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# Toxicity Effect of Some Insecticides on Spiders and Coccinellids in Brinjal and Cabbage Ecosystem

Sakil Dhamala[1*]• SandipPatra[2]• DwipendraThakuria[1]• Pankaj Baiswar[2]• M. PrabhaDevi[2]• Kennedy Ningthoujam[1]

[1]College of Post-Graduate Studies, Central Agricultural University, Umiam, Meghalaya

[2]ICAR Research Complex for NEH Region, Umiam, Meghalaya

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ABSTRACT

To determine the effect of insecticides on natural enemies namely spiders and coccinellids in crop ecosystems, two field experiments were conducted at Entomology Research Farm, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya during *kharif*- 2016 on brinjal and *rabi*-2017 on cabbage. The experiments were laid out in randomized block design (RBD) with three replications for each treatment. Brinjal and cabbage seedlings (30days old) were transplanted in the plot size of 3m x 3m. Three insecticides *viz.* indoxacarb 14.5SC (75 and 150 g a.i./ha), chlorfenapyr 10SC (100 and 200 g a.i./ha) and chlorpyrifos 20EC (200 and 400 g a.i./ha) were applied with initiation of pest infestation along with control check. Spiders and coccinellids population were recorded from randomly selected 5 tagged plants/ plot before spray and subsequently 7 and 14 days after each spray for both the crops. Results revealed that there was a negative impact of chlorfenapyr and chlorpyrifos on spider population in brinjal and cabbage ecosystems. In brinjal, the lowest mean spider population was recorded in chlorpyrifos at higher doses (400 g a.i./ha) with 2.51 spiders/5plants followed by same insecticide at recommended dose (200 g a.i./ha) with 2.74 spiders/5plants and chlorfenapyr @200 ga.i./ha (2.94 spiders/5plants) and chlorfenapyr @100 g a.i./ha (5.02spiders/5plants). The highest percentage reduction of coccinellids was also found in higher dose of chlorpyrifos (78.65%) followed by chlorpyrifos at recommended dose (75.44%), and higher dose of chlorfenapyr (32.74%) in brinjal. In cabbage, the similar trend of impact of insecticides on both spiders and coccinellids were observed.

## 1. Introduction

In India, pesticide plays an important role to increase production through protection of crop from destructive insect pests and diseases and also form an integral part of overall pest management strategy. Pesticides are not only saving crop losses and improving agricultural productivity, these are also playing an important role in quality improvement by disease control, food security, weed control, health management and preventing outbreak of epidemics, creating employment and in foreign exchange earnings.

Therefore, pesticides become inevitable in agriculture especially in developing countries to struggle against hunger and diseases and thus saved million of human and animal lives in the country. In India, annual consumption of pesticides showed a rising trend from 1955-56 to 1990-91 and thereafter it started declining. The present consumption of technical grade pesticides in the country during year 2010-11 is around 55,542 tonnes (Kodandaram*et al.*, 2013). Predominant classes of pesticides used in India are insecticides which account for 60% of total consumption, followed by fungicide (19%), herbicides (16%), biopesticides (3%) and others (3%).It is estimated that around 13-14 % of

*Corresponding author:sakil.dhamala@gmail.com

total pesticides used in the country are applied on vegetables, of which insecticides account for two-thirds of total pesticides used in vegetables (Kodandaramet al., 2013). Several insecticides that are widely used to suppress various pests also disrupt the effectiveness of various beneficial agents.The reduction of these beneficial arthropods caused by non-selective insecticides may bring serious problems for crops all over the world (Fernandeset al., 2008). Insecticides can show its activity on the biology and physiology or biochemical processes of a non-target organism. The interference on these processes may produce impacts on the survival, growth, development, reproduction and behavior of organisms (Haynes, 1988; Delpuechet al., 1998; Delpuech and Meyet, 2003).

