Screening Some Non-Phosphorous Insecticides Against Adult Greenhouse Whiteflies Tolerant to Organophosphates

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ABSTRACT

The non-phosphorous insecticides pyrethrin, lindane and fenvalerate were tested against a population of greenhouse whitefly tolerant to some organophosphorous chemicals. Pyrethrin was the most effective insecticide followed by lindane. The former was 10 times more toxic than lindane, while the dosage of fenvalerate should be twice as much as that of lindane to obtain 49% mortality. The LC_{50} values for pyrethrin, lindane, and fenvalerate were 0.004, 0.042 and 0.092 respectively. These chemicals also varied in their slope values. They were 1.34, 0.84 and 0.28 respectively. These insecticides are recommended for the control of tolerant whitefly because they proved to be 66, 6.6, and 3.0 times, respectively, more toxic than malathion.

INTRODUCTION

Insecticides are the most powerful tool for controlling insect pest outbreaks and for reducing their destructive populations below damaging levels. The growing use of these pesticides, since the development of synthetic organic materials in the 1940s, has caused resistance in more than 119 species of agriculture insect pests (5).

The greenhouse whitefly *Trialeurodes vaporariorum* (West-Wood) is one of those pests which developed high resistance to pesticides (7 and 8). In the Libyan Arab Jamahiriya, a tolerant strain to malathion, dimethoate and fenitrothion had developed in the greenhouse of the Faculty of Agriculture, University of Al-Fateh, Tripoli due to heavy and repeated applications of malathion and dimethoate (2).

The purpose of this study is to test and screen few non-phosphorous insecticides against this pest hoping to find alternative chemicals for its control.

MATERIALS AND METHODS

The following insecticides were diluted with distilled water and five concentrations were prepared (Table 1):

1. Lindane (gamma isomer of hexachlorocyclohexane) 25% E.C.
2. Pyrethrin/mineral oil 1.4%/5.8% E.C. (produced by McLaughlin Gormley King Co., U.S.A., under the trade-mark Pyrocide).
3. Fenvalerate (α-cyano-m-phenoxybenzyl α-isopropyl-p-chlorophenylacetate) 20% E.C. (produced by Sumitomo Chemical Co., Japan under the trade-mark Sumicidin).

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Table 1 Effect of pyrethrin, lindane and fenvalerate on adults of greenhouse whitefly tolerant to organophosphorous insecticides and exposed to treated alfalfa terminals.

Insecticide	Used rate % a.i.	Percentage of mortality		LC_{50}	Slope
		Corrected	Calculated		
Pyrethrin/mineral oil	0.0028	42.4	43	0.004	1.34
1.4/5.8% e.c.	0.0056	58.2	60		
(Pyrocide)	0.0112	77.7	74		
	0.0224	87.4	85		
	0.0448	91.9	93		
Lindane	0.02	46.2	39	0.042	0.84
20% e.c.	0.04	22.2	49		
	0.08	51.2	59		
	0.16	65.2	69		
	0.32	72.9	72		
Fenvalerate	0.02	29.8	43	0.092	0.28
20% e.c.	0.04	40.8	46		
(Sumicidin)	0.08	70.4	49		
	0.16	43.5	53		
	0.32	63.5	56		

These chemicals were tested in September 1979, and each concentration was replicated four times. The same technique that was described by Ahmed and Ghaleb (2) was followed in these experiments. Adult whitefly were collected from alfalfa plants grown in the greenhouse (Faculty of Agriculture) and infested with whitefly tolerant to organophosphorous insecticides (2). Alfalfa terminals were treated by dipping in the diluted pesticide and when dry, each was exposed to twenty adult whitefly inside a glass vial.

Mortalities were counted after 24 hours then corrected by applying Abbott's formula (1). Data of these experiments were statistically evaluated by the linear regression equation (3,6). This equation helped to draw accurate straight dosage mortality lines instead of the eye best-fit lines. Both of LC_{50} and slope values were also calculated using same equation.

