Vegetable Science (2022) 49(1):26-32

Population dynamics of arthropods under different insecticide and biopesticide treatments in okra

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Received: January 2022/ Accepted: May 2022

Abstract

Efficacy of different insecticides and biopesticides was evaluated against arthropods on okra crop at Vegetable Research Farm, Punjab Agricultural University, Ludhiana during 2019-20. For sucking arthropods, all evaluated insecticides were significantly effective and amongst them flonicamid 50% WP (0.8g/l water) proved to be more effective having higher percent reduction (67.31 to 96.14%) compared to controls. However, imidacloprid 200 SL (0.4ml/l water) was effective against okra fruit and shoot borer and American bollworm (79.18% and 78.60%, percent reduction over control) and spiromesifen 240 SC (1.5ml/l water) against red spider mite. Interestingly, neem based biopesticides enhance predator population as compared to insecticides. Although, the use of chemical pesticides cannot be omitted completely as they form mainstay of management strategies, yet their use can be limited by including cheaper alternative biopesticides like azadiractin 50,000 ppm @ 0.8 ml/l of water which may provide good control of above sucking arthropods as compared to controls.

Keywords: Arthropods, biopesticides, flonicamid, imidacloprid, neem baan, okra crop

Introduction

Arthropods form the largest group among animals in terms of their diversity, in habitat specialization, form and colour, which together make them one of the most rewarding groups of animals. Among 31 recognized insect orders known globally, insects of 27 orders occur in India (Thakur et al. 2008). India's diversity is immensely rich and it is exemplified in its diversified ecosystems. Okra (*Abelmoschus esculentus* L.) is an important vegetable crop grown in India. It is infested by a large number of pests. It is cultivated throughout tropical and subtropical regions of the world. It has important role in the human diet. Low yield of okra in India is because of damage caused by many insect pests (Rachana et al. 2009). Among all insect pests infesting okra, borer and sucking pests serves as a major constraint. At present, the use of pesticides remains one of the most extensively and best known used measures to control pest. Injudicious uses of pesticides for the control of insect pests of okra had resulted in development of resistance to pesticides in target pests and also have adverse effects on predators, resurgence of minor pests, environmental pollution, hazards to economy and health (Mandal et al. 2006). Furthermore, their excessive use has resulted in diminution of biodiversity of natural enemies (Hill et al. 2017) and breakdown of food webs in ecosystem. To obtain more yield large amount of pesticides have been used by farmers in India. Therefore, to combat these problems, plant derivatives and microbial insecticides are now emerging as viable inputs to manage insect pests on all crops in view of their pesticidal potency as well as safety to predators and parasitoids (Hill et al. 2017). In addition to other plant extracts more than 68 neem (*Azadirachta indica*) based formulations are now commercially available in India (Sarkar et al. 2016) which have been largely used against number of insect pest species on various crops. Neem extracts have been reported as eco-friendly option for the management of noxious arthropods infesting okra crop (Bindu et al. 2003). Neem formulations are less toxic to environment, least harmful to non-target organisms and have very less chances of developing resistance in pests and acts as oviposition deterrent, growth inhibitor and antifeedant (Patel et al. 1996). Keeping in view the importance of okra, present study was proposed to have a more detailed and consolidated account of efficacy of different insecticides and biopesticides against important sucking arthropods of okra crop under agro ecological conditions of Punjab.

