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Research Article

Comparative Acute Toxicity of Five Insecticide against Rice Weevil

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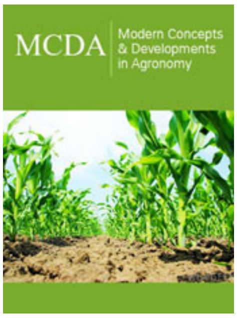

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Abstract

The effect of two temperatures (20oC and 30oC) on the toxicity of deltamethrin, and pirimiphos methyl against *Sitophilus oryzae*were studied using the residual film method. Results revealed that mortality increased proportionally with an increase in temperature, where the optimum temperature for toxicity of both tested insecticides was 30°C either the mortality recorded at 24 or 48 hours after treatment. The insecticidal efficacy of five contact insecticides was also compared against *Sitophilus oryzae*(deltamethrin, imidacloprid, abamectin, emamectin benzoate and pirimiphos methyl at 30 oC temperature. Mortality of tested insecticides against rice weevils was recorded at 30 °C after 24 and 48 hours of exposure. Among the insecticides, deltamethrin was the most effective insecticide against rice weevils with median lethal concentration ranging from 0.48to 0.35ppm followed by abamectin 0.682 to 0.399 and pirimiphos methyl with LC500.472 to 0.85ppm at 24 and 48 hoursexposure periods, respectively. On the other hand, the other insecticides (emamectin benzoate and imidachloprid) were in-between according to the median lethal concentration recorded.

Keywords: Pirimiphos-methyl; Mammals; Organophosphorus; Emamectin benzoate; *Sitophilus oryzae*

Introduction

Rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), is one of the most destructive pests of stored cereals and processed cereal products worldwide. It is classed as a primary pest, one which can easily infest sound cereal seeds [1-3]**.** Control of this pest two categories of insecticides are usually applied: fumigants and residual grain protectants. Over the past few decades, the fumigants phosphine and methyl bromide have come to play a significant part in controlling *S.oryzae* and other stored-product pests. However, a phase-out of methyl bromide has already started, because this substance is considered as a contributor to the reduction of the ozone layer [4,5]. In addition, many stored-product pests, including rice weevil, have developed resistance to phosphine, due to its wide application [6]. This situation could result in residual insecticides becoming the dominant control measure against stored-cereal pests. Moreover, grain protectants

(a) can be applied easily without specialized equipment,

(b) are compatible with international cereal trade and global restrictions for zero insect tolerance,

(c) are generally less expensive than fumigants or biopesticides and

(d) are effective against a wide range of storage pests [7].

Therefore, it is likely that grain protectants will continue to constitute a valuable tool in pest management programs [7-9]. A large number of pesticides are in common use as grain protectants [10,11]. These insecticides protect the grain aginst the attack of pests trying to fix themselves into the grain mass.

Traditional organophosphates, such as malathion and pirimiphos-methyl are the most commonly used residual insecticides in stored wheat [7]. Also, pyrethroids have proved to be successful alternatives to traditional organophosphorus insecticides, given that they are cost-effective and generally less toxic to mammals.

However, *Sitophilus* spp. has rapidly developed a considerable level of resistance to organophosphorus and pyrethroids grain protectants [6,7,12].

The current work is an investigation into the possibility of using several contact insecticides to control *Sitophilus oryzae* (L). Therefore, the present study was conducted to compare the effect of pirimiphos-methyl, deltamethrin, imidacloprid, emamectin benzoate and abamectin which belong to different insecticide groups, on *Sitophilus oryzae*.

Material and Methods

Source and rearing of *S. oryzae* (L.) culture

Adults of the rice weevil, *Sitophilus oryzae* (L.) were reared in the laboratory as previously described by [13]. The initial stock of *S. oryzae* was obtained from infested wheat. Insects were mass produced in a climatized chamber at 27±1C and 70±5% r.h. with alternating light ± dark cycles of 12h. Insects were maintained in glass jars (0.25L capacity) with 200g of wheat free from pesticides. The jars were covered with a muslin cloth and after 2 weeks the original adults were removed by sieving. Once new adult weevils started to emerge, each jar was observed daily to collect the progeny which were kept in separate jars, according to their age group. Under these conditions, the period from egg lay to adult emergence was about 5 weeks. Adult insects (2-3 weeks after emergence were used for experimental work.

