Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(3): 357-364

Received: 04-03-2020
Accepted: 06-04-2020

BB Gaikwad
Department of Agricultural Entomology, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

BB Bhosle
Department of Agricultural Entomology, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AB Mudgalkar
Department of Agricultural Entomology, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
BB Gaikwad
Department of Agricultural Entomology, College of Agriculture, Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Efficacy of different biopesticide against *Coccinellids* on okra

BB Gaikwad, BB Bhosle and AB Mudgalkar

Abstract
An experiment has been conducted to assess the efficacy of different biopesticides against *Coccinellids* in Okra. Among the tested biopesticides LAMIT 0.6%, eucalyptus oil 0.2%, karanj oil 0.5% and biomix 0.3% recorded maximum population. Followed by *Beauveria bassiana* 0.4%, Neem oil 0.2% and NSKE 5%. These were followed by *Verticilium lecanii* 0.4% *Metarhizium+Beauveria bassiana* 0.4% and dashparni ark 0.6%. The most toxic insecticides were emamectin benzoate 5% SG and thiamethoxam 25% WG.

Keywords: Emamectin benzoate, LAMIT, *Metarhizium+ Beauveria and Biomix*

Introduction
Okra (*Hibiscus esculentus* L.) Commonly known as bhindi or lady's finger belong to family Malvaceae. This genus of okra contains more than 140 species [1, 2]. In Pakistan okra is grown in summer the area under cultivation is 232.05 hectares with the production of 303.16 tons per year [3]. Okra as a human food contains protein, vitamins, carbohydrate, fat, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries. The okra fruits are useful with some medicinal values. A mucilaginous preparation from the pod can be used for plasma replacement or blood volume expansion. The okra fruit has good iodine contents which are useful to reduce goiter [4]. The ripened and mature pod seeds are used as chicken feed and also for oil production on small scale [5]. Okra production is affected by many biotic and abiotic factors, which cause significant yield losses. In biotic the insect pest especially, the okra fruit borer (Earias vittella) is a major threat that reduces almost 50 – 70% yield [6, 7].

In India, vegetables have occupied the prime position in human diet, as these are the cheaper source of carbohydrate, minerals, vitamins, proteins, dietary fibers besides having medicinal value and provide nutritional security to a predominately vegetarian population. Among different vegetables, okra, *Abelmoschus esculentus* (L.) Moench belonging to the family Malvaceae is an important annual vegetable, grown for its immature green non-fibrous edible fruits in the tropical and sub-tropical regions of the world. It is commonly known as "Gumbo" as well as "Okra" in USA, lady's finger in England and "*Bhindi*" or "*Bhinda*" in India. It is probably originated in Ethiopian region of Africa, but is now widely grown in Sudan and Nigeria regions of the Africa besides being grown in other countries. Because of its high nutritive value and prolonged shelf life as compared to others, okra has captured a prominent position among export-oriented vegetable crops. It has a vast potential as one of the foreign exchange earner crop and accounts for about 60 per cent of the total export of fresh vegetables [1b, 2b, 3b, 4b].

Okra has its own importance, taste, flavor and nutritional values as human food. It has good nutritional value particularly high content of calcium and vitamin C [5b, 6b]. It is grown extensively in the tropical, subtropical and warm temperature regions of the world especially in India, U.S.A., Africa, Asia, Nigeria, Sudan, Iraq, Pakistan, Turkey, Australia, U.K. and other neighboring countries. India ranks first in area and production in the world. It is a major commercial vegetable cultivated all over India particularly in the states of Andhra Pradesh, West Bengal, Jharkhand, Orissa, Uttar Pradesh, Madhya Pradesh, Karnataka, Gujarat and Maharashtra. India occupies an area of 532.66 thousand hectares with a production of 6346.37 thousand tones and productivity of 11.9 MT/ha [7b, 32, 33, 34, 35]. The *Earias vittella* (Lepidoptera: Noctuidae) is a widely distributed insect pest.

The attack of shoot and fruit borer (*E. vittella*) on okra starts 4 to 5 weeks after germination both in *Kharif* and summer seasons. The infested top tender shoots dries-up while flower, buds and developing fruits drop down pre-maturely and damaged fruits become unfit for human consumption. It is estimated that about 69 per cent loss in marketable yield due to attack of this insect on okra [8, 29, 30, 31]. In general, the overall damage due to the insect pests attack, results in 48.97 per cent loss in pod yield [9].

Material and Methods

The field experiment on evaluation of different bio-pesticides against major pests of okra using Parbhani OK-1 variety was conducted in a randomized block design with thirteen treatments including untreated control replicated thrice at the farm of Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *Kharif* season 2017-18 and 2018-19. The number *coccinellids* (grubs and adults) population was counted on five randomly selected plants in each plot. The pre-treatment count was made a day before each spray, while the post treatment counts were made on 1, 3, 7 and 15 days after each spray. The number of *coccinellids* per plant was transformed into suitable transformation (square root transformation) before the data was subjected to statistical analysis. The data were subjected to square root ($\sqrt{x}$ +0.5) and angular transformation as per data and then statistically analyzed to obtain critical difference for comparison of treatments as per Panse & Sukhatme [11].

Results and Discussion

First spray

The observations on effect of different bio-pesticides after first spray on *coccinnellid* on okra one day before spraying (precount), 1, 3, 7 and 15 DAS are presented in Table 1

Table 1: Effect of different bio-pesticides against *Coccinellids* on okra after first spraying during the years 2017 and 2018

