75	54.45	20.54	392.26	4.57	0.06	5.23	Low
	α-Cypermethrin	8.19	5.62	14.49	1.01	2.21	100.27	48.54	253.88	1.72	0.86	12.24	Moderate
	Imidacloprid	22.3	13.09	49.49	1.55	1.54	142.28	34.68	569.91	2.35	0.54	6.38	Low
	Lambda-cyhalothrin	63.45	39.43	103.24	1.13	0.87	960.89	213.78	2621.87	2.45	1.52	15.14	Moderate
	Deltamethrin	5.31	2.72	8.74	1.23	0.95	90.8	31.4	291.52	2.35	1.05	17.1	Moderate
	Chlorpyrifos	66	38.03	110.06	1.77	0.77	1452.16	626.47	5050.51	3.01	0.54	22	Moderate
Females	**Spinosad**	37.36	11.42	81.6	1.75	1.65	252.59	135.19	675.93	2.17	0.26	6.76	Low
	Emamectin benzoate	11.92	5.27	26.95	1.82	0.25	64.37	24.7	155.22	2.33	0.58	5.4	Low
	α-Cypermethrin	8.92	3.04	29.52	2.85	0.59	117.44	65.74	273.43	1.57	1.46	13.17	Moderate
	Imidacloprid	28.56	8.9	79.58	2.39	0.23	102.83	32.81	337.26	2.98	0.57	3.6	Low
	Lambda-cyhalothrin	50.92	28.05	108.19	1.55	0.1	962.68	327.7	2211.13	1.94	1.53	18.91	Moderate
	Deltamethrin	6.164	0.69	13.82	1.93	0.23	122.62	54.68	285.88	1.87	1.55	19.89	Moderate
	Chlorpyrifos	67.73	28.32	124.61	1.38	1.26	1730.57	738.08	2985.86	1.19	1.53	25.55	Moderate

RR: Resistance Ratio = LC_{50} of field strain/ LC_{50} of laboratory strain; X^2 = calculated Chi square

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Table (4): Toxicity and resistance ratio of seven insecticides against laboratory and field strains of *Bactrocera zonata* at 48 h post treatment:

	Insecticides	Laboratory strain					Field strain					RR	Class
		LC_{50}	Confidence limits		Slope	X^2	LC_{50}	Confidence limits		Slope	X^2		
			Lower	Upper				Lower	Upper				
Males	**Spinosad**	12.3	7.82	20.63	1.02	0.96	66.32	37.74	148.52	1.49	0.84	5.39	Low
	Emamectin benzoate	3.91	1.73	7.8	1.48	1.23	22.68	7.54	92.26	2.74	0.94	5.8	Low
	α-Cypermethrin	2.21	1.42	7.49	2.38	0.87	24.57	8.54	93.88	3.69	2.94	11.14	Moderate
	Imidacloprid	12	7.09	19.49	1.105	1.56	49.94	14.68	119.91	2.35	1.85	4.16	Low
	Lambda-cyhalothrin	29.59	19.43	43.24	1.31	2.24	471.17	113.78	1621.87	3.05	0.94	15.92	Moderate
	Deltamethrin	2.5	1.72	8.74	3.02	1.74	30.8	8.4	171.52	4.76	0.86	12.33	Moderate
	Chlorpyrifos	35.52	15.03	60.06	1.66	0.95	953.25	226.47	6050.51	4.68	0.85	26.84	Moderate
Females	**Spinosad**	13.23	7.42	18.6	1.29	0.05	73.7	15.19	275.93	3.52	0.13	5.57	Low
	Emamectin benzoate	5.13	2.27	9.95	1.38	1.49	29.3	8.7	155.22	4.25	0.24	5.71	Low
	α-Cypermethrin	2.68	1.04	8.521	2.53	0.64	30.57	7.74	173.43	3.79	0.85	11.41	Moderate
	Imidacloprid	16.6	5.9	79.58	3.06	0.04	52.37	18.81	237.26	4.02	0.05	3.16	Low
	Lambda-cyhalothrin	36.36	18.05	108.19	2.05	1.04	460	147.7	1311.13	2.26	0.94	12.66	Moderate
	Deltamethrin	3.15	0.69	13.82	4.03	1.47	57	24.68	185.88	2.69	2.48	18.08	Moderate
	Chlorpyrifos	41.41	28.32	124.61	2.12	2.3	739.98	338.08	1985.86	2.28	1.83	17.87	Moderate

RR: Resistance Ratio = LC_{50} of field strain/ LC_{50} of laboratory strain; X^2 = calculated Chi square

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مستويات المقاومة للمبيدات في السلالات الحقلية والمعملية لحشرتي ذبابة ثمار فاكهة البحر المتوسط *Ceratitis capitata* (Wiedemann) وذبابة ثمار الخوخ *Bactrocera zonata* (Saunders)

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الملخص العربي

في هذه الدراسة تم تقييم حساسية ومستويات المقاومة في حشرتي ذبابة ثمار فاكهة البحر المتوسط *Ceratitis capitata* (Wiedemann) وذبابة ثمار الخوخ *Bactrocera zonata* لسبع مبيدات حشرية عن طريق الطعوم السامه تحت الظروف المعملية. المبيدات المستخدمة هي كلوروبيروفوس الميثيل، الفاسيبرمثرين، اللامبادا سيهالوثرين، الدلتامثرين، ايمامكتين بنزوات، سبينوساد وايميداكلوبريد. اشارت النتائج الي وجود مقاومة متوسطه الي عالية لكلا من الدلتامثرين، كلوروبيروفوس الميثيل، اللامبادا سيهالوثرين. استجابة كلا الحشرتين للايميداكلوبريد والايمامكتين بنزوات كانت من حساسة الي مقاومة متوسطة. اشارت النتائج الي ان الايمامكتين بنزوات والدلتامثرين كانت الاكثر سمية لحشرة ذباب ثمار فاكهة البحر المتوسط وحشرة ثمار الخوخ، علي الترتيب. مبيد الكلوربيروفوس ميثيل كان الاقل سمية لكلا الحشرتين. حشرة ذباب ثمار فاكهة البحر المتوسط كانت أكثر حساسية للمبيدات المختبرة عن حشرة ذبابة ثمار الخوخ. وكذلك ذكور كلا الذبابتين أكثر حساسية للمبيدات المختبرة عن الاناث في كلا السلالتين الحقلية والمعملية. سمية المبيدات المختبرة زادت مع زيادة مدة التعرض للمبيد.