Egypt. J. Agric. Res., 73 (4), 1995.

TOXICITY OF PIRIMIPHOS-METHYL AND PERMETHIN TO GAMMA IRRADIATED AND NON-IRRADIAED ADULTS OF THE RICE WEEVIL *SITOPHILUS ORYZAE* (L.)

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(Manuscript received 13 July 1994)

Abstract

Tests were conducted to study the combined action of gamma radiation with the insecticides pirimiphos-methyl and permethrin against *Sitophilus oryzae* adults. Radiation was applied befor pesticide treatment. Dosages of 2and 4 Krad did not produce any mortality when applied alone, and actually afforded some protection to the insects against the two insecticides up to three days.

After 12 days, radiation combined with insecticides was slightly more lethal than either insecticides or radiation alone. Combined treatments produced quick mortalities than did radiation alone.

The combination of permethrin and gamma radiation was more toxic to *S. oryzae* adults than with primiphos-methyl.

INTRODUCTION

Most of the available literature regarding the lethal and sterilizing effects of gamma radiation on stored-product insects was reviewed by Watters (1968). The possibility that irradiation may become an established technique for controlling stored grain insects has been increased. Studies on the combined effects of gamma radiation with other treatmens like infra red (Cogburn et al., 1971), microwaves (Tilton et al., 1972) have been reported. Combination of these treatments is likely to be economical and complementary in their effectiveness against insect pests. The studies on the combined effects of ionizing radiations and insecticides conducted if

insects are exposed to radiations prior to insecticidal treatment.

This study was designed to determine the effecs of sublethal doses of gamma radiation on the susceptibility of the rice weevil *Sitophilus oryzae* (L.) fed on maize treated wih primiphos-methyl and permethrin.

MATERIALS AND METHODS

Insects

All treatments were carried out on 48h-old adults of a susceptible strain of *Sitophilus oryzae* (L.).

a. Common name : Pirimiphos-methyl (Actellic 50% EC) (2- diethylamino-6-methylpyrimidin-4-yl dimethyl phos-phorothinoate).

b. Common name : Permethrin (Coopex) (3- phenoxybenzyl-cistrans (±) -2,2 dimethyl-3-(2,2 dichlorovinyl) cyclopropane-1- carboxylate).

Irradiation

The insects were subjected to gamma radiation using the model 1-2 Cobalt-60 irradiation unit (Gamma Cell 220) Located at the Nuclear Atomic Energy Establishment.

Application

Four concentrations of each insecticide were prepared in volumetric flasks. The solvent used was acetone. One ml of each concentration was applied to a 9 cm diameter filter paper and then to dry under a gentle stream of air. After complete dryness, 20 insects were confined in each dish and left exposed to the pesticide film for 24 h after which mortality was recorded. This technique was repeated after 3 and 12 days from radiation.

Experimental design and analysis of data

The experiments were designed to determine the LC_{50} values when the insecticides were either used alone or after irriadiation. Mortality percentages were corrected for natural mortality according to Abbott's formula (Abbott, 1925).

Two types of treatments were invesigated :

1. Insecticides tested on unirradiated insects (the control was normal insects).

2. Insecticides tested on insects after immediate irradiation with a dose of 2 and 4 Krad, and at 3 and 12 days after irradiation (the conrol was irradiated insects).

To study productivity, bactches of 150 newly emerged couples of adults were irradiated with 2 and 4 Krad then exposed to the LC_{50} of the two tested insecticides.

The total number of offspring emerged was recorded after 6 weeks.

All tests were carried out at 28 ±1^{o}C and 65-70% R.H.

RESULTS AND DISCUSSION

Data in Table 1 showed that after one day exposure, irradiated adults (2 Krad) receiving various concentrations of permethrin spray ranging from 0.01 to 0.07 ppm were almost normal.

After three days of irradiation and at the lower concentrations 0.01 and 0.03 ppm, no mortality occurred with permethrin treatment.

After 12 days of irradiation, mortality of the irradiated adults was highly increased.

In non-irradiated adults, however, mortality ranged from 31.6 to 82.7% at the respective concentrations (after 12 days).

In case of pirimiphos-methyl treatment, no mortality was observed when irradiated adults were subjected to all concentrations after one and three days of irradiation. Morality ranging from 37.3 to 86.0% was observed after 12 days of irradiation. On the other hand, in the non-irradiated adults, mortality ranged between 35.0 and 77.0%.

With both insecticides at the periods one and three days, irradiated insects were obviously more tolerant than the non-irradiated adults.

Seemingly, radiation suppressed the toxicity of the tested insecticides to S.oryzae adults, but radiation was lethal after 12 days and eventually killed the insects. This agreed with Robert and Roy (1972) who found that a low dosage of radiation (5 Krad) suppressed the toxicity of malathion to red flour beetles.

Results of S.oryzae adults irradiated at 4 Krad then treated with different

Table 1 . Susceptibility of *Sitophilus oryzae* (L.) adults irradiated at 2 krad, then treated with insecticides by direct spray at 1,3 and 12 days.