Bioassay of insecticides:

Laboratory-reared adult insects (2-3 weeks old) were used for this study. The weevils were collected from rearing jars, placed in a Petri dish and mixed thoroughly to facilitate random selection of the insects. Five replicates were made for each insecticide concentration tested. Insecticides effectiveness against rice weevil adults from the laboratory population was determined after applying a series of concentrations of each commercial product via surface deposit application on Petri-dishes (9cm i.d.) using a method described by Moustafa et al. [14]. The treatments consisted of five concentrations of each of primiphos-methyl ranged (0.1-4ppm), emamectin benzoate (0.01-1ppm), imidachloprid (0.1-6ppm), abamectin (0.01-1ppm), and deltamethrin (0.1-0.8ppm). One ml of diluted insecticide solution (diluted with acetone), at the selected concentrations, was applied on the surface of the Petri-dishes and then allowed to dry for approximately half an hour before use. Twenty adults (2-3 weeks old) were transferred to each Petri-dish, confined by plastic rings, incubated at 30 °C and the mortality was recorded 1 and 2 days later. Also, another two groups of Petri dishes contained deltamethrin and pirimiphos-methyl insecticides were kept at two different temperatures (20 and 30 °C) and the mortality was recorded at the same manner. All data were corrected by Abbott's WS [15]. The LC_{50} values as (ppm), slopes and their confidence limits were calculated according to Finney [16].

Results and Discussion

Effect of temperature on toxicity of insecticides to *Sitophilus oryzae*

Impregnated filter paper technique was used to evaluate the toxicity of pirimiphos-methyl to *S. oryzae* at two different temperatures 20 °C and 30 °C. The adult of *S. oryzae* was exposed to the residue of pirimiphos-methyl for 24h. Mortality was recorded for both temperature and parameters of toxicity were estimated which include LC_{50}, slope and their confidence limits beside the regression equations and Ld-p line was presented in (Table 1).

Table 1: Toxicity of Pirimiphos-methyl and deltamethrin insecticides to *Sitophilus oryzea* adults at 20 and 30 °C after 24 hours exposure time.

Temperature	LC_{50} (Confidence Limits) (ppm) Lower-Upper	Slope	Slope±SE	Regression Equation
Pirimiphos-methyl				
20 °C	1.78 (1.01-2.56)	1.1	0.12	Y=0.27+1.10X
30 °C	0.85 (0.90 -1.73)	0.95	0.11	Y=0.07+0.95X
Deltamethrin				
20 °C	1.42 (0.42 -2.91)	1.02	0.2	Y=0.16+1.02X
30 °C	0.48 (0.35 - 0.70)	1.95	0.21	Y=0.68+1.54X

Since the LC_{50} value at 30 °C (0.85ppm) was less than that at 20 °C (1.78ppm) which revealed that the toxicity increased with increasing temperature for tested temperatures (Figure 1). Also, the toxicity of deltamethrin against *S. oryzae* expressed as LC_{50} was increased with an increasing temperature from 1,42ppm at 20 °C to 0.48ppm at 30 °C (Figure 2). Generally, our results were not in line with some earlier findings by the previous research carried out by Subramanyam and Hagstrum [17]; Fleurat-Lessard et al. [18]. Both researchers pointed out that the research of storage insects has revealed that organophosphate compounds are more toxic at temperatures 30 °C, and pyrethroids at 20 °C.

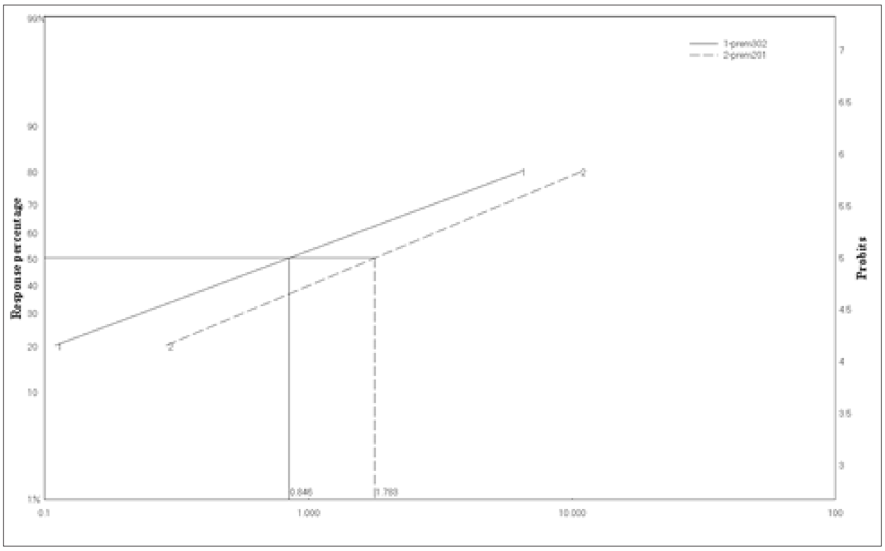

Figure 1: Ld-P line of pirimiphos methyl bioassayed against *S. oryzae* after 24hr of exposure at 20 and 30 °C.