RESULTS AND DISCUSSION

Pyrethrin proved to be more effective than lindane and fenvalerate. Their LC_{50} were 0.004, 0.042 and 0.092 respectively. These values also indicate that pyrethrin was ten times more toxic than lindane. This was evident from the low dosage of 0.0056% pyrethrin which had resulted in 60% mortality as compared to 0.08% lindane that resulted in almost same mortality, 59% (Table 1).

It was found that the dosage of fenvalerate was almost twice as much as that of lindane to obtain 49% mortality. This percentage of greenhouse adult whitefly was killed by 0.08% and 0.04% concentration of fenvalerate and lindane, respectively (Table 1). Fenvalerate was more effective at lower concentration than the rest. Mortalities resulted from 0.02% concentration of fenvalerate and lindane were 43% and 39% respectively. At higher doses of 0.16% and 0.32% concentrations gave higher mortalities in the experiments of lindane than in those of fenvalerate. Mortalities of 69% and 53% were obtained from lindane and fenvalerate respectively, at 0.16% concentration. While 77% and 56% of the insects were killed by both chemicals at 0.32% concentration (Table 1).

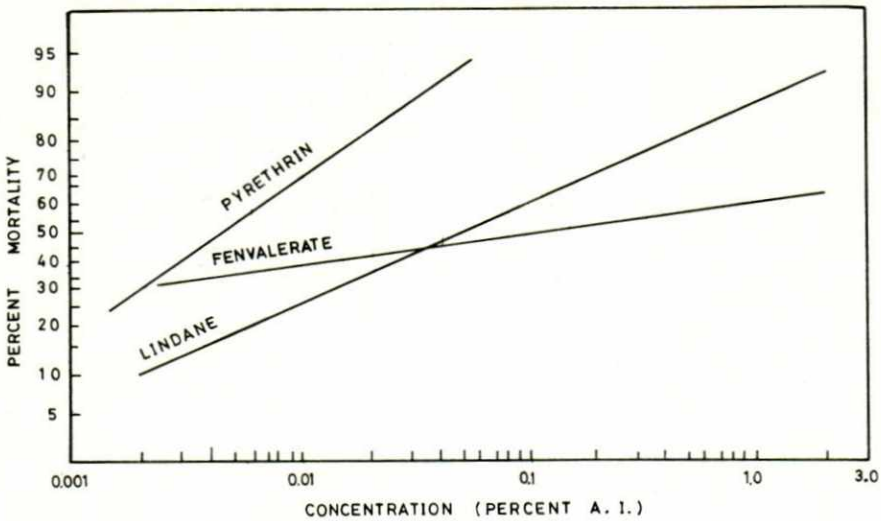

Fig. 1. Dosage mortality lines expressing the effectiveness of pyrethrin, lindane, and fenvalerate against adult greenhouse whitefly.

Dosage mortality line of pyrethrin, lindane, and fenvalerate varied also in slope values. Their slopes were 1.34. 0.84 and 0.28 respectively. This might explain the flatness of fenvalerate dosage mortality line. Whereas pyrethrin had a steeper line than lindane (Fig. 1).

The data indicate that these three insecticides are very effective against adult whitefly tolerant to organophosphorous insecticides. It has been stated before, that dimethoate, malathion and fenitrothion had failed to control the whitefly population. The LC_{50} for malathion which proved to be the best of these chemicals was 0.278 (2).

The present study showed that lindane was 6.6 times more effective than malathion because its LC_{50} was 0.042 as compared with 0.278 for malathion. Fenvalerate and pyrethrin were also 3 and 66 times, respectively, more toxic than malathion, their LC_{50} values were 0.092 and 0.004 respectively. (Table 1 and Fig. 1).

These non-phosphorous chemicals are still more potent than oxydemeton-methyl[1] and mevinphos[2] which were previously recommended for the control of whitefly (2). Fenvalerate, lindane, and pyrethrin were 2.0–2.7, 4.6–6.1 and 46–61 times, respectively, more effective than oxydemeton-methyl and mevinphos.