Conc. (ppm)	Permethrin							Pirimiphos - methyl					
	1		3		12		Conc. (ppm)	1		3		12	
	Irr.	Non Irr.	Irr.	Non Irr.	Irr.	Non Irr.		Irr.	Non Irr.	Irr.	Non Irr.	Irr.	Non Irr.
0.01	0.0		6.82	0.0	16.66	41.00	31.60	0.1	0.00	3.33	0.00	29.66	37.33	35.00
0.03	0.0		13.33	0.0	29.66	61.06	42.00	0.3	0.00	21.66	0.00	34.43	46.00	41.67
0.05	0.0		23.00	5.33	37.00	77.33	48.60	0.5	0.00	33.89	0.00	46.70	58.66	48.00
0.07	0.0		31.67	19.67	56.66	90.33	82.70	0.7	0.00	51.70	3.30	62.66	86.03	77.00
Control untreated	3.3		2.66	3.67	3.33	17.43	8.66	Cont.	3.3	2.66	3.67	3.33	17.43	8.66

Table 2 . Susceptibility of *Sitophilus oryzae* (L.) adults irradiated at 4 Krad then treated with insecticides by direct spray at 1,3 and 12 days

Conc. (ppm)	Permethrin					Conc. (ppm)	Pirimiphos - methyl					
	1		3		12		1		3		12	
	Irr.	Non Irr.	Irr.	Non Irr.	Irr. Non Irr.		Irr.	Non Irr.	Irr.	Non Irr.	Irr. Non Irr.	
0.01	0.0		6.82	0.0	16.66	44.66 31.60	0.1	0.00	3.33	0.00	29.66	0.00 35.00
0.03	0.0		13.33	0.0	29.66	59.80 42.00	0.3	0.00	21.66	0.00	34.43	10.00 41.67
0.05	0.0		23.00	0.00	37.00	76.67 48.60	0.5	0.00	33.89	0.00	46.70	91.33 48.00
0.07	0.0		31.67	6.67	56.66	88.33 82.70	0.7	0.00	51.70	1.66	62.66	98.67 77.00
Control untreated	3.3		2.66	4.89	3.33	31 .70 8.66	Cont.	3.3	2.66	4.89	3.33	31.70 8.66

concentrations of insecticides are shown in Table 2. Again, the first two periods 1 and 3 days, showed no mortality. After 12 days of irradiation, mortality ranged from 44.66 to 88.33% for permethrin and occurred only at the highest three concentrations of primiphos-methyl (10.0 to 98.67%).

The LC_{50} values of permethrin and pirimiphosmethyl in non-irradiated and radiated adults are given in Table 3. These values showed that irradiated *S.oryzae* adults were significantly more susceptible to both insecticides than non-irradiated adults. The decrease of the LC_{50} of the insecticides when applied after irradiation indicated a certain degree of synergism. This agrees with Rush and Ware (1969) who observed an increase in the toxicity of azinophosmethyl against irradiated pink bollworm, *Pectinophora gossypiella* (Saunders). They suggested that the mode of azinphosmethyl action in irradiated and normal moths is different.

It seems that the interaction of irradiation and insecticides should be thoroughly investigated. It is likely that reduction of insecticide toxicity by radiation would be more pronounced in some other insects or in other metamorphic stages. In this connection, Georghiou (1965) pointed out that radiation may alter somatic tissues to the extent of decreasing or increasing the efficiency of cells which can detoxify pesticides, or by modifying permeability, transportation or retention mechanism for the pesticide.

Table 4 indicates that adult fecundity measured as the number of F_1 progeny was completely inhibited in irradiated females not treated with insecticides.

Table 3 . LC50s and slopes of permethrin and pirimimiphos-methyl for non-irradiated and irradiated adults of *S.oryzae* (L.) at 2 and 4 Krad after 12 days from irradiation.

Insecticide	Non-irradiated		Irradiated			
			2 Krad		4 Krad	
	LC50	slope	LC50	slope	LC50	slope
Permethrin	0.049	1.295	0.020	1.643	0.014	1.386
Primiphos-methyl	0.560	0.935	0.230	1.40	0.403	0.816

Table 4 . Average number of offspring of *S.oryzae* irradiated by 2 and 4 Krad then treated wih LC_{50}s of insecticides.

	Control	Permethrin	Primiphos-methyl
Control	81.33	28.67	36.33
2 Krad	0.00	0.00	0.00
4 Krad	0.00	0.00	0.00

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تأثير مبيدى البريميفوس ميثيل والبيرمثرين على حشرة سوسة الأرز المعاملة والغير معاملة بالاشعاع

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تم معاملة حشرة سوسة الأرز بجرعتين إشعاعيتين قدرهما ٢، ٤ كيلوراد قبل معاملة الحشرة بكل من مبيدى البريميفوس ميثيل والبيرمثرين وقد أدت هذه المعاملة الى الاتى :

بالنسبة للحشرات الغير مشعة أعطى مبيد البيرمثرين زيادة فى السميه عنها بالنسبة لمبيد البريميفوس ميثيل حيث كان التركيز الوسطى المميت لكل منهما ٠,٠٥٣ ، ٠,٥٥١ جزء فى المليون على التوالى . وبالنسبة للحشرات التى تم تشعيعها ثم عوملت بالمبيدين المختبرين سميه البيرمثرين عنها فى مبيد البريميفوس ميثيل. كذلك أدت المعاملة الى انخفاض قيمة التركيز الوسطى المميت لكل من البيرمثرين والبريميفوس ميثيل بعد المعاملة بجرعتى الاشعاع . ولقد أدت أسبقية الاشعاع الى منع الذرية الجديدة الناتجة من المعاملة بكل من المبيدين المختبرين.

كما اثبتت الدراسة أن مبيد البرمثرين كان اشد كفاءة ضد حشرة سوسة الأرز عن مبيد البريميفوس ميثيل.