Original Research Article

Effect of BiopesticidesagainstSucking of Jassid,(*Amrascabiguttulabiguttula* Ishida) on Okra, [*Abelmoschusesculentus* (L.) Moench] in Madhya Pradesh India

ABSTRACT

An experiment was conducted in the field, Department of Entomology, RVSKVV, College of Agriculture, Gwalior (M.P.) in *Kharif*- 2018 and 2019.Efficacy of biopesticides against jassid on okra. Experiment was laid out in Randomized Block Design with eight treatments. Biopesticides used in the experiments were *Beauveriabassiana* @ 0.5 kg/ha, *Verticilliumlacanii*@ 1.0 kg/ha, Neem oil 5% @ 2.5 litre, Neem leaf extract 5% @ 25 kg/ha, NSKE 5% @ 25 kg/ha, Garlic clove extract 5% @ 25 kg/ha and Panchgavya 3% @15 litre/ha. All the biopesticides treatments were found significantly effective in reducing the population of jassid over control (untreated) plots. The biopesticides treatments, NSKE 5% were found most effective in reducing the jassid population followed by neem oil 5%, *V. lecanii*, neem leaf extract 5% and garlic clove extract 5%. Whereas, panchgavya 3% was found least effective in both the years.The highest fruit yield (119.56 q/ha) was recorded in NSKE 5% followed by *B. bassiana* and neem oil 5%. Whereas, minimum fruit yield was recorded in panchgavya 3% in both years. The highest net profit (27,128 Rs/ha) was obtained from the plots treated with *B. bassiana* followed by NSKE 5% (25,938 Rs/ha) and maximum benefit ratio in the *B. bassiana* (1:14.13) followed by *V. lecanii* (1:8.36), NSKE 5% (1:8:11) and garlic clove extract 5% (1:6.78).

Keywords: Okra, Efficacy, Jassid, Biopesticides, Yield

INTRODUCTION

Okra,[*Abelmoschusesculentus*(L.) Moench]belongs to family Malvaceae a common vegetable in India. Okra locally known as ‘Bhindi’ also called ‘Lady’s Finger’ is a popular

and most common annual vegetable crop in tropical and subtropical parts of the world"[14].It has good nutritional value, 100 g of edible fruit contains 2 gprotein, 0.19 g fat, 7.45 g carbohydrate, 1.48 g of sugars, 0.7 g minerals, 3.2 g fiber, minerals like K (299 mg), Ca (82 mg), Mg (57 mg), Fe (0.62 mg), Zn (0.58 mg) and Vitamins like A, B1, B2, C, E and K"[9].Okra crop is cultivated for its young tender fruits, which is used as vegetable, tried, in curry and soups. The root and stem are used for clearing cane juice in preparation of jiggery/gur. Seeds are a source of oil, protein and are also used as a coffee substitute, while ground up okra seeds has been used as a substitute for aluminum salts in water purification.

India is the largest producer of okra in the world. It occupy nearly 513thousand hectare area with production of 6170thousand matrictonnesand productivity 12.00 matrictonnesha^{-1}. In Madhya Pradesh okra is grown in 0.4012 lakh ha area with production 5.3673 lakh MT and 13.02 tonnes ha^{-1} productivity"[3].

The pest problem is the main limiting factor in production of okra. As high as, 72 species of insects have been recorded on okra which, the sucking pest *viz*., aphids (*Aphis gossypii* Glover); leafhopper (*Amrascabiguttulabiguttula* Ishida); whitefly (*Bemisiatabaci*Gennadius); shoot and fruit borer (*Eariasvittella* Fab.) and mite (*Tetranychuscinnabarinus*Boisduval) causes significant damage to the crop. Okra fruit and shoot borer, *Eariasvittella* (Fab.) is a widely distributed insect pest. When the crop is young, larvae bore into tender shoots and tunnel downwards which wither, drop down and growing points are killed. In fruits, the larvae bore inside these and feed on inner tissues which become deformed in shape with no market value. The infested fruits become unfit for human consumption, thus resulting in 35 to 76 % decrease in yield and caused severe damage to the crop leading to yield losses to an extent of 35-90 per cent"[5].

