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Seasonal Fluctuations and Management of Sucking Insect Pests on Bitter Gourd (*Momordica charantia* L.)

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ABSTRACT

Background: Bitter gourd, an important tropical and sub-tropical vegetable which occupies a predominant position in Indian vegetables. The aphids and leafhoppers are more serious agricultural insect pests and aphids indirectly transmit plant virus diseases like, Cucumber Mosaic Virus (CMV) in cucurbit crops. Our study aimed to noticed seasonal fluctuations and bio-inputs using management of sucking pests in bitter gourd.

Methods: Field experiments were conducted during 2017-19 in a farmer's field at Ellamanam village, Tiruchirappalli district, Tamil Nadu in insect pest population was monitored at weekly intervals from ten randomly selected plants in three plots. In field efficacy studies conducted Randomised Block Design with eight treatments and three replications.

Result: Our results showed in the maximum aphid and leafhopper populations were recorded in September 2018 during 39th SMW (Standard Meteorological Week). In *Rabi*, the aphids and leaf hopper population were maximum in 9th and 10th SMW in February and March. The population of aphids and leafhopper were positively correlated with maximum temperature, minimum temperature, wind speed and wind direction. Rainfall and relative humidity were negatively associated to aphids and leafhopper infestation. In *Kharif* and *Rabi*, high reduction of aphid and leafhopper pest population were noticed in chlorantraniliprole 18.5 SC and spinosad 45 SC compared to control. Among the bio-inputs agniastram recorded higher reduction of pest population followed by karpurakaraisal, NSKE, fish acid and ten leaf extract.

Key words: Bio-inputs, Bitter gourd, Insecticides, Seasonal incidence, Sucking pest.

INTRODUCTION

Bitter gourd (*Momordica charantia* Linnaeus) (Cucurbitaceae : 2n = 2x = 22), the most important tropical and sub-tropical vegetable among the cucurbitaceous crops which occupies a predominant place in Indian vegetables and is cultivated throughout the world (Rai *et al.,* 2008)**.** The tender fruit of bitter gourds are found to have medicinal and nutritional properties (Oishi *et al.,* 2007) as it contains steroidal compound saponins (charantin) and insulin like peptide (Altinterim, 2012). Leafhoppers (*Amrasca biguttula biguttula* Ishida) and Aphids (*Myzus persicae* Sulzer) are more serious agricultural insect pests, which cause considerable loss to the crops as it indirectly transmit plant virus diseases like, Cucumber Mosaic Virus (CMV) in cucurbit crops. The affected leaves exhibit wrinkling, slight distortion, mottling, downward rolling and curved petioles (Zitter and Murphy, 2009). With repeated usage of toxic insecticides, the sucking pests have gained resistance and resurgence (Wang *et al.,* 2015).Additional amount of about 25 per cent cost of cultivation in bitter gourd production (Nasiruddin *et al.,* 2004) is further required. However, synthetic insecticides are also found to be carcinogenic and teratogenic in humans. They pollute environment by upsetting the balance of nature, cause ground water contamination, reduce the population of natural enemies and non-target organisms (Jenkins *et al.,* 2013). Therefore, integrated pest management practices and host plant resistance are found to be an alternative to synthetic chemical pesticides for pest management (El-Wakeil, 2013)

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MATERIALS AND METHODS

Seasonal fluctuations of sucking insect pests on bitter gourd

Bitter gourd seeds (East west hybrid (F_1)) were sown in farmer's field for two seasons *viz.* third week of July 2018 (*Kharif*) and last week of December 2018 (*Rabi*) at Elamanam village, Tiruchirappalli District, Tamil Nadu in a plot of 24 m × 4 m at a spacing of 0.6 m × 2.0 m and recommended package of practices were adopted as per the TNAU crop production guide except plant protection measures. The experimental plot was divided into three subplots of 8 m × 4 m to record the observations. The insect pest population was monitored and recorded after a week

of transplanting from ten randomly selected and labelled plants per subplot. The pest population was observed at weekly intervals during different growth stages based on standard protocols. The incidence of aphids and leafhopper were recorded on three randomly selected leaves *viz.,* from top, middle and bottom of labelled plants. The observed data was correlated with abiotic factors like maximum and minimum temperature, rainfall, relative humidity and wind speed.

