Effect of pesticides on the population dynamics of Green lacewing (*Chrysoperla carnea*) and Ladybird beetle (*Coccinella septempunctata)* under field condition of okra

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ABSTRACT: Natural enemies play very important role in the reduction of insect pest populations. Pesticides are measured the first line of protection for the control of pests. At least in the short and moderate term, the consumption of pesticides will remain a vital strategy for pest management, allowing growers to yield of the crops of sufficient quality at low costs. Integrated Pest Management (IPM) as well known approach combines several different pest-control tactics, among the chemical and biological control stands out. The current experiment was conducted to find out the effect of different pesticides on the population of natural enemies of major insect pest of okra. The experiment was Randomized Complete Block Design (RCBD) with three replications and eight treatments along with control. Different pesticides used in the experiment i.e Garlic extract, Lemon grass extract, Tobacco extracts, Neem extracts, Onion extract, Pyriproxyfen 10.8% EC, Imidacloprid 25% WP. The highest mean population of ladybird beetle was recorded in control plot (2.97) and followed by garlic extract, Tobacco extract, Neem extract, Lemon grass extract (2.23, 1.93, 1.93 and 1.80 respectively) which was nonsignificant. The lowest mean population of ladybird beetle was observed in plot treated with Imidacloprid and Pyriproxyfen (0.90 and 1.03 respectively). The highest mean population of Green lacewing was recorded in control plot (2.34), followed by Garlic extract Neem extract Tobacco extract Lemon grass extract and Onion extract (1.81, 1.73, 1.66, 1.58, 1.57 respectively). While lowest mean population of Green lacewing was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.73, 0.82 respectively). It is concluded from the experiment that chemical insecticides Imidacloprid and Pyriproxyfen are more hazardous to natural enemies of major insect pests of okra. Plant extracts can be recommended because it is ecofriendly management of many insect pests and their natural enemies.

Key words. Chemicals, Plant extracts, Okra and natural enemies.

INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench, is an important vegetable crop of Pakistan. Okra is short duration crop propagated through seeds (Neeraja *et al.*, 2004). It is the kharif season vegetable but it can be grown throughout the year (Dash *et al*, 2013). Okra is a nutritive vegetable, contain both soluble and insoluble fiber which helps to lower blood cholesterol, reduce the risk of heart disease also keeps the intestinal tract healthy and decrease colorectal cancer (Broek *et al.*,2007). Okra is a best source of minerals, vitamins, salts and has 175 calories per pound (Lanjar and Sahito, 2007). Among the limiting factors, insect pest is the most imperative. Insect pests are major threat to okra crop from the time of germination till harvesting. The major insect pests attacking okra include whitefly, aphids, jassids, thrips and fruit borer (Rakesh *et al.,* 2006).

Aphids on canola usually are pale green to grayish green in color and found in large numbers near the top of individual plant. Infested plants often appear shiny due to the honeydew they excrete (Knodel and Beauzay, 2011). Whitefly give indirect damage by producing honeydew. The honeydew serves as a substrate for the growth of black sooty mold on leaves and fruit. Photosynthesis process slow down due to honeydew (Berlinger, 2002). Among the beneficial organisms of agricultural importance, the natural enemies of arthropods are noteworthy for their contribution to reducing pest outbreaks. However, while there are many examples of successful biological control, chemical control is still widely used to safeguard profitable yields. Pesticides, such as insecticides, fungicides, herbicides and acaricides are important tools for crop management and play a significant role in agricultural production worldwide (Bueno and Bueno, 2012). Nevertheless, chemical control is frequently overused, mainly in crops cultivated on a large scale, such as soybean (Bueno *et al.*, 2011). It is current practice of soybean growers to apply insecticides without considering the recommended pest threshold level (Song and Swinton 2009). This incorrect use of agrochemicals is endangering the sustainability of important crops worldwide (Song and Swinton 2009; Bueno *et al.,* 2011).

Overuse of non-selective pesticides in agriculture has several important adverse effects, of which the harm caused to biological control agents is the most relevant (Carmo *et al.*, 2010; (Fernandes *et al.,* 2010. Among other negative effects, reduced activity of biological control agents usually leads to pest resurgence, occurrence of secondary pests and selection for resistance (Fernandes *et al.,* 2010). Natural insecticides contain chemical, mineral, and biological materials and some products are available commercially, e.g., pyrethrum, neem, spinosad, rotenone, abamectin, *Bacillus thuringiensis* (*Bt*), garlic, cinnamon, pepper, and essential oil products [Dybas, 1989 and Jurat-Fuentes *et al.,* 2012]. Practically, the major categories of natural insecticides are botanical, soaps and oils, minerals, and microbial. The selectivity and safety of natural insecticides are not absolute and some natural compounds are toxic; for example, arsenic and nicotine are used historically as natural pesticides. Currently, these natural compounds are not considered as safe and not used as pesticides.

