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Toxic prospective of some novel chemistry insecticides for resistance echelon in two foremost Lepidopterous insect pests

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Abstract

Resistance development in arthropods is the natural phenomena that is reinforced against any unbalanced revolutionize in the execution of any agro ecosystem. Its intensity has multifold during the management of major crop insect pests as a result of misuse of the conventional insecticides had not only made them ineffective but also threat for new chemistry insecticides in future. For that purposes a study was planned for toxicity bioassay against two notorious lepidopterous pests as *Helicoverpa armigera* and *Spodoptera litura* by using 9 modern insecticides each replicated thrice with four different concentrations and a control. Response was recorded after 48hours after application showed marvelous results as Chlorfenpyr was most effective against *S. litura* at all concentrations (100, 93, 100,97,87 and 14% mortality) at 330,165,82.5,41.5,20.6 and 0 ppm (Control) while Leufenuron was least effective showing highest susceptibility to armyworm as (53, 53, 47, 40, 27, and 33%) from low to high concentration 50,25,12.5,6.25 and 0 ppm. Similarly Leufenuron was least effectual demonstrated highest susceptibility to heliothis as (67, 70, 47, 40, 27, and 14% mortality) from low to high concentration 50, 25,12.5,6.25 and 0 ppm while Chlorfenpyr was highly efficient against *H. armigera* at all concentrations (97, 100, 87, 97, 87 and 14% mortality) at 330,165,82.5,41.5,20.6 and 0 ppm (Control) respectively.

Keywords: *H. armigera*, *S. litura*, Mortality, Insecticide

1. Introduction

Helicoverpa armigera and *Spodoptera litura* are the major polyphagous insect pests attack plentiful crops like cotton, tomato, okra, potato, chili, cucumber, pumpkin, cabbage, pigeon pea and gram etc [1-10]. In Pakistan, control of these lepidopterous insects is mostly performed through the chemical insecticides [5, 11, 12]. As a result of continuous and non judicious use of pesticides, the field population of these major insect pests has developed resistance [13, 14].

In under developed world like in Pakistan extensive use of the conventional insecticides, such as organophosphates, carbamates and synthetic pyrethroids against *S. litura* and *H. armigera* have provided an ideal environment for its evolution of resistance [4, 5, 8-11, 15]. Furthermore due to its high fecundity, polyphagous nature, voracious feeding habit, quick adaptation against insecticides, control of these pests with any single potent toxicant for a long time is quiet difficult and rather impossible [11, 12, 15, 16]. The new chemistry insecticides bearing novel modes of action are now gaining attention [2, 3, 17]. So it is a matter of great interest to find the susceptibility of these major polyphagous insect pests towards modern chemistry insecticides.

2. Material and Method

2.1 Insect Culture

The last instars larvae of *S. litura* and *H. armigera* were preferably collected from the fields. The larvae were then fed on semi solid diet in the laboratory at 20-25°C and 60-65% RH as given in Table No. 1. Diet was placed in the chambers of the 3 x 12 tray, having one larva per chamber. The pupae were collected after they turn into dark brown color. At moth emergence, the adults were placed in the egg laying glass chambers having two baby nappy strips suspended in each. The adult were fed on solution having Sucrose 50g Distilled water 500 ml, Methyl-4-hydroxybenzoate1g and vitamin mixture 10ml. The male to female ratio was kept 4:6 per chamber.

Table 1: Semi-synthetic Larval diet provided during culture rearing in laboratory

Sr. No.	Ingredients	Quantity
1.	Chickpea flour	300g
2.	Ascorbic acid	4.7g
3.	Methyl-4-hydroxybenzoate	3g
4.	Sorbic acid	1.5g
5.	Streptomycin	1.5g
6.	Corn oil	12ml
7.	Yeast	48g
8.	Agar	17.3g
9.	Distilled water	1300ml
10.	Vitamin mixture	10 ml

2.2 Insecticides

New chemistry insecticides used for bioassays were Indoxacarb, Flubendamide, Spinetoram, Flafenoxuaron, Chlorfenpyr, Leufenuron, Emamectin, Coragen and Spinosad. These insecticides were of different brands taken from a multinational company.

