Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.3017

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (3):** 1035-1043 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Seasonal Incidence and Bioefficacy of Newer Insecticides and Biopesticide against Aphids on Okra and Their Effect on Natural Enemies

B. A. Bade*, N. A. Nimbalkar, S. B. Kharbade and A. S. Patil

Department of Entomology, National Agricultural Research Project, Ganeshkhind, Pune, Maharashtra, India

*Corresponding Author E-mail: bade.babasaheb@gmail.com

Received: 24.05.2017 | Revised: 5.06.2017 | Accepted: 6.06.2017

ABSTRACT

Okra, Abelmoschus esculentus (L.) Moench commonly known as Bhendi is one of the most important vegetable crops in India. It is attacked by about twenty insect pests during different growth stages of which aphids, Aphis gossypii Glover is the most important sucking pest of okra which attacks at any stage of crop growth.

In present investigation, insecticidal treatments with acetamiprid 20 SP @ 15 g a.i./ha followed by Verticillium lecanii @ 2.5 kg/ha, acetamiprid 20 SP @ 15 g a.i./ha and thiamethoxam 25 WG @ 25 g a.i./ha were found most effective treatment against aphids after four sprays. The use of V. lecanii @ 2.5 kg/ha alone was found effective in controlling population of aphids on okra with minimum mortality of lady bird beetles as compared to other insecticides. At 10 days after sprays, the treatment with V. lecanii recorded highest population of 4.49 lady bird beetles/plant and it was superior over all the treatments except untreated control.

Key words: *Okra, Aphids, Seasonal Incidence, Newer Insecticides, V. lecanii*

INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench is an important vegetable crop, commonly known as *Bhendi* in India. Okra is of African origin but grown extensively in the tropical, subtropical and warm temperature regions of the world especially in U.S.A., Africa, Asia, Nigeria, Sudan, Iraq, Pakistan, Turkey, Australia, U.K. and other neighboring countries. In India, it is cultivated in all seasons and occupies an area of 533 thousand hectares with a production of 6346 thousand tones and productivity of 11.90 mt/ha[2].

Okra plants are attacked by about twenty insect pests during different growth stages. The major pests of okra are shoot and fruit borer and sucking pests. Among the important sucking pests of okra, aphids (*Aphis gossypii* Glover) attacks the crop right from early seedling stage to last fruit harvesting and found damaging okra all over India. It also acts as vector of virus and transmits mosaic, leaf curl etc[3].

The multiplication of aphids has been found to be favoured by different environmental factors.

Cite this article: Bade, B.A., Nimbalkar, N.A., Kharbade, S.B. and Patil, A.S., Seasonal Incidence and Bioefficacy of Newer Insecticides and Biopesticide against Aphids on Okra and Their Effect on Natural Enemies, *Int. J. Pure App. Biosci.* **5(3):** 1035-1043 (2017). doi: http://dx.doi.org/10.18782/2320-7051.3017

To formulate effective management strategy against this pest proper understanding of its behavior and seasonal abundance in relation to weather parameters is very essential. The excessive use of insecticides is also responsible for problems of insecticide residues in okra. Hence, the entomophagous fungi like *V. lecanii* may be exploited against aphids on okra in *Kharif* season when the climatic conditions are most favourable for their use.

MATERIALS AND METHODS

The field experiment was conducted to study the seasonal incidence and bioefficacy of newer insecticides and biopesticide (*Verticillium. lecanii*) against aphids on okra during *Kharif* season 2015 at Vegetable Improvement Project, NARP Ganeshkhind, Pune. The experiment was laid out in Randomized Block Design with twelve treatments and three replications. The net plot size was maintained at 1.80 x 1.50 m^2 with spacing of 30 x 15 cm. Okra seeds of variety 'Phule Utkarsha' was sown in July, 2015. The details of treatments used for conducting experiment are given in Table 1.The spraying was done in early morning hours to avoid the mid day heat. The insecticidal concentration for different treatment was prepared and spraying was done using knapsack sprayer with solid cone nozzle. Care was taken to see that all plant parts of okra were covered by spray solution.

