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Symptoms of Pepper Fruits Infested with Dipterous Pests and Their Control by Soil Treatment

MOSTAFA KAMAL AHMED[1]

ABSTRACT

Pepper fruits are attacked by the lonchaeid fly, *Lonchaea aurea* Macq. and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann). Larvae from both species tunnel inside fruit tissues, and only specie, which develop in the fruit. Peppers were not attacked until they became about 3.5 cm long and 2.5 cm in diameter. Peppers attacked by Medfly larvae kept their shape and rigidity. But those infested with the lonchaeid larvae became soft and watery.

Early symptoms of infestation showed small, creamy round scars about 1.0 mm in diameter. Infested parts became tender and soft areas gradually increased. The fruits then lost shape, all green tissues turning to a thin paste, that accumulated inside the skin at the bottom of the fruit. Some infested fruits dried on their plants.

Pirimphos-methyl proved more effective as a soil treatment against the pupae of both insects than formothion. *L. aurea* was more sensitive than the Medfly. LC_{50} of pirimphos-methyl were 9.6 and 10.96 for both species respectively, and LC_{50} for formation were 26 and 59 respectively.

INTRODUCTION

A survey during the last 2 years had revealed that a high percentage of peppers sold in the markets of Tripoli are badly infested with two different types of dipterous larvae, and infestation is present throughout the season.

In the literature, the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) and the lonchaeid fly, *Lonchaea aurea* Macq., are listed as pests of pepper in the Libyan Jamahiriya (2 and 6), and Damiano (3) indicated that the former fly severely attacks pepper crop.

The purpose of this study is to investigate insect pest infestation in peppers under jar conditions, determine the pests responsible for the damage, and search for effective control measures to save the crop.

MATERIALS AND METHODS

Data were obtained from small experimental plots which were planted with sweet peppers in the farm of the Experimental Station of the Faculty of Agriculture, University of Al-Fateh, Tripoli, Libyan Jamahiriya. All pepper fruits on five mature plants were examined every week to record percentage of infestation.

Some newly infested fruits were collected and kept singly in glass jars inside the laboratory to observe closely any changes in the symptoms of infestation.

[1]*Department of Plant Protection, Faculty of Agriculture, University of Al-Fateh, Tripoli, S.P.L.A.J.*

Because the full-grown larvae of *Ceratitis capitata* and *Lonchaea aurea* pupate in the soil, tests were carried out to study the effect of soil treatment on the survival of pupae that contact treated soils. The puparia used in these tests were obtained from field-collected infested fruits. When papers were brought to the laboratory, they were kept over filter paper in glass jars until the larvae became full-grown and left the fruits. They were left to pupate. The pupae which were used in the tests were 2–3 days old.

The experiments were conducted during September and October, 1979 when large quantities of highly-infested pepper fruits were available to obtain the necessary number of larvae and pupae needed for this investigation. Formothion (S-(N-formyl-N-methylcarbamoylmethyl) O,O-dimethyl phosphorodithioate) (produced by Celamerck Co., under the trade-mark 'Anthio'); and pirimphos-methyl (O-2-diethylamine-6-methylpyrimidin-4-yl O,O-dimethyl phosphorothioate) (manufactured by Plant Protection Ltd, under the trade mark 'Actellic') were the insecticides used in this study. Both materials were an emulsifiable concentrate formulation containing 33% and 50% active ingredient respectively. The chemicals were dissolved in acetone to prepare the dilutions used in treating the soil.

A sample of sandy loam soil from the Faculty of Agriculture Experimental Farm in Sidi El-Masri was ground, sifted through a mesh sieve with 1.0 mm long apertures, and treated at the rate of 4, 20, 100 and 500 microgram of formothion or 6, 30, 150 and 750 microgram of pirimphos-methyl per gram of soil. Five millilitres of acetone containing the required dose of the toxicant was mixed thoroughly with 200 g of soil. Acetone was allowed to evaporate by spreading the treated soil in a thin layer over a sheet of clean paper for about 5 hours.

The experiments were carried out using 200 cc ice-cream paper cups about 5.5 cm high and 8.5 cm in diameter at the open end. Each cup was filled with treated soil, and 10 pupae were placed in each cup at a depth of 2.0 cm. Each insecticide dilution was replicated 3 times. The experiments contained an untreated check with the same number of replicates.