Treatment Name and Number		Dose/mg/g or ml/ha	No. of Coccinellids (Grub & adults)/plant											
			2017						2018					
			Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean	Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean
T1	NSKE	25 kg	1.58 (1.60)	1.47 (1.56)	1.57 (1.60)	1.81 (1.67)	1.87 (1.69)	1.68 (1.63)	1.82 (1.67)	1.68 (1.63)	1.74 (1.65)	1.80 (1.67)	1.90 (1.70)	1.78 (1.66)
T2	LAMIT	3 lit	1.64 (1.62)	1.60 (1.61)	1.67 (1.63)	1.86 (1.69)	1.98 (1.72)	1.77 (1.66)	1.67 (1.36)	1.41 (1.55)	1.68 (1.63)	1.81 (1.67)	1.84 (1.68)	1.68 (1.63)
T3	Eucalyptus oil	1 lit	1.70 (1.64)	1.59 (1.60)	1.66 (1.63)	1.86 (1.69	1.95 (1.71)	1.76 (1.65)	1.74 (1.35)	1.70 (1.64)	1.73 (1.65)	1.82 (1.68)	1.87 (1.69)	1.78 (1.66)
T4	Karanj oil	2.5 lit	1.72 (1.65)	1.43 (1.58)	1.66 (1.63)	1.85 (1.69)	1.94 (1.71)	1.72 (1.65)	1.70 (1.63)	1.68 (1.63)	1.71 (1.64)	1.83 (1.68)	1.91 (1.70)	1.78 (1.66)
T5	Neem oil	1 lit	1.57 (1.63)	1.49 (1.57)	1.65 (1.62)	1.82 (1.68)	1.91 (1.70)	1.71 (1.64)	1.68 (1.63)	1.62 (1.61)	1.60 (1.61)	1.80 (1.67)	1.82 (1.67)	1.71 (1.64)
T6	*Metarhizium +Beauveria*	2 kg	1.56 (1.59)	1.35 (1.52)	1.52 (1.58)	1.73 (1.64)	1.82 (1.67)	1.60 (1.60)	1.69 (1.63)	1.66 (1.63)	1.72 (1.64)	1.90 (1.70)	1.91 (1.70)	1.79 (1.66)
T7	*Beauveria bassiana*	2 kg	1.49 (1.57)	1.41 (1.54)	1.59 (1.60)	1.78 (1.66)	1.81 (1.67)	1.64 (1.61)	1.71 (1.64)	1.51 (1.58)	1.69 (1.63)	1.78 (1.66)	1.92 (1.70)	1.72 (1.64)
T8	*Verticillium lecanii*	2 kg	1.50 (1.57)	1.36 (1.53)	1.50 (1.57)	1.71 (1.64)	1.87 (1.69)	1.61 (1.60)	1.72 (1.64)	1.50 (1.57)	1.61 (1.61)	1.73 (1.65)	1.79 (1.66)	1.65 (1.62)
T9	Dashparni ark	3 lit	1.44 (1.55)	1.27 (1.49)	1.44 (1.55)	1.61 (1.61)	1.77 (1.66)	1.52 (1.57)	1.73 (1.65)	1.53 (1.59)	1.59 (1.60)	1.67 (1.63)	1.75 (1.65)	1.63 (1.61)
T10	Biomix	1.5 kg	1.51 (1.58)	1.29 (1.51)	1.61 (1.61)	1.75 (1.66)	1.90 (1.70)	1.63 (1.62)	1.67 (1.63)	1.60 (1.61)	1.68 (1.63)	1.78 (1.66)	1.83 (1.68)	1.72 (1.64)
T11	Thiamthoxam 25 WG	225 g	1.54 (1.59)	0.90 (1.38)	0.92 (1.38)	0.95 (1.40)	1.00 (1.41)	0.94 (1.39)	1.83 (1.68)	0.60 (1.26)	0.62 (1.27)	0.72 (1.31)	0.81 (1.34)	0.68 (1.29)
T12	Emamectin benzoate 5 SG	100 g	1.41 (1.54)	0.82 (1.34)	0.85 (1.34)	0.88 (1.37)	0.92 (1.38)	0.86 (1.35)	1.80 (1.67)	0.52 (1.23)	0.57 (1.25)	0.60 (1.26)	0.69 (1.29)	0.59 (1.25)
T13	Control (water spray)		1.56 (1.59)	1.70 (1.64)	1.76 (1.66)	1.93 (1.71)	2.14 (1.77)	1.88 (1.69)	1.77 (1.66)	1.79 (1.66)	1.80 (1.67)	1.94 (1.71)	1.98 (1.74)	1.87 (1.69)
SE±			0.07	0.10	0.08	0.07	0.11	0.09	0.12	0.18	0.15	0.10	0.11	0.16
C.D. at 5%			NS	NS	0.24	0.21	0.34	0.27	NS	NS	NS	0.31	0.33	NS
CV			5.12	8.11	7.56	6.26	10.13	8.05	12.92	19.04	17.06	11.38	13.26	15.18

*Figures in parentheses are square root transformed values
DAS: Days After Spray
NS: Non-Significant

Precount

The precount of *coccinnellids* during 2017-18, 2018-19 was non-significant. It varied from 1.41 to 1.72/plant, and 1.67 to 1.83/plant during 2017-18, 2018-19, respectively.

One day after spray

During 2017-18, there were no significant differences of the effect of various bio-pesticides on *coccinellids*. The lowest population was observed in the plots treated with emamectin benzoate 5% SG (0.82/plant) and thiamethoxam 25 WG (0.90/plant). The untreated control recorded maximum population of *coccinellids* (1.70 /plant). Dashparni ark 0.6%, biomix 0.3%, *Metarhizium + Beauveria* 0.4%, *Verticilium lecanii* 0.4%, *Beauveria bassiana* 0.4% and karanj oil 0.5% were statistically at par with each other. Next biopesticides were NSKE 5%, neem oil 0.2% and eucalyptus oil 0.2%. LAMIT 0.6% (1.60/plant) recorded highest population among all the treated plots and were proved to be safer biopesticide against *Coccinellids.*

During 2018-19, significantly minimum number of

coccinellids was noticed in emamectin benzoate 5% SG (0.52/plant) and thiamethoxam 25 WG (0.60/plant) followed by LAMIT 0.6%. Remaining all treatments was statistically at par with each other. Eucalyptus oil 0.2% (1.70/plant) were beneficial biopesticides among the rest of the rest of treatments. Significantly maximum number of *coccinellids* (1.79 /plant) was recorded in untreated control. [11, 12, 13, 14]
Three days after spray.
During 2017-18, the population of *coccinellids* varied from 0.85 to 1.76/plant in various treatments. The untreated control recorded highest population and at par with LAMIT 0.6% (1.76/plant), eucalyptus oil 0.2%, karanj oil 0.5% and neem oil 0.2%. Among the all treatments emamectin benzoate 5% SG (0.85/plant) were proved to be harmful treatments. Next harmful treatments were thiamethoxam 25 WG and dashparni ark 0.6%.
During 2018-19, highest *coccinellids* was noticed in untreated control (1.80/plant) followed by NSKE 5% (1.74/plant), eucalyptus oil 0.2% (1.73/plant), *Metarhizium+Beauveria* 0.4%, karanj oil 0.5%, *Beauveria bassiana* 0.4%, LAMIT 0.6% and biomix 0.3% were safest among all bio-pesticides and at par with untreated control. The next less toxic biopesticides were *Verticilium lecanii* 0.4%, neem oil 0.2% and dashparni ark 0.6%. The most harmful insecticides to *coccinellids* were emamectin benzoate 5% SG (0.57/plant) and thiamethoxam 25 WG (0.62 /plant) which were at par with each other.