For taking counts of aphids, five plants were selected randomly in each plot and were tagged. From such tagged plants, the aphid population on 3 leaves, one each from top, middle and bottom were recorded. The observations were made at one day before spraying (DBS) and 3, 7 and 10 days after spray (DAS). The data were subjected to square root ($\sqrt{x+0.5}$) transformation and then statistically analyzed. During the experimentation the weather parameters *viz.*, maximum and minimum temperature, relative humidity and rainfall were recorded and the pest population was correlated with the meteorological factors.

RESULTS AND DISCUSSION

Seasonal incidence of aphids *(Aphis gossypii)* on okra

The activity of aphid population was initiated on okra crop during second week of August (0.60 aphids/3 leaves). There was a gradual increase in aphid population up to third week of September and subsidized next two weeks (Table 2). The peak activity again resumed during first week of October (13.40 aphids/3 leaves). Present findings are in line with Slosser *et al*[8]., who showed peak population of aphids in August was related to high temperatures and it reached to 15 aphids per leaf in mid September. Aphid numbers declined rapidly to levels generally below 5 aphids per leaf within two week after peak densities.

Seasonal occurrence of lady bird beetles on okra aphids

The population of lady bird beetles was noticed during second week of August and then it gradually increased when incidence of sucking pests occurred during the peak activity of aphids in October (1.00 to 5.00 beetles/plant). Highest population of lady bird beetle (5.20 beetles/plant) was observed in 4th week of September 2015 (Table- 2).

Role of weather parameters on aphid population on okra

Correlation coefficient between different weather parameters and aphid population on okra and their natural enemies revealed that maximum temperature recorded non significant but positive correlation with population of aphids and lady bird beetles with correlation coefficient of r=+0.1706 and r=+0.3752, respectively (Table 3). Minimum temperature showed significant but negative correlation with population of aphids and lady bird beetles with r=-0.6445 and r=-0.8020 values, respectively. However, evening relative humidity had significant positive correlation with aphids and lady bird beetle with correlation of r=+0.4891 and r=+0.5632, respectively. The rainfall showed negative correlation on aphids and lady bird beetles. The correlation coefficient values were r=-0.4720 and r=-0.4373, respectively.

Effect of insecticidal sprays on aphid population on okra

The aphid population after 1st, 2nd, 3rd and 4th sprays were recorded at 3, 7 and 10 days during each spraying (Table 4). The results of the average data of four sprays against aphids of okra are given in Table 5 and graphically depicted in Fig. 1.

The pre-count population of aphids ranged from 10.39 to 12.60 aphids/3 leaves/plant. All the different sequential treatments with insecticides significantly reduced the population of aphids at 3, 7 and 10 days during each spraying. The observations recorded on 3rd day after four sprayings indicated that all insecticidal treatments significantly reduced the aphid population. The number of aphids ranged from 4.30 to 8.12 aphids/3 leaves in the insecticidal treatments as against 13.56 aphids/3 leaves in untreated control (Table-4). The treatment with acetamiprid 20 SP @ 15 g a.i./ha was most promising, but it was at par with the treatments with acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha which recorded 4.36 aphids/3 leaves. The next effective treatment against aphids was thiamethoxam 25 WG @ 25 g a.i./ha which recorded 4.89 aphid population/3 leaves/plant. The least effective treatment was *V. lecanii* @ 2.5 kg/ha which recorded highest aphid population (8.12 aphids/3 leaves/plant).

The observations recorded on 7th day after four sprayings revealed that the number of aphids ranged from 4.16 to 7.67 aphids/3 leaves in the insecticidal treatments as against 13.70 aphids/3 leaves in untreated control. The treatment with acetamiprid 20 SP @ 15 g a.i./ha was significantly superior and it was at par with the treatment with acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha which recorded 4.26 aphids/3 leaves. The next effective treatment was thiamethoxam 25 WG @ 25 g a.i./ha which recorded 4.75 aphid population/3 leaves.