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Materials and Methods

The field surveys were carried out (at weekly intervals and data was pooled at total crop period) to determine the efficacy of different insecticides namely, Flonicamid 50% WP @ 0.8 g/l of water (ulala), Imidacloprid 200 SL @ 0.4 ml/l of water (confidor), Spiromesifen 240 SC @ 1.5 ml/l of water (oberon) and biopesticides namely, as Azadirachtin 50,000 PPM (Neembaan) @ 0.6, 0.7 and 0.8 ml/l of water and Azadirachtin 3,000 PPM (Neembaan) @ 5, 7 and 10 ml/ l of water in suppressing the population of sucking arthropods in okra (variety Punjab Suhawani) from July to October 2019 at the Vegetable Farm, PAU, Ludhiana. The experiment was laid out in a randomized block design (RBD) with three insecticide treatments and six biopesticide treatments along with control plot (where no application of spray was done). To record observations on count of important sucking arthropods (jassid, whitefly, stink bug, dusky cotton bug, okra fruit and shoot borer, American bollworm, mealy bug and red spider mite) of okra crop, five plants were randomly selected from each plot (belonging to four sides as well as from the centre of field) and from each plant three leaves were randomly selected each from upper, middle and lower canopy of plant (nine leaves/plant). The population of sucking arthropods was observed separately in each replication (plot) and efficacy of pesticides and biopesticides was analysed. Data was analysed using one way of variance (ANOVA) using SPSS software to record the efficacy of different treatments along with control. Comparison was made between different treatments using Tukey's test.

Results and Discussion

The results from the regular surveys revealed the occurrence of 33 invertebrate species belonging to 10 orders namely, Hemiptera, Coleoptera, Lepidoptera, Trombidiformes, Orthoptera, Odonata, Diptera, Hymenoptera, Araneae and Mantodea having 25 families (Table 1). Among various invertebrates recorded, order Hemiptera represented the highest number of species (eight) followed by Coleoptera (six).

Table 1: Inventory of different arthropod species found in okra crop

Sr. no.	Common name	Scientific name	Family	Order
Phytophagous arthropods				
1	Jassids	*Amrasca biguttulla biguttulla*(Ishida)	Cicadellidae	Hemiptera
2	Whitefly	*Bemisia tabaci*(Gennadium)	Aleyrodidae	Hemiptera
3	Coreid bug	*Cletus punctiger* (Dallas)	Coreidae	Hemiptera
4	Mealy bug	*Phenococcus solenopsis* (Tinsley)	Pseudococcidae	Hemiptera
5	Dusky cotton bug	*Oxycarenus laetus*(Kirby)	Lygaeidae	Hemiptera
6	Red cotton bug	*Dysdercus cingulate* (Fabricius)	Pyrrhocoridae	Hemiptera
7	Sugarcane leafhopper	*Pyrilla perpusilla* (Walker)	Lophopidae	Hemiptera
8		*Halyomorpha halys* (Stal)		
9	Stink bug	*Nezara viridula* (Linnaeus)	Pentatomidae	Hemiptera
10		*Podisusmaculiventris* (Say)		
11	Blister beetle	*Mylabris pustulatus* (Latreille)	Meloidae	Coleoptera
12	Ash weevil	*Myllocerus unidecimpustulatus* (Schonherr)	Curculionidae	Coleoptera
13	White spotted leaf beetle	*Monolepta signata* (Chevrolat)	Chrysomelidae	Coleoptera
14	Red pumpkin beetle	*Raphidopalpa foveicollis* (Lucus)	Chrysomelidae	Coleoptera
15	Chafer beetle	*Oxycetonia versicolor* (Fabricius)	Scarabaeidae	Coleoptera
16	Rice stem borer	*Scirpophaga nivella* (Fabricius)	Crambidae	Lepidoptera
17	Okra fruit and shoot borer	*Earias vittella* (Fabricius)	Nolidae	Lepidoptera
18	American bollworm	*Helicoverpa armigera* (Hubner)	Noctuidae	Lepidoptera
19	Tobacco cutworm	*Spodoptera lituraI* (Fabricius)	Noctuidae	Lepidoptera
20	Red spider mite	*Tetranychus urticae* (Koch)	Tetranychidae	Trombidiformes
21	Grasshopper	*Atractomorpha crenulate* (Fabricius)	Pyrgomorphidae	Orthoptera
Predator arthropods				
22		*Cheilomenes sexmaculata* (Fabricius)		
23	Lady bird beetle	*Brumoides suturalis* (Fabricius)	Coccinellidae	Coleoptera
24		*Coccinella septempunctata* (Linnaeus)		
25		*Coccinella transversalis*(Fabricius)		
26	Dragonfly	*Crocothemis servilia* (Drury)	Libelluidae	Odonata
27	Damselfly	*Ischnura aurora*(Brauer)	Coenagrionidae	Odonata
28	Robber fly	*Laphria canis* (Williston)	Asilidae	Diptera
29	Yellow wasp	*Polistes watti* (Latreille)	Vespidae	Hymenoptera
30	Spiders	*Neoscona theisi* (Walckenaer)	Araneidae	Araneae
31		*Oxyopes salticus* (Hentz)		
32	Praying mantid	*Stagnomantis carolina* (Johansson)	Mantidae	Mantodea
33	Silent leaf runner	*Metiochevittaticollis* (Stal)	Gryllidae	Orthoptera