Some factors associated with natural enemies that may impact the incidentally changed of chemical insecticides include type of natural enemy, life stages, visible to pesticides and sex. Cloyd *et al.,* 2011 and Bartlett *et al.*, 1964. Foliar spray applications remaining indirectly residues of insecticides. Dicke *et al.*, 1999 and Teodoro *et al.*, 2009. Indirectly the remaining residues affected parasitoid by inhibiting adults emergence. Rill *et al.*, 2009. Insect prey feeding on contaminated honeydew excreted indirectly affected by natural enemies Longley *et al.*, 1996 and Wang *et al.*, 2008. Some pesticides have repellent activity or alter host plant physiology Elzen *et al.*, 1989 and Tran *et al.*, 2004. Indirectly affecting the capacity of natural enemies to regulate existing arthropod pest populations. Ripper *et al.*, 1951. In this scenario it is necessary to develop an effective and ecologically sound and environmentally safe IPM strategy to manage pests infestation (Zhu *et al*., 2016). Use of selective insecticides are considered as an important component of IPM strategies due to their efficacy to pests and safety to natural enemies (Delia *et al.*, 2013 and Hussain *et al.*, 2022).The natural enemies of okra are syrphid fly, green lacewing and ladybird beetle (Saljoqi *et al.*, 2013) ants, Chrysoperla spp, Coccinellidae and Encarsia spp were also used for the reduction of insect pest of okra (Leite *et al.*, 2005). Keeping in view the above facts the present study is designed with the objective to develop an effectiveness of pesticides against natural enemies of major insect pests of okra.

Materials and Methods

The present research on "Effect of insecticides on the natural enemies of major pests of Okra was conducted at Agriculture research field in The university of Agriculture Peshawar, Khyber Pakhtunkhwa" during summer 2021. Sowing hybrid seed of okra (Viraj F1) in ridges in the third week of March. The experiment was Randomized Complete Block Design (RCBD) with three replicates. Plot size was 5 x 4m^2. Row to row and plant to plant distances was 30 cm and 10 cm respectively. Standard agronomic practices (irrigation, fertilizer, weeding e.t.c) were applied uniformly to all experimental plots.

Treatments

T1. Garlic extracts T2. Lemon grass extracts T3. Tobacco extracts T4. Neem extracts, T5. Onion extracts, T6. Imidacloprid 25% WP, T7. Pyriproxyfen 10.8% EC, T8. Control

Natural enemies of insect pest of okra

Natural enemies were recorded on 5 randomly selected plants. Data on natural enemies of whitefly was recorded 1 day before pesticide application and then 7, 14, 21, 28 and 35 days interval after different treatments application.

Statistical Analysis

Data on the above parameters were subjected to analysis of variance by using statistical software STATISTIX 8.1 and means were separated by using LSD test at P=0.05%.

Results

Ladybird beetle population plant^{-1}

Before 24 hours of spray application (Table 1.) the mean population of Ladybird beetle were nonsignificant. The highest mean population of ladybird beetle after 7th day of spray application was recorded in control plot (2.84) and Garlic extract (2.70) which nonsignificant to each other. Followed by Tobacco extract, Neem extract, Lemon grass extract and Onion extract (1.81, 1.81, 1.79 and 1.68 respectively). While the lowest mean infestation was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.65 and 0.71). The highest mean population of Ladybird beetle after 14th day of spray application was observed in control plot (2.90) and followed by Garlic extract (2.25). Then followed by Tobacco extract, Lemon grass extract, Onion extract and Neem extract (1.85, 1.84, 1.81 and 1.72 respectively). While the lowest mean population of ladybird beetle was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.77 and 0.80). After 21st day of spray application the highest mean population of ladybird beetle was recorded in control plot (2.98) and followed by Garlic extract (1.90). Then followed by Neem extract and Tobacco extract (1.83 and 1.80) which was nonsignificant to each other and then followed by Lemon grass extract and Onion extract (1.66 and 1.63). While lowest mean population was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.59 and 0.74 respectively).After 28th day of spray application highest mean population of ladybird beetle was observed in control plot (3.13), while followed by Garlic extract (1.89). Then followed by Neem extract and Tobacco extract (1.74 and 1.72 respectively) and Onion extract, Lemon grass extract (1.72, 1.74) which are nonsignificant to each other. While lowest mean population of ladybird beetle Imidacloprid and Pyriproxyfen (0.41 and 0.59 respectively). After 35th days of spray application the highest mean population of ladybird beetle was recorded in control plot (3.17), followed by Garlic extract (1.85). Then followed by Tobacco extract and Neem extract (1.64 and 1.65 respectively) which was nonsignificant. While followed by Onion extract and Lemon grass extract (1.26 and 1.30 respectively) which was nonsignificant. While lowest mean population of ladybird beetle was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.20 and 0.56 respectively) which significant to each other. The highest mean population of ladybird beetle was recorded in control plot (2.97) and followed by garlic extract (2.23). Followed by Tobacco extract and Neem extract (1.93 and 1.93 respectively) which was nonsignificant and then followed by Lemon grass extract (1.80). The lowest mean population of ladybird beetle was observed in plot treated with Imidacloprid and Pyriproxyfen (0.90 and 1.03 respectively).

