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Effect of Abiotic Factors on Seasonal Incidence of Leaf hoppers and Bioefficacy of Some Newer Insecticides and Biopesticides Against Leaf hoppers on Okra

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ABSTRACT

Okra, *Abelmoschus esculentus* (L.) Moench is one of the most important vegetable crops cultivated in India and because of its high nutritional values and human disease curing ability it is largely consumed all over the world. It is attacked by about twenty insect pests during different growth stages of which, jassids or leaf hoppers attacks the crop at any stage of its growth. The study of the seasonal incidence of jassids in relation to weather parameters gives idea for application of different insecticidal sprays for their effective control. Evening relative humidity had significant positive correlation with leaf hopper (r=+0.4525), whereas rainfall showed negative correlation with leaf hopper population on okra (r=-0.4203). In present investigation, insecticidal treatment with acetamiprid 20 SP @ 15 g a.i./ha was found most effective against leaf hoppers and it was at par with the treatment acetamiprid 20 SP @ 15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha, thiamethoxam 25 WG @ 25 g a.i./ha, thiacloprid 21.7 SC @ 54 g a.i./ha and acephate 75 SP @ 500 g a.i./ha respectively.

Key words: *Okra, Leaf hoppers, Seasonal incidence, Newer insecticides, Biopesticides.*

INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) Moench is one of the most important vegetable crops extensively grown in the tropical, subtropical regions of the world especially in 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. In India, it is cultivated in all seasons and in all parts over 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 sucking pests of okra, jassids or leaf hoppers (*Amrasca biguttula biguttula* Ishida) attacks the crop right from early seedling stage to last fruit harvesting.

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The multiplication of jassids on okra has been found to be favoured by different abiotic factors. To formulate effective management strategy of this pest proper understanding of their behavior and seasonal abundance in relation to weather parameters is very essential. Also, the excessive use of insecticides may be responsible for problems of insecticide residues in okra. Hence, the entomophagous fungi like *Verticillium lecanii* may be exploited against jassids on okra in *Kharif* season when the climatic conditions are most favourable for their use, besides some new safer insecticides.

MATERIALS AND METHODS

The field experiment was conducted to study the seasonal incidence and bioefficacy of newer insecticides and *biopesticide* against jassids/leaf hoppers an important sucking pest of okra during *Kharif* 2015 at Vegetable Improvement Project, NARP Ganesh hind, Pune. The experiment was conducted in Randomized Block Design with twelve treatments and three replications. The net plot size was maintained at 1.80 m x 1.50 m with a spacing of 30 cm 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. Spraying of formulations 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.

To know the seasonal incidence of jassids/leaf hoppers, the observations were recorded at weekly intervals throughout the experimental period on 10 randomly selected plants. For taking counts of leaf hoppers, five plants were selected randomly in each plot and were tagged. From such tagged plants, the pest 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 temperatures, relative humidity and rainfall were recorded and the pest population was correlated with the meteorological parameters.

RESULTS AND DISCUSSION

Seasonal incidence of leaf hoppers (*Amrasca biguttula biguttula*) on okra

On okra, the population of leaf hoppers ranged from 1.60 leaf hoppers/3 leaves (Second week of August) to 11.50 leaf hoppers/3 leaves (first week of October 2015). The incidence was noticed till the end of the crop period (last week of October) (Table 2). The incidence was low from second week of August to first week of September 2015 (1.60 to 5.60 leaf hoppers/3 leaves). The population was increased during next three weeks (8.80 leafhoppers/3 leaves) which was later dropped down due to high rainfall (5.40 leaf hoppers/3 leaves). The population was then increased in first week of October, 2015 (11.50 leaf hoppers/3 leaves). Present findings are in close conformity with the findings of Selvraj et al.[7] who reported that leaf hopper population on okra was peak during last week of October (19.43 leaf hoppers/3 leaves).

Role of abiotic factors on population of leaf hoppers on okra

Correlation coefficient between different weather parameters and population of leaf hoppers of okra presented in Table 3 revealed that maximum temperature recorded non significant but positive correlation with population of leaf hopper (r=+0.0598). Evening relative humidity had significant positive correlation with leaf hopper (r=+0.4525), whereas rainfall showed negative correlation with leaf hopper population on okra (r=-0.4203).

Effect of insecticidal sprays on leaf hoppers population

The data on surviving population of leaf hoppers on okra after insecticide sprays are presented in Tables 4 and 5. The average surviving leaf hopper population after fourth spray is graphically depicted in Fig. 1. The pre-count population was recorded one day before application of insecticides. The population ranged between 5.57 to 6.36 leaf hoppers/3 leaves/plant. The post count survival population of leaf hoppers was recorded at 3, 7 and 10 days after application of spray.