Field efficacy of bio-inputs and insecticides against sucking insect pests of bitter gourd

Two field experiments were conducted during *Kharif* and *Rabi* 2018-19 at Elamanam village, Tiruchirappalli District in Randomised Block Design with eight treatments and three replications. Bitter gourd seeds (East west F_1hybrid) were raised in a plot of 6m × 4m size at 60 cm × 200 cm spacing and recommended package of practices was followed as per the TNAU crop production guide except for plant protection measures. The treatments imposed for the study comprised of five bio-inputs and two insecticides *viz,*. karpurakaraisal (camphor) (5%), tobacco mixture (agniastram) (5%), fish acid (mennamilam) (0.5 %), ten leaf extract (pathilaikasayam) (5%), NSKE (5%), spinosad 45SC 0.12ml /l and chlorantraniliprole 18.5SC 0.4ml/l. The pre-treatment counts of sucking pests *viz.* aphid and leaf hopper were observed a day before spraying by selecting five randomly selected plants tagged in each replication. The post-treatment count was made after 3, 7 and 10 days post-spraying and the crop was sprayed at 15 days interval. The effectiveness of bio-inputs, the reduction percentage of pest population was calculated using (Abbott, 1987) formula:

Reduction percentage of pest population =

$$\frac{X - Y}{X} \times 100$$

X- per cent living in the check.
Y-per cent living in the treatment.

Preparation of bio-inputs

Meenamilam (Fish acid)

The waste of fish and jaggery were taken each at the rate of one kg and mixed well and kept in a plastic bucket. The content was mixed once in five days upto one month and then kept undisturbed for fermentation upto 40 days. After 45 days, the content was filtered using muslin cloth and kept in an airtight container for future use.

Agniastram (Tobacco extract)

The main constituents for 'Agniastram' were green chilli (500g), crushed garlic and ginger, dry tobacco leaves (250 g) and country cow urine (10 L). The constituents are boiled in a mud pot till one third of the total volume of the extract was obtained. The extract was kept for 24 h and then filtered and stored in an air tight plastic container in room temperature for future use.

Pathilaikasayam (Ten leaf extract)

The ten leaf extract includes the leaves of Notchi (*Vitex negundo* L.) (5 kg), Aristolochia (*Aristolochia indica* L.) (5 kg), Papaya (*Carica papaya* L.) (5 kg), Heartleaf moonseed (*Tinospora cordifolia* M.) (5 kg) and custard apple (*Annona squamosa* L.), Neem (*Azadirachta indica* A. juss) (2 kg), calotropis (*Calotropis gigantea* L.) (2 kg), waste land weed (*Tephrosia purpurea* L.) (2 kg), physic nut (*Jatropha curcas* L.) (2 kg), pungam (*Millettia pinnata* L.) (2 kg). The leaves were taken in 200 l of water, 5 l of country cow urine and 3 kg of cow dung and stored in an airtight plastic container for three months for fermentation. The plastic container was

Table 1: Seasonal fluctuations of sucking insect pests on bitter gourd, (*Kharif*, 2018).

Month	SMW 2018	Insects/plant/3 leaves (no.)* *Kharif* 2018	
		Aphid	Leafhopper
Aug	35	0.57	0.73
Sep	36	1.00	1.13
	37	0.40	0.50
	38	0.73	0.93
	39	1.03	1.37
Oct	40	0.27	0.20
	41	0.47	0.40
	42	0.63	0.57
	43	0.57	0.67
Nov	44	0.70	0.63
	45	0.77	0.73
	46	0.60	0.50
	47	0.33	0.40

SMW-Standard Meteorological Week, *Mean of three replication.

Table 2: Seasonal fluctuations of sucking insect pests on bitter gourd, (*Rabi*, 2018-19).

Month	SMW 2018-19	Insects/plant/3 leaves (no.) *Rabi* 2018-19	
		Aphid	Leafhopper
Dec	52	0.13	0.03
Jan	1	0.20	0.13
	2	0.20	0.17
	3	0.40	0.17
	4	0.53	0.23
	5	0.70	0.40
Feb	6	0.77	0.53
	7	0.77	0.63
	8	0.73	0.70
	9	0.83	0.73
Mar	10	0.67	0.83
	11	0.46	0.67
	12	0.37	0.43
	13	0.27	0.30
Apr	14	0.20	0.27

SMW-Standard Meteorological Week, *Mean of three replication.

kept in a cool shaded place and stirred three times in a day for efficient mixing and uniform fermentation.