Green lacewing population plant^{-1}

Before 24 hours of spray application (Table 2.) the mean population of Green lacewing was nonsignificant. After 7th days of spray application the highest mean population of Green lacewing was observed in control plot (2.18), followed by Garlic extract (1.91), Neem extract (1.86) and Tobacco extract (1.85) which are nonsignificant. While followed by Lemon grass extract (1.46) and Onion extract (1.42). Lowest mean population was recorded in plot treated with Pyriproxyfen and Imidacloprid (1.08, 0.76 respectively). After 14th days of spray application the highest mean population of Green lacewing was recorded in control plot (2.29). Followed by Neem extract, Garlic extract, Onion extract, Lemon grass extract and Tobacco extract (1.87, 1.83, 1.77, 1.72 and 1.61 respectively) which was nonsignificant. While the lowest mean population of Green lacewing was recorded in plot treated with Pyriproxyfen and Imidacloprid (0.77, 0.61 respectively). After 21st days of spray application the highest mean population of Green lacewing was observed in control plot (2.46). Followed by Garlic extract (1.75), Lemon grass extract (1.46) and Onion extract (1.47). Closely, followed by Neem extract (1.65) and Tobacco extract (1.59) respectively. While lowest mean population of Green lacewing was recorded in plot treated with Pyriproxyfen (0.40) and Imidacloprid (0.48). After 28th days of spray application the highest mean population of Green lacewing was observed in control plot (2.51). Followed by Garlic extract (1.67), Lemon grass extract (1.41), Onion extract (1.37) and followed by Neem extract (1.51) and Tobacco extract (1.45) respectively. While lowest mean population of Green lacewing was recorded in plot treated with Imidacloprid (0.31) and Pyriproxyfen (0.30) was nonsignificant. After 35th days of spray application the highest mean population of Green lacewing was observed in control plot (2.62), followed by Garlic extract (1.61), Lemon grass extract (1.36) Neem extract (1.44) and Tobacco extract (1.44) which are nonsignificant. While followed by Onion extract (1.35) respectively. While lowest mean population was recorded in plot treated with Pyriproxyfen and Imidacloprid (0.24, 0.30 respectively). The highest mean population of Green lacewing was recorded in control plot (2.34), followed by Garlic extract (1.81), Neem extract (1.73), Tobacco extract (1.66), Lemon grass extract (1.58) and Onion extract (1.57) respectively. While lowest mean population of Green lacewing was recorded in plot treated with Imidacloprid and Pyriproxyfen (0.73, 0.82 respectively).

Discussions

The current experiment was conducted at Agriculture research field in, The University of Agriculture Peshawar during 2021. To study the Effect of pesticides on the natural enemies of major insect pests of okra. Before spray applications the population of natural enemies are nonsignificant. This finding is line with the finding of Hussain *et al.*, 2022. Botanical extracts are less harmful to natural enemies of okra, green lacewing and ladybird beetle reduces the population of aphids and whiteflies. Similar finding are recorded Saljoqi *et al.*, 2013 and Leite *et al.*, 2005 were also used for the reduction of insect pests of okra. Imidacloprid found to be toxic to benefical insects. Similar finding has also been reported by Rondeau *et al.*, 2014 that imidacloprid is more toxic to bees and other beneficial insects. In the present study two insect predators were recorded ladybird beetle and green lacewing. The comparative effeciacy of tobacco, neem and synethic insecticides and use of natural enemies on okra. Similar finding is reported by Shabozoi *et al.*, 2008 and Zia *et al.,* 2022 also reported the same results . Ladybird beetle play very important role in the reduction of whitefly population. Similar result was observed by Kedar *et al.*, 2014. Chemical insecticides Imidacloprid is more toxic to the natural enemies of aphids and whiteflies. This finding is similar to the finding of Swami *et al.,* 2018. Botanical extracts of tobacco and garlic are reduce the population of major insect pests of okra. But save the population of natural enemies of Green lacewing and ladybird beetle. These botanical extracts are used against many insect pests and showed best results. Similar result was reported Hussain *et al.,* 2022. Chemical insecticides pyriproxyfen, indirect harmful effects against adult female oviposition and egg viability of green lacewing, *C. carnea*. This results are similar to the results of Koehler *et al.*, 1991, Ishaaya *et al.,* 2007 and Nagai *et al.,* 1990. Also, not indirect effects on development time, female longevity, and fertility of *Orius* sp. Similar reported was recorded Nagai *et al.*, 1990. Exposure to pyriproxyfen delayed growth and declined the rate of parasitism of, *Hyposoter didymator*, and demonstrated to substantially change of enlargement time on *Chrysoperla rufilabris* of immatures Schneide *et al.,* 2004 also reported , did not indirect impact against *Delphastus catalinae* female fecundity Koehler *et al.,* 1991. Fifth instars of *Podisus maculiventris* exposure to pyriproxyfen did not an indirect effect against reproduction. *Encarsia pergandiella* and *Encarsia transvena* are not indirect affect after exposure while *Encarsia formosa* exhibited decreased rates of emergence .Liu *et al.*, 1997. The botanical extracts are environmental safely and showed results against many insect pests of agricultural crops. This result are similar to the results of Hussain *et al.*, 2022.