All the insecticidal sprayings of different sequential treatments significantly reduced mean cumulative population of leaf hoppers at 3, 7 and 10 days during each spray. The observations recorded on 3rd day after four sprayings indicated that all insecticidal treatments significantly reduced the leaf hoppers population as compared to untreated check. The number of leaf hoppers ranged from 2.86 to 4.70 leaf hoppers/3 leaves in the insecticidal treatments as against 7.82/3 leaves in untreated control. The treatment with acetamiprid 20 SP @ 15 g a.i./ha (T_2) was most effective against leaf hoppers and it was at par with the treatments with thiamethoxam 25 WG @ 25 g a.i./ha (T_5), 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}) which recorded 3.02, 3.03 and 3.14 leaf hoppers/3 leaves. The highest population of 7.82 leaf hoppers/3 leaves was recorded in untreated control.

The observations recorded on 7th day after four sprayings indicated that all the insecticidal treatments were significantly superior over untreated control. The average number of leaf hoppers ranged from 3.02 to 6.04/3 leaves in the insecticidal treatments as against 7.98/3 leaves in untreated control. The treatment with acetamiprid 20 SP @ 15 g a.i./ha (T_2) recorded 3.02 hoppers/3 leaves and significantly superior over all the treatments and it was at par with the treatments with 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) which recorded 3.11 and 3.19 leaf hoppers /3 leaves.

The observations recorded on 10th day after four sprayings revealed that the number of leaf hoppers ranged from 3.20 to 6.75/3 leaves in the insecticidal treatments as against 10.30/3 leaves in untreated control. The treatment with acetamiprid 20 SP @ 15 g a.i./ha (T_2) was most effective against leaf hoppers. However, it was at par with the treatments with acetamiprid 20 SP @15 g a.i./ha followed by *V. lecanii* @ 2.5 kg/ha (T_7), thiamethoxam 25 WG @ 25 g a.i./ha (T_5), thiacloroprid 21.7 SC @ 54 g a.i./ha (T_4) and acephate 75 SP @ 500 g a.i./ha (T_1) which recorded 3.29, 3.43, 3.66 and 3.68 leaf hopper population/3 leaves, respectively.

Present findings are in confirmation with the results of Acharya *et al.*[1] and Gosalwad *et al*.[3] 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 in okra. Misra[5] reported that thiamethoxam 25 WG was superior over the conventional insecticides, whereas Katyare[4] reported that imidacloprid and thiamethoxam were equally effective as foliar sprays for sucking pests of okra. Raghuraman and Gupta[6], however, reported that acetamiprid and imidacloprid were the most effective against the cotton jassid, *Amrasca devastans*, using foliar application.

Table 1: Treatment 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 g	666 g
T_2	Acetamiprid 20 % SP	15 g	75 g
T_3	Diafenthiuron 50 % WP	300 g	600 g
T_4	Thiacloroprid 21.7 % SC	54 ml	225 g
T_5	Thiamethoxam 25 % WG	25 g	200 g
T_6	Acephate 75% SP followed by *V. lecanii*	500 g	666 g and 2.5 kg/ha
T_7	Acetamiprid 20% SP followed by *V. lecanii*	15 g	75 g and 2.5 kg/ha
T_8	Diafenthiuron 50 % WP followed by *V. lecanii*	300 g	600 g and 2.5 kg/ha
T_9	Thiacloroprid 21.7% SC followed by *V. lecanii*	54 ml	225 g and 2.5 kg/ha
T_{10}	Thiamethoxam 25% WG followed by *V. lecanii*	25 g	200 g and 2.5 kg/ha
T_{11}	*Verticillium lecanii*	-	2.5 kg/ha
T_{12}	Untreated control	-	-

Table 2: Seasonal incidence of leaf hopper on okra during *kharif* 2015 and meteorological parameters

Month	SMW	Leaf hoppers/3leaves	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)
			Maximum	Minimum	Morning	evening	
July	30	00	30.80	23.20	74.00	60.00	0.00
	31	00	30.70	22.90	81.00	63.00	3.70
Aug	32	00	28.30	22.50	87.00	78.00	32.60
	33	1.60	26.60	21.90	88.00	77.00	18.70
	34	2.10	29.30	22.20	88.00	71.00	10.60
	35	3.80	28.60	21.90	87.00	76.00	6.30
Sept	36	5.60	29.70	21.50	85.00	64.00	4.10
	37	6.20	29.90	21.40	85.00	68.00	2.70
	38	6.90	29.10	21.30	86.00	65.00	8.00
	39	8.80	32.00	20.90	84.00	54.00	22.10
	40	5.40	30.60	21.60	90.00	68.00	17.00
Oct	41	11.50	28.40	22.00	87.00	68.00	14.30
	42	8.60	32.10	19.40	88.00	52.00	0.00
	43	5.70	32.10	20.60	90.00	55.00	37.70
	44	4.20	33.20	21.60	89.00	50.00	25.00

