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The lethal effects of three insecticides Deltamethrin, Cypermethrin and Chlorpyrifos against adult stage of alfalfa weevil, *Hypera postica* Gyllenhal (Col.: Curculionidae)

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Abstract

Alfalfa *Medicago sativa* L. is an economic crop with a great number of natural or invasive pest species mainly from the Curculionoidea superfamily. The alfalfa weevil, *Hypera postica* (Gyllenhal) (Col.: Curculionidae), is a major pest of alfalfa. In this research, three insecticides Deltamethrin, Cypermethrin and Chlorpyrifos were evaluated for their efficacy in the control of adult stage of *H. postica* under field conditions. The LC₂₅ and LC₅₀ values of Deltamethrin, Cypermethrin and Chlorpyrifos were estimated on adult insect. Furthermore, LC₂₅ and LC₅₀ values for Deltamethrin, Cypermethrin and Chlorpyrifos on adult insects were 838.52, 44.52, 994.00 and 1443.14, 408.93, 341.50 ppm for 24 hours and 520.6, 125.148, 198.74 and 1046.87, 31.24, 545.79 ppm for 48 hours, respectively. According to LC₅₀ values after 24 and 48 hours Chlorpyrifos and Cypermethrin with the least value can be suggested as the most potent insecticide. To evaluate effects of three insecticides, one experiment with completely randomized block design in three replications by recommendation doses carried out in field conditions. The results show that there were significant differences between treatments (Deltamethrin, Cypermethrin, Chlorpyrifos and control) after 24, 48 and 72 hours. After 24 and 48 hours Cypermethrin showed more lethality in comparison other treatments, and after 72 hours the Chlorpyrifos showed lethality.

Keywords: *Hypera postica*, deltamethrin, cypermethrin, chlorpyrifos, LC₂₅ and LC₅₀

Introduction

Alfalfa, *Medicago sativa* L., is one of the important forage crops cultivated in most regions of the world. Lucerne is another name sometimes used for alfalfa, which was first cultivated in Iran. Because of its importance among forage crops, alfalfa is referred to as the 'Queen of Forages' [3]. Alfalfa is an extremely adaptable plant and can be grown under a wide range of soil and climatic conditions. In Iran, more than 600,000 hectares of alfalfa are planted yearly across large parts of Iran [15]. It is annually attacked by a diversity of arthropod pests. Among arthropods attacking alfalfa, *Hypera postica* (Gyllenhal) is the most damaging phytophagous pest and the major limiting factor in alfalfa production in the most regions of the world [2, 4]. The alfalfa weevil is a snout beetle that is usually univoltine [14, 3]. *H. postica* not only decreases yield and quality of the first cutting, but can also harm subsequent cuttings [5]. Both larvae and adults damage terminals, foliage and new crown shoots, thereby lowering crop yield and quality [11]. However, the larvae caused the most damage [13]. During severe infestations, larvae can cause substantial defoliation, resulting in severe first cutting losses [2]. Heavily infested fields may appear silver or white, with most leaves skeletonized or consumed entirely [14]. If large numbers of adults or larvae survive until harvest, they damaged stems and crown buds, retarding regrowth [6]. A decrease in stem elongation occurred at a density of 30–100% of the smallest larval density [8]. Residual effects from severe damage decrease plant vigor, resulting in lower stand density and poor yields in subsequent harvests [5]. In this research, the effects of Deltamethrin, Cypermethrin and Chlorpyrifos on adult stage of *H. postica* were evaluated.

Material and Methods

The present study was carried out in Noshan village, Urmia city, West Azerbaijan province, Iran.

Determination of LC₅₀ and LC₂₅ values

To estimate the LC₅₀ and LC₂₅ five concentration of each insecticides with distill water as control in three replication used in filter paper dipping method on 10 adult pests in Petri dish and mortality recorded after 24 and 48 hours [7].

Fields bioassay with pesticides on adult stage

Field trials were conducted during the spring of 2016 at the experimental field located in a suburb of Urmia, Iran. The 12 plots measuring 4×6 m², arranged in a randomized complete block design with three replications, three treatments and one control for each replication. The treatments randomly allocated to the plots were as follows: 1.Recommended dose of Deltamethrin (0.5 L/ha), 2. Recommended dose of Cypermethrin (0.2 L/ha), 3. Recommended dose of Chlorpyrifos (2 L/ha) and 4. Control that was treated only with equal amount of distilled water that was used in insecticide applications. Before experiment population of

adults was estimated by quadrat (25×25 cm²). After 24, 48 and 72 hours after spraying pesticide percentage of adults insect mortality recorded by quadrat.