Table 1. Mean number of Ladybird beetle plant^{-1} recorded before and after different spray application during 2021.

Treatments	Ladybird beetle population plant^{-1}						
	24	After treatment application (Days)					
	BSA	7	14	21	28	35	Mean
Garlic extract	2.79^{a}	2.70^{a}	2.25^{b}	1.90^{b}	1.89^{b}	1.85^{b}	2.23^{b}
Lemon grass extract	2.77^{a}	1.79^{b}	1.84^{c}	1.66^{d}	1.42^{d}	1.30^{d}	1.80^{d}
Tobacco extract	2.76^{a}	1.81^{b}	1.85^{c}	1.80^{c}	1.72^{c}	1.64^{c}	1.93^{c}
Neem extract	2.85^{a}	1.81^{b}	1.72^{c}	1.83^{bc}	1.74^{c}	1.65^{c}	1.93^{c}
Onion extract	2.86^{a}	1.68^{b}	1.81^{c}	1.63^{d}	1.41^{d}	1.26^{d}	1.78^{d}
Imidacloprid	2.78^{a}	0.65^{c}	0.77^{d}	0.59^{f}	0.41^{f}	0.20^{f}	0.90^{f}
Pyriproxyfen	2.78^{a}	0.71^{c}	0.80^{d}	0.74^{e}	0.59^{e}	0.56^{e}	1.03^{e}
Control	2.82^{a}	2.84^{a}	2.90^{a}	2.98^{a}	3.13^{a}	3.17^{a}	2.97^{a}
CV	5.87	7.04	7.09	9.088	11.0689	7.0593	6.055

Means followed by different letters are significantly different at P 0.05 level of significance followed by LSD Test.

Table 2. Mean number of Green lacewing plant^{-1} recorded before and after different spray application during 2021.

Treatments	Green lacewing population plant^{-1}						
	24 BSA	After treatment application (Days)					
		7	14	21	28	35	Mean
Garlic extract	2.07^{a}	1.91^{ab}	1.83^{b}	1.75^{b}	1.67^{b}	1.61^{b}	1.81^{b}
Lemon grass extract	2.04^{a}	1.46^{bcd}	1.72^{b}	1.46^{c}	1.41^{c}	1.36^{bc}	1.58^{c}
Tobacco extract	2.02^{a}	1.85^{abc}	1.61^{b}	1.59^{bc}	1.45^{bc}	1.44^{bc}	1.66^{bc}
Neem extract	2.04^{a}	1.86^{abc}	1.87^{b}	1.65^{bc}	1.51^{bc}	1.44^{bc}	1.73^{bc}
Onion extract	2.05^{a}	1.42^{cd}	1.77^{b}	1.47^{c}	1.37^{c}	1.33^{c}	1.57^{c}
Imidacloprid	2.01^{a}	0.76^{e}	0.61^{c}	0.40^{d}	0.31^{d}	0.24^{d}	0.73^{d}
Pyriproxyfen	2.00^{a}	1.08^{de}	0.77^{c}	0.48^{d}	0.30^{d}	0.30^{d}	0.82^{d}
Control	1.99^{a}	2.18^{a}	2.29^{a}	2.46^{a}	2.51^{a}	2.62^{a}	2.34^{a}
CV	6.59	10.19	15.08	10.50	11.08	11.37	7.06

Means followed by different letters are significantly different at P 0.05 level of significance followed by LSD Test.

Conclusion and recommendation

It is concluded from the experiment that chemical insecticides are more hazardous to natural enemies of major insect pests of okra. Plant extracts can be recommended because it is ecofriendly management of many insect pests and their natural enemies.

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