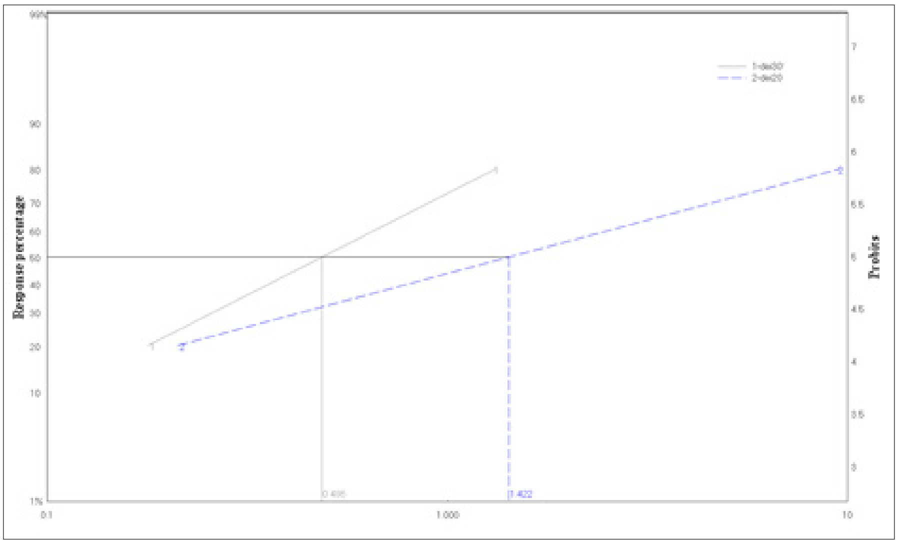

Figure 2: Ld-P line of deltamethrin bioassayed against S. oryzae after 24hr of exposure at 20 and 30 oC.

Comparing the toxicity of pirimiphos-methyl and deltamethrin to the adult of weevil at the same temperature, deltamethrin was more effective, since the LC_{50} was 1.42 and 0.48ppm while it was 1.78 and 0.85ppm for pirimiphos-methyl at 20 and 30 °C, respectively [19]. The LC_{50} values at 30 °C could be attributed to increasing the active ingredient penetration rate of insecticide throughout the cuticle of *S. oryzae* or/and increasing the activities of the adult weevils at the high temperature that allowed the adults weevil pick up more insecticides

Effect of the exposure time on toxicity of five insecticides to adult of *S. oryzae*.

Five insecticides belong to different groups of insecticides were evaluated for their toxicity to *S. oryzae* using impregnated filter paper technique of bioassay at 30 °C. Mortality of weevil was recorded after 24h and 48h of exposure to the residues of insecticides. The parameters of toxicity was presented in (Table 2&3) and the Ld-plines (Figure 3&4). The results in terms of LC_{50} showed that the deltamethrin was the most effective insecticides whereas LC_{50} value was 0.48ppm followed with abamectin 0.682ppm, pirimiphos-methyl 0.85ppm and emamectin benzoate 1.088ppm whereas, imidacloprid was the less toxic one among the tested insecticides with LC_{50} 1.8 ppm against *S. oryzae* at 30 °C for 24hr exposure time. Also, the toxicity trend was increased with an increasing of the exposure time from 24hr. to 48hr. for all the insecticides tested against the adults of rice weevils at the same temperature. The LC_{50} could be arranged to the descending order as fellow: deltamethrin 0.35ppm ≥ abamaction 0.399ppm > pirimiphos-methyl= emamectin benzoate 0.58ppm > Imidachloprid 0.68ppm.

Table 2: Toxicity of insecticides to Sitophilus oryzea adults at 30 °C after 24 hours of exposure using impregnated filter paper technique.

Insecticide	LC_{50}(Confidence Limits) (ppm) Lower Upper	Slope	Slope±SE	Regression Equation
Pirimiphos methyl	0.85(0.90 -1.73)	0.95	0.11	Y=0.07+ 0.95X
Emamectin benzoate	1.088(0.60-3.97)	1.04	0.15	Y=0.04+ 1.04X
Imidachloprid	1.8(1.251-2.80)	1.833	0.17	Y=0.48+1.83X
Abamectin	0.68 (0.29-2.21)	0.9	0.1	Y=0.15+ 0.92X
Deltamethrin	0.48 (0.70- 0.35)	1.95	0.21	Y=0.69+1.95X

Table 3: Toxicity of insecticides to Sitophilus oryzea adults at 30 °C after 48 hours of exposure using impregnated filter paper technique.