The observations recorded on 10th day after four sprayings indicated that all insecticidal treatments significantly reduced the aphid population as compared to untreated check. The number of aphids ranged from 5.12 to 8.98 aphids/3 leaves in the insecticidal treatments as against 14.90 aphids/3 leaves in untreated control. The treatment with acetamiprid 20 SP @ 15 g a.i./ha (T_2) recorded lowest number of aphid population 5.12/3 leaves and it was most effective, but it was at par with acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_7) which recorded 5.38 aphid population/3 leaves/plant.

These findings are in confirmation with the results of Gosalwad *et al*[5]., who reported that the treatment of imidacloprid 17.8 SL @ 20 g a.i./ha and acetamiprid 20 SP @ 40 g a.i./ha were recommended in management of sucking pests like leaf hoppers and aphids on okra. Dakulge[4] reported that acetamiprid 20 g a.i./ha was most effective in controlling sucking pest complex on cotton and recorded numerically higher yield. Also, Misra[7] reported that thiamethoxam 25 WG was superior over the conventional insecticides in controlling aphids and leaf hoppers of okra. The present findings of effectiveness of imidacloprid are in agreement with that of Katyare[6] who reported that imidacloprid and thiamethoxam were equally effective as foliar sprays for sucking pests of okra.

Effect of Insecticidal sprays on lady bird beetles on aphids of okra

The insecticidal sprays with acephate 75 SP, acetamiprid 20 SP, diafenthiuron 50 WP, thiacloprid 21.7 SC, thiamethoxam 25 WG and *Verticillium lecanii* were found safer to the lady bird beetle population in okra crop (Table 6 and Fig. 2).

At 3 DAS, the treatment with *V. lecanii* @ 2.5 kg/ha recorded highest population of 3.68 beetles/plant and it was superior over all the treatments. Among the chemical treatments, the treatment with thiacloroprid 21.7 SC @ 54 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_9) recorded maximum population (1.35 beetles/plant) and it was at par with the diafenthiuron 50 WP @ 300 g a.i/ha followed by *V. lecanii* @ 2.5 kg/ha (T_8), acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_7) and

thiamethoxam 25 WG @ 25 g a.i./ha (T_5). Least population of beetles (1.08) was observed in acephate 75 SP @ 500 g a.i./ha (T_1).

At 7 DAS, the treatment with *V. lecanii* @ 2.5 kg/ha recorded highest beetle population (4.04 beetles/plant) and it was superior over all the treatments. In chemicals, the treatment with thiacloroprid 21.7 SC @ 54 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_9) recorded maximum beetle population (1.63 beetles/plant) and it was at par with the diafenthiuron 50 WP @ 300 g a.i/ha followed by *V. lecanii* @ 2.5 kg/ha (T_8), acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_7) and thiamethoxam 25 % WG @ 25 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_{10}). Least beetle population (1.32) was observed in acephate 75 % SP @ 500 g a.i./ha.

At 10 DAS, the treatment with *V. lecanii* @ 2.5 kg/ha recorded highest population of 4.49 beetles/plant and it was superior over all the treatments. In chemicals, the treatment with thiacloroprid 21.7 SC @ 54 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_9) recorded maximum population of 2.00 beetles/plant and it was at par with the diafenthiuron 50 WP @ 300 g a.i/ha followed by *V. lecanii* @ 2.5 kg/ha (T_8) and thiamethoxam 25 WG @ 25 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_{10}). Least beetle population (1.58) was observed in acetamiprid 20 SP @ 15 g a.i./ha. The present findings are in confirmation with Acharya *et al*[1]., who reported that acetamiprid @ 20 g a.i./ha and thiamethoxam and imidacloprid (both @ 25 g a.i./ha) were found safe to lady bird beetle.