Jassid, whitefly and stink bug: The analysis of data (Table 2) indicates that all the treatments (both pesticides and biopesticides) were different from control in okra crop. The lowest jassid, whitefly and stink bug population was recorded in flonicamid treated plot of okra crop. Among biopesticide treatments, all the treatments reduced the population of jassids, whitefly and stink bug. However, Azadirachtin 50,000 ppm @ 0.6 ml/l of water supported minimum jassid population and Azadiractin 50,000 ppm @ 0.8 ml/l of water supported minimum whitefly and stink bug population. Interestingly, it is evident from the study that flonicamid showed the highest reduction in the population of jassid (84.67%), whitefly (96.19%) and stink bug (79.27%). Hence, apart from the overall ranking of treatments, Azadirachtin 50,000 ppm @ 0.6 and 0.8 ml/ l of water moderately suppressed the population of jassid, whitefly and stink bug in okra crop. Similar results were obtained by Surwase et al. (2017) who evaluated efficacy of flonicamid 50 WG @ 75 g/ha against jassid in cotton. They observed minimum jassid population in plots treated with flonicamid. Similarly, Muhammad et al. (2004) evaluated efficacy of imidacloprid 200 SL (@ 250 ml/ ha) and acetamiprid 20 SP (@ 150 g/acre) against jassid infesting cotton crop in Multan. Results of the study revealed that maximum reduction in population of jassid was observed in plots treated with imidacloprid insecticide. Singh et al. (2020) revealed that flonicamid 50 WG was effective in reducing the population of whitefly infesting okra crop in Uttar Pradesh (India). Sarkar et al. (2016) reported that azadirachtin 1% EC was moderately effective in controlling the population of whitefly infesting okra crop in West Bengal (India). Jan et al. (2022) evaluated the biopesticidal potential of three- plant based extracts (clove [*Syzygium aromaticum*], hing [*Asafetida*] and wood ash [*Eucalyptus globulas*]) against different insects pests on five okra varieties. The results of the study revealed among various treatments that application of *E. globulas* was most effective in controlling the insect pests.

Red cotton bug, dusky cotton bug and mealy bug: The analysis of data (Table 2) indicates that all the treatments (both insecticides and biopesticides) were statistically similar to control. The lowest red cotton bug and dusky cotton bug population was recorded in flonicamid treated plot and lowest population of mealy bug was recorded in spiromesifen treated plot. Among biopesticides treatments, all the treatments reduced the population of red cotton bug, dusky cotton bug and mealy bug. However, azadirachtin 3000 ppm @ 10 ml/ l of water supported minimum population of red cotton bug and azadiractin 50,000 ppm @ 0.8 ml/l of water

Table 2: Population of sucking arthropods under different insecticides and biopesticide treatments in okra crop