Information about the effect of most of the insecticides on the beneficial fauna of insects is scanty, causing difficulties for the selection of appropriate insecticides which would be compatible with integrated pest management. Improved understanding of pest-natural enemy-insecticide interactions will assist in formulating more effective pest management strategies. Pesticides should be compatible with natural enemies which are already present in the particular crop ecosystem. Hence, only those pesticides should be used that are most selective and which have no or minute adverse effects on beneficial organisms. Therefore, it is very essential to preserve natural enemies, so that they may present a good performance in biological control, which is a critical control method used in the programme of integrated pest management (IPM). As chemical control is inevitable for adequate food production and without its application, complete protection is almost impossible, therefore, need to screen out the pesticides having new and novel mode of action, safer towards non-target organisms as well as compatible with IPM programme. Keeping these views, the present experiments were undertaken to evaluate the adverse effect of some insecticides on spiders and coccinellids in brinjal and cabbage ecosystems.

## 2. Materials and Methods

To determine the effect of insecticides on natural enemies namely spiders and coccinellids in crop ecosystems, two field experiments were conducted at Entomology Research Farm, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya during *kharif*- 2016 on brinjal and *rabi*-2017 on cabbage. The experiments were laid out in randomized block design (RBD) with three replications for each treatment. Brinjal and cabbage seedlings (30days old) were transplanted in the plot size of 3m x 3m.Three insecticides *viz.* indoxacarb 14.5SC (75 and 150 g a.i. /ha), chlorfenapyr 10SC (100 and 200 g a.i. /ha) and chlorpyrifos 20EC (200 and 400 g a.i. /ha) were applied with initiation of pest infestation along with control check. Spiders and coccinellids population were recorded from randomly selected 5 tagged plants/ plot before spray and subsequently 7 and 14 days after each spray for both the crops. Then mean data of both natural enemies were subjected to square root ($\sqrt{x+0.5}$) transformation and the critical difference (CD) was worked out at 5% level of significance.

## 3. Results and Discussion

### *3.1 Effect of insecticides on spiders and coccinellids in brinjal*

Effect of insecticides on natural enemies (spiders and coccinellids) in brinjal are illustrated in Table 1. The results of the present study showed that before the first foliar application of insecticides, the population of spider ranged from 7.80-10.05 spiders/5plants and there were no significant differences among the treatments. After all application, the highest number of mean spider population was observed in untreated control plots (10.27 spiders/5plants) followed by both doses (75 and 150 g a.i./ha) of indoxacarb with 8.89 and 8.32 spiders/5plants, respectively. Results clearly showed that there was a negative impact of chlorfenapyr and chlorpyrifos on spider population in brinjal ecosystem. The lowest mean spider population was recorded in chlorpyrifos at higher doses (400 g a.i./ha) with 2.51 spiders/5plants followed by same insecticide at recommended dose (200 g a.i./ha) with 2.74 spiders/5plants and chlorfenapyr @200 ga.i./ha (2.94 spiders/5plants) and chlorfenapyr @100 g a.i./ha (5.02spiders/5plants). Reduction of spider population in different treatments over untreated control is also presented in Figure 1. In case of coccinellids, the pretreatment population ranged from 1.76-2.01coccinellids/5plants before spray and it was non-significant among the treatments (Table 1). After final spray the overall mean of coccinellids population was highest in untreated control plots (2.81 coccinellids/5plants) followed by indoxacarb @75 g a.i./ha (2.36 coccinellids/5plants), indoxacarb @150 g a.i./ha (2.22 coccinellids/5plants), chlorfenapyr @100 g a.i./ha (2.11 coccinellids/5plants). Lowest number of coccinellids were recorded in chlorpyrifos @400 g a.i./ha (0.60 coccinellids/5plants) followed by chlorpyrifos @200 g a.i./ha (0.69 coccinellids/5plants) and chlorfenapyr 200 g a.i./ha (1.89 coccinellids/5plants). Figure 1 showed that highest percentage reduction was found in higher dose of chlorpyrifos (78.65%) followed by chlorpyrifos at recommended dose (75.44%), and higher dose of chlorfenapyr (32.74%).