Seven days after spray
During 2017-18, the *coccinellids* population was significantly highest in untreated control (1.93/plant) than other treatments. Among the bio-pesticides, eucalyptus oil 0.2%, (1.86/plant) and LAMIT 0.5% (1.86/plant), recorded maximum *coccinellids* population and at par with karanj oil 0.5% (1.85/plant), neem oil 0.2% (1.82/plant) and NSKE 5% (1.81/plant). These were followed by *Beauveria bassiana* 0.4%, biomix 0.3%, *Metarhizium + Beauveria* 0.4% and *Verticilium lecanii* 0.4%. The most toxic insecticide was emamectin benzoate 5% SG (0.88 /plant) and thiamethoxam 25 WG (0.95/plant) [15, 16, 17, 18, 19].
The observations on *coccinellids* during 2018-19 revealed that the population varied from 0.60 to 1.94/plant in different treatments. The untreated control was statically significant over all bio-pesticides treatments. Among the bio pesticides, the safest bio pesticides to *coccinnellids* was *Metarhizium + Beauveria* 0.4%, (1.90/plant) followed by karanj oil 0.5% (1.83/plant), eucalyptus oil 0.2% (1.82/plant), LAMIT 0.5% (1.81/ plant), neem oil 0.2% (1.80/plant), NSKE 5% (1.80/plant), *Beauveria bassiana* 0.4% (1.78/plant), biomix 0.3% (1.78/plant)and *Verticilium lecanii* 0.4%(1.73/plant) which were at par with each other. The most deleterious effect on *coccinellids* was observed due to spraying of emamectin benzoate 5% SG (0.60/ plant) followed by thiamethoxam 25 WG.

Fifteen days after spray
During 2017-18, LAMIT 0.5% (1.98/plant), eucalyptus oil 0.2% (1.95 /plant), karanj oil 0.5% (1.94/plant), neem oil 0.2% (1.91/plant), biomix 0.3% (1.90/plant), were safest bio-pesticides than other bio-pesticides which were at par with each other. These were followed by *Verticilium lecanii* 0.4%, NSKE 5%, *Metarhizium + Beauveria* 0.4%, *Beauveria bassiana* 0.4%, and dashparni ark 0.6%. The plots treated with emamectin benzoate 5% SG (1.78/plant) and thiamethoxam 25 WG recorded lowest population. The untreated control recorded significantly highest population than other treatments [20, 21, 22, 23].
During 2018-19, it was found that emamectin benzoate 5% SG (0.69/ plant) and thiamethoxam 25% WG (0.81/plant) treated plots recorded minimum *coccinellids* population. The population was significantly highest in untreated control (1.98/plant). Among the biopesticides *Beauveria bassiana* 0.4% (1.92/plant) registered maximum population which was at par with *Metarhizium+Beauveria* 0.4% (1.91/plant), karanj oil 0.5% (1.91/plant) and NSKE 5% (1.90/plant). These were followed by eucalyptus oil 0.2% (1.87/plant), LAMIT 0.5% (1.84/plant), biomix 0.3% (1.83/ plant), neem oil 0.2% (1.82/plant) and *Verticilium lecanii* 0.4% (1.79/ plant).

Second spray
The data recorded on effect of different bio-pesticides on *coccinellids* after second spray on okra one day before spraying (precount), 1, 3, 7and 15 DAS are presented in Table 2.

Table 2: Effect of different bio-pesticides against *Coccinellids* on okra after second spraying during the years 2017 and 2018

Treatment Name and Number		Dose/mg/g or ml/ha	No. of Coccinellids (Grub & adults)/plant											
			2017						2018					
			Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean	Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean
T1	NSKE	25 kg	1.56 (1.59)	1.46 (1.56)	1.56 (1.59)	1.80 (1.67)	1.86 (1.68)	1.67 (1.62)	1.88 (1.69)	1.43 (1.56)	1.80 (1.67)	2.01 (1.73)	2.16 (1.77)	1.85 (1.68)
T2	LAMIT	3 lit	1.63 (1.62)	1.59 (1.61)	1.66 (1.63)	1.85 (1.69)	1.97 (1.72)	1.76 (1.66)	2.36 (1.82)	2.06 (1.74)	2.36 (1.85)	2.46 (1.85)	2.57 (1.88)	2.36 (1.83)
T3	Eucalyptus oil	1 lit	1.69 (1.64)	1.58 (1.60)	1.66 (1.63)	1.85 (1.68)	1.95 (1.71)	1.76 (1.65)	2.38 (1.83)	1.97 (1.71)	2.31 (1.81)	2.41 (1.84)	2.52 (1.87)	2.30 (1.80)
T4	Karanj oil	2.5 lit	1.73 (1.65)	1.51 (1.58)	1.62 (1.61)	1.84 (1.68)	1.93 (1.71)	1.72 (1.64)	2.41 (1.83)	1.84 (1.68)	2.27 (1.80)	2.36 (1.83)	2.47 (1.85)	2.23 (1.79)
T5	Neem oil	1 lit	1.56 (1.60)	1.48 (1.57)	1.64 (1.62)	1.81 (1.67)	1.90 (1.70)	1.70 (1.64)	2.06 (1.74)	1.77 (1.66)	2.16 (1.77)	2.28 (1.80)	2.38 (1.83)	2.14 (1.76)
T6	*Metarhizium +Beauveria*	2 kg	1.55 (1.59)	1.34 (1.52)	1.52 (1.58)	1.72 (1.64)	1.81 (1.67)	1.59 (1.60)	1.87 (1.68)	1.45 (1.56)	1.63 (1.61)	1.79 (1.66)	1.98 (1.71)	1.71 (1.63)
T7	*Beauveria bassiana*	2 kg	1.48 (1.57)	1.40 (1.54)	1.59 (1.60)	1.77 (1.66)	1.80 (1.67)	1.64 (1.61)	2.08 (1.75)	1.66 (1.62)	2.05 (1.74)	2.16 (1.77)	2.25 (1.79)	2.03 (1.73)
T8	*Verticilium lecanii*	2 kg	1.50 (1.57)	1.35 (1.53)	1.50 (1.57)	1.70 (1.64)	1.87 (1.69)	1.60 (1.60)	2.04 (1.73)	1.54 (1.59)	1.74 (1.65)	1.87 (1.69)	2.07 (1.74)	1.80 (1.66)
T9	Dashparni ark	3 lit	1.43	1.26	1.43	1.60	1.76	1.51	1.86	1.37	1.55	1.71	1.88	1.62