Treatment	Jassids		Whitefly		Stinkbug		Red cotton bug		Dusky cotton bug		Red spider mite	
	Total population	%Reduction over control	Total population	%Reduction over control	Total population	%Reduction over control	Total population	%Reduction over control	Total population	%Reduction over control	Total population	%Reduction over control
Control	131.87^{b}	-	94.07^{c}	-	2.75^{b}	-	2.77^{a}	-	2.84^{a}	-	49.03^{b}	
Spiromesifen	37.88^{a}	71.27	4.67^{a}	95.03	0.63^{ab}	77.09	1.23^{a}	55.59	1.18^{a}	58.84	11.68^{a}	76.17
Flonicamid	20.21^{a}	84.67	3.58a	96.19	0.57^{a}	79.27	0.85^{a}	69.31	0.91^{a}	67.95	20.9^{ab}	57.37
Imidacloprid	30.81^{a}	76.63	3.70^{a}	96.06	0.76^{ab}	72.36	1.11^{a}	59.92	0.97^{a}	65.84	20.96^{ab}	45.01
Azadirachtin 50000 ppm @ 0.6 ml/ l of water	45.01^{a}	65.86	35.69^{ab}	62.06	1.28^{ab}	5345	2.12^{a}	23.46	1.78^{a}	37.32	38.03^{ab}	22.43
Azadirachtin 50000 ppm @ 0.7 ml/ l of water	52.55^{a}	60.15	14.08^{a}	85.03	1.36^{ab}	50.54	2.03^{a}	26.74	1.70^{a}	40.14	33.35^{ab}	31.98
Azadirachtin 50000 ppm @ 0.8 ml/ l of water	46.42^{a}	64.79	8.50^{a}	90.96	1.09^{ab}	60.36	1.87^{a}	32.49	1.44^{a}	49.29	19.88^{ab}	59.45
Azadirachtin 3000 ppm @ 5 ml/ l of water	47.76^{a}	63.78	67.42^{bc}	28.32	1.94^{ab}	29.45	2.14^{a}	22.74	1.97^{a}	30.63	29.28^{ab}	40.28
Azadirachtin 3000 ppm @ 7 ml/ l of water	62.75^{a}	52.41	62.37^{bc}	33.69	1.70^{ab}	38.18	1.90^{a}	31.4	1.92^{a}	32.39	22.07^{ab}	54.98
Azadirachtin 3000 ppm @ 10 ml/ l of water	63.34^{a}	51.96	17.42^{a}	81.48	1.29^{ab}	53.09	2.27^{a}	18.05	1.90^{a}	33.09	22.24	54.64

Mean value followed by same letter (a, b, c) in the table given above are not significantly different at 0.05% level of probability, as per Tukey's test

supported minimum dusky cotton bug population. It is evident from the data that flonicamid showed the highest reduction in the population of red cotton bug (69.31%) and dusky cotton bug (67.95%) whereas for mealy bug spiomesifen showed highest reduction (97.16%). Hence, apart from the overall ranking of treatments, azadirachtin 3000 ppm @ 10 ml/ l of water and azadirachtin 50,000 ppm @ 0.8 ml/ l of water moderately suppressed the population of red cotton bug and dusky cotton bug, respectively in okra crop. Abbate et al. (2022) evaluated the effectiveness of different combinations of thiamethoxam + lambda- cyhalothrin, imidacloprid +beta- cyfluthrin, acetamiprid + cypermethrin, + imidacloprid + carbaryl, trichlorfon, thiamethoxam, imidacloprid and spirotetramat + thiamethoxam for control of stink bugs infesting soyabean. Among these pesticide mixtures thiamethoxam + lambda- cyhalothrin provided highest level control of stink bugs. Parsad and Ashwini (2021) reported that neem oil, chloropyriphos and flonicamid significantly reduced the population of sucking pests infesting cotton crop in Telangana, India.