Biopesticides are considered to be the best alternative to synthetic pesticides that are highly effective, target specific and reduce environmental risks. These factors lead to their incorporation in pest management programme, instead of chemical pesticides throughout the world. Biopesticides are derived from animals, plants and other natural micro-organisms such as fungi, bacteria, algae, viruses, nematodes, and protozoa. The advanced research and development in the field of biopesticides applications greatly reduces the environmental pollution caused by the chemical synthetic insecticidal residues and promotes sustainable development of agriculture. Since the advent of biopesticides, a large number of products have been registered and released, some of which have played a leading role in the agro-

market. The development of biopesticides has incited to replace the chemical pesticide in pest management. The current status and advancement of biopesticidesfocusing mainly on improving action spectra, replacing chemical pesticides, its role in integrated pest management are the main factors of biopesticides"[8].

MATERIALS AND METHODS

The field experiment was conducted at Entomological Research Farm, Department of Entomology, RajmataVijayarajeScindiaKrishiVishwaVidyalaya, College of Agriculture, Gwalior Madhya Pradesh in*Kharif*- 2018 and 2019.The experiment were conducted withseven treatments in a Randomized Block Design and replicated thrice with plot sizeof 3.60 × 2.40m^2 each wassown at 60×45 cm spacing. All the recommended package of practices was adopted for raisingthe crop except plant protection measures.

Observations

Observations on jassid (both adult as well as nymph) were recorded on six leaves at weekly interval during morning hours on five plants. The plants were selected randomly in each plot to record the population from six leaves, each to from top, middle and bottom canopies and mean population per six leaves was worked out.

First spray was given at time of initiation of insect infestation. The second spray was given at 15 days after first spray. Pretreatment observations on the population of different insect pests were recorded on six leaves (2 upper, 2 middle and 2 lower leaves of the plant canopy) at one day before treatment. Post treatment observations were recorded on 7 and 14 days after each spray. The population were calculated by applying the following formula – Population (per/leaf) = Total number of insects/ Number of leaves observed. The data obtained on pest infestation from experimental field were subjected to analysis of variance after transforming into ($\sqrt{x+0.5}$). Economics of different treatments were also worked out.

RESULTS AND DISCUSSION

The efficacy of biopesticides treatments was assessed on the basis of sucking pests of jassidpopulation. Data recorded on population of jassid different treatments at one day before and 7 and 14 days after each spray are presented in Table 1, 2 and 3.

Effect of biopesticides against jassid, (*Amrascabiguttulabiguttula* Ishida)population on Okra during Kharif - 2018

The polled data indicates that the jassid population in different biopesticides at one day before spray ranged from 15.47 to 16.07 jassid/six leaves with statistically at par population in all the plots. Signification reduction in jassid population was noted at 7 and 14 days after spray of biopesticides compared to untreated control plot. Average population of jassid per six leaves at seven days after first spray showed that all the biopesticides treatments were found significantly effective over control plots (20.60 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population of jassid(9.20 jassid/six leaves) was recorded in NSKE 5%than rest of the treatments. Among the treated plots maximum and significantly higher than rest the treatments population of jassid(13.93 jassid/six leaves) was recorded in panchgavya 3%. Data recorded at fourteen days after first spray showed that all the biopesticides treatments were found significantly effective over control plot (23.53 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population (10.93 jassid/six leaves) was recorded in NSKE 5% than rest of thetreatments. Among the biopesticides maximum and significantly higher than rest of the treatments populationjassid (13.93 jassid/six leaves) was recorded in panchgavya 3%.The average of two observations recorded at 7 and 14 days after first spray, all the treatments were found significantly effective over control plot (22.07 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population of jassid5% (10.07 jassid/six leaves) was recordedin NSKE 5% than rest of the treatments except inneem oil 5%.Among the treated plots maximum and significantly higher than rest of the treatments population of jassid(14.83 jassid/six leaves) was recorded inpanchgavya 3%.

Data was recorded at seven days after second spay showed that all the biopesticides treatments were foundsignificantly effective in reducing the jassid population over control plot (13.33 jassid/six leaves). Minimum and significantly less population of jassid(5.00 jassid/six leaves) was recorded in NSKE 5% than rest of the treatments except garlic clove extract 5%.Among the treated plots maximum and significantly higher than the rest of the treatments population of jassid (7.40 jassid/six leaves) was recorded in panchgavya 3%. The average of population of jassid at fourteen days after second spay showed that all the biopesticides treatments were foundsignificantly effective over control (7.20 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population of jassid (5.40 jassid/six leaves) was recorded in NSKE 5% than rest of the treatments. Among the treated plots, maximum and significantly higher than rest of the treatments population (6.87 jassid/six leaves) was recorded in panchgavya 3%.The average populations of two

observations recorded at 7 and 14 days after second spray, all the biopesticides treatments werefound significantly effective over control plots (10.27 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population (5.20 jassid/six leaves) was recorded in NSKE 5% than rest of the treatments. Among the treated plots, maximum and significantly higher than rest of the treatments population of jassid (7.13 jassid/six leaves) was recorded in panchgavya 3%.