*SMW= Standard Meteorological Week

Table 3: Relationship of weather parameters with the incidence of leaf hoppers on okra during *kharif* 2015

Pest on okra	Correlation coefficient values (r)				
	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	RH-I	RH-II	
Leaf hoppers	+0.0598	-0.1310	0.0153	+0.4525*	-0.4203

**- significant at 1% (r=0.457) *- significant at 5% (r=0.423)

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

Tr. No.	Pre-count	Mean survival population of leaf hoppers per 3 leaves/plant after 1st spray			Mean survival population of leaf hoppers per 3 leaves/plant after 2nd spray			Mean survival population of leaf hoppers per 3 leaves/plant after 3rd spray			Mean survival population of leaf hopper per 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	6.13 (2.58)	6.05 (2.56)	6.41 (2.63)	6.84 (2.71)	3.73 (2.06)	2.83 (1.82)	3.16 (1.91)	2.20 (1.64)	2.40 (1.70)	2.53 (1.74)	1.90 (1.55)	2.07 (1.60)	2.17 (1.63)
T2	5.87 (2.52)	5.59 (2.47)	5.85 (2.52)	6.03 (2.55)	2.50 (1.73)	2.23 (1.65)	2.46 (1.72)	1.86 (1.54)	2.25 (1.66)	2.41 (1.71)	1.49 (1.41)	1.76 (1.50)	1.90 (1.55)
T3	6.16 (2.58)	5.87 (2.52)	6.25 (2.60)	6.65 (2.67)	3.83 (2.08)	3.47 (1.97)	3.40 (1.97)	2.17 (1.63)	2.46 (1.72)	2.65 (1.77)	1.97 (1.57)	2.16 (1.63)	2.27 (1.66)
T4	6.03 (2.56)	5.82 (2.51)	6.10 (2.57)	6.40 (2.63)	3.70 (2.05)	2.73 (1.19)	2.97 (1.86)	2.05 (1.60)	2.60 (1.76)	2.93 (1.85)	2.03 (1.59)	2.25 (1.66)	2.35 (1.69)
T5	5.92 (2.53)	5.74 (2.50)	5.97 (2.54)	6.29 (2.61)	2.73 (1.79)	2.57 (1.75)	2.85 (1.83)	2.06 (1.60)	2.30 (1.67)	2.56 (1.75)	1.56 (1.43)	1.93 (1.56)	2.03 (1.59)
T6	6.07 (2.56)	5.90 (2.53)	7.47 (2.82)	8.59 (3.01)	3.10 (1.89)	3.53 (2.00)	3.73 (2.05)	2.03 (1.59)	2.33 (1.68)	2.60 (1.76)	1.93 (1.56)	2.14 (1.63)	2.35 (1.69)
T7	5.57 (2.46)	5.67 (2.48)	5.94 (2.54)	6.13 (2.57)	2.70 1.79)	2.47 (1.72)	2.60 (1.76)	2.17 (1.63)	2.23 (1.65)	2.49 (1.73)	1.57 (1.44)	1.82 (1.52)	1.93 (1.56)
T8	5.71 (2.49)	5.75 (2.50)	7.09 (2.75)	7.28 (2.79)	3.43 (1.97)	2.97 (1.86)	3.15 (1.91)	2.00 (1.58)	2.31 (1.68)	2.73 (1.80)	1.87 (1.54)	2.08 (1.61)	2.16 (1.63)
T9	6.03 (2.55)	5.80 (2.51)	7.33 (2.80)	8.06 (2.93)	3.33 (1.94)	2.93 (1.84)	3.52 (2.00)	2.20 (1.64)	2.35 (1.69)	2.76 (1.81)	2.00 (1.58)	2.14 (1.62)	2.00 (1.58)
T10	6.36 (2.62)	5.90 (2.53)	8.08 (2.93)	8.26 (2.96)	2.95 (1.86)	3.30 (1.94)	3.47 (1.99)	2.13 (1.61)	2.41 (1.71)	2.66 (1.77)	1.60 (1.45)	1.96 (1.57)	2.01 (1.58)
T11	6.12 (2.57)	5.83 (2.52)	7.58 (2.84)	8.29 (2.96)	5.42 (2.42)	4.85 (2.31)	5.30 (2.40)	4.20 (2.17)	5.50 (2.52)	6.76 (2.69)	3.33 (1.95)	5.40 (2.42)	6.47 (2.64)
T12	6.25 (2.60)	7.13 (2.76)	8.26 (2.96)	14.80 (3.89)	11.14 (3.41)	11.37 (3.44)	12.33 (3.58)	6.32 (2.61)	6.60 (2.66)	7.23 (2.78)	6.70 (2.68)	6.90 (2.72)	7.00 (2.73)
	.	0.03	0.04	0.08	0.10	0.11	0.07	0.04	0.06	0.05	0.04	0.05	0.05
	N.S	0.10	0.12	0.24	0.31	0.32	0.21	0.14	0.19	0.14	0.12	0.15	0.15