			(1.55)	(1.49)	(1.55)	(1.61)	(1.66)	(1.57)	(1.68)	(1.53)	(1.59)	(1.64)	(1.68)	(1.61)
T10	Biomix	1.5 kg	1.51 (1.58)	1.40 (1.54)	1.60 (1.61)	1.74 (1.65)	1.89 (1.70)	1.65 (1.62)	2.01 (1.73)	1.49 (1.57)	2.11 (1.76)	2.26 (1.80)	2.34 (1.82)	2.05 (1.73)
T11	Thiamthoxam 25 WG	225 g	1.53 (1.58)	0.76 (1.32)	0.82 (1.35)	0.93 (1.39)	1.00 (1.41)	0.87 (1.36)	1.63 (1.62)	1.02 (1.42)	1.15 (1.45)	1.24 (1.49)	1.39 (1.54)	1.20 (1.47)
T12	Emamectin benzoate 5 SG	100 g	1.40 (1.54)	0.67 (1.29)	0.73 (1.31)	0.76 (1.33)	0.85 (1.35)	0.75 (1.32)	1.74 (1.65)	0.94 (1.39)	1.00 (1.41)	1.12 (1.45)	1.22 (1.48)	1.07 (1.43)
T13	Control (water spray)		1.56 (1.59)	1.64 (1.62)	1.76 (1.66)	1.92 (1.70)	1.99 (1.73)	1.82 (1.67)	1.86 (1.69)	2.21 (1.79)	2.39 (1.83)	2.53 (1.87)	2.63 (1.90)	2.44 (1.84)
SE±			0.12	0.09	0.07	0.09	0.10	0.08	0.06	0.05	0.08	0.06	0.07	0.06
C.D. at 5%			NS	NS	NS	NS	0.32	NS	NS	0.15	0.24	0.19	0.22	0.20
CV			11.01	9.86	6.44	8.12	10.44	8.85	6.78	5.33	7.23	5.86	8.56	6.74

*Figures in parentheses are square root transformed values
DAS: Days after Spray
NS: Non-Significant

Precount
The precount of ladybird beetle was non-significant in 2017-18 and 2018-19. The population ranged from 1.40 to 1.73 and 1.40 to 1.73, respectively.

One day after spray
During 2017-18, there were no statistically significant differences among different treatments. The untreated control (1.64/plant) recorded maximum population followed by LAMIT 0.5% (1.59/plant), eucalyptus oil 0.2% (1.58/plant) and karanj oil 0.5% (1.51/plant). The next less harmful biopesticides were neem oil 0.2%, NSKE 5%, *Beauveria bassiana* 0.4%, biomix 0.3%, *Verticilium lecanii* 0.4% and *Metarhizium+ Beauveria* 0.4%. Emamectin benzoate 5% SG (0.67/plant) recorded lowest population [24, 25, 26, 27].
During 2018-19, the safest bio-pesticide to *coccinellids* was LAMIT 0.5% (2.06/plant) which recorded highest population among all biopesticide. The next less harmful biopesticides were eucalyptus oil 0.2%, karanj oil 0.5%, neem oil 0.2%, *Beauveria bassiana* 0.4%, *Verticilium lecanii* 0.4%, biomix 0.3%, *Metarhizium+ Beauveria* 0.4%, NSKE 5% and dashparni ark 0.6%. The most toxic insecticides were emamectin benzoate 5% SG (0.94/plan) and thiamethoxam 25% WG (1.02/ plant). The untreated control (2.21/plant) noted highest population over all treatments.

Three days after spray
During 2017-18, it was found that the most toxic insecticide was emamectin benzoate 5 SG (0.73/plant) which was at par with thiamehoxam 25 WG. The safer biopesticides were LAMIT 0.6 (1.66/plant) and eucalyptus oil 0.2% which recorded maximum *coccinnellids* among all biopesticides. The next best treatments were neem oil 0.2%, karanj oil 0.5%, biomix 0.3%, *Beauveria bassiana* 0.4%, NSKE 5%, *Metarhizium+ Beauveria* 0.4% and *Verticilium lecanii* 0.4%. The highest *coccinellids* was observed in untreated control (1.76/plant) among all treatments.
During 2018-19, there were no statistically significant differences among treatments. The untreated control (2.39/plant) recorded higher *coccinellids*. Among the biopesticides, LAMIT 0.6% (2.36/plant) was safer to *coccinellids* than any other biopesticides. These were followed by eucalyptus oil 0.2%, karanj oil 0.5%, neem oil 0.2%, biomix 0.3%, *Beauveria bassiana* 0.4%, NSKE 5%, *Verticilium lecanii* 0.4
%, *Metarhizium+Beauveria bassiana* 0.4% and dashparni ark 0.6% (1.55/plant). The lowest population was observed in the plots treated with emamectin benzoate 5% SG (1.00/plant) followed by thiamethoxam 25% WG (1.15/plant) [28].

Seven days after spray
During 2017-18, the *coccinellids* population ranged from 0.76 to 1.92/plant. The *coccinellids* population was statistically significant high in untreated control (1.92/plant). Among the bio-pesticide treatment, the plots sprayed with LAMIT 0.6% (1.85/plant) and eucalyptus oil 0.2% (1.85/plant) registered maximum population. The next less harmful bio-pesticides were karanj oil 0.5%, neem oil 0.2%, NSKE 5%, *Beauveria bassiana* 0.4%, biomix 0.3%, *Metarhizium+Beauveria* 0.4% and *Verticilium lecanii* 0.%. The minimum population was observed in biopesticide treatments was dashparni ark 0.6%. The most deleterious effects were of emamectin benzoate 5% SG and thiamethoxam 25% WG.
The data on effect of various bio-pesticides on *coccinellids* during 2018-19 revealed that the plots treated with emamectin benzoates 5% SG (1.12/plant) recorded lowest population followed by thiamethoxam 25% WG (1.36/plant). The plots sprayed with LAMIT 0.6% (2.46/plant) noted maximum population and safer to *coccinnellids* among all biopesticides. It was at par with eucalyptus oil 0.2% (2.46/plant) and karanj oil 0.5% (2.41/ plant). These were followed by neem oil 0.2% (2.36/plant), biomix 0.3% (2.26/plant), *Beauveria bassiana* 0.4%(2.16/plant) and NSKE 5% (2.01/plant), *Verticilium lecanii* 0.4% (1.87/plant), *Metarhizium+Beauveria* 0.4% (1.79/plant) and dashparni ark 0.6% (1.71/plant). The highest population was noticed in untreated control (2.53/plant) among all treatments.