Data recoded in *Kharif*- 2018, on the basis of average of four observations recorded at 7 and 14 days after first and second spray, all the biopesticides treatments were found significantly effective over control plots (16.17 jassid/six leaves) in reducing the jassid population. Minimum and significantly less population of jassid(7.63 jassid/six leaves) was recorded in NSKE 5% than rest of the treatments. Among the treated plots maximum and significantly higher than rest of the treatments population (10.98 jassid/six leaves) was recorded in panchgavya 3%.

Effect of biopesticides against jassid, (*Amrascabiguttulabiguttula* Ishida) population on Okra during Kharif - 2019

The pooled data (Table 2) indicates that the jassid population in different biopesticides at one day before spray ranged from 9.40 to 10.00 jassid/six leaves with statistically at par population in all the plots. Significant reduction in jassid population was noted at 7 and 14 days after spray of biopesticides compared to untreated control plot.Average population of jassid per six leaves at seven days after first spray, showed that the all the biopesticides treatments were found significant over control plots (10.27 jassid/six leaves) in reducing the population of jassid. Among the biopesticides treatments, NSKE 5% (4.87 jassid/six leaves) was found most effective in reducing jassidpopulation followed by neem oil 5% (4.93 jassid/six leaves) *V.lecanii* (5.00 jassid/six leaves) and garlic clove extract 5% (5.00 jassid/six leaves). Whereas, panchgavya 3% (9.00 jassid/six leaves) was found least effective and statistically at par with control plots.The average populations of jassidwere recorded at fourteen days after first spray showed that all the biopesticides treatments were found significantly effective over control plots in reducing the jassid population. Minimum and significantly population less of jassid(6.40 jassid/six leaves) was recorded in plots treated with NSKE 5% than rest of the treatments except neem oil and *V. lecanii*. Among the treated plots maximum and significantly higher population (11.53 jassid/six leaves) was recorded in panchgavya 3% than rest of the treated plots except *B. bassiana* and statistically at par with

neem leaf extract and garlic clove extract.The population of jassid on thebasis of average of two observations recorded at 7 and 14 days after first spray showed that all the biopesticides treatments were found significantlyeffective over control plots (13.07 jassid/six leaves). Among the treatments, NSKE 5% (5.63 jassid/six leaves) was found most effective in reducing jassid population followed by neem oil 5% (6.03 jassid/six leaves), *V.lecanii* (6.40 jassid/six leaves) and garlic clove extract 5% (7.07 jassid/six leaves). Whereas, panchgavya 3% (10.27 jassid/six leaves) was found least effective and statistically at par with control plots.

The population of jassidrecorded at seven days after second spray showed significant differences among different treatments. *V. lecanii* and NSKE 5% were found effective significantly over control plots (12.20 jassid/six leaves) in reducing the jassid population except panchgavya and *B. bassiana*. Minimum population (5.13 jassid/six leaves) was recorded in plots treated with NSKE 5% which found significantly less than the plot treated with panchgavya 3% but was at par with rest of the treated plots. Data recorded at fourteen days after second spray showed significant differences among different treatments. NSKE 5% were found effective significantly over control plots (3.73 jassid/six leaves) in reducing the jassid population. Minimum population (1.53 jassid/six leaves) was recorded in plots treated with NSKE 5% which found significantly less than the plot treated with *B. bassiana*, neem leaf extract 5% and panchgavya 3% but was at par with rest of the treated plots. The average population of jassidtwo observations recorded at 7 and 14 days after second spray showed significant differences among different treatments with regards to population of jassid over control plots (7.97 jassid/six leaves) except panchgavya and *B. bassiana*. Minimum and significantly less population (3.33 jassid/six leaves) was recorded in plots treated with NSKE 5% than rest of the treatments except *V. lecanii*, neem oil, neem leaf extract and garlic clove extract. Among the biopesticides maximum and significantly higher population (6.20 jassid/six leaves) was recorded in panchgavya 3% than rest of the treated plots except *B. bassiana*, neem oil, garlic clove extract and neem leaf extract.

Data recorded in*Kharif*- 2019, on the basis of average of four observations recorded at 7 and 14 days after first and second spray showed significant differences were observed in different treatments with regards to population of jassid over control plots (10.52 jassid/six leaves) except panchgavya. Minimum and significantly less population (4.48 jassid/six leaves) was recorded in plots treated with NSKE 5% than rest of the treatments except *V. lecanii*, neem oil, neem leaf extract and garlic clove extract. Among the biopesticides

maximum and significantly higher population (6.20 jassid/six leaves) was recorded in panchgavya 3% than rest of the treated plots except *B. bassiana*, garlic clove extract and neem leaf extract.