Table 1: Details of treatments of experiment on bio-efficacy of insecticides

Tr. No.	Insecticide	Dose/ha	
		g a.i./ha.	g/ha
T_1	Acephate 75% SP	500 gm	666gm
T_2	Acetamiprid 20% SP	15 gm	75gm
T_3	Diafenthiuron 50% WP	300 gm	600gm
T_4	Thiacloroprid 21.7% SC	54 ml	225gm
T_5	Thiamethoxam 25% WG	25 gm	200gm
T_6	Acephate 75% SP followed by *V. lecani*	500 gm	666gm and 2.5 kg/ha
T_7	Acetamiprid 20% SP followed by *V. lecanii*	15 gm	75gm and 2.5 kg/ha
T_8	Diafenthiuron 50% WP followed by *V. lecanii*	300 gm	600gm and 2.5 kg/ha
T_9	Thiacloroprid 21.7% SC followed by *V. lecanii*	54 ml	225gm and 2.5 kg/ha
T_{10}	Thiamethoxam 25% WG followed by *V. lecanii*	25 gm	200gm and 2.5 kg/ha
T_{11}	*Verticillium lecanii*	-	2.5 kg/ha
T_{12}	Untreated control	-	-

Table 2: Seasonal incidence of aphids and population of lady bird beetles on okra during *kharif* 2015 and weather parameters

Month	SMW	Aphid /3leaves	Natural enemies (Lady bird beetle)	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)
				Maximum	Minimum	Morning	evening	
July	30	00	00	30.80	23.20	74.00	60.00	0.00
	31	00	00	30.70	22.90	81.00	63.00	3.70
Aug	32	00	00	28.30	22.50	87.00	78.00	32.60
	33	0.60	1.00	26.60	21.90	88.00	77.00	18.70
	34	2.20	1.25	29.30	22.20	88.00	71.00	10.60
	35	5.20	1.00	28.60	21.90	87.00	76.00	6.30
Sept	36	8.20	2.20	29.70	21.50	85.00	64.00	4.10
	37	11.20	2.00	29.90	21.40	85.00	68.00	2.70
	38	12.60	2.00	29.10	21.30	86.00	65.00	8.00
	39	14.80	5.20	32.00	20.90	84.00	54.00	22.10
	40	11.90	3.20	30.60	21.60	90.00	68.00	17.00
Oct	41	13.40	4.80	28.40	22.00	87.00	68.00	14.30
	42	10.60	5.00	32.10	19.40	88.00	52.00	0.00
	43	6.80	2.00	32.10	20.60	90.00	55.00	37.70
	44	3.50	1.10	33.20	21.60	89.00	50.00	25.00

Table 3: Relationship of weather parameters with aphids and lady bird beetles on okra during 2015

Pests/ natural enemies	Correlation coefficient values (r)				
	Temperature (^{o}C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	RH-I	RH-II	
Aphids	+0.1706	-0.6445**	0.0411	+0.4891**	-0.4720**
Lady bird beetles	+0.3752	-0.8020**	0.1506	+0.5632**	-0.4373*

**- significant at 1% (r=0.457)

*- significant at 5% (r=0.423)

Table 4: Bioefficacy of newer insecticides and *Verticillium lecanii* against aphids on okra after 1st, 2nd , 3rd and 4th spray