Red spider mite: The analysis of data (Table 2) indicates that all the treatments (both insecticides and biopesticides) were statistically different from control. The lowest red spider mite population was recorded in spiromesifen treated plot, followed by flonicamid treated plots. Interestingly, all the biopesticides treatments reduced the population of red spider mite. However, azadirachtin 50,000 ppm @ 0.8 ml/l of water supported minimum population. It is evident from the data that spiromesifen (76.17%) showed the highest reduction in the population of red spider mite followed by flonicamid (57.37%). Hence, apart from the overall ranking of treatments, azadirachtin 50,000 ppm @ 0.8ml/ l of water moderately suppressed the population of red spider mite in okra crop. These results suggest that azadirachtin 50,000 ppm @ 0.8 ml/l of water could be incorporated in management programmes of red spider mite in okra crop. Earlier, Randhawa et al. (2020) reported that oberon 22.9% @ 500 ml/ha was effective in reducing the population of red spider mite infesting okra in Gurdaspur (Punjab). Raghavendra et al. (2017) revealed that spiromesifen reduced the red spider mite population fourteen days after spray in okra, rose and cucumber crops, respectively. Khan et al. (2015) revealed that neem (*Azadirachta indica*) was moderately effective in reducing the population of red spider mite infesting okra crop in Tandojam.

Okra fruit and shoot borer and American bollworm: The data (Table 3) indicates the lowest okra fruit and shoot borer and American bollworm population recorded in imidacloprid treated plot, followed by flonicamid and spiromesifen treated plots. Among biopesticides treatments, all the treatments reduced the population of okra fruit and shoot borer and American bollworm. However, azadiractin 50,000 ppm @ 0.8 ml/l of water supported minimum population of okra fruit and shoot borer and American bollworm. It is evident from the data that imidacloprid showed the highest %reduction in the population of okra fruit and shoot borer (79.18%) and American bollworm (78.60%). Hence, apart from the overall ranking of treatments, azadirachtin 50,000 ppm @ 0.8ml/ l of water moderately suppressed the population of okra fruit and shoot borer and American bollworm. Earlier, Gautam et al. (2015) revealed that both imidacloprid (50%) and neem leaf extract (25.5%), were effective in reducing the population of okra fruit and shoot borer infesting okra crop in Varanasi, India. Janu and Kumar (2022) tested seven insecticides (Imidacloprid 17.8% SL, spinosad 45% SC, indoxcarb 14.5% SC, chlorantraniliprole 18.5% SC, cypermethrin 25% EC, profenofos 50 EC, neem oil 0.03% EC) to compare their efficacy against *Earias vittella*. Among them, the best and most economical treatment was chlorantraniliprole 18.5% SC, which was at par with spinosad, followed by imidacloprid 17.8% SL and neem oil 0.03% EC.

Table 3: Population of lepidopteran arthropods under different insecticides and biopesticide treatments in okra crop

Treatment	Okra fruit and shoot borer		American bollworm	
	Total population	%Reduction over control	Total population	%Reduction over control
Control	7.83^{b}	-	13.23^{a}	-
Spiromesifen	2.12^{ab}	72.92	4.36^{a}	67.26
Flonicamid	1.63^{a}	79.18	2.85^{a}	69.74
Imidacloprid	1.97^{ab}	74.84	4.03^{a}	78.60
Azadirachtin 50000 ppm @ 0.6 ml/ l of water	5.36^{ab}	31.54	10.77^{a}	19.14
Azadirachtin 50000 ppm @ 0.7 ml/ l of water	2.83^{ab}	51.08	7.82^{a}	41.29
Azadirachtin 50000 ppm @ 0.8 ml/ l of water	2.83^{ab}	63.85	5.63^{a}	57.73
Azadirachtin 3000 ppm @ 5 ml/ l of water	5.64^{ab}	27.96	11.15^{a}	16.29
Azadirachtin 3000 ppm @ 7 ml/ l of water	5.63^{ab}	28.09	11.28^{a}	15.37
Azadirachtin 3000 ppm @ 10 ml/ l of water	4.16^{ab}	46.87	8.83^{a}	33.70

Mean value followed by same letter (a, b, c) in the table given above are not significantly different at 0.05% level of probability, as per Tukey's test