2.3 Bioassays

The bioassay was performed on second instars larvae of both insects individually. Leaf dip method using the leaf discs of Cauliflower leaves, was employed. The washed and dried leaf discs were allowed to dip in the serial concentrations for 10-20 sec. The leaf discs were allowed to be air dried on the tissue papers. The discs were then placed in the Petri dishes and each concentration was repeated three times. 50 larvae per Petri dish were exposed to treated leaf discs and the data was taken after 48 hours.

3. Results

Toxic effect of all insecticides was high at high concentration after wards decreased with further dilution proving less effective against these insect pests. Chlorfenpyr was most effective against *S. litura* at all concentrations (100, 93, 100,97,87 and 14%) at 330,165,82.5,41.5,20.6 and 0 ppm (Control) while Leufenuron was least effective showed highest susceptibility to armyworm as (53, 53, 47, 40, 27, and 33%) from low to high concentration 50,25,12.5,6.25 and 0 ppm in ascending order respectively. A very little resistance was noted in Coragen and Spinosad giving maximum larval mortality at high and medium poisoned solution of these chemical even no mortality was found in control solution of the Spinosad. On the other hand *S. litura* showed a reasonable level of resistance against Flubendamide, Emamectin, Spinetoram and Indoxacarb respectively as shown in figure No. 1. Overall order of insecticide resistance against *S. litura* was Leufenuron, Flubendamide, Emamectin, Spinetoram, Indoxacarb and Chlorfenpyr respectively. Resistance level in *H. armigera* was variable due to toxic effect of all insecticides observed at high concentrations but diminished with further dilutions bearded out less effective against this pest.

Leufenuron was least effectual demonstrated highest susceptibility to heliothis as (67, 70, 47, 40, 27, and 14%) from low to high concentration 50, 25,12.5,6.25 and 0 ppm while Chlorfenpyr was highly efficient against *H. armigera* at all concentrations (97, 100, 87, 97, 87 and 14%) at 330,165,82.5,41.5,20.6 and 0 ppm (Control) in ascending order respectively. An incredibly diminutive confliction was note down in Emamectin, Coragen and Indoxacarb giving highest larval transience at elevated and medium concentrations of these chemicals even no larval death was bring into being in control solution of the Spinosad. Furthermore *H. armigera* showed a reasonable level of resistance against rest of the insecticides like Flubendamide, Emamectin, Spinetoram and Indoxacarb respectively as shown in figure No. 2.

4. Discussion

Such toxicity bioassays were investigated by various scientists as significant dilapidation of Spinosad was slower under field conditions as result residues can ground lethal and sub lethal effects to *S. exigua* [18]. [19] reported the larval mortality observed after seven days efficiently against armyworm and found to be secure against numerous beneficial fauna. Study can be judge against the research of [20] ml/acre of Emamectin benzoate [19]. [21] who found 100 percent mortality after seven days of dose application insecticides, Emamectin benzoate and Leufenuron resulted in rates of Leufenuron amongst new chemistry. Maximum mortality of *S. litura* was high at higher dose rate of chlorpyrifos [21, 22]. Another study proved 96.56 percent mortality high toxic as decrypted that Emamectin benzoate proved to be the best against larvae [23]. Results also prop up our conclusion as acknowledged by Ahmad and Research work also proposed that Emamectin benzoate as the best insecticide agreement with our findings[20].Very low mortality was noted in Indoxacarb, Leufenuron, methoxy fenozide and Spinosad noted in his article [20, 21]. *Spodoptera spp.* especially (Armyworm) has shown resistant being key insect pest of cotton in a study conducted in Pakistan [24]. In Iran, beet army worm was managed inefficiently against Spinosad and Indoxacarb on farms. While on the other hand both were highly effective against lepidopteran pests particularly noctuids [2, 17, 25, 26].