Tr. No.	Pre-count	Mean survival population of aphids/3 leaves/plant after 1st spray			Mean survival population of aphids/3 leaves/plant after 2nd spray			Mean survival population of aphids/3 leaves/plant after 3rd spray			Mean survival population of aphids/3 leaves/plant after 4th spray		
		3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T1	11.02 (3.93)	8.28 (2.96)	8.30 (2.97)	11.23 (3.42)	6.30 (2.61)	5.77 (2.50)	8.25 (2.96)	5.27 (2.40)	4.86 (2.31)	5.05 (2.35)	3.18 (1.92)	2.83 (1.82)	3.03 (1.88)
T2	12.44 (3.59)	5.95 (2.54)	6.13 (2.58)	7.63 (2.85)	4.55 (2.25)	4.28 (2.19)	6.40 (2.63)	4.47 (2.23)	4.20 (2.17)	4.30 (2.19)	2.22 (1.65)	2.02 (1.59)	2.15 (1.63)
T3	10.92 (3.37)	8.83 (3.05)	9.03 (3.09)	12.33 (3.58)	6.00 (2.55)	5.70 (2.49)	8.83 (3.05)	5.52 (2.45)	5.27 (2.40)	5.43 (2.43)	3.43 (1.98)	3.11 (1.90)	3.22 (1.93)
T4	12.29 (3.57)	8.79 (3.05)	8.97 (3.08)	12.67 (3.63)	6.60 (2.66)	6.37 (2.62)	8.53 (3.00)	6.01 (2.55)	5.71 (2.49)	5.93 (2.54)	3.19 (1.92)	2.96 (1.86)	3.08 (1.89)
T5	11.43 (3.45)	6.57 (2.66)	6.83 (2.71)	9.10 (3.10)	5.28 (2.40)	5.11 (2.73)	7.68 (2.86)	5.14 (2.38)	4.85 (2.31)	5.08 (2.36)	2.58 (1.76)	2.22 (1.65)	2.94 (1.85)
T6	11.60 (3.48)	8.17 (2.94)	8.33 (2.97)	11.30 (3.43)	6.43 (2.63)	6.23 (2.59)	8.56 (3.01)	5.82 (2.51)	5.38 (2.42)	5.63 (2.48)	3.21 (1.92)	2.84 (1.83)	3.11 (1.90)
T7	10.39 (3.30)	6.10 (2.57)	6.33 (2.61)	8.67 (3.03)	4.43 (2.22)	4.21 (2.17)	6.05 (2.56)	4.61 (2.26)	4.39 (2.21)	4.57 (2.25)	2.28 (1.67)	2.10 (1.61)	2.23 (1.65)
T8	10.46 (3.31)	8.70 (3.03)	9.00 (3.08)	10.23 (3.27)	6.40 (2.63)	6.23 (2.59)	8.52 (3.00)	7.33 (2.80)	7.17 (2.77)	7.40 (2.81)	3.72 (2.05)	3.49 (2.00)	3.58 (2.02)
T9	11.55 (3.47)	8.50 (3.00)	8.77 (3.04)	11.43 (3.45)	6.82 (2.70)	6.67 (2.68)	8.87 (3.06)	6.16 (2.58)	6.00 (2.55)	6.23 (2.59)	3.00 (1.87)	2.99 (1.86)	3.13 (1.90)
T10	12.03 (3.54)	7.96 (2.90)	8.53 (3.00)	10.97 (3.38)	5.77 (2.50)	5.51 (2.45)	7.96 (2.91)	5.82 (2.51)	5.34 (2.42)	5.63 (2.47)	2.95 (1.86)	2.53 (1.74)	2.73 (1.80)
T11	12.23 (3.56)	9.33 (3.13)	9.93 (3.23)	14.33 (3.85)	10.67 (3.34)	9.30 (3.13)	9.83 (3.21)	7.74 (2.87)	7.33 (2.80)	7.60 (2.85)	4.73 (2.29)	4.10 (2.14)	4.13 (2.15)
T12	12.60 (3.62)	13.00 (3.67)	13.10 (3.69)	15.70 (4.02)	15.53 (4.00)	15.59 (4.01)	15.72 (4.03)	15.90 (4.05)	15.97 (4.06)	16.07 (4.07)	9.81 (3.21)	10.15 (3.26)	12.10 (3.54)
		0.06	0.05	0.09	0.04	0.04	0.06	0.05	0.06	0.06	0.05	0.06	0.07
	N.S.	0.18	0.15	0.26	0.12	0.12	0.19	0.17	0.19	0.18	0.15	0.18	0.22