Lady bird beetle, dragonfly, robberfly, spider, damselfly and praying mantid: The analysis of data (Table 4) on occurrence of different predators like lady bird beetle, dragonfly, robberfly, spiders, damselfly and praying mantid revealed that all the treatments (both insecticide and bopesticide) were different from control. The total population of all observed predators after treatments showed that the control plot recorded highest population. Neem baan 50,000 ppm (@ 0.6, 0.7 and 0.8 ml/l of water), neem baan 3000 ppm (@ 5, 7 and 10 ml/l of water) and spiromesifen supported highest population of lady bird beetle, dragonfly, robberfly, spider and damselfly, however, imidacloprid treated plots recorded relatively lower population. It is evident from the data that imidacloprid showed highest reduction in population of lady bird beetle (79.83%), dragonfly (64.22%), robberfly (94.57%), spider (57.79%), damselfly (88.99%) and praying mantid (80.64) followed by flonicamid in okra crop. These results revealed that all the selected dosages of biopesticides were relatively safer to predator population in okra crop as compared to insecticides. However, yellow wasp and silent leaf runner were reported to be visitors in okra crop and do not cause any interaction with plant.

The above findings are in agreement with Xiao et al. (2016) who reported that imidacloprid had adverse effect on lady bird beetle population, a natural enemy of aphids in fields and greenhouses of Chins. Akter et al. (2019) reported that inorganic insecticides reduced the population of predators in okra crop. Choudhary et al. (2017) revealed neem baan, neemazal, multineem, NSKE and neem oil safer for predators whereas, pesticide (dinotefuran @ 0.5 g/l) was more fatal to predators. Abdallah et al. (2018) revealed that imidacloprid had adverse effect on population of natural enemies of cereal aphids. Randhawa et al. (2020) reported that oberon 22.9 % SC was safer for predator population in okra crop in Bathinda (Punjab). Joseph et al. (2010) reported that NSKE, neem oil and azadirachtin were relatively safer whereas insecticides (triazophos 0.05% and quinalphos 0.05%) were extremely toxic to predator population of spiders (*Tetragnatha mandibulata* (Walckenaer) and *T. maxillosa* (Linnaeus) found in rice fields of Kerela.

Pre-dominance of lady bird beetles and spiders: Four species (Table 5) of lady bird beetle, six spotted ladybird beetle (*Cheilomenes sexmaculata*), seven spotted lady

Table 4: Population of predator arthropods under different insecticides and biopesticide treatments in okra crop

Treatments	Ladybird beetle		Dragonfly		Robberfly		Spider		Damselfly		Praying mantid	
	Total population	% Reduction over control	Total population	% Reduction over control	Total population	% Reduction over control	Total population	% Reduction over control	Total population	% Reduction over control	Total population	% Reduction over control
Control	5.95^{c}	-	4.36^{a}	-	1.10^{b}	-	4.62^{a}	-	4.22^{a}	_	0.31^{a}	-
Spiromesifen	2.48^{abc}	58.31	2.49^{a}	42.88	0.12^{a}	89.09	2.76^{a}	40.25	2.69^{a}	36.25	0.06^{a}	80.64
Flonicamid	1.20^{a}	79.83	1.56^{a}	64.22	0.12^{a}	89.09	2.62^{a}	43.29	2.23^{a}	47.15	0.06^{a}	80.64
Imidacloprid	2.15^{ab}	63.86	2.16^{a}	50.45	0.06^{a}	94.54	1.95^{a}	57.79	1.63^{a}	61.37	0.06^{a}	80.64
Azadirachtin 50000 ppm @ 0.6 ml/ l of water	3.61^{abc}	39.32	2.89^{a}	33.71	0.25^{ab}	77.27	3.3^{a}	28.57	3.14^{a}	25.59	0.19^{a}	38.7
Azadirachtin 50000 ppm @ 0.7 ml/ l of water	3.81^{abc}	35.96	3.23^{a}	25.91	0.37^{ab}	66.36	3.81^{a}	17.53	3.53^{a}	16.35	0.19^{a}	38.7
Azadirachtin 50000 ppm @ 0.8 ml/ l of water	5.26^{bc}	11.59	3.51^{a}	19.46	0.63^{ab}	42.72	4.08^{a}	11.68	3.62^{a}	14.21	0.25^{a}	18.35
Azadirachtin 3000 ppm @ 5 ml/ l of water	3.29^{abc}	44.7	2.98^{a}	31.65	0.24^{ab}	78.58	3.48^{a}	24.67	3.09^{a}	26.77	0.26^{a}	16.12
Azadirachtin 3000 ppm @ 7 ml/ l of water	4.14^{abc}	30.42	3.06^{a}	29.12	0.18^{a}	83.63	3.55^{a}	23.16	3.36^{a}	20.37	0.12^{a}	61.29
Azadirachtin 3000 ppm @ 10 ml/ l of water	5.00^{bc}	15.96	3.56^{a}	18.34	0.57^{ab}	48.18	3.69^{a}	20.12	3.65^{a}	13.5	0.06^{a}	80.64