The dead pupae were recorded after emergence was completed. Mortalities were corrected for natural mortality by Abbott's formula (1). Dosage mortality lines, LC_{50} and slope values were dicsussed after applying the linear regression equation (4) to express direct toxicity of the 2 tested insecticides.

RESULTS AND DISCUSSION

The newly infested fruit showed a round, depressed scar which was creamy in colour and measured about 1.0 mm in diameter. A dark ring later appeared around the scar (Fig. 1). These early symptom of infestation resulted from tissues that healed around the small hole made by the ovipositor of female *Ceratitis capitata* (Wiedeman) or by the newly hatched larva of *Lonchaea aurea* Macq.

The larvae of both species can be differentiated easily by colour, size, and posterior spiracles. The Medfly larva is yellowish while the lonchaeid larva is white. Also, the former is larger and measures, on average, about 9.0 mm in length and 0.12 mm in width at the posterior end. The larva of *L. aurea* is thinner and averages 0.75 mm in length and 0.08 mm in width, with black and protruded posterior spiracles, while those of the Medfly larvae have the same colour as the body but do not project from the body surface.

Both species of larvae tunnel inside the fruit flesh. The lonchaeid larvae are more destructive than the Medfly larvae because the latter damaged only part of the fruits while the former species ruined them completely.

Pepper fruits attacked by the Medfly larvae kept their shape and rigidity. But those infested with the lonchaeid larvae became extremely soft and watery around the areas where feeding had taken place (Fig. 2). The soft areas increased gradually (Fig. 3) until

all the fruit became tender. At this stage the fruit lost its shape; the inside green tissues turned to a thin paste, moved to the bottom of the fruit, and accumulated inside the skin. Most of the larvae reached maturity at this stage of infestation and left the fruits.

Many peppers dropped before these advanced symptoms appeared, while others dried on their plants. The dried peppers became whitish in colour and consisted of thin and wrinked pale skin (Fig. 4).