*Figures in parentheses are means of square root transformed value

Table 5: Efficacy of newer insecticides and *Verticillium lecanii* against aphids on okra (Average of four sprays)

Tr. No.	Treatment	Mean cumulative survival population of aphids/3 leaves/plant			
		Pre-count	3 DAS	7 DAS	10 DAS
T1	Acephate 75%SP	11.02 (3.93)	5.76 (2.50)	5.44 (2.44)	6.89 (2.72)
T2	Acetamiprid 20% SP	12.44 (3.59)	4.30 (2.19)	4.16 (2.16)	5.12 (2.37)
T3	Diafenthiuron 50% WP	10.92 (3.37)	5.95 (2.54)	5.78 (2.51)	7.45 (2.82)
T4	Thiacloprid 21.7% SC	12.29 (3.57)	6.15 (2.58)	6.00 (2.55)	7.55 (2.84)
T5	Thiamethoxam 25 %WG	11.43 (3.45)	4.89 (2.32)	4.75 (2.29)	6.20 (2.59)
T6	Acephate 75%SP followed by *V. lecanii*	11.60 (3.48)	5.91 (2.53)	5.70 (2.49)	7.15 (2.77)
T7	Acetamiprid 20% SP followed by *V. lecanii*	10.39 (3.30)	4.36 (2.20)	4.26 (2.18)	5.38 (2.42)
T8	Diafenthiuron 50% WP followed by *V. lecanii*	10.46 (3.31)	6.54 (2.65)	6.47 (2.64)	7.43 (2.82)
T9	Thiacloroprid 21.7%SC followed by *V. lecanii*	11.55 (3.47)	6.12 (2.56)	6.11 (2.57)	7.42 (2.81)
T10	Thiamethoxam 25%WG followed by *V. lecanii*	12.03 (3.54)	5.67 (2.47)	5.48 (2.44)	6.82 (2.70)
T11	*Verticillium lecanii*	12.23 (3.56)	8.12 (2.94)	7.67 (2.86)	8.98 (3.08)
T12	Untreated control	12.60 (3.62)	13.56 (3.75)	13.70 (3.77)	14.90 (3.92)
	SE+		0.03	0.03	0.04
	CD at 5%	N.S.	0.09	0.10	0.12

*Figures in parentheses are means of square root transformed value

Table 6: Effect of insecticidal sprays on lady bird beetle population on aphis in okra

Tr. No.	Treatment	Mean population of lady bird beetle/ plant		
		After 3 days	After 7 days	After 10 days
		Mean	Mean	Mean
T1	Acephate 75% SP	1.08 (1.26)	1.32 (1.35)	1.61 (1.45)
T2	Acetamiprid 20% SP	1.13 (1.28)	1.36 (1.36)	1.58 (1.44)
T3	Diafenthiuron 50% WP	1.14 (1.28)	1.35 (1.36)	1.65 (1.46)
T4	Thiacloprid 21.7% SC	1.11 (1.27)	1.36 (1.36)	1.60 (1.45)
T5	Thiamethoxam 25% WG	1.19 (1.30)	1.42 (1.38)	1.63 (1.46)
T6	Acephate 75% SP followed by *V. lecanii*	1.14 (1.28)	1.44 (1.39)	1.70 (1.48)
T7	Acetamiprid 20% SP followed by *V. lecanii*	1.30 (1.34)	1.51 (1.42)	1.79 (1.51)
T8	Diafenthiuron 50% WP followed by *V. lecanii*	1.31 (1.34)	1.62 (1.45)	1.99 (1.58)
T9	Thiacloroprid 21.7% SC followed by *V. lecanii*	1.35 (1.36)	1.63 (1.46)	2.00 (1.58)
T10	Thiamethoxam 25% WG followed by *V. lecanii*	1.16 (1.29)	1.51 (1.42)	1.88 (1.54)
T11	*Verticillium lecanii*	3.68 (2.04)	4.04 (2.13)	4.49 (2.23)
T12	Untreated control	4.20 (2.17)	4.38 (2.21)	4.68 (2.28)
	SE+	0.02	0.02	0.02
	CD at 5% level	0.06	0.07	0.06