**Table 1.** Effect of different insecticidal treatments on spiders and coccinellid in brinjal

| Treatments | Dose (g a.i./ ha) | Pre-treatment | Spider population per 5 plants(Mean population after spray) | | | Overall mean | Pre-treatment | Coccinellids population per 5 plants(Mean population after spray) | | | Overall mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1st spray | 2nd spray | 3rd spray | | | 1st spray | 2ndspray | 3rd spray | |
| Indoxacarb14.5SC | 75 | 9.20 (3.11) | 8.13 (2.94) | 10.5 (3.32) | 8.05 (2.92) | 8.89 (3.06) | 1.95 (1.57) | 2.15 (1.63) | 1.92 (1.56) | 3.00 (1.87) | 2.36 (1.69) |
| Indoxacarb14.5SC | 150 | 10.05 (3.25) | 7.15 (2.77) | 8.92 (3.07) | 8.9 (3.07) | 8.32 (2.97) | 2.01 (1.58) | 1.60 (1.45) | 2.25 (1.66) | 2.82 (1.82) | 2.22 (1.65) |
| Chlorfenapyr10SC | 100 | 8.50 (3.00) | 6.00 (2.55) | 4.80 (2.30) | 4.25 (2.18) | 5.02 (2.35) | 1.76 (1.50) | 1.95 (1.57) | 2.05 (1.60) | 2.32 (1.68) | 2.11 (1.62) |
| Chlorfenapyr10SC | 200 | 8.92 (3.07) | 4.08 (2.14) | 2.10 (1.61) | 2.65 (1.77) | 2.94 (1.85) | 1.98 (1.57) | 2.10 (1.61) | 1.62 (1.46) | 1.96 (1.57) | 1.89 (1.55) |
| Chlorpyrifos20EC | 200 | 9.85 (3.22) | 2.15 (1.63) | 2.07 (1.60) | 4.87 (2.32) | 2.74 (1.80) | 1.85 (1.53) | 0.78 (1.13) | 0.35 (0.92) | 0.95 (1.20) | 0.69 (1.09) |
| Chlorpyrifos10EC | 400 | 8.15 (2.94) | 2.20 (1.64) | 2.78 (1.81) | 3.27 (1.94) | 2.51 (1.73) | 2.00 (1.58) | 0.32 (0.91) | 0.66 (1.08) | 0.81 (1.14) | 0.60 (1.05) |
| Control | - | 7.80 (2.89) | 7.89 (2.90) | 11.42 (3.45) | 11.50 (3.46) | 10.27 (3.28) | 1.90 (1.55) | 2.00 (1.58) | 3.57 (2.02) | 2.86 (1.83) | 2.81 (1.82) |
| SE. m ± | - | | 0.22 | 0.30 | 0.21 | 0.16 | | - | - | 0.12 | 0.08 |
| P=(0.05) | - | NS | 0.66 | 0.91 | 0.65 | 0.50 | NS | NS | NS | 0.36 | 0.23 |