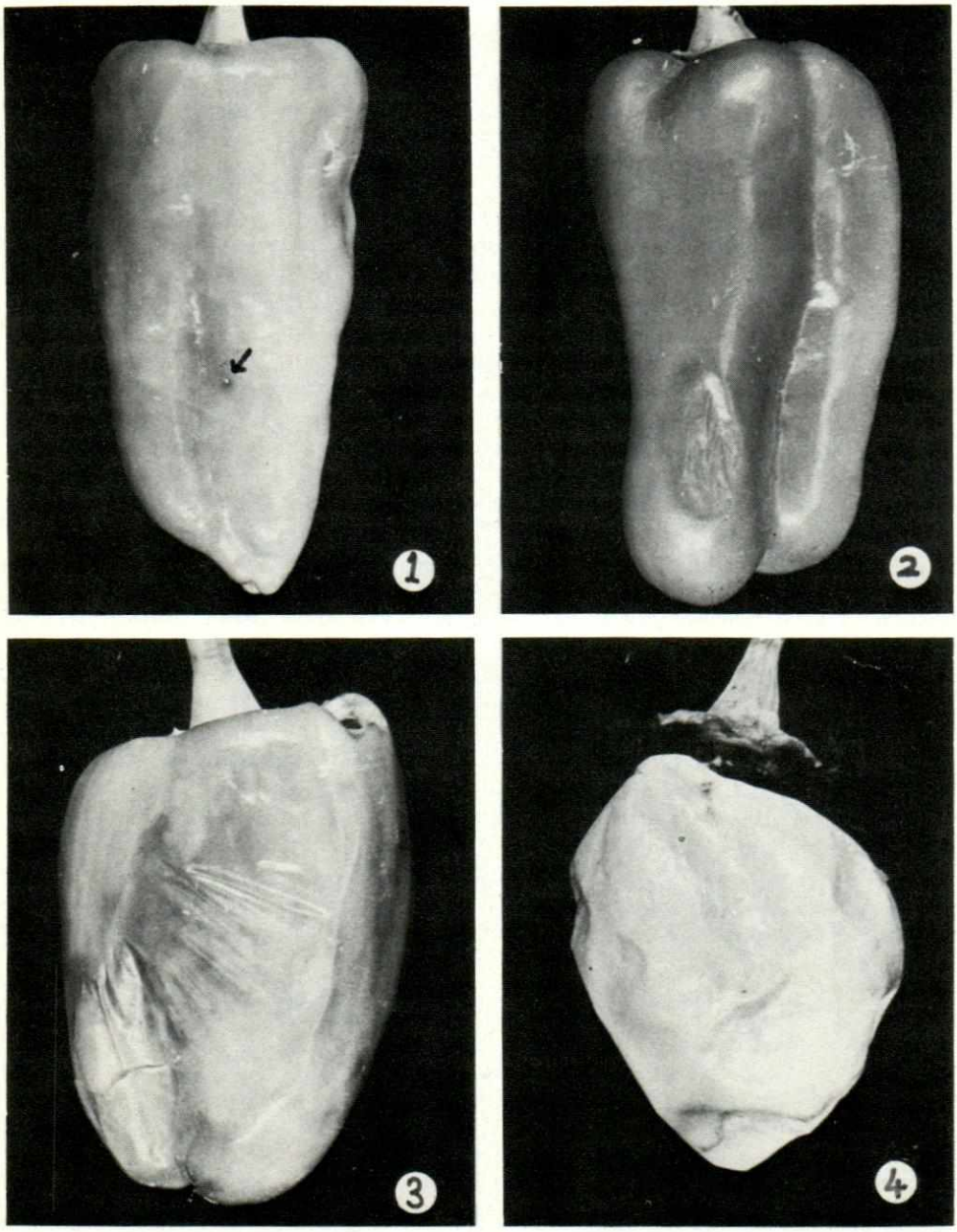

Fig. 1. Newly infested pepper fruit showing small round scar.

Fig. 2. Soft tissue of infested area.

Fig. 3. Infested fruit with increased tender area.

Fig. 4. Dried pepper fruit with white skin.

Table 1 Effect of pirimphos-methyl and formothion on *Lonchaea aurea* pupae in treated soil.

Insecticide	Used rate ppm	Percentage of Mortality		LC_{50}	Slope
		Corrected	Calculated		
Pirimphos-methyl	6	28.8	40	9.6	1.22
	30	83.3	73		
	150	91.5	93		
	750	100.0	99		
Formothion	4	28.9	28	26	0.73
	20	48.8	47		
	100	59.3	66		
	500	86.4	83		

Infested fruits were always found to contain only one species, and none of the peppers was infested with both pests. Infestation with the lonchaeid species was usually higher than that with the Medfly. Several counts showed that an average of 55% to 37.5% of peppers were infested with the 2 pests, respectively.

Small peppers were not attacked until they became about 3.5 cm long and 2.5 cm in diameter, and infestation increased gradually in older fruits. For this reason highest infestations appeared in fruits at the bottom of plants. The average number of punctures observed on fruits located at different heights on plants were, from top to bottom, as follows: 3, 5, 9, 11, and 18 per fruit.

In general, pirimphos-methyl ('Actellic') was more effective as a soil treatment against *L. aurea* and *C. capitata* pupae than formothion (Anthio), and the former species was slightly more sensitive to pirimphos-methyl than the latter one. The toxicity of pirimphos-methyl was quite dominant even at low doses. Percentage of mortality was 37% and 40% for the lonchaeid species and Medfly respectively when 6.0 μg/g of soil was used.

Other doses seemed to have similar effects on both insects. For example, 73% and 71% mortality resulted from the pupae of both species respectively, at a dose of 30 μg/g soil; and 99% of both insects were killed by 750 μg/g of soil (Tables 1 and 2). The LC_{50} of pirimphos-methyl for the two insects were very close and showed values of 9.6 and 10.96 for *L. aurea* and *C. capitata* respectively. Swailem (5) who carried out a similar test on the latter insect found that fenthion was the most effective chemical followed by lindane, endrin, dimethoate, dieldrin, malathion and methoxychlor.

Formothion was poorer in its effect. But it was significantly more effective against *L. aurea* than against *C. capitata*. Its lowest dose (4.0 μg/g of soil) gave 28% and 10% mortality of both species respectively. The higher concentrations were also more toxic

Table 2 Effect of pirimphos-methyl and formothion on *Ceratitis capitata* pupae in treated soil.