NSKE (Neem seed kernel extract)

The neem seed kernel (4 kg) was ground gently into powder using a blender. One kg of powdered neem seed kernel was tied in a filter cloth and soaked in one litre of water overnight. Then the extract was filtered twice or thrice and the filtered extract was diluted to 5 per cent for field experiments.

Karpurakaraisal (Camphor mixture)

The camphor mixture was prepared by mixing one litre of neem oil with 50 ml of country fresh cow urine and 5 g of camphor (pachaikarpuram), stirred gently and kept in closed containers. Prepared mixture (5 %) was used in field and laboratory experiments. Since, camphor is insoluble in water, alcohol was used to dissolve the camphor and mixed with neem oil.

RESULTS AND DISCUSSION

Seasonal fluctuations

The results showed, maximum aphid and leafhopper population in *Kharif* was recorded in September 2018 during 39th SMW (Standard Meteorological Week) (1.03 and 1.37 no./3 leaves/plant) respectively and the minimum in October 40th SMW (0.27 and 0.20 no. /3 leaves/plant), respectively (Table 1). In *Rabi*, aphids were high during February 9th SMW (0.83 no. /3 leaves/plant), while the leafhopper population was high during 10th SMW (0.83 no. /3 leaves/plant) of March and low in 52nd SMW (0.03 no. /3 leaves/plant) of December (Table 2). The results are in conformity with the findings of Thippaiah *et al.* (2017), reported that the maximum aphid (1.73 no. /plant) and leafhopper (2.60 no. /plant) in November 45th SMW in *Kharif,* 2014. In *Rabi,* 2014-15, the aphids (13.33 no. /plant) and leafhopper (3.26 no. /plant) was maximum in 9th SMW of March.

The correlation analysis result clearly showed that pest population fluctuation in bitter gourd depends upon weather parameters (Table 3 and Fig 1). The aphids and leafhopper were positively correlated with maximum temperature (0.452 and 0.577), minimum temperature (0.254 and 0.415), wind speed (0.267 and 0.446) and wind direction (0.263 and 0.321). The rainfall (-0.484 and -0.411) and relative humidity (-0.473 and -0.570) were negatively associated to aphids and leafhopper infestation. In *Rabi* 2019, rainfall was not correlated to insect pests due to its lack but their population showed positive correlation with maximum temperature

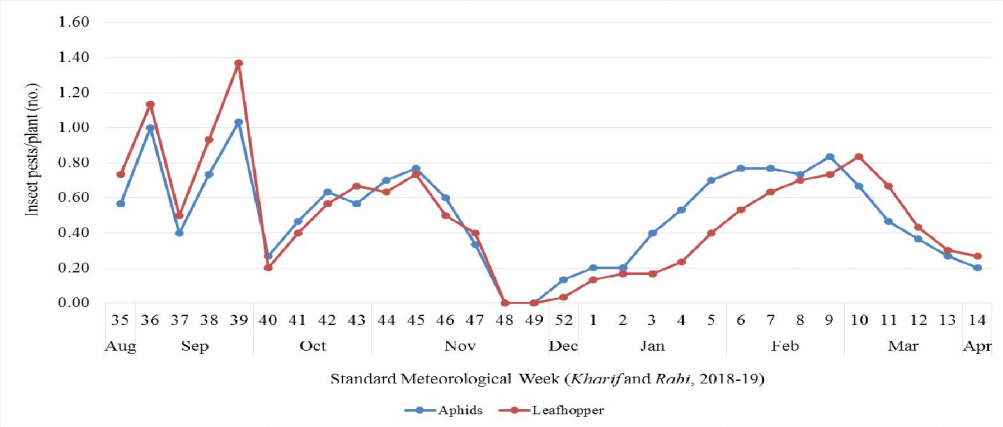

Fig 1: Seasonal fluctuations of sucking pests of bitter gourd, (*kharif* and *Rabi*, 2018-19).