*Figures in parentheses are means of square root transformed value

Table 5: Efficacy of newer insecticides and *Verticillium lecanii* against leaf hoppers 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	6.13 (2.58)	3.47 (1.99)	3.43 (1.98)	3.68 (2.04)
T2	Acetamiprid 20% SP	5.87 (2.52)	2.86 (1.83)	3.02 (1.88)	3.20 (1.92)
T3	Diafenthiuron 50% WP	6.16 (2.58)	3.46 (1.99)	3.58 (2.02)	3.74 (2.06)
T4	Thiacloprid 21.7% SC	6.03 (2.56)	3.40 (1.97)	3.42 (1.98)	3.66 (2.04)
T5	Thiamethoxam 25 %WG	5.92 (2.53)	3.02 (1.88)	3.19 (1.92)	3.43 (1.98)
T6	Acephate 75% SP followed by *V. lecanii*	6.07 (2.56)	3.24 (1.93)	3.87 (2.09)	4.32 (2.19)
T7	Acetamiprid 20% SP followed by *V. lecanii*	5.57 (2.46)	3.03 (1.88)	3.11 (1.90)	3.29 (1.95)
T8	Diafenthiuron 50% WP followed by *V. lecanii*	5.71 (2.49)	3.26 (1.94)	3.61 (2.03)	3.83 (2.08)
T9	Thiacloroprid 21.7%SC followed by *V. lecanii*	6.03 (2.55)	3.33 (1.96)	3.79 (2.07)	4.08 (2.14)
T10	Thiamethoxam 25%WG followed by *V. lecanii*	6.36 (2.62)	3.14 (1.91)	3.94 (2.11)	4.10 (2.14)
T11	*Verticillium lecanii*	6.12 (2.57)	4.70 (2.28)	6.04 (2.55)	6.75 (2.69)
T12	Untreated control	6.25 (2.60)	7.82 (2.88)	7.98 (2.91)	10.30 (3.29)
	SE±	.	0.03	0.03	0.04
	CD at 5%	N.S	0.09	0.09	0.12

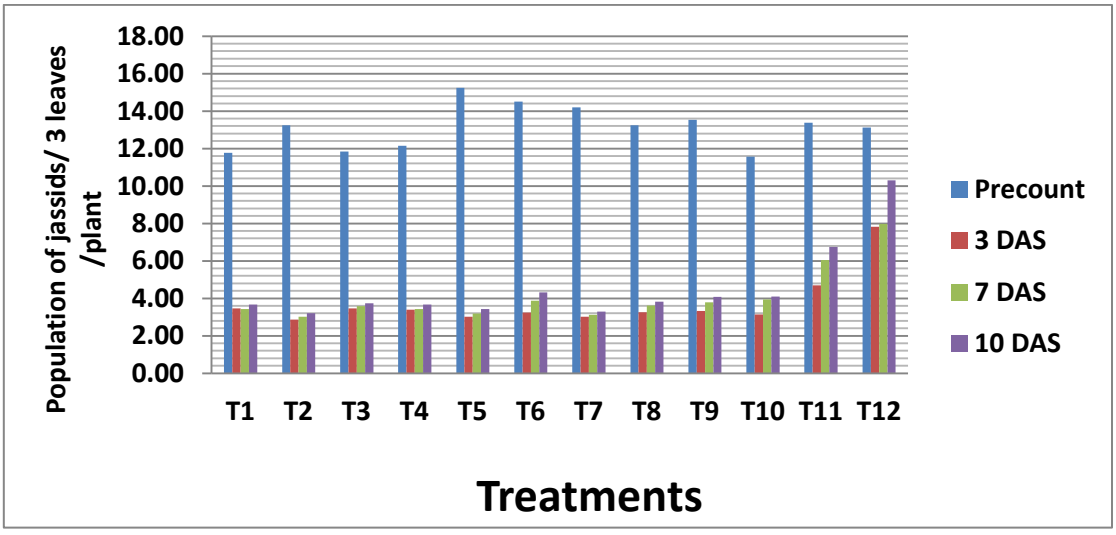

Fig. 1: Efficacy of all insecticidal sprays against leaf hopper population on okra after fourth spray (Average of four sprays)

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