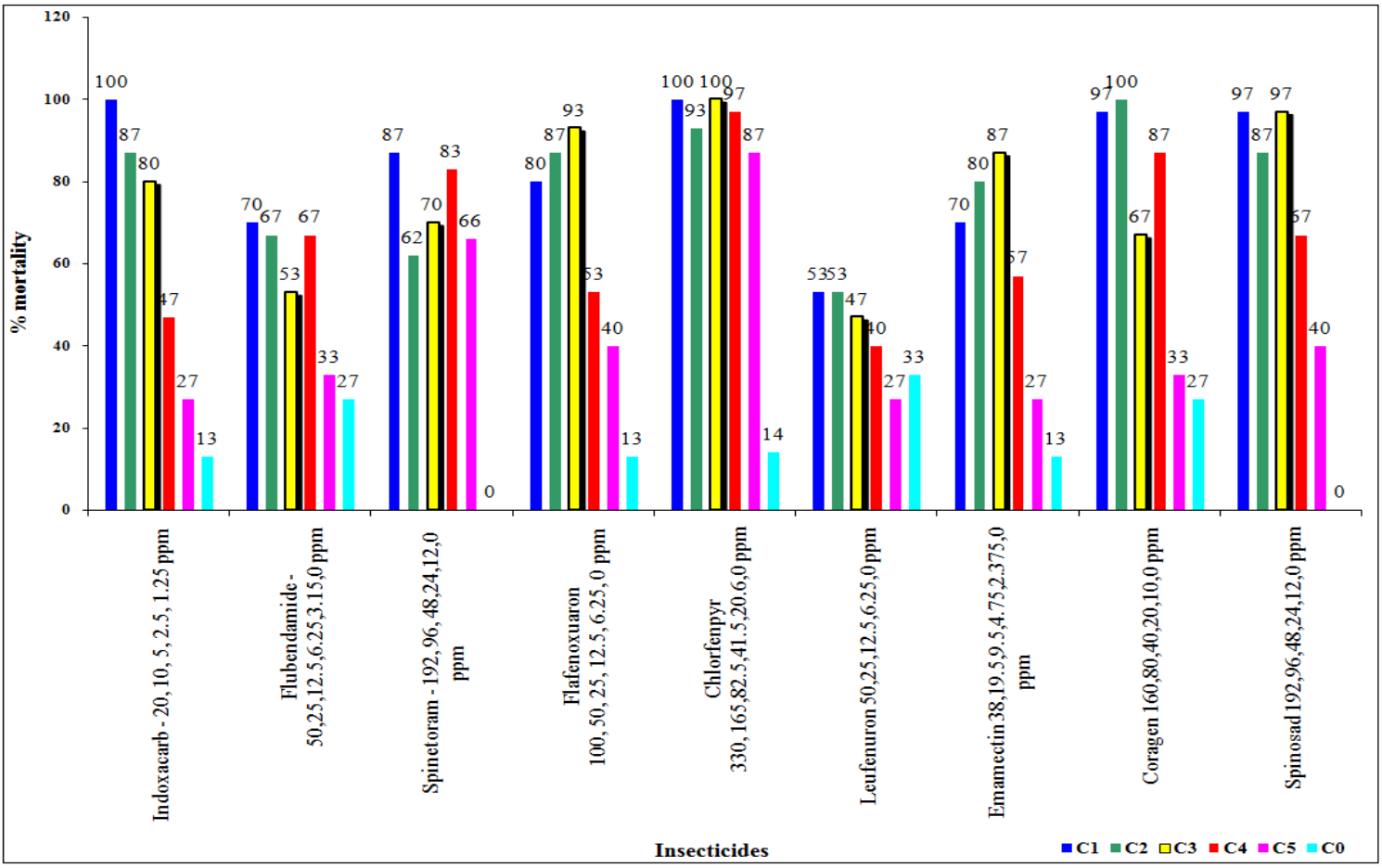

Fig 1: Susceptibility of 2nd instar larvae of *Spodoptera litura* against different new chemistry insecticides