Fifteen days after spray
During 2017-18, the *coccinellids* population was highest in untreated control (1.99/plant). Among all bio-pesticides the maximum population was observed in LAMIT 0.6% (1.97/plant) followed by eucalyptus oil 0.2% (1.95/plant), karanj oil 0.5% (1.93/plant) and neem oil 0.2% which was at par with untreated control. These were followed by biomix 0.3% (1.89/plant), *Verticilium lecanni* 0.4% (1.87 / plant), NSKE 5% (1.86 / plant), *Metarhizium + Beauveria* 0.4% (1.81/plant), NSKE 5% (1.86 / plant), *Metarhizium + Beauveria* 0.4% (1.81/plant), *Beauveria bassiana* 0.4% (1.80/plant) and dashparni ark 0.6% (1.76/plant). The lowest population was recorded in emamectin benzoate 5% SG (0.85/plant) followed by thiamethoxam 25% WG (1.00/plant).
During 2018-19, LAMIT 0.6% (2.57/plant) recorded maximum population and safer to *coccinnellids* and at par with eucalyptus oil 0.2% and karanj oil 0.5%. Next beneficial biopesticides were neem oil 0.2%, biomix 0.3%, *Beauveria*

bassiana 0.4%, NSKE 5% and *Verticilium lecanii* 0.4%. These were followed by *Metarhizium* + *Beauveria* 0.4% and dashparni ark 0.6%. The most harmful insecticide were emamectin benzoate 5% SG (1.22/plant) and thiamethoxam 25% WG (1.39 / plant). The highest population was noted in untreated control (2.63/plant) among all treatments.

Third spray

The data on ladybird beetle population on one day before, 1, 3 7 and 15 DAS of third spraying are given in Table 3

Table 3: Effect of different bio-pesticides against *Coccinellids* on okra after third spraying during the years 2017 and 2018

Treatment Name and Number		Dose/mg/g or ml/ha	No. of Coccinellids (Grub & adults)/plant											
			2017						2018					
			Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean	Pre-count	1 DAS	3 DAS	7 DAS	15 DAS	Mean
T1	NSKE	25 kg	1.87 (1.69)	1.41 (1.55)	1.78 (1.66)	1.99 (1.72)	2.14 (1.77)	1.83 (1.67)	3.01 (2.00)	2.15 (1.76)	2.25 (1.79)	2.32 (1.81)	2.40 (1.83)	2.28 (1.79)
T2	LAMIT	3 lit	2.34 (1.77)	2.04 (1.74)	2.34 (1.82)	2.44 (1.85	2.55 (1.88)	2.34 (1.82)	3.34 (2.08)	2.69 (1.91)	2.78 (1.93)	2.88 (1.96)	3.03 (2.00)	2.84 (1.95)
T3	Eucalyptus oil	1 lit	2.36 (1.80)	1.95 (1.71)	2.29 (1.81)	2.40 (1.84)	2.50 (1.87)	2.28 (1.80)	3.35 (2.08)	2.58 (1.88)	2.64 (1.90)	2.76 (1.93)	2.89 (1.96)	2.71 (1.91)
T4	Karanj oil	2.5 lit	2.39 (1.84)	1.82 (1.67)	2.25 (1.80)	2.34 (1.82)	2.45 (1.85)	2.21 (1.78)	3.26 (2.06)	2.51 (1.86)	2.58 (1.88)	2.68 (1.91)	2.80 (1.94)	2.64 (1.89)
T5	Neem oil	1 lit	2.80 (1.94)	1.75 (1.65)	2.14 (1.77)	2.26 (1.80)	2.36 (1.83)	2.12 (1.76)	2.59 (1.88)	2.25 (1.79)	2.35 (1.82)	2.42 (1.84)	2.51 (1.86)	2.38 (1.82)
T6	*Metarhizium* +*Beauveria*	2 kg	3.00 (2.00)	1.43 (1.56)	1.61 (1.61)	1.77 (1.66)	1.96 (1.72)	1.69 (1.63)	2.32 (1.81)	1.92 (1.69)	1.99 (1.72)	2.08 (1.74)	2.17 (1.77)	2.04 (1.73)
T7	*Beauveria bassiana*	2 kg	2.06 (1.74)	1.64 (1.61)	2.03 (1.74)	2.14 (1.76)	2.23 (1.79)	2.01 (1.72)	3.11 (2.02)	2.34 (1.82)	2.43 (1.84)	2.51 (1.86)	2.59 (1.88)	2.46 (1.85)
T8	*Verticillium lecanii*	2 kg	2.02 (1.73)	1.53 (1.58)	1.72 (1.64)	1.85 (1.68)	2.05 (1.74)	1.78 (1.66)	2.84 (1.96)	2.01 (1.72)	2.10 (1.75)	2.20 (1.78)	2.28 (1.80)	2.14 (1.76)
T9	Dashparni ark	3 lit	1.84 (1.68)	1.35 (1.53)	1.53 (1.58)	1.69 (1.64)	1.86 (1.68)	1.60 (1.60)	2.71 (1.92)	1.80 (1.66)	1.90 (1.69)	1.99 (1.72)	2.08 (1.74)	1.94 (1.70)
T10	Biomix	1.5 kg	1.99 (1.72)	1.47 (1.56)	2.09 (1.75)	2.24 (1.80)	2.32 (1.82)	2.03 (1.73)	3.22 (2.05)	2.43 (1.84)	2.49 (1.86)	2.58 (1.88)	2.68 (1.91)	2.54 (1.87)
T11	Thiamthoxam 25 WG	225 g	1.61 (1.61)	0.95 (1.39)	1.17 (1.47)	1.34 (1.52)	1.49 (1.57)	1.23 (1.48)	3.53 (2.12)	1.16 (1.47)	1.30 (1.51)	1.41 (1.55)	1.53 (1.59)	1.35 (1.53)
T12	Emamectin benzoate 5 SG	100 g	1.35 (1.53)	0.82 (1.35)	0.92 (1.37)	1.22 (1.48)	1.37 (1.53)	1.08 (1.43)	3.40 (2.09)	1.09 (1.44)	1.20 (1.48)	1.32 (1.52)	1.44 (1.56)	1.26 (1.50)
T13	Control (water spray)		1.84 (1.68)	2.19 (1.78)	2.37 (1.83)	2.51 (1.87)	2.62 (1.89)	2.42 (1.84)	2.74 (1.93)	3.08 (2.02)	3.21 (2.05)	3.32 (2.07)	3.47 (2.11)	3.27 (2.06)
SE±			0.05	0.07	0.05	0.06	0.04	0.05	0.06	0.13	0.08	0.05	0.10	0.09
C.D. at 5%			0.17	0.21	0.15	0.18	0.14	0.17	0.20	0.39	0.24	0.16	0.30	0.27
CV			5.01	6.19	4.39	7.01	4.76	5.58	7.86	11.13	8.15	5.68	9.47	8.60

*Figures in parentheses are square root transformed values
DAS: Days after Spray
NS: Non-Significant

Precount

The precount of ladybird beetle was significant in 2017-18 and 2018-19. The population ranged from 1.35 to 3.00 and 2.32 to 3.53 /plant during 2017-18 and 2018-19, respectively.