Statistical Analyses

The LC₅₀ and LC₂₅ values (with 95% confidence limits) were calculated by using Probit Analysis Statistical Method and mortality data of different treatments subjected to analysis of variance (One Way ANOVA) and mean separation tests were conducted with Tukey's HSD with SPSS statistical analysis software (Version 22.0).

Results

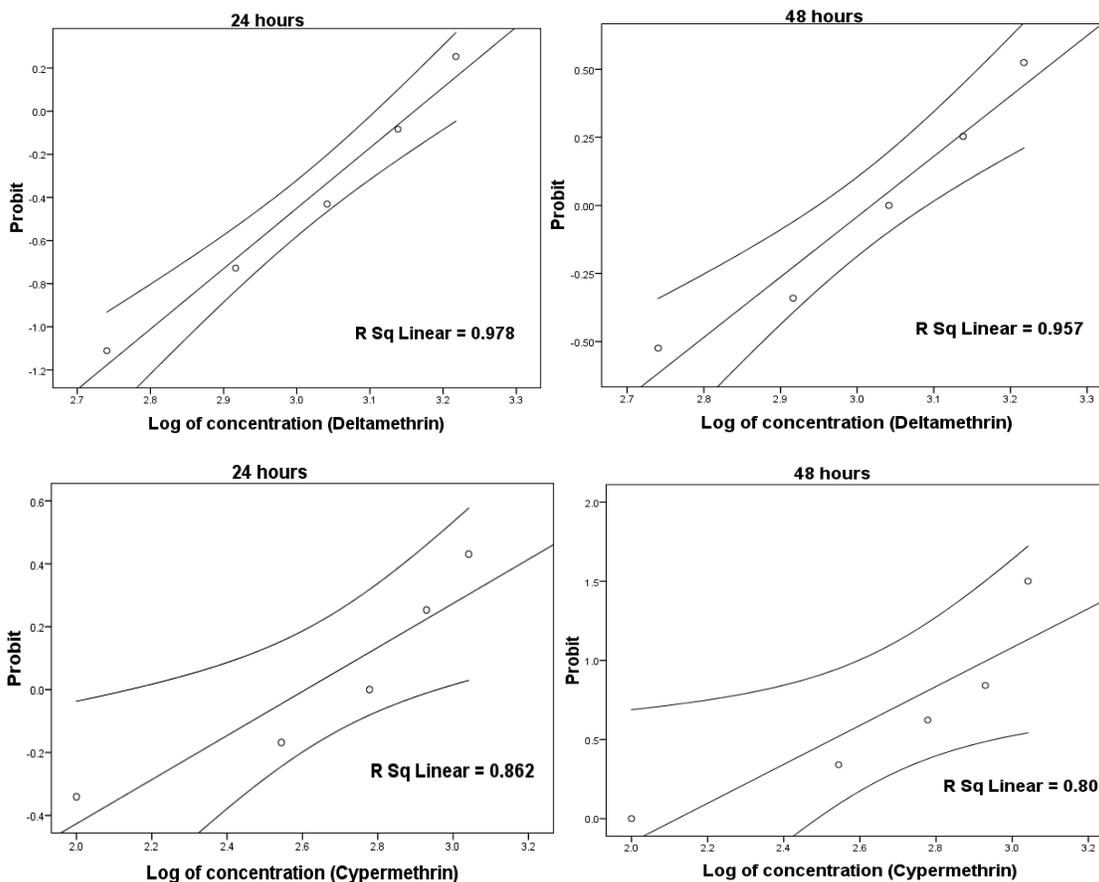
LC₅₀ and LC₂₅ pesticides on adult stage

LC₅₀ and LC₂₅ of Deltamethrin, Cypermethrin and Chlorpyrifos on adult stages in 24 and 48 hours are shown in Table 1.

Table 1: LC₅₀ and LC₂₅ Values calculated Deltamethrin, Cypermethrin and Chlorpyrifos effect on adult *H. postica* within 24 and 48 hours.

Insecticide	Time Hours	Total insect	χ^2 (df=3)	Slope ± SE	Intercept(a)	LC ₅₀ (PPM)	LC ₂₅ (PPM)
Deltamethrin	24	30	0.41	0.7±2.86	9.03	1443.14	838.52
	48	30	0.55	0.63±2.22	6.71	1046.87	520.65
Cypermethrin	24	30	0.99	0.28±0.70	1.82	408.93	44.52
	48	30	2.68	0.29±1.11	2.34	31.24	125.148
Chlorpyrifos	24	30	0.70	0.49±1.45	4.35	341.50	994.00
	48	30	0.94	0.49±1.53	4.20	545.79	198.74

The LC₅₀ show that the Cypermethrin was more toxic as compared to Deltamethrin and Chlorpyrifos after 24 and 48 hours.