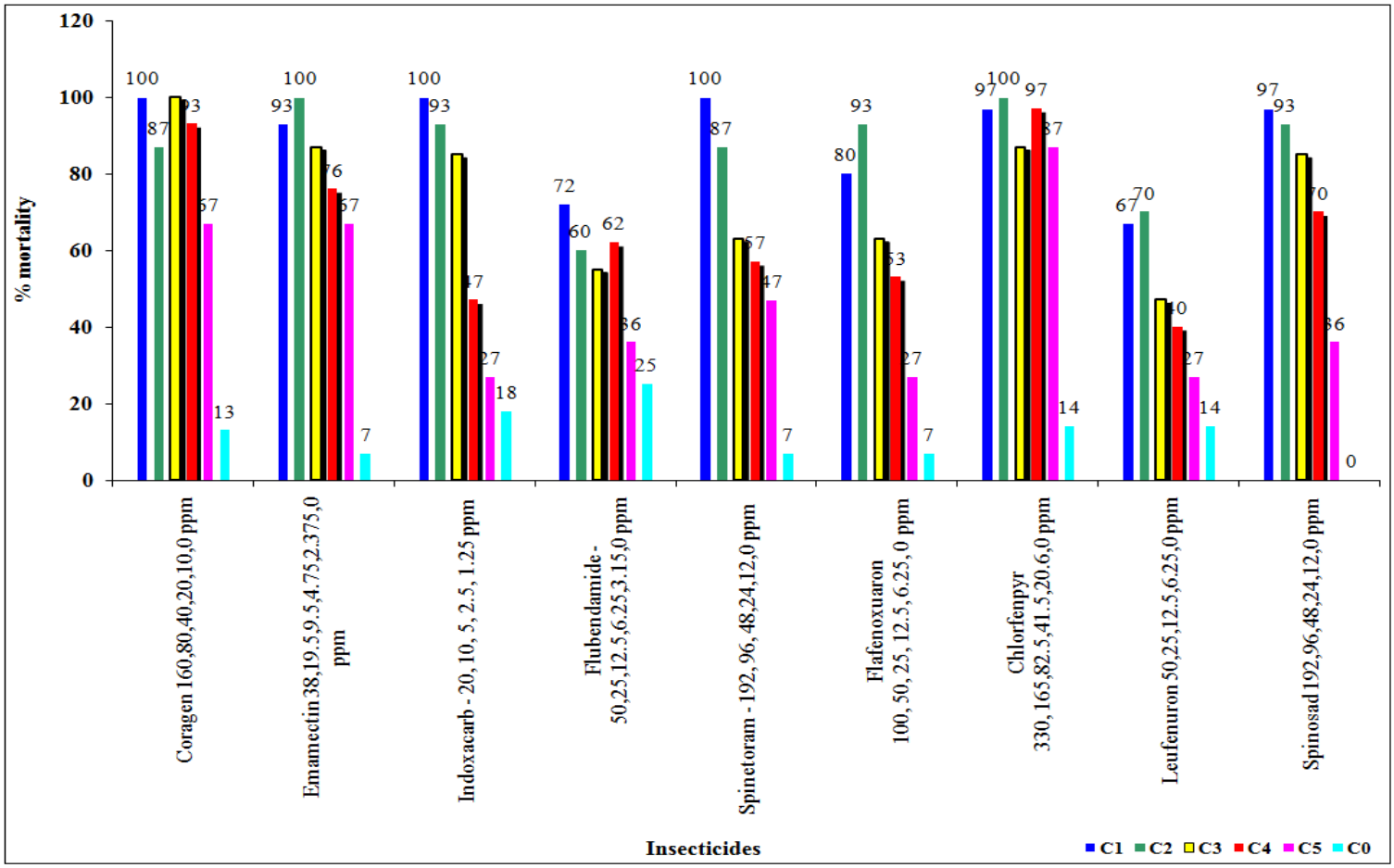

Fig 2: Susceptibility of 2nd instar larvae of *H. armigera* against different new chemistry insecticide

Results for LC_{50} values noted as same as found by [25] against larvae of armyworm that were showing to pepper leaves covered with Spinosad [26].

5. Conclusion

Blind use of traditional and conventional insecticides has cause the resistance development. Furthermore it was multifold due to over and under dose. That's why research was made for the use of new chemistry insecticides. A few insecticides like Chlorfenpyr Coragen and Spinosad were highly effective against the mortality of *H. armigera* and *S. litura* but Flafenoxuaron, Flubendamide and Leufenuron were found to be least effective in toxicity bioassay.

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