Insecticide	Used rate ppm	Percentage of Mortality		LC_{50}	Slope
		Corrected	Calculated		
Pirimphos-methyl	6	20.6	37	10.96	1.26
	30	89.3	71		
	150	89.3	92		
	750	100.0	99		
Formothion	4	12.5	10	59	1.10
	20	20.0	30		
	100	65.9	60		
	500	—	—		

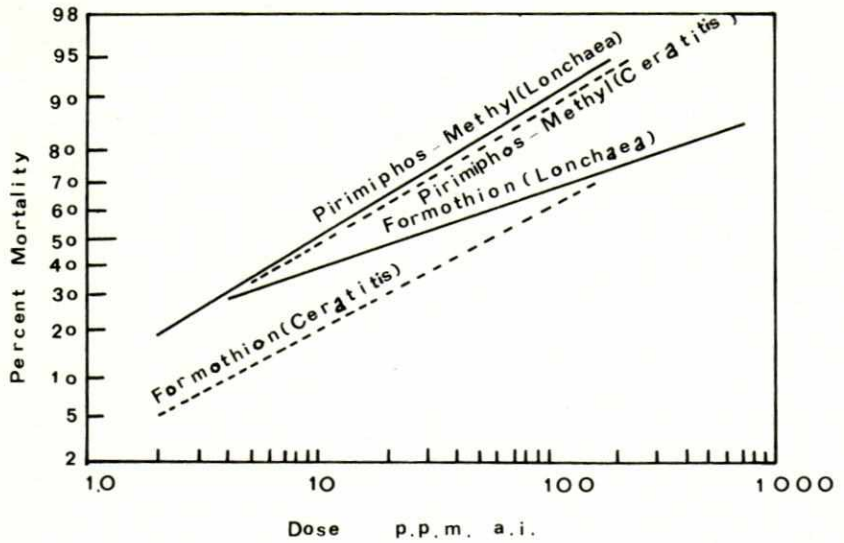

Fig. 5. Dosage mortality lines for pirimphos-methyl and for formothion used as soil treatment against *Lonchaea aurea* and *Ceratitis capitata* puparia.

to *Lonchaea* than *Ceratitis* because 100 μg/g of soil killed 66% and 60% from both insects respectively (Tables 1 and 2). Its LC_{50} were 26 and 59 for the 2 pests respectively. This may indicate that formothion was twice as effective on *Lonchaea* as on *Ceratitis* puparia.

The dosage mortality lines of pirimphos-methyl for both species were almost similar and parallel to each other. Because this insecticide had a better direct toxicity against *L. aurea* than *C. capitata*, the line of the first species appeared slightly in advance of the line of the second species. But the lines of formothion were quite apart because this chemical had different toxic effects on the two insects (Fig. 5).

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أعراض اصابة ثمار الفلفل بآفات من الذباب ومكافحتها بمعاملة التربة

مصطفى كمال أحمد

المستخلص

يصيب ثمار الفلفل نوعان من الذباب هما ذبابة لونشا أوريا وذبابة فاكهة البحر المتوسط سيراتيتس كابيتاتا التى تحفر يرقاتها داخل أنسجة الثمار . ويعيش نوع واحد فقد داخل الثمرة . ولا تصاب الثمار الصغيرة الا بعد أن يبلغ طولها ٣ر٥ سم وقطرها ٢ر٥ سم . وتحتفظ الثمار المصابة بذبابة فاكهة البحر المتوسط بشكلها وتماسكها ، بينما تصبح الثمار المصابة بيرقات لونشيا لينة ومائية .

وتبدأ أعراض الاصابة على شكل ندبه مستديرة سمنية اللون لا يزيد قطرها عن ١ ملم ، ثم يصير جانب الثمرة لينا ومع تقدم الاصابة تصبح أنسجة الثمرة مائية وتتراكم جميع المحتويات فى أسفل الثمرة . وتجف بعض الثمار على النباتات .

وقللت معاملة التربة بالمبيدين بريمفوس ـ ميثيل وفورموثيون من نسبة الذباب الذى يخرج من العذارى المدفونه بالتربه . وكان أكثرها مفعولا هو المبيد بريمفوس ـ ميثيل . كما كانت عذارى اللونشيا أكثر حساسية للمبيدات من عذارى ذبابة فاكهة البحر المتوسط . وبلغت س٥٠ للمبيد بريمفوس ـ ميثيل ٩ر٦ ، ١٠ر٩٦ للحشرتين على التوالى . كما بلغت س٥٠ للمبيد فورموثيون ٢٦ ، ٥٩ على التوالى .