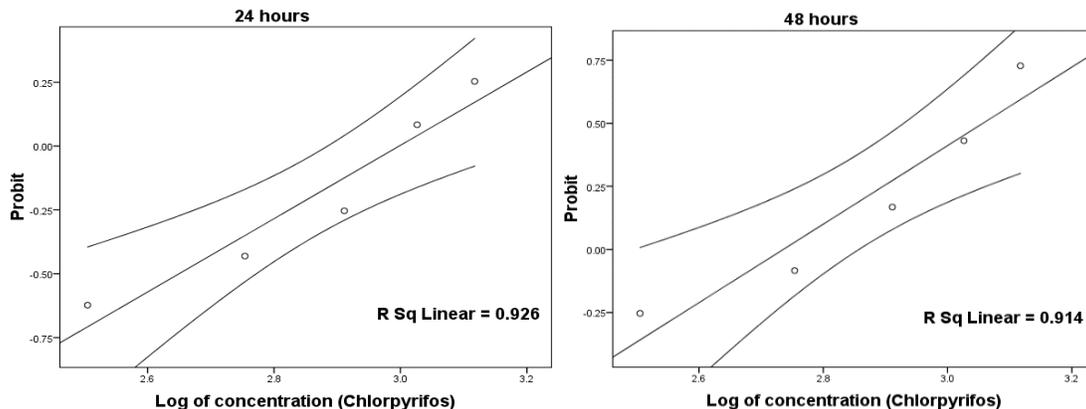


Fig 1: Relationship between log of concentration and Probit in three pesticides with R square

The dose-response and R square show that the relation between concentration and mortality of Deltamethrin had best fitted.

Fields bioassay with pesticides on adult stage

Effects of treatments, Deltamethrin LC₅₀, Cypermethrin LC₅₀ and Chlorpyrifos LC₅₀ and control on adult stage of *H. postica* was evaluated and counting the percentage mortality after 24, 48 and 72 hours. The results showed that there was a significant difference between treatment with 95% confidence in 24, 48 and 72 hours with [F(3, 8) = 1.257, p=0.001], [F(3, 8) = 3.050, p=0.001] and [F(3, 8) = 2.212, p=0.001], respectively (Fig 2).

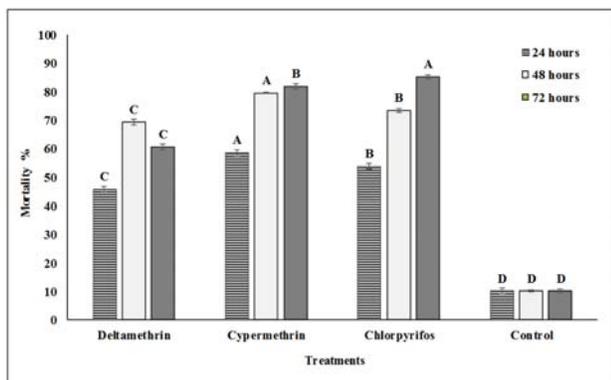


Fig 2: Mortality percentage \pm SE of different treatments include Deltamethrin, Cypermethrin, Chlorpyrifos and control on adult stage after 24, 48 and 72 hours.

The results show that there were significant differences between treatments (Deltamethrin, Cypermethrin, Chlorpyrifos and control) after 24, 48 and 72 hours. After 24 and 48 hours Cypermethrin was more lethal as compared to other treatments, and after 48 hours the Chlorpyrifos (Fig 2).

Discussion

For controlling *H. postica* in Iranian alfalfa fields, several pest management strategies have been suggested [9, 10, 12]. But the best management method is use of effective pesticides in integrated pest management in outbreak of pest [12]. For this aim, three insecticides against this pest were assessed. The LC₅₀ values were invariably lower for Cypermethrin than for Deltamethrin and Chlorpyrifos, indicating that the former is more toxic to adults. Results showed that with a fairly small increase in insecticides concentration, the mortality would increase considerably. This requires more careful use of these chemicals in the field to prevent exerting a high

selection pressure that could eliminate the susceptible insects and lead to selection of resistant ones [1].

Since these compounds do not belong to the groups of chemical compounds conventionally applied for *H. postica* control in Iran, so they can be used in rotation with other insecticides. This would confirm that for an effective *H. postica* management program, the same class of insecticides should not be applied more than once within a growing season.

Overall, all three insecticides tested in present study significantly reduced density of alfalfa weevil. According to LC₅₀ values after 24 and 48 hours Chlorpyrifos and Cypermethrin with the least value can be suggested as the most potent insecticide. Cypermethrin is recommended with satisfactory control due to low values of toxin needed for more mortality percentage, relatively wider margin of safety, reducing cost and risk of insecticide for *H. postica* in Iran. Although additional research with these insecticides is needed, the results presented in this study should aid producers in making alfalfa weevil management decisions [12].

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