The data observations of the average of two years indicated that all the treatments were found significantly effective over control plots (13.35 jassid/six leaves) in reducing the jassid population. Among the biopesticidesNSKE 5%jassid population (6.06 jassid/six leaves) was found most effective and significantly superior than rest of treatments except neem oil 5%, *V. lecanii* and garlic clove extract 5%. Whereas, panchgavya 3% (9.61 jassid/six leaves) was found least effective and it at par with *B. bassiana*.Data computed on per cent reduction in jassid population indicate that 28.03 to 54.6 % population may be recorded by spraying of different biopesticides, however, NSKE 5% (54.6%) was found most effective in reducing the jassid population followed by neem oil 5%, *V. lecanii* and garlic clove extract 5%.Similar to the present findings Adilakshmi*et al*. (2008), Rudramuni*et al*. (2011), Saha (2015) and Meena*et al*. (2020) reported NSKE 5% to be effective treatment against jassid population.Kalyan*et al.* (2017) also reported NSKE 5% comparatively higher per cent reduction in population of jassid in compared to entomopathogenic fungus.Rosaiah (2001), Anitha and Nandihalli (2008) and Vishwvanath and Singh (2009) also reported neem based product to be effective against jassid.Naik*et al*. (2012) and Saha (2015) reported *V. lecanii* to be effective jassid population.Similar to the present finding Thapa*et al*. (2019) reported neem formulation to be effective control for per cent reduction in okra jassid, which corroborate the present findings.

Fruit yield under different biopesticides

Data recorded in Kharif- 2018, all the biopesticides were found significantly effective in registering the higher yield (112.22 to 118.66 q/ha) over control with (98.67 q/ha). Maximum fruit yield (118.66) was recorded in *B. bassiana* followed by NSKE 5% (118.22 q/ha) and neem oil 5% (117.08 q/ha). Whereas, minimum fruit yield (112.22 q/ha) was recorded in panchgavya 3% followed by neem leaf extract 5% and *V. lacanii*. In Kharif-2019, maximum fruit yield (120.89 q/ha) was recorded in NSKE 5% followed by *B. bassiana* (120.33 q/ha) and neem oil 5% (118.42 q/ha). Whereas, minimum fruit yield (113.89 q/ha) was recorded in panchgavya 3% followed by neem leaf extract 5% and garlic clove extract 5%. The average of two year observations data, all the biopesticides found significantly effective in registering the higher yield (113.06 to 119.56 q/ha) over control (100.13 q/ha).

Maximum fruit yield (119.56 q/ha0 was recorded in NSKE 5% followed by *B. bassiana* (119.50 q/ha) and neem oil 5% (117.75 q/ha). Whereas, minimum fruit yield (113.06 q/ha) was recorded in panchgavya 3%. Data computed on per cent avoidable loss in fruit yield caused by shoot and fruit borer indicate that 12.9 to 19.4% loss in fruit yield may be avoided by the protecting with different biopesticides. Maximum fruit loss may be avoided by protecting the crop with NSKE 5% (19.4%) followed by *B. bassiana* and neem oil 5% (Table 4). Similar to the present finding Adilakshmi*et al*. (2008), Sohail*et el*. (2015) and Yeole and Gawande (2019) also reported highest fruit yield over control was recorded in neem seed extract. Vishwvanath and Singh (2009) also reported that neem formulations protect the crop from the fruit borer infestation and increase the marketable yield of okra.

Economics of different biopesticides

The data computed on economics of different treatments revealed that all the biopesticides treatments were economical over control. Maximum net profit (27,128 Rs/ha) was recorded in *B. bassiana* followed by NSKE 5% (25,938 Rs/ha). However, maximum cost benefit ratio of (1:14.13) was recorded in *B. bassiana* (Table 5). Similar to the present finding Anitha and Nandihalli (2008) and Shreedevi (2011) also reported that NSKE 5% gave higher net return and coast benefit ratio followed by GCK and panchgavya.

Conclusion

Inconclusion, the study affirms the significant efficacy of biopesticides, particularly NSKE 5%, *B. bassiana* and neem oil 5% in effectively controlling jassid populations on okra crops. The varied impact on jassid reduction, fruit yield, net profit and benefit cost ratio highlights the potential of these biopesticides for sustainable pest management in okra cultivation in Madhya Pradesh in India.