Note: Figures in parentheses are square root ($\sqrt{x+0.5}$) transformed value

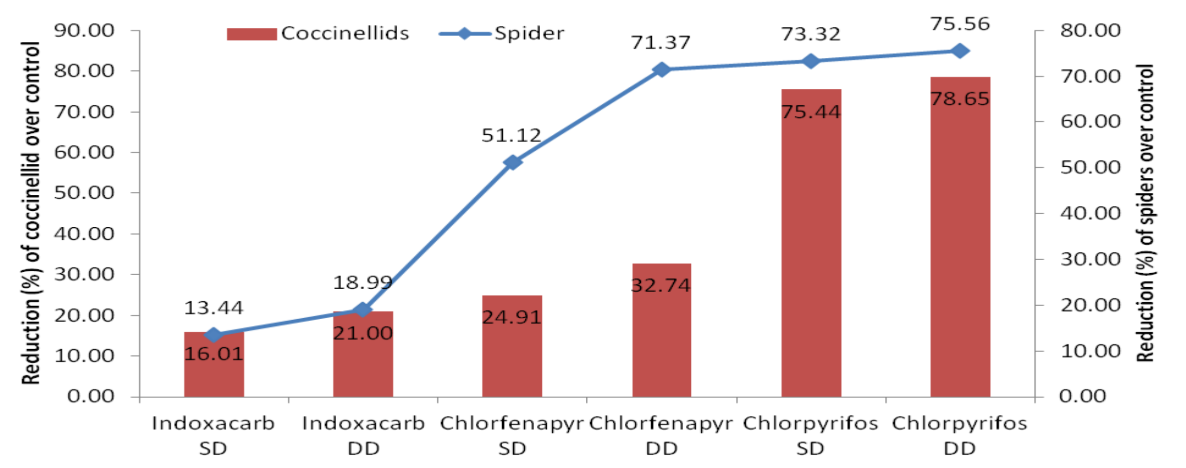

**Figure 1. Effect of insecticides on spiders and ciccinellids in brinjal**

### *3.2 Effect of insecticides on spiders and coccinellids in cabbage*

The experimental results on effect of different insecticidal treatments on non-target organism in cabbage are presented in Table 2. Results revealed that all the plots treated with insecticides showed relatively less number of natural enemies (spider and coccinellids). In case of spider, the pretreatment count ranged from 2.00 to 3.33 spiders/5plants and there was no significant variation among the treatments. After spraying, the highest number of spider population was observed in untreated control plots (2.67 spiders/5plants) followed by indoxacarb @75 and 150 g a.i./ha with 2.17 and 2.00 spiders/5plants, respectively. Chlorpyrifos was highly toxic to the spider populations and recorded lowest number of spiders in both the doses (200 and 400 g a.i./ha) with 0.33 and 0.50 spiders/5plants, respectively. Results showed that chlorfenapyr was also moderately toxic towards spider population (Table 2). Highest percentage reduction of spider was recorded in both the doses of chlorpyrifos treatments followed by chlorfenapyr and indoxacarb (Figure 2).

In case of coccinellids, pretreatment count was ranged from 4.33 to 5.67coccinellids/5 plants and there were no significant differences in the coccinellids population among thetreatments. After spraying of insecticides, there was variation in the coccinellids population among the treatments (Table 2).The results revealed that highest number of coccinellids were found in untreated control plots (5.33 coccinellids/5plants) followed by indoxacarb @75 g a.i./ha (3.83 coccinellids/5plants), indoxacarb @ 150 g a.i./ha (3.0coccinellids/5plants). Similar impact of chlorpyrifos and chlorfenapyr on coccinellids were observed as in found towards spider population. Highest reduction of coccinellids (Figure 2) was recorded in chlorpyrifos at higher dose (78.05%) followed by chlorfenapyr at higher (75.05%), chlorpyrifos atrecommended dose (68.67%) and chlorfenapyr at recommended dose (59.29%). In the present experiments, the results revealed that the plots treated with insecticidal treatments recorded comparatively less population of predatory coccinellids and spiders as compared to untreatedcheck. Results showed that indoxacarb was relatively safe to the natural enemies (coccinellids and spiders) which had least effect on natural enemies' population in both brinjal and cabbage ecosystems. Conventional insecticide, chlorpyrifos was found to be more toxic to both predatory coccinellids and spiders whereas chlorfenapyr was alsofound to be moderate toxic to these natural enemies.

The above findings are in accordance with reports of Karthick*et al.* (2015) who reported that indoxacarb found to be safest insecticides to predatory coccinellids and spiders.Rezaei*et al.* (2014) reported that chlorpyrifos showed 100 % mortality of *Cotesiavestalis* after 48 hours while Patra and Samanta (2017) reported that chlorpyriphos was highly toxic to*Trichogrammachilonis* and *Braconbrevicornis*.It is reported that under laboratory condition, chlorfenapyr was harmful to several beneficial organisms but the level of selectivity was increased under semi-field condition (Leonard, 2000). Haseeb*et al.* (2000) reported that the fresh residue of chlorfenapyr caused high mortality of *Diadegmasemiclausum* (parasitoid of diamond backmoth)but its toxicity did not persist long. Detrimental effects of chlorpyrifos on coccinellids are in conformity with Thomas and Phadke (1991) and El-Hawary*et al.* (2010). Chlorpyrifos was also highly toxic to spiders (Stark and Crawford, 2005; Sontakke, 1993). From this study, it may be concluded that indoxacarb was relatively less toxic to spiders and predatory coccinellids and it may be safely incorporated in the Integrated Pest Management (IPM) programme. Chlorpyrifos was found to be more toxic to both predatory coccinellids and spiders whereaschlorfenapyr was also found to be moderate toxic to these natural enemies. Therefore, chlorpyrifos and chlorfenapyr may be included in the pest management programme with caution.