One day after spray

During 2017-18, the untreated control recorded highest population (2.19/plant) which was at par with LAMIT 0.6% (2.04/plant). Itwas Followed by eucalyptus oil 0.2% (1.95/plant), karanj oil 0.5% (1.82/plant) and neem oil 0.2% (1.75/plant). The next treatment were *Beauveria bassiana* 0.4% (1.64/plant), *Verticilium lecanii* 0.4% (1.53/plant), biomix 0.3%(1.47/plant), *Metarhizium+Beauveria* 0.4% (1.43/plant), NSKE 5% (1.41/plant) &dashparni ark 0.6% (1.35/plant). The lowest population was noticed in emamectin benzoate 5% SG (0.82/plant) which was at par with thiamethoxam 25% WG (0.95/plant).

During 2018-19, the maximum ladybird beetle population was observed in untreated control (3.08/plant). The safer biopesticides against lady bird beetle were LAMIT 0.6% (2.69/plant), eucalyptus oil 0.2% (2.58/ plant), karanj oil 0.5% (2.51/plant), biomix 0.3% (2.43/plant), and *Beauveria bassiana* 0.4% (2.34/plant). These were followed by neem oil 0.2% (2.25/plant), NSKE 5% (2.15/plant), *Verticilium lecanii* 0.4% (2.01/plant), *Metarhizium+Beauveria* 0.4% (1.92/plant) and dashparni ark 0.6% (1.80/plant). The treatment emamectin benzoate 5% SG G (1.09/plant) recorded minimum population which was at par with remaining treatments.

Three days after spray

During 2017-18, the untreated control recorded highest lady bird beetle population (2.37/plant) which was at par with LAMIT 0.6% (2.34/plant) and eucalyptus oil 0.2% (2.29/plant) followed by karanj oil 0.5% (2.25/plant), neem oil 0.2% (2.14/plant) biomix 0.3% (2.09/plant) and *Beauveria bassiana* 0.4% (2.03/plant).These were followed by NSKE 5% (1.78/plant), *Verticilium lecanii* 0.4%(1.72/plant), *Metarhizium+Beauveria* 0.4% (1.61/plant) and dashparni ark 0.6% (1.53/plant).The lowest population was noted in emamectin benzoate 5% SG (0.92/plant) and thiamethoxam 25% WG (1.17/plant).

During 2018-19, the untreated control (3.21/plant) recorded highest ladybird beetle population. The best safer biopesticides among the all treatments to *coccinellids* were LAMIT 0.6% (2.78/plant), eucalyptus oil 0.2% (2.64/ plant)

and karanj oil 0.5% (2.58/plant). These were followed by biomix 0.3% (2.49/plant), *Beauveria bassiana* 0.4% (2.43/plant), neem oil 0.2% (2.35/plant), NSKE 5% (2.25/plant), *Verticilium lecanii* 0.4% (2.10/plant), *Metarhizium+Beauveria* 0.4% (1.99/plant) and dashparni ark 0.6% (1.90/plant). The lowest population was found in emamectin benzoate 5% SG (1.20/plant) which was at par with thiamethoxam 25 WG (1.30/plant).

Seven days after spray

During 2017-18, the maximum ladybird beetle population was observed in untreated control (2.51/plant) which was at par with LAMIT 0.6% (2.44/plant) and eucalyptus oil 0.2% (2.40/plant). Next safer biopesticides were karanj oil 0.5% (2.34/plant), neem oil 0.2% (2.26/plant), biomix 0.3% (2.24/plant), and *Beauveria bassiana* 0.4% (2.14/plant). These were followed by NSKE 5%, *Verticilium lecanii* 0.4%, *Metarhizium+Beauveria*0.4% and dashparni ark 0.%. The plots sprayed with emamectin benzoate 5% SG (1.22/plant) and thiamethoxam 25% WG were noticed less population as compared to other treatments.

The data of ladybird beetle during 2018-19 revealed that the untreated control (3.32/plant) registered highest population. LAMIT 0.6% (2.88/plant), eucalyptus oil 0.2% (2.76/plant), karanj oil 0.5% (2.68/plant), biomax 0.3% (2.58/plant) and *Beauveria bassiana* 0.4% (2.51/plant) were proved to best biopesticides against *coccinellids.* These were followed by neem oil 0.2% (2.42/plant) and NSKE 5% (2.32/plant).These were followed by *Verticilium lecanii* 0.4% (2.20/plant), *Metarhizium+Beauveria* 0.4% (2.08/plant) and dashparni ark 0.6% (1.99/plant). The plots treated with emamectin benzoate 5% SG (1.32/plant) and thiamethoxam 25% WG observed minimum population among the all treatments.

Fifteen days after spray

During 2017-18, it was found that the untreated control (2.62/plant) recorded maximum population which was at par with LAMIT 0.6% (2.55/plant). Next safer biopesticides were eucalyptus oil 0.2% (2.50/plant), karanj oil 0.5% (2.45 / plant), neem oil 0.2% (2.36 / plant), biomix 0.3% (2.32 /plant), *Beauveria bassiana* 0.4% (2.23/plant) and NSKE 5% (2.14/ plant). These were followed by *Verticilium lecanii* 0.4% (2.05/plant), *Metarhizium+Beauveria* 0.4% (1.96/plant) and dashparni ark 0.6% (1.86 / plant). The lowest population was found in emamectin benzoate 5% SG followed by thiamethoxam 25% WG.

During 2018-19, the maximum population of ladybird beetle was observed in untreated control (3.47/plant), LAMIT 0.6% (3.03/plant), eucalyptus oil 0.2% (2.89/plant) and karanj oil 0.5% (2.80/plant) were safest biopesticides as compared to other treatments. These were followed by biomix 0.2% (2.68/plant), *Beauveria bassiana* 0.4% (2.59/plant)and neem oil 0.2% (2.51/plant). The next treatments were NSKE 5% *Verticilium lecanii* 0.4%, *Metarhizium+Beauveria* 0.4% and dashparni ark 0.6%. The minimum population was recorded in emamectin benzoate 5% SG (1.44/plant) and thiamethoxam 25% WG which were at par with each other.