Insecticide	LC_{50} (ppm) (Confidence Limits) Lower- Upper	Slope	Slope±SE	Regression Equation
Primiphos-methyl	0.58(1.04 -0.25)	1.44	0.11	Y=0.04+ 1.44 X
Emamectin benzoate	0.58(1.262 – 0.316)	1.252	0.15	Y=0.292+ 1.25 X
Imidachloprid	0.68(1.033-0.421)	1.696	0.17	Y=0.27+1.69X
Abamectin	0.399(1.052-0.119)	0.741	0.1	Y=0.339+ 0.74 X
Deltamethrin	0.35 (0.525- 0.247)	1.65	0.21	Y=0.734+1.65X

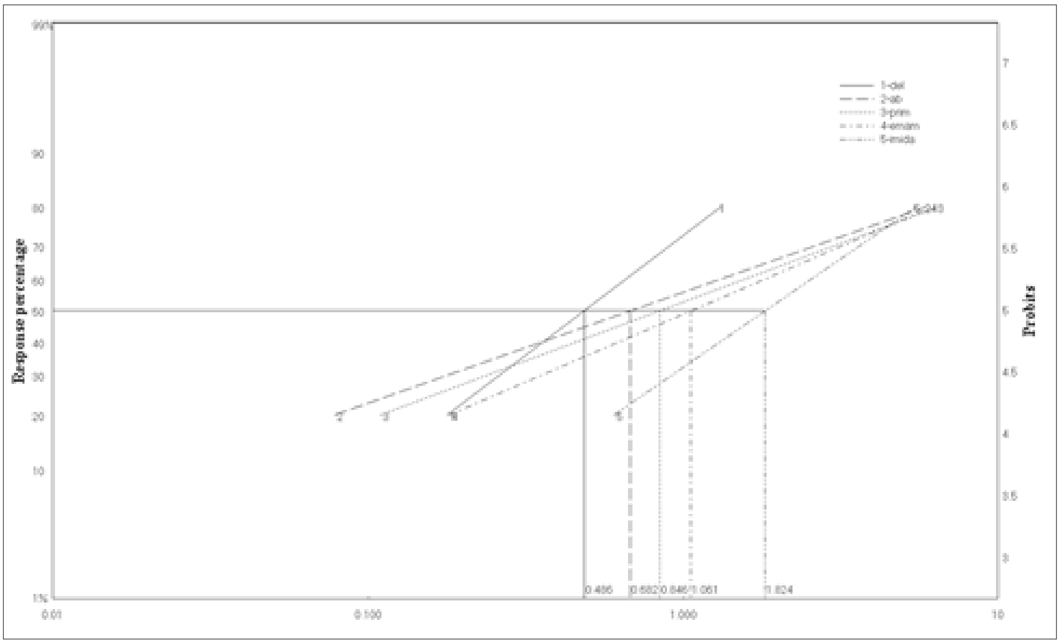

Figure 3: Ld-P line of Pirimiphos methyl, Emamectin benzoate, imidachloprid, deltamethrin and abamectin bio-assayed against S. oryzae after 24hr of exposure.

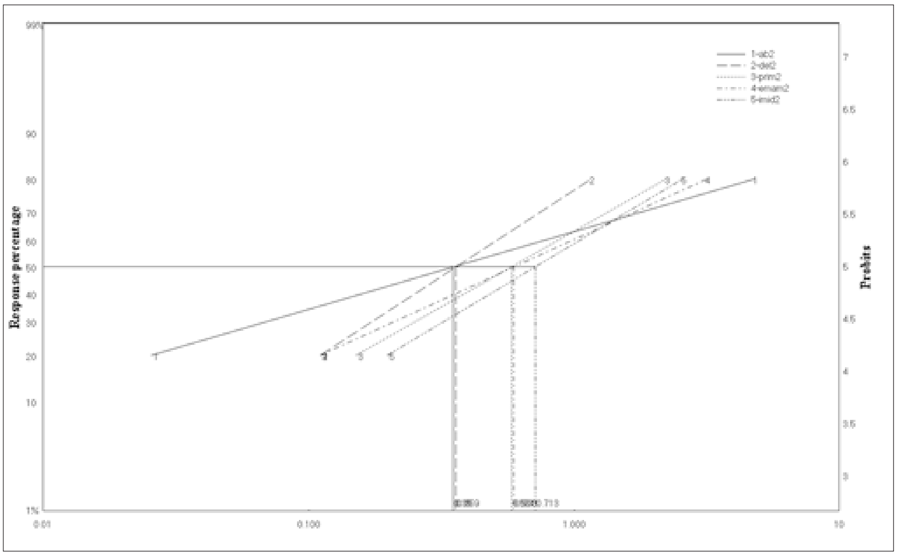

Figure 4: Ld-P line of Pirimiphos methyl, emamectin benzoate, imidacloprid, deltamethrin and abamectin bio-assayed against S. oryzae after 48hr of exposure.

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