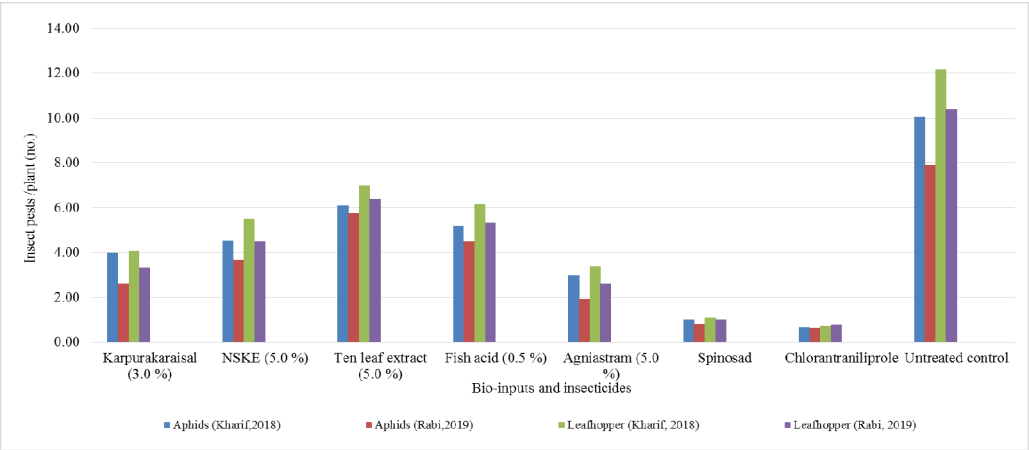

Fig 2: Field efficacy of bio-inputs and insecticides against sucking insect pests on bitter gourd (*Kharif* and *Rabi*, 2018-19).

Table 3: Correlation and regression analysis of weather parameters with the incidence of insect pests of bitter gourd (*Kharif* and *Rabi*, 2018-19).

Weather parameters	*Kharif*		*Rabi*		Regression equations		R^2
	Aphids	Leafhopper	Aphid	Leafhopper			
						Aphid	
Max. Temperature	0.452	0.577*	0.111	0.464	*Kharif*	$Y= 1.248+0.015X_1+0.035X_2-0.046X_3-0.014X_4 -0.059X_5-0.003X_6$	0.52
Min. Temperature	0.254	0.415	0.279	0.558*	*Rabi*	$Y= -0.841-0.082X_1 +0.115X_2 +0.012X_4+ 0.056X_5 -0.003$	0.45
Rainfall	-0.484	-0.411	-	-		Leafhopper	
Relative Humidity	-0.473	-0.570*	-0.016	-0.380	*Kharif*	$Y= 0.083+0.085X_1-0.022X_2-0.063X_3-0.006X_4 +0.078X_5-0.007X_6$	0.61
Wind Speed	0.267	0.446	0.181	0.372	*Rabi*	$Y= -1.994-0.009X_1 +0.071X_2 +0.009X_4 + 0.083X_5 -0.003X_6$	
Wind Direction	0.263	0.321	-0.131	-0.012			0.47

*Significant at 5% level, **Significant at 1% level, X_1-Maximum temperature; X_2-Minimum temperature; X_3-Rainfall; X_4-Relative humidity; X_5-Wind speed; X_6-Wind direction; Y=Numbers of insect pests, R^2=Coefficient of determination.

Table 4: Field efficacy of bio-inputs and insecticides against sucking pests in bitter gourd (*Kharif and Rabi*, 2018-19).

Treatment	Dose (ml/l)	Mortality of sucking pest/plant (no.)*							
		Aphid				Leafhopper			
		Kharif 2018	Reduction over control (%)	*Rabi* 2019	Reduction over control (%)	*Kharif* 2018	Reduction over control (%)	*Rabi* 2019	Reduction over control (%)
T_1- Karpura karaisal (Camphor mixture)	30.0	4.00(2.12)^{c}	60.19	2.59(1.76)^{c}	67.17	4.06(2.14)^{d}	66.61	3.33(1.96)^{c}	68.01
T_2- NSKE (Neem Seed Kernel Extract)	50.0	4.55(2.25)^{cd}	54.73	3.66(2.04)^{d}	53.61	5.50(2.45)^{e}	54.77	4.48(2.23)^{d}	56.96
T_3- Ten leaf extract (Pathilaikasayam)	50.0	6.11(2.57)^{e}	39.20	5.76(2.50)^{f}	27.00	7.00(2.74)^{g}	42.43	6.37(2.62)^{f}	38.81
T_4- Fish acid (Meenamilam)	5.0	5.19(2.39)^{d}	48.36	4.48(2.23)^{e}	43.22	6.16(2.58)^{f}	49.34	5.23(2.42)^{e}	49.76
T_5- Agniastram (Tobacco mixture)	50.0	3.00(1.87)^{b}	70.14	1.93(1.56)^{b}	75.83	3.39(1.97)^{c}	72.12	2.59(1.76)^{b}	75.12
T_6- Spinosad 45 SC	0.12	1.00(1.22)^{a}	90.04	0.82(1.15)^{a}	89.61	1.11(1.27)^{b}	90.87	1.00(1.22)^{a}	90.39
T_7- Chlorantraniliprole 18.5 SC	0.40	0.67(1.08)^{a}	93.33	0.63(1.06)^{a}	92.01	0.72(1.11)^{a}	94.08	0.78(1.13)^{a}	92.51
T_8- Untreated control		10.05(3.25)^{f}		7.89(2.90)^{g}		12.16(3.56)^{h}		10.41(3.30)^{g}	
SEd	0.06		0.04		0.06		0.05		
CD (p-=0.05%)	0.16		0.09		0.13		0.10		