Pooled data 2017-18 and 2018-19

The data recorded on *coccinellids* population one day before spraying and after each spraying were presented in Table 4

Table 4: Effect of different bio-pesticides against *Coccinellids* on okra after different spraying (Pooled data of 2017 & 2018)

Tr No	Treatment	Dose g or ml/ha	No. of *Coccinellids* (Grub & adults)/plant					
			Precount	After first spray	Precount	After second spray	Precount	After third spray
T1	NSKE	25 kg	1.70 (1.63)	1.73 (1.64)	1.72 (1.64)	1.76 (1.65)	2.44 (1.84)	2.05 (1.73)
T2	LAMIT	3 lit	1.65 (1.62)	1.72 (1.64)	1.99 (1.72)	2.06 (1.74)	2.84 (1.92)	2.59 (1.88)
T3	Eucalyptus oil	1 lit	1.72 (1.64)	1.77 (1.65)	2.03 (1.73)	2.03 (1.72)	2.85 (1.95)	2.49 (1.98)
T4	Karanj oil	2.5 lit	1.71 (1.64)	1.75 (1.65)	2.07 (1.74)	1.97 (1.71)	2.82 (1.92)	2.42 (1.83)
T5	Neem oil	1 lit	1.62 (1.61)	1.71 (1.64)	1.81 (1.67)	1.92 (1.70)	2.69 (1.90)	2.25 (1.79)
T6	*Metarhizium +Beauveria*	2 kg	1.62 (1.61)	1.69 (1.63)	1.71 (1.63)	1.65 (1.61)	2.66 (1.90)	1.86 (1.68)
T7	*Beauveria bassiana*	2 kg	1.60 (1.60)	1.68 (1.62)	1.78 (1.66)	1.83 (1.67)	2.58 (1.88)	2.23 (1.78)
T8	*Verticilium lecanii*	2 kg	1.61 (1.61)	1.63 (1.61)	1.77 (1.65)	1.70 (1.63)	2.43 (1.84)	1.96 (1.71)
T9	Dashparni ark	3 lit	1.58 (1.59)	1.57 (1.59)	1.64 (1.61)	1.56 (1.59)	2.27 (1.80)	1.77 (1.65)
T10	Biomix	1.5 kg	1.59 (1.60)	1.67 (1.63)	1.76 (1.65)	1.85 (1.67)	2.60 (1.88)	2.28 (1.80)
T11	Thiamthoxam 25 WG	225 g	1.68 (1.63)	0.81 (1.34)	1.58 (1.60)	1.03 (1.41)	2.57 (1.86)	1.29 (1.50)
T12	Emamectin benzoate 5 SG	100 g	1.60 (1.60)	0.72 (1.30)	1.57 (1.59)	0.91 (1.37)	2.37 (1.81)	1.17 (1.46)
T13	Control (water spray)		1.66 (1.62)	1.87 (1.69)	1.71 (1.64)	2.15 (1.76)	2.29 (1.80)	2.84 (1.95)
SE±			0.09	0.12	0.09	0.07	0.05	0.07
C.D. at 5%			NS	0.36	NS	0.22	NS	0.22
C.V.%			9.02	11.65	8.89	7.79	6.43	7.09

Precount

The Precount of *coccinellids* was showing non-significant population in all plots during both years 2017-18 and 2018-19. Before first, second and third spray, it varied from 1.58 to 1.72, 1.57 to 2.07 and 2.27 to 2.85/plant, respectively. The pooled data were also non-significant.

After spray

The pooled data of two years showed that after first spray the untreated control (1.87/plant) recorded maximum population. Eucalyptus oil 0.2% (1.77/plant) was proved to be safer biopesticides among the all treatments followed by karanj oil 0.5 (1.75/plant), NSKE 5% (1.73/plant), LAMIT 0.6% (1.72/plant), neemoil 0.2%(1.71/plant),*Metarhizium+Beauveria* 0.4% (1.69/plant), *Beauveria bassiana* 0.4%,biomix 0.3%, *Verticilium lecanii* 0.4%, and dashparni ark 0.6%. Emamectin benzoate 5 SG proved harmful insecticides to *coccinellids* followed by thiamethoxam 25% WG.

The pooled data of two years indicated that after second spray maximum population was observed in untreated control (2.15/plant) which was at par with LAMIT 0.6%. The less harmful biopesticides were eucalyptus oil 0.2%, karanj oil 0.5% and neem oil 0.2%. These were followed by biomix 0.3%, *Beauveria bassiana* 0.4%, NSKE 5%, *Verticilium lecanii* 0.4%, *Metarhizi-um+Beauveria* 0.4% and dashparni ark 0.6%. The minimum population was recorded in emamectin benzoate 5% SG and thiamethoxam 25% WG.

The pooled data of two years observed that after third spray the population ranged between 1.17 to 2.81/ plant in various treatments. The untreated control recorded maximum ladybird beetle population. Among the biopesticides LAMIT 0.6%, eucalyptus oil 0.2%, karanj oil 0.5% and biomix 0.3% recorded maximum population. These were followed by *Beauveria bassiana* 0.4%, neem oil 0.2%, NSKE 5%, *Verticilium lecanii* 0.4%, *Metarhizium+Beauveria bassiana* 0.4% and dashparni ark 0.6%. The most toxic insecticides were emamectin benzoate 5% SG (1.17/plant) and thiamethoxam 25% WG (1.29/plant).

Conclusion

Okra is an important crop grown throughout India during *Kharif* as well as in *Zayad* cropping seasons. The crop is subjected to attacked by many insect-pests including okra fruit and shoot borer, aphids and whiteflies. The use of pesticides is been more popular to manage these pests without knowing these pesticides effect on our friend insects like natural enemies of aphids and whiteflies. The present study was dealt with these aspects of pesticides and the results revealed that tested biopesticides LAMIT 0.6%, eucalyptus oil 0.2%, karanj oil 0.5% and biomix 0.3% recorded maximum population. Followed by *Beauveria bassiana* 0.4%, Neem oil 0.2% and NSKE 5%. These were followed by *Verticilium lecanii* 0.4% *Metarhizium+Beauveria bassiana* 0.4% and dashparni ark 0.6%. The most toxic insecticides were emamectin benzoate 5% SG and thiamethoxam 25% WG.

