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Seasonal incidence of sucking insect pests and their association with predatory coccinellid beetles on bitter gourd

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ABSTRACT: The seasonal incidence of sucking insect pests (aphid, leafhopper, thrips and whitefly) on bitter gourd and their association with predatory coccinellid beetles was studied during *kharif* and *rabi* seasons, 2014-15. The mean population of aphid, leafhopper, thrips and whitefly varied from 0.40, 0.65, 0.30 and 0.60 in *kharif*, 3.86, 1.66, 1.50 and 0.11 in *rabi*, respectively. Similarly the numbers of predatory coccinellid beetles varied from 0.15 in *kharif* and 0.48 in *rabi*. The incidence of aphids, leafhopper and predatory coccinellids were positively correlated (r = 0.85, 0.62, 0.86) respectively, with maximum temperature. The association of sucking pests and predatory coccinellids revealed a positive correlation. A significant positive correlation existed between aphid and predatory coccinellid beetles (r = 0.69 and r = 0.94 per cent) during *kharif* and *rabi* season, respectively. These results showed that increase in the incidence of sucking insect pests led to increased population of predatory coccinellid beetles on bitter gourd. Numbers of predatory beetles and other natural enemies should maintain populations of sucking pests below economic injury level on bitter gourd.

KEYWORDS: Bitter gourd, seasonal incidence, sucking insect pests, predatory coccinellids

INTRODUCTION

Bitter gourd, like other cucurbits, is attacked by a wide array of insect and non-insect pests, the major being fruit fly, red pumpkin beetle, *Epilachna* beetle, whitefly, aphids and thrips. Infestation by these pests is an important limiting factor in the commercial cultivation of the crop. Attack of these pests begin at very early stage of crop growth and continues till harvest and degree of infestation depends upon prevailing agronomic conditions (Vandana *et al*., 2001). Sucking insect pests like aphids, whitefly, thrips and leafhoppers attack the crop throughout the growth period resulting in the reduction of yields. So management interventions are required to save the yield loss. Coccinellids are used as an effective predator for sucking insect pest management (Elliott and Kieckhefer, 1990). The beetles prey on a number of species of aphids on different host plants (Sakuratani, 1977; Winder *et al*., 1994). The lady beetles are predacious both at larval and adult stages and feed on pests such as aphids, brown plant hopper and thrips (Rawat and Modi, 1969; Sumalde *et al*., 1993). This paper deals with the seasonal incidence of sucking insect pests on bitter gourd and determines the role of predatory coccinellid beetles in suppressing sucking pest populations. The present hypothesis of the investigation was that predatory beetles do effectively suppress sucking pests on bitter gourd.

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MATERIALS AND METHODS

The present investigation was conducted during *kharif* and again during *rabi* season of 2014-15 at the Department of Horticulture , UAS, GKVK, Bengaluru (12° 58' N lati and 77° 35' E long, at an alti of 930 m AMSL) and at IIHR, Hesaraghatta, Bengaluru (13° 13' N lati and 77° 48' E long, at an alti of 890 m AMSL), respectively. For this study, seeds of the variety 'Arka Harit' were sown during second week of August (*kharif)* and during second week of November (*rabi*). The experiment was laid out in randomised block design with three replications with a plot size 8 m X 11 m. To record observations on sucking insect pests populations, ten plants per plot (total n = 30) were randomly selected, labelled and on each selected plant, three leaves each from top, middle and lower parts were observed. The observations on pest activity and predatory coccinellid beetles were recorded at weekly intervals.

Standardised sampling procedures were adopted while counting the insects on bitter gourd. For sucking pests [aphids (*Aphis gossypii* Glover), leafhoppers (*Empoasca motti* Pruthi, *Amrasca biguttula biguttula* (Ishida)), white flies (*Bemicia tabaci* Gennadius) and thrips (*Thrips palmi* Karny)], observations were recorded by counting the number of nymphs and adults on three leaves i.e., one each from top, middle and bottom canopy of the selected and labelled plants (Barma and Jha, 2013; Mari and Bugti, 2016; Singh *et al*., 2013).

The adult and grub stages of two predatory coccinellid beetles (*Cheilomenes sexmaculata* Fab. and *Coccinella transversalis* Fab.) were counted on thirty randomly selected whole plants at weekly intervals during *kharif* and *rabi* season on bitter gourd plants (Vennila *et al*., 2007; Patel and Purohit, 2014).