Table- 1: Effect of biopesticides against jassid, *Amrascabiguttulabiguttula*(Ishida) on okra (*Kharif*- 2018)

Treatments	Dose/ha	Number of nymphs and adults of jassid/6 leaves							Mean of four observation
			First spray			Second spray			
		1 DBS	7 DAS	14 DAS	Mean	7 DAS	14 DAS	Mean	
T_1*Beauveriabassiana*	0.5 kg	16.00 (4.06)	12.00 (3.54)	14.33 (3.85)	13.17 (3.69)	6.00 (2.55)	6.67 (2.68)	6.33 (2.61)	9.75 (3.20)
T_2 *Verticilliumlacanii*	1.0 kg	15.80 (4.04)	9.80 (3.21)	12.00 (3.54)	10.90 (3.37)	6.20 (2.59)	6.73 (2.69)	6.47 (2.64)	8.68 (3.03)
T_3Neem oil 5%	2.5 litre	15.47 (3.99)	9.73 (3.20)	11.73 (3.50)	10.73 (3.35)	5.73 (2.50)	6.00 (2.55)	5.87 (2.52)	8.30 (2.97)
T_4Neem leaf extract 5%	25 kg	15.87 (4.05)	11.87 (3.52)	13.80 (3.78)	12.83 (3.65)	5.73 (2.50)	6.53 (2.65)	6.13 (2.57)	9.48 (3.16)
T_5 NSKE 5%	25 kg	16.20 (4.09)	9.20 (3.11)	10.93 (3.38)	10.07 (3.25)	5.00 (2.34)	5.40 (2.43)	5.20 (2.39)	7.63 (2.85)
T_6 Garlic clove extract 5%	25 kg	15.73 (4.03)	11.53 (3.47)	13.73 (3.77)	12.63 (3.62)	5.33 (2.41)	6.07 (2.56)	5.70 (2.49)	9.17 (3.11)
T_7Panchgavya 3%	15 litre	16.07 (4.07)	13.93 (3.80)	15.73 (4.03)	14.83 (3.91)	7.40 (2.81)	6.87 (2.71)	7.13 (2.76)	10.98 (3.39)
T_8 Control (untreated)		16.07 (4.07)	20.60 (4.59)	23.53 (4.90)	22.07 (4.75)	13.33 (3.72)	7.20 (2.77)	10.27 (3.25)	16.17 (4.08)
SEm ±		**(0.03)**	**(0.04)**	**(0.03)**	**(0.03)**	**(0.03)**	**(0.01)**	**(0.02)**	**(0.03)**
CD at 5%		**NS**	**(0.11)**	**(0.08)**	**(0.09)**	**(0.08)**	**(0.03)**	**(0.05)**	**(0.09)**

Figures in the parentheses are transformed ($\sqrt{n+0.5}$) values, NS= Non-significant

- DBS - Day before spray
- DAS - Day after spray

Table- 2: Effect of biopesticides against jassid, *Amrascabiguttulabiguttula*(Ishida) on okra (*Kharif*- 2019)

Treatments	Dose/ha	Number of nymphs and adults of jassid/6 leaves							Mean of four observation
			First spray			Second spray			
		1 DBS	7 DAS	14 DAS	Mean	7 DAS	14 DAS	Mean	
T_1*Beauveriabassiana*	0.5 kg	9.60 (3.18)	5.33 (2.41)	9.80 (3.21)	7.57 (2.81)	7.73 (2.87)	2.53 (1.74)	5.13 (2.37)	6.35 (2.62)
T_2 *Verticilliumlacanii*	1.0 kg	9.80 (3.21)	5.00 (2.33)	7.80 (2.86)	6.40 (2.60)	5.67 (2.41)	1.93 (1.55)	3.80 (2.04)	5.10 (2.36)
T_3Neem oil 5%	2.5 litre	9.40 (3.15)	4.93 (2.33)	7.13 (2.75)	6.03 (2.54)	5.53 (2.45)	1.80 (1.52)	3.67 (2.04)	4.85 (2.31)
T_4Neem leaf extract 5%	25 kg	9.67 (3.19)	5.13 (2.37)	9.67 (3.16)	7.40 (2.76)	7.67 (2.82)	2.60 (1.76)	5.13 (2.37)	6.27 (2.59)
T_5 NSKE 5%	25 kg	9.73 (3.20)	4.87 (2.31)	6.40 (2.62)	5.63 (2.46)	5.13 (2.37)	1.53 (1.42)	3.33 (1.95)	4.48 (2.23)
T_6 Garlic clove extract 5%	25 kg	9.67 (3.18)	5.00 (2.34)	9.13 (3.10)	7.07 (2.72)	7.60 (2.84)	2.47 (1.72)	5.03 (2.35)	6.05 (2.56)
T_7Panchgavya 3%	15 litre	10.00 (3.24)	9.00 (3.08)	11.53 (3.46)	10.27 (3.27)	9.67 (3.16)	2.73 (1.78)	6.20 (2.57)	8.23 (2.95)
T_8 Control (untreated)		9.93 (3.23)	10.27 (3.28)	15.87 (4.04)	13.07 (3.66)	12.20 (3.56)	3.73 (2.06)	7.97 (2.91)	10.52 (3.32)
SEm ±		**(0.06)**	**(0.10)**	**(0.19)**	**(0.10)**	**(0.24)**	**(0.11)**	**(0.15)**	**(0.10)**
CD at 5%		**NS**	**(0.29)**	**(0.56)**	**(0.30)**	**(0.72)**	**(0.31)**	**(0.46)**	**(0.30)**