DAS-Days After Spray, Figures in parentheses are “x+0.5 transformed values, DAS-Days After Spray, *Mean of Three Replication In a column, means followed by different letters are significantly different (p=0.05) as per LSD.

(0.111 and 0.464), minimum temperature (0.279 and 0.558) and wind speed (0.181 and 0.372) and negatively correlated to relative humidity (-0.016 and -0.380) and wind direction (-0.131 and -0.012). These results are in consonance with the findings that the aphid and leafhopper are significant and positively correlated to maximum temperature and negatively correlated with rainfall and relative humidity (Chakraborty, 2011; Deepika *et al.,* 2013; Shilpakala and Murali Krishna, 2016). In contrast, Kumar and Paul, (2017) reported significant negative correlation of aphid population was found with maximum temperature in B. rapa (r= -0.963**). The weather parameters of maximum temperature (X_1), minimum temperature (X_2), rainfall (X_3), relative humidity (X_4), wind speed (X_5) and wind direction (X_6) influenced 52.00 and 0.45 per cent (R^2) of aphids population and leafhopper (61.00 % and 0.47 %) in *Kharif* and *Rabi* season.

Field efficacy

The effect of bio-inputs and insecticides showed significant difference between aphids and leafhoppers when compared to control (Table 4). The aphids maximum reduction of its population was noticed in chlorantraniliprole 18.5 SC (93.33 and 92.01 %) and spinosad 45 SC (90.04 and 89.61 %) compared to control. Among the bio-inputs agniastram (70.14 and 75.83 %) recorded maximum reduction of aphid population followed by karpurakaraisal (60.19 and 67.17 %) and minimum reduction in ten leaf extract (39.20 and 38. 81 %). Likewise the reduction of leafhopper population was seen in chlorantraniliprole 18.5 SC (94.08 and 92.51 %) and spinosad 45 SC (90.87 and 90.39 %). Among the bio-inputs, agniastram (72.12 and 75.12 %) was significantly effective followed by karpurakaraisal (66.61 and 68.01 %) and ten leaf extract (42.43 and 38.81 %).

However, Wagh *et al.* (2017) witnessed that spinosad 45 SC reduced the population of aphids, whitefly and thrips effectively. From the results obtained, agniastram and karpurakaraisal was more effective against management of sucking pests among the bio inputs (Fig. 2). Patil (2016) documented that 20 l cow urine + 2 kg neem leaves + 500 g tobacco + 250 g crushed garlic and 500 gm of green chilles as effective management practices for sucking and leaf feeding insects. Deka *et al.,* (2006) indicated bio-inputs and organic based plant products as less expensive with non-hazardous and long term sustainable management.

CONCLUSION

The aphids and leafhopper were maximum during September in 39th SMW (Standard Meteorological Week) in *Kharif* 2018 and 9 and 10th SMW in February and March in *Rabi* 2019. The aphids and leafhopper showed a positive correlation to maximum temperature, minimum temperature, wind speed and negative correlation to rainfall and relative humidity. Chlorantraniliprole 18.5 SC and spinosad 45 SC are very effective followed by bio-inputs *viz*., agniastram, karpurakaraisal and NSKE are effective for management of sucking insect pests in bitter gourd.

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