Although fenvalerate is a synthetic pyrethroid, the activity of pyrethrin was 23 times higher than fenvalerate. In England, the synthetic pyrethroid, Permethrin, was effective against greenhouse whitefly resistant to both DDT and malathion. However, resistance against this chemical was developed in a short time. In 1974, about 53% of the tested population showed up to a 17-fold resistance (8), while in 1973 it was only 6-fold in 36% of the population (7).

Bioresmethrin was another synthetic pyrethroid highly effective against malathion resisistant whitefly in England. It gave complete mortality at 0.005% concentration. The three rates of pyrethrum (0.019%, 0.0095% and 0.0048% a.i.) had killed 99.6%, 98.4% and 90.8% of the resistant population (4).

In conclusion, synthetic pyrethroids such as Permethrin, Bioresmethrin, and fenvalerate, natural pyrethrin and lindane can be used as alternatives to organophosphorous insecticides. They proved to be effective for the control of greenhouse whitefly tolerant or resistant to organophosphorous chemicals.

[1,2]*Systemic organophosphorous insecticides.*

LITERATURE CITED

1. Abbot, W. S. 1925. A method of computing the effectiveness of an insecticide. Jour. Econ. Entomol. 18: 265–267.
2. Ahmed, M. K. and A. H. Ghaleb. 1980. Laboratory evaluation of several phosphoric ester insecticides against the greenhouse whitefly. Libyan J. Agr. (in press).
3. Clarke, G. M. 1976. Statistics and experimental design. Edward Arnold (Publishers) Ltd., London. pp. 82–90.
4. French, N., F. A. B. Ludlam and L. R. Wardlow. 1973. Observations on the effects of insecticides on glasshouse whitefly (*Trialeurodes vaporariorum* West.). Pl. Path. 22: 99–107.
5. Metcalf, R. L. 1975. Insecticides in pest management. Introduction to insect pest management. Ed. R. L. Metcalf, and W. H. Luckmann. John Wiley & Sons, New York, p. 171.
6. Omar, A. M. 1974. Lecture in statistics and experimental design for graduate students. Azhar University, Cairo. pp. 147–154.
7. Wardlow, L. R. and F. A. B. Ludlam. 1973. Insecticide resistance testing and chemical control of glasshouse whitefly. Proc. 6th Br. Insectic. Fungic. Conf. 1: 217–225.
8. Wardlow, L. R., A. B. Ludlam and L. F. Bradley. 1976. Pesticide resistance in glasshouse whitefly (*Trialeurodes vaporariorum* (West.). Pestic. Sci. 7: 320–324.

فاعلية بعض المبيدات الغير فوسفورية على حشرات الذبابه البيضاء المقاومه لفعل المبيدات الفوسفورية فى البيوت الزجاجية

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اختبر مفعول مبيدات البيرترين ، الليندين و الفينفاليريت ضد عدد من الحشرات الكاملة للذبابة البيضاء المقاومة لبعض المبيدات الفوسفوريه فى البيوت الزجاجية . ولقد تثبت أن البيرثرين هو أكثرها فاعلية يليه اللندين . بينما لم يعط مبيد الفينفاليريت ٥٠ ٪ ابداه الا بعد استعماله بضعف تركيز اللندين وكانت ت س ٥٠ لمبيدات البيرثرين ، اللندين و الفينفاليريت هى ٠٠٤ر٠ ، ٠٤٢ر٠٥ ، ٠٩٢ر على التوالى و اختلفت أيضا هذه المبيدات فى درجة ميل خطوط السميه حيث كانت ٣٤ر١ ، ٨٤ر٠ ، ٢٨ر٠ على التوالى ويمكن التوصيه باستعمال هذه المبيدات فى مكافحة الذباب الأبيض المقاوم لفعل المبيدات الفوسفورية حيث ثبت أن سميتها تبلغ ٦٦ ، ٦ر٦ ، ٣ مرات مثل سمية الملايثون على التوالى .