Figures in the parentheses are transformed ($\sqrt{n+0.5}$) values, NS= Non-significant

- DBS - Day before spray
- DAS - Day after spray

Table- 3: Effect of biopesticides against jassid, *Amrascabiguttulabiguttula*(Ishida) on okra (Pooled- 2018 & 2019)

Treatments	Dose/ha	Number of nymphs and adults of jassid /six leaves			Reduction in jassid population (%)
		Mean 2018	Mean 2019	Average of two years	
T_1*Beauveriabassiana*	0.5 kg	9.75 (3.20)	6.35 (2.62)	8.05 (2.86)	**39.7**
T_2 *Verticilliumlacanii*	1.0 kg	8.68 (3.03)	5.10 (2.36)	6.89 (2.65)	**48.4**
T_3Neem oil 5%	2.5 litre	8.30 (2.97)	4.85 (2.31)	6.58 (2.60)	**50.7**
T_4Neem leaf extract 5%	25 kg	9.48 (3.16)	6.27 (2.59)	7.88 (2.82)	**41.0**
T_5 NSKE 5%	25 kg	7.63 (2.85)	4.48 (2.23)	6.06 (2.50)	**54.6**
T_6 Garlic clove extract 5%	25 kg	9.17 (3.11)	6.05 (2.56)	7.61 (2.77)	**43.0**
T_7Panchgavya 3%	15 litre	10.98 (3.39)	8.23 (2.95)	9.61 (3.11)	**28.0**
T_8 Control (untreated)		16.17 (4.08)	10.52 (3.32)	13.35 (3.72)	
SEm ±		**(0.03)**	**(0.10)**	**(0.05)**	
CD at 5%		**(0.09)**	**(0.30)**	**(0.15)**	

Figures in the parentheses are transform ($\sqrt{x+0.5}$) values, NS= Non-significant

- DBS - Day before spray
- DAS - Day after spray

Table-4: Fruit yield under different biopesticides

Treatments	Dose/ha	Yield (q/ha)			Avoidable losses/ha
		***Kharif*- 2018**	***Kharif*- 2019**	**Average**	
T_1*Beauveriabassiana*	0.5 kg	118.66	120.33	119.50	**19.34**
T_2 *Verticilliumlecanii*	1.0 kg	115.78	117.44	116.61	**16.46**
T_3Neem oil 5%	2.5 litre	117.08	118.42	117.75	**17.60**
T_4Neem leaf extract 5%	25 kg	114.00	115.33	114.66	**14.51**
T_5 NSKE 5%	25 kg	118.22	120.89	119.56	**19.40**
T_6 Garlic clove extract 5%	25 kg	116.22	117.22	116.72	**16.56**
T_7Panchgavya 3%	15 litre	112.22	113.89	113.06	**12.91**
T_8 Control (untreated)		98.67	101.60	100.13	
SEm ±		**1.80**	**1.52**	**1.18**	
CD at 5%		**5.30**	**4.47**	**3.46**	

Figures in the parentheses are mean values

Table- 5: Economics of different biopesticides for the control of major insect pests on okra crop