**Table 2.** Effect of different insecticidal treatments on spider and coccinellids in cabbage

| **Treatments** | **Dose (ga.i. /ha)** | **No. of spiders/5plants before spray** | **Number of spiders/5 plants** | | | **No. of coccinellids/ 5 plants before spray** | **Number of coccinellids/5 plants** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **1st spray** | **2nd spray** | **Mean** | | **1st spray** | **2nd spray** | **Mean** |
| Indoxacarb14. 5SC | 75 | 2.00 (1.58) | 2.33 (1.68) | 2.00 (1.58) | 2.17 (1.63) | 4.67 (2.27) | 3.67 (2.04) | 4.00 (2.12) | 3.83 (2.08) |
| Indoxacarb14. 5SC | 150 | 2.33 (1.68) | 2.33 (1.68) | 1.67 (1.47) | 2.00 (1.58) | 5.33 (2.42) | 2.67 (1.78) | 3.33 (1.96) | 3.00 (1.87) |
| Chlorfenapyr1 0SC | 100 | 2.00 (1.58) | 1.67 (1.47) | 1.33 (1.35) | 1.50 (1.41) | 5.00 (2.35) | 2.00 (1.58) | 2.33 (1.68) | 2.17 (1.63) |
| Chlorfenapyr1 0SC | 200 | 2.33 (1.68) | 1.33 (1.35) | 1.00 (1.22) | 1.17 (1.29) | 5.67 (2.48) | 0.67 (1.08) | 2.00 (1.58) | 1.33 (1.35) |
| Chlorpyrifos2 0EC | 200 | 3.00 (1.87) | 0.67 (1.08) | 0.33 (0.91) | 0.50 (1.00) | 4.33 (2.20) | 2.67 (1.78) | 0.67 (1.08) | 1.67 (1.47) |
| Chlorpyrifos1 0EC | 400 | 3.33 (1.96) | 0.67 (1.08) | 0.00 (0.71) | 0.33 (0.91) | 4.67 (2.27) | 2.00 (1.58) | 0.33 (0.91) | 1.17 (1.29) |
| Control | - | 2.33 (1.68) | 2.67 (1.78) | 2.67 (1.78) | 2.67 (1.78) | 5.33 (2.42) | 5.00 (2.35) | 5.67 (2.48) | 5.33 (2.42) |
| SE. m ± | | | 0.10 | 0.18 | 0.12 | | - | 0.26 | 0.21 |
| P= (0.05) | | NS | 0.32 | 0.56 | 0.35 | NS | NS | 0.81 | 0.66 |

Note: Figures in parentheses are square root ($\sqrt{x+0.5}$) transformed value

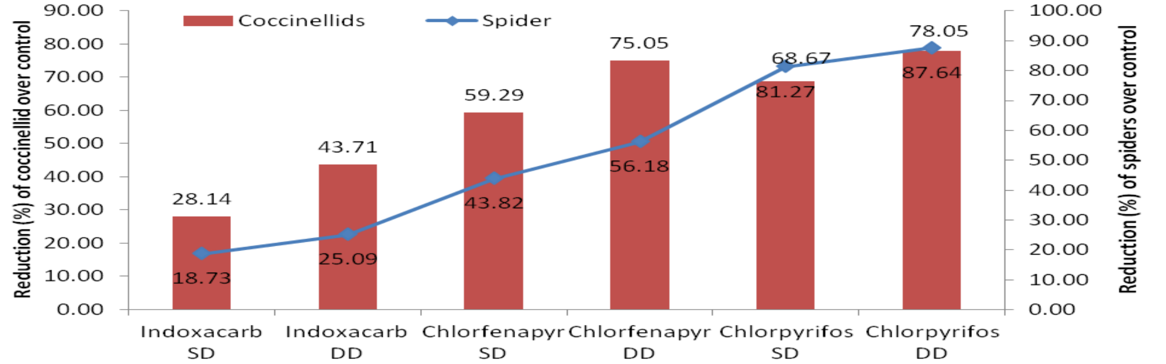

**Figure 2. Effect of insecticides on spiders and coccinellids in cabbage**


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