The data were statistically ananlysed by correlation analysis between sucking insect pests, predatory coccinellid with weather parameter and also between sucking insect pest with predatory coccinellid beetle. The data on sucking insect pest and predatory coccinellid were subjected to multiple regression analysis to know their association (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

During *kharif* season, aphid numbers on bitter gourd varied from 0.00 to 1.73 with a mean of 0.40 aphids per three leaves per plant. However, higher aphid numbers were recorded during first week of November (45^{th} SW). Similarly, during *rabi* season, the aphids numbers varied from 0.00 to 13.33 with a mean of 3.86 aphids per three leaves per plant of bitter gourd. However, the maximum numbers of aphids were observed during first week of March (9^{th} SW) (Tables 1 and 2). The correlation studies revealed that, during *kharif*, weak positive correlation existed between incidence of aphids and maximum temperature (r = 0.08), whereas, negative correlation was observed with minimum temperature (r = -0.49), maximum RH (r = -0.005) and minimum RH (r = -0.40). However, during the *rabi* season, significant positive correlation existed between aphids and maximum temperature (r = 0.85), whereas, significant negative correlation existed between minimum temperature (r = -0.77), maximum RH (r = -0.86) and minimum RH (r = -0.79) (Tables 3 and 4). These observations are in conformity with the observations made earlier by Chakraborthy (2011) who reported that abiotic factors such as temperature and relative humidity significantly influenced *A. gossypii* population on tomato crop.

During *kharif*, leafhopper numbers varied from 0.13 to 2.60, with a mean of 0.65 per three leaves per plant. Similarly, during *rabi* season, leafhopper numbers varied from 0.50 to 3.26, with a mean of 1.66 leafhoppers per three leaves per plant (Tables 1 and 2). During *kharif*, a weak positive correlation existed between the infestation of leafhoppers and minimum temperature (r = 0.24) and minimum relative humidity (r = 0.09). However, non-significant negative correlation was observed between the infestation of leafhoppers with maximum temperature (r = 0.10), maximum relative humidity (r = -0.04) and rainfall (r = -0.29). Moreover, during the *rabi* season, a significant positive correlation existed between leafhoppers and

Table 1. Seasonal incidence of sucking pests and predatory coccinellids on bitter gourd at GKVK during *kharif*, 2014

Month	Standard week	Aphids*	Leaf hoppers*	Thrips*	Whitefly*	Coccinellids**
August	35	0.00	0.16	0.00	0.00	0.00
	36	0.00	1.70	0.40	0.33	0.00
September	37	0.00	2.60	0.76	0.50	0.00
	38	0.00	1.40	0.40	0.30	0.06
	39	0.00	0.56	0.50	0.56	0.16
	40	0.00	0.13	0.10	1.16	0.00
October	41	0.43	0.16	0.26	1.33	0.16
	42	1.40	0.13	0.43	1.03	0.26
	43	0.16	0.26	0.00	0.63	0.00
	44	0.00	0.13	0.00	0.00	0.16
November	45	1.73	0.13	0.26	0.93	0.30
	46	1.10	0.50	0.50	0.50	0.73
	Mean	0.40	0.65	0.30	0.60	0.15
	Max	1.73	2.60	0.76	1.33	0.73
	Min	0.00	0.13	0.00	0.00	0.00
	SD	0.63	0.80	0.24	0.43	0.21

*Mean no./ 3leaves/plant **mean no./plant

Table 2. Seasonal incidence of sucking pests and predatory coccinellids on bitter gourd at Hessaraghatta during *rabi*, 2014 - 15

Month	Standard week	Aphids*	Leaf hoppers*	Thrips*	Whitefly*	Predatory Coccinellids**
November	47	0.00	0.50	0.20	0.00	0.00
	48	0.00	0.66	0.60	0.00	0.00
December	49	0.60	0.83	0.66	0.00	0.13
	50	0.50	0.83	2.50	0.00	0.20
	51	1.16	0.83	0.96	0.13	0.13
	52	1.33	1.46	1.03	0.60	0.26
January	01	1.50	1.86	1.83	0.33	0.26
	02	1.46	0.83	1.63	0.30	0.36
	03	1.83	1.93	3.40	0.26	0.43
	04	4.13	2.33	2.53	0.00	0.50
February	05	6.33	2.43	1.60	0.00	0.60
	06	7.66	2.83	1.57	0.06	0.83
	07	6.50	2.30	1.30	0.00	1.10
	08	11.66	2.10	1.36	0.00	1.30
March	09	13.33	3.26	1.40	0.00	1.16
Mean		3.86	1.66	1.50	0.11	0.48
Max		13.33	3.26	3.40	0.60	1.16
Min		0.00	0.50	0.20	0.00	0.00
SD		4.30	0.87	0.82	0.18	0.42