Treatments	Dose/ha	Yield (q/ha)	Additional yield over control (q/ha)	Additional profit (Rs/ha)	Cost of treatments (Rs/ha)	Net profit (Rs/ha)	C:B ratio
T_1*Beauveriabassiana*	0.5 kg	119.50	19.37	29055	1920	27128	1:14.13
T_2 *Verticilliumlacanii*	1.0 kg	116.61	16.48	24720	2640	22078	1:8.36
T_3Neem oil 5%	2.5 litre	117.75	17.62	26430	3700	22728	1:6.14
T_4Neem leaf extract 5%	25 kg	114.66	14.53	21795	3200	18598	1:5.81
T_5 NSKE 5%	25 kg	119.56	19.43	29145	3200	25938	1:8.11
T_6 Garlic clove extract 5%	25 kg	116.72	16.59	24885	3200	21683	1:6.78
T_7Panchgavya 3%	15 litre	113.06	12.93	19395	5700	13688	1:2.40
T_8 Control (untreated)		100.13	-	-	-	-	-

Note:

Selling rate of okra fruit (Rs/q) : 1500

Labour charge for sprays (Rs) : 600 per spray

Rate of insecticides Rs/litre or kg.

Beauveriabassiana : 720

Verticilliumlecanii : 720

Neem oil : 1000

Neem leaf extract : 40

NSKE : 40

Garlic clove extract : 40

Panchgavya : 150

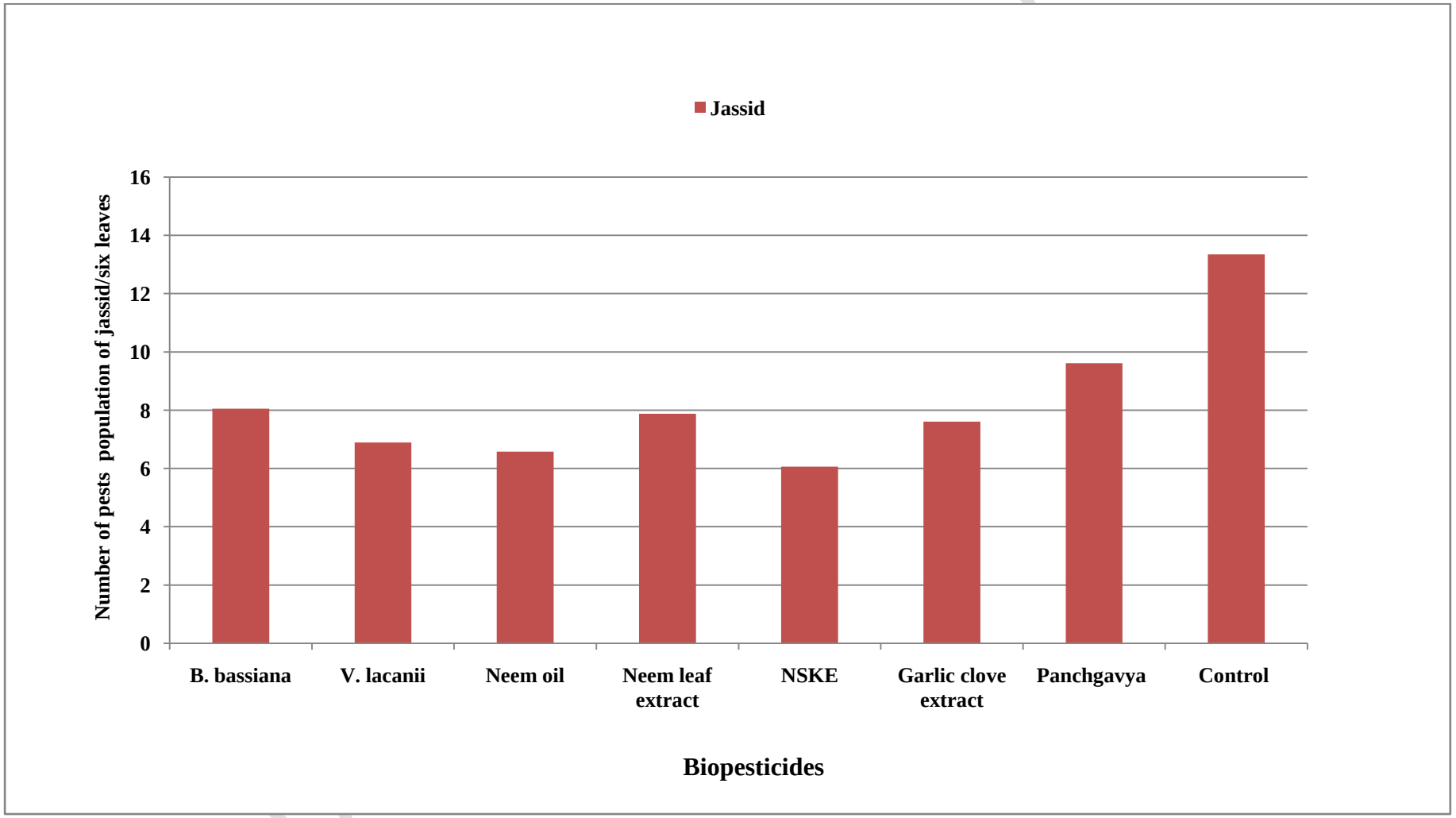

Fig 1:Population of jassid under different biopesticides

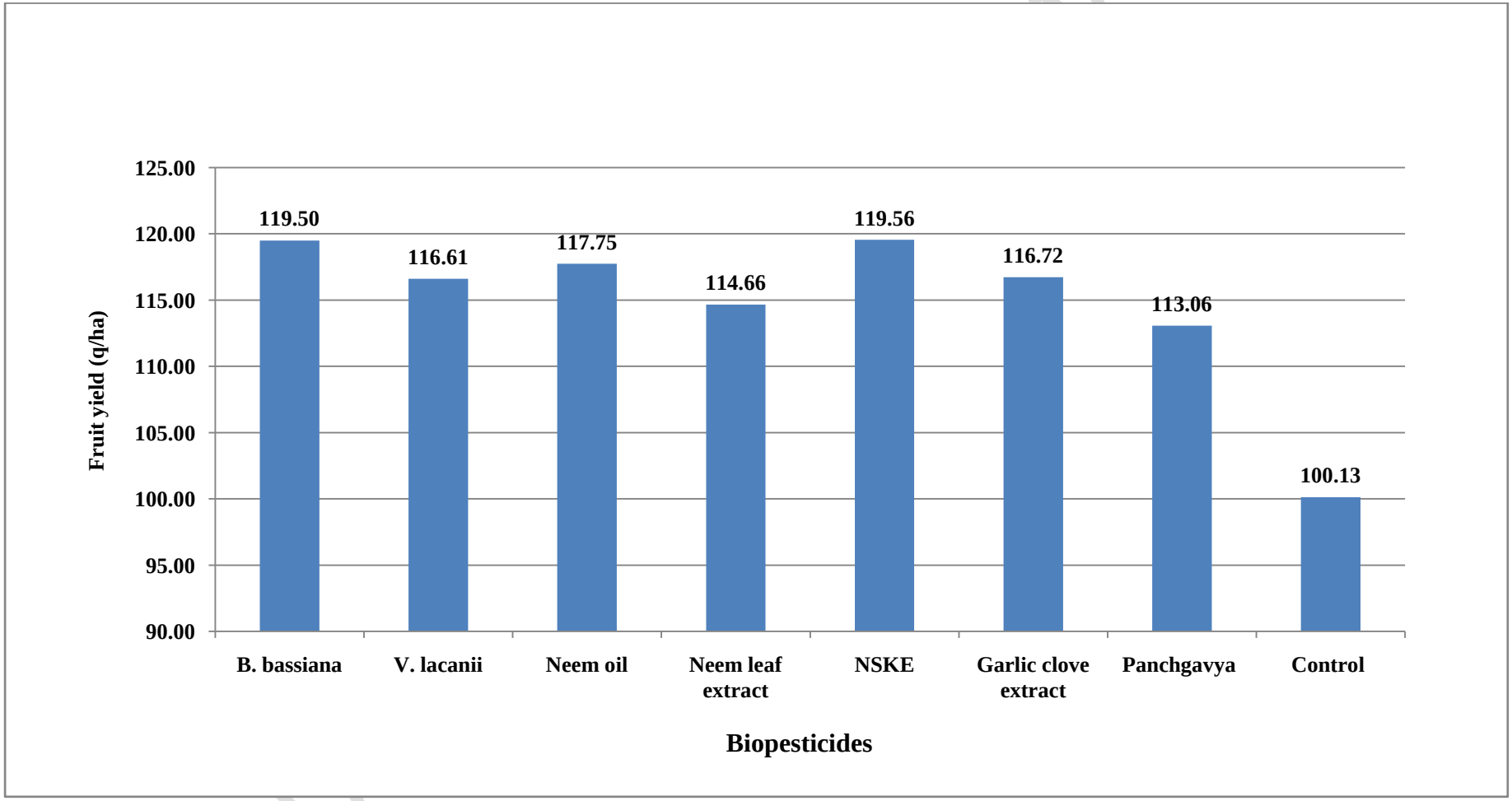

Fig 2:Fruit yield under different biopesticides

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