*Figures in parentheses are means of square root transformed value

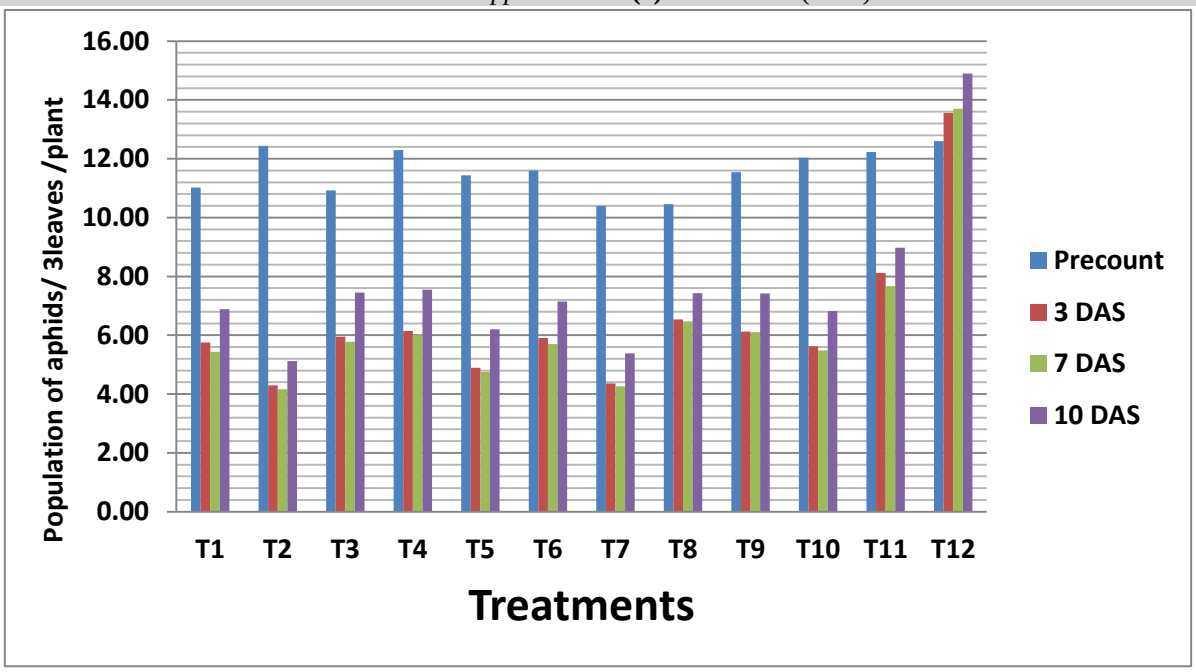

Fig. 1: Efficacy of insecticidal sprays against aphid population on okra after fourth spray (Average of four sprays)