References

1. Abhishek Shukla, Pathak SC, Agrawal RK. Seasonal incidence of okra shoot and fruit borer *Earias vittella* (Fab.) and effect of temperature on its infestation Advances in Plant Sciences Anonymous (2014). Indian Horticulture database. 1997; 10(1):169-172.
2. Dhaka SR, Pareek BL. Estimation of avoidable losses due to insect pest complex and economics of spray schedules in cotton. Indian Journal of Entomology. 2007; 69(4):387-391.
3. Jagtap CR, Shetgar SS, Nalwandikar PK. Fluctuations in population of lepidopterous pests infesting okra in relation to weather parameters during kharif. Indian J. of Entomol. 2007; 69(3):221-223.
4. Kanwar N, Ameta OP. Assessment of losses caused by insect pests of okra (*Abelmoschus esculentus* (L.) Moench), Pestology. 2007; 31 (6):45-47.
5. Muhammad AA, Mansoor Ul H, Jamshaid I, Amjad A. Role of different weather factors on fluctuation of fruit and shoot infestation of spotted bollworms, *Earias* spp. on okra. (*Abelmoschus esculentus* L.). Int. J for Agro Vete. Med. Sci. 2009; 3(2):64-72.
6. Rawat RR, Sahu HR. Estimation of losses in growth and yield of okra due to *Empoasca devastans* Dist. (Cicadellidae) and *Earias* spp. Indian J Entomol. 1973; 35(3):252-254.
7. Sharma RP, Swaminathan R, Bhati KK. Seasonal incidence of fruit and shoot borer of okra along with climatic factors in Udaipur Region of India. Asian Journal of Agricultural Research. 2010; 4:232-236.
8. Varmudy V. Marketing of vegetable in India. Daya Publishing House, New Delhi. 2001; 72:110-035.
9. Ahmed MMM. Studies on the control of insect pests in vegetables (okra, tomatoes and onion) in Sudan with special reference to neem preparations. Ph. D Thesis, University of Giessen, Germany, 2000.
10. Bhargava KK, Ashok B, Bhatnaga A. Bioefficacy of imidacloprid as a seed dresser against sucking pests of okra. Pest. Manage. Economic Zoology. 2001; 9:31-34.
11. Chinniah C, Ali KA. Relative efficacy of insecticides/acaricides against sucking insects of okra. Pest. Manage. Economic Zoology. 2000; 8:111-116.
12. Chopra R, Nayar SL, Chopra IC. Glossary of Indian Medicinal Plants. 1st Edn. National Institute of Science Communications, New Delhi, India, 1956.
13. Fuson KJ, Godfrey LD, Wynholds PF. Agronomic and environmental factors influencing cotton aphid, *Aphis gossypii* Glover insecticide efficacy. Proceedings of the Beltwide Cotton Conference, January 1995, National Cotton Councial America Memphis, TN. 1995; 5-8:995-997.
14. Gahukar RT. Botanicals for use against vegetable pests and diseases: A review. International Journal of Vegetable. Science. 2005; 13:41-60.
15. Godfrey LD, Fuson KJ. Environmental and host plant effects on insecticide susceptibility of the cotton aphid (Homoptera: Aphididae). Journal of Cotton Science. 2001; 5:22-29.
16. Isman MB, Koul O, Luczynski A, Kaminski J. Insecticidal and antifeedant bioactivities of neem oils and their relationship to azadirachtin content. Journal of Agricultural and Food Chemistry. 1990; 38:1406-1411.
17. Jaetzold R, Schmidt H. Farm Management Handbook of Kenya: MOALD. 1st Edn., Eastern Kenya, Nairobi, 1983.
18. Kerns DL, Gaylor MJ, Insecticide resistance in field populations of the cotton aphid (Homoptera: Aphididae). Journal of Economic Entomology. 1992; 85:1-8.
19. Khaire VA, Naik RL. Efficacy of some synthetic pyrethroids against the pest complex on okra. South

Indian Horticulture. 1986; 34:112-114.
20. Lowery DT, Isman MB, Bhard NL. Laboratory and field evaluation of neem for the control of aphids (Homoptera: Aphididae). Journal of Economic Entomology. 1993; 6:864-870.
21. MOA. Annual Report. Ministry of Agriculture, Horticulture Division. Nairobi, Kenya, 2006.
22. Misra HP. Field evaluation of some newer insecticides against aphids (*Aphis gossypii*) and jassids (*Amrasca biguttula biguttula*) on okra. Indian Journal of Entomology. 2002; 64:80-84.
23. Obeng-Ofori D, Sackey J. Field evaluation of non-synthetic insecticides for the management of insect pests of okra (*Abelmoschus esculentus* (L.) Moench) in Ghana. SINET: Eth. Journal of Science. 2003; 26:145-150.
24. Praveen PM, Dhandapani N. Eco-friendly management of major pests of okra (*Abelmoschus esculentus* (L.) Moench). Journal of Vegetable Crop Production. 2002; 7:3-11.
25. Schmutterer H. Properties and potential of natural pesticides from the neem tree, *Azadirachta indica*. Annual Review of Entomology. 1990; 35:271-297.
26. Seif A. Preparing small holder export vegetable producer for compliance with the European Union regulations on maximum pesticide residues limits and hygiene standards. International Centre of Insect Physiology and Ecology (ICIPE) Final Report, ICIPE Science Press, Nairobi, 2002.
27. Sreelatha, Divakar BJ. Impact of imidacloprid seed treatment on insect pest incidence in okra. Indian Journal of Plant Protectection. 1997; 25:52-55.
28. Uthamasamy S, Balasubramanian M. Efficacy of some insecticides in controlling the pests of bhendi (*Abelmoschus esculentus* (L.) Moench). Pesticides. 1976; 12:39-41.
29. Varela AN, Seif A. A Guide to IPM and Hygiene Standards in okra Production in Kenya. ICIPE Science Press, Nairobi, ICIPE, 2004.
30. Yamasaki RB, Klocke JA. Structure bioactivity relationship of azadirachtin, a potential insect control agent. Journal of Agricultural and Food Chemistry. 1987; 35:467-471.
31. Anonymous. Indian Horticulture database, 2014.
32. Anitha KR, Nandihalli BS. Seasonal incidence of sucking pests in okra ecosystem. Karnataka Journal of Agricultural Science. 2008; 21(1):137-138.
33. Chaudhary HR, Dadheech LN. (Incidence of insects attacking okra and the avoidable losses caused by them. Annual Report of Arid Zone. 1989; 28(3-4):305-307.
34. Krishnaiah K. Methodology for assessing crop losses due to pests of vegetable and assessment of crop losses due to pests and diseases in: Proc. of Workshop held from Sept, 1977 at U.A.S., Bangalore. 1980; 19-30:259-267.
35. Rawat RR, Sahu HR. Estimation of losses in growth and yield of okra due to *Empoasca devastans* Dist. (Cicadellidae) and Earias spp. Indian Journal of Entomology. 1973; 35(3):252-254.
36. Srinivasa R, Rajendran R. Joint action potential of neem with other plant extracts against the leaf hopper *Amrasca devastance* (Distant) on okra. Pest Mangement and Economic Zoology. 2003; 10:131-136.