Mean value followed by same letter (a, b, c) in the table given above are not significantly different at 0.05% level of probability, as per Tukey's test

Table 5: Pre-dominance of lady bird beetle and spider species in okra crop

Sr. no.	Common name	Scientific name	Total number of individuals	% Population
Lady bird beetles				
1	Six spotted lady bird beetle	*Cheilomenes sexmaculata*	92.77	24.45
2	Three striped lady bird beetle	*Brumoides suturalis*	91.65	24.15
3	Transverse lady bird beetle	*Coccinella transversalis*	35.00	9.22
4	Seven spotted lady bird beetle	*Coccinella septempunctata*	160.00	42.16
Spiders				
5	Spotted orb weaver	*Neoscona theisi*	11.93	36.22
6	Lynx spider	*Oxyopes salticus*	21.00	63.77

bird beetle (*Coccinella septempunctata*), transverse lady bird beetle (*C. transversalis*) and three striped lady bird beetle (*Brumoides suturalis*) were found on okra. Amongst them, seven spotted lady bird beetle was most abundant one with pre-dominance of 42.16%. Likewise, two species (Table 5) of spider, lynx spider (*Oxyopes salticus*) and spotted orb weaver (*Neoscona theisi*) were recorded on okra crop with lynx spider as most abundant (63.77%).

Lkkjka'k

पंजाब कृषि विश्वविद्यालय, लुधियाना (पंजाब) के सब्जी अनुसंधान प्रक्षेत्र पर वर्ष 2019–20 के दौरान भिंडी की फसल पर फाइटोफैगस आर्थ्रोपोड्स (कीट) के विरूद्ध विभिन्न कीटनाशकों की प्रभावशीलता का मूल्यांकन किया गया। रस चूसने वाले आर्थ्रोपोड्स के लिए मूल्यांकन किया गया जिनमें कीटनाशक महत्वपूर्ण रूप से प्रभावी थे लेकिन अनुपचारित क्षेत्र की तुलना में 67.31–96.14 प्रतिशत तक उच्च प्रतिशत कमी के साथ 50 प्रतिशत डब्ल्यू.पी. (0.8 ग्राम प्रति लीटर पानी) फ्लोनिकैमाइड अधिक प्रभावी पाया गया। हालांकि इमिडाक्लोप्रिड 200 एस.एल. (0.4 मिली. प्रति लीटर पानी) भिंडी के फल और प्ररोह बेधक और अमेरिकन बोलवर्म (क्रमशः प्रतिशत 79.18 और 78.60) और स्पिरोमेसिफेन 240 एस.सी. (1.5 मिली प्रति लीटर पानी), रेड स्पाइडर माइट के विरूद्ध प्रभावी थे। हालांकि रासायनिक कीटनाशकों के उपयोग को पूरी तरह से नहीं छोड़ा जा सकता है अतः उपरोक्त रसायन प्रबंधन रणनीतियों का मुख्य आधार हैं फिर भी उनके उपयोग को नीम बाण 50,000 पी.पी.एम (0.8 मिली. प्रति लीटर) पानी जैसे सस्ते विकल्पिक जैव कीट नाशकों को शामिल करके सीमित किया जा सकता है क्योंकि अनुपचारित क्षेत्र की तुलना में अच्छा नियंत्रण प्रदान कर सकते हैं।

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