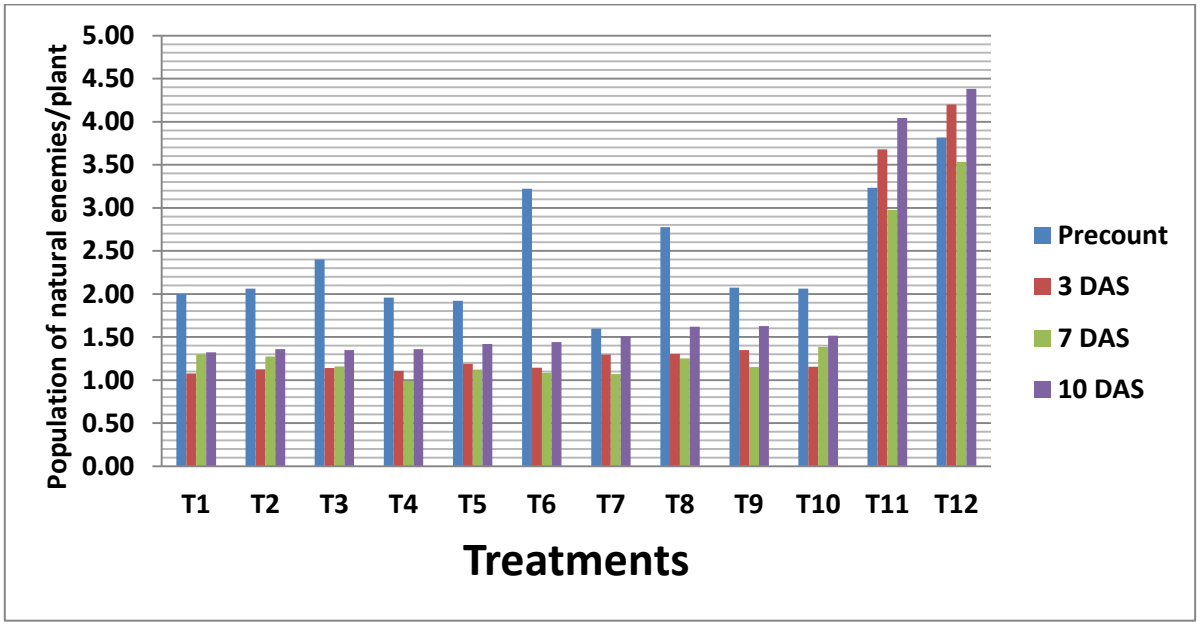

Fig. 2: Efficacy of all insecticidal sprays on natural enemies of sucking pests of okra (Average of four sprays)

Acknowledgement

The authors are thankful to Associate Director of Research, NARP, Ganeshkhind, Pune for his support and providing necessary facilities for conducting the research experiment.

REFERENCES

1. Acharya, S., Mishra, H.P. and Dash, D., Efficacy of insecticides against okra jassid, *Amrasca biguttula biguttula* (Ishida). *Ann. Pl. Protec. Sci*., **10(2):** 230-232 (2002).

2. Anonymous, Worldwide area, production and productivity details for bhendi during 2014. http://www.ikisan.com/links/apbhendiHistory. shtml (2014).
3. Butani, D.K. and Verma, S., Insect-pests of vegetables and their control-3: Lady's finger. *Pesticides*, **10(7):** 31-37 (1976).
4. Dakulge, S.L., Bioefficacy of newer insecticides against sucking pest complex of cotton. M.Sc. (Agri) Thesis, M.A.U., Parbhani, M.S. India (2000).
5. Gosalwad, S.S., Kawathekar, B.R., Wadnekar, D.W., Asewar, B.V. and Dhutraj, D.N., Bioefficacy of newer insecticides against sucking pest of okra, (*Abelmoschus esculentus* Moench) *J. Maharashtra agric. Univ*., **33(3):** 343-346 (2008).
6. Katyare, J.P., Efficacy of new insecticides as seed dressers and foliar sprays on the infestation of sucking pests of summer okra. M.Sc. (Agri.) Thesis, MPKV, Rahuri, Maharashtra, India (1999).
7. Misra, H.P., Field evaluation of some newer insecticides against aphids (*Aphis gossypii*) and jassids (*Amrasca biguttula biguttula*) on okra. *Indian J. Ent*., **64(1):** 80-84 (2002).
8. Slosser, J.E., Pinchak, W.E. and Rummel, D.R., Abiotic and biotic regulation of aphid populations in Texas rolling plains. Proceedings of Beltwide Cotton Conference San-Digeo – California, USA, 5-9, January 1998, **2:** 1065-1067 (1998).