*Mean no./ 3leaves/plant **mean no./plant maximum temperature (r = 0.62), whereas, significant negative correlation existed between leafhopper and minimum temperature (r = -0.83), maximum RH (r = -0.57) and minimum RH (r = -0.78) (Tables 3 and 4). These observations are in agreement with the observations of Deepika *et al.* (2013) who observed that leafhoppers population was significantly and positively correlated with maximum temperature. The infestation of leafhoppers was negatively correlated with rainfall. During *kharif*, thrips numbers varied from 0.00 to 0.76, with a mean of 0.30 thrips per three leaves per plant. Similarly, during *rabi*, thrips numbers varied from 0.20 to 1.50, with a mean of 1.50 thrips per three leaves per plant (Tables 1 and 2). During *kharif*, a non-significant negative correlation existed between the thrips incidence and maximum temperature (r = -0.22), minimum temperature (r = -0.01), maximum relative humidity (r = -0.04), minimum relative humidity (r = -0.12) and rainfall (r = -0.03). Similarly, during *rabi*, non-significant positive correlation was observed between thrips population and maximum temperature (r = 0.08) and non-significant negative correlation existed between thrips and minimum temperature (r = -0.25), maximum RH (r = -0.03) and minimum RH (r = -0.25) (Tables 2 and 4). This observation is in agreement with observations of Krishna Kumar *et al*. (2006) who reported the population of thrips increased from three to six weeks after sowing of watermelon. During *kharif*, whitefly numbers varied from 0.00 to 1.33 with a mean of 0.60 whitefly per three leaves per plant. Similarly, during *rabi*, whitefly numbers varied from 0.00 to 0.60, with a mean of 0.11 whitefly per three leaves per plant (Tables 1 and 2). During *kharif*, a non-significant positive correlation existed between incidence of whitefly and maximum temperature (r = 0.39), minimum temperature (r = 0.05) and rainfall (r = 0.23). While, non-significant negative correlation was observed with maximum RH (r = -0.35) and minimum RH (r = -0.12). Similarly, during *rabi*, positive correlation existed between whitefly population and minimum temperature (r = 0.34), maximum RH (r = 0.29) and minimum RH (r = 0.36) (Tables 3 and 4). This observation was similar to that of Lekshmi *et al*. (2014), who reported that the maximum and minimum temperatures were significantly and negatively correlated with the population build-up of whitefly.

The number of predatory coccinelids during *kharif* season ranged from 0.00 to 0.73, with a mean of 0.15 per plant. During *rabi* season their numbers ranged from 0.00 to 1.16 with a mean of 0.48 beetles per plant (Tables 1 and 2). During *kharif,* predatory coccinellid beetle population was non-significantly and positively correlated with rainfall (r = 0.61) and non-significant and negatively correlated with maximum temperature (r = -0.22) and maximum RH (r = -0.30). The relationship was significantly and negatively correlated with minimum temperature (r = -0.71) and minimum RH (r = -0.61). In the *rabi* season, significant positive correlation existed between coccinellid population and maximum temperature (r = 0.86). Significant negative correlation existed between coccinellids and minimum temperature (r = -0.80), maximum RH (r = -0.77) and minimum RH (r = -0.74) (Tables 3 and 4). These results are in conformity with Singh *et al*. (2013) who reported that coccinellid beetle population had a negative correlation with minimum and mean temperature, rainfall and maximum and minimum RH. Khuhro *et al*. (2014) revealed that temperature had overall positive impact on all the insect pests and their predators on tomato crop.

During *kharif* season the aphid population was significantly and positively correlated with the predatory coccinellid population (r = 0.69). Similarly, during *rabi* season the aphid population was significantly positively correlated with predatory coccinellid population (r = 0.94) (Tables 5 and 6). These results were in agreement with the findings of Patel and Purohit (2014) where predatory coccinellid beetles had significant positive correlation with aphids during *kharif* and *rabi* season in sorghum crop. Similarly, Singh *et al*. (2013) reported that the predatory coccinellid beetles showed positive correlation with aphid population and maximum temperature in okra ecosystems. The multiple linear regression equation suggests that the predatory coccinellid population on bitter gourd crop was influenced to an extent of 47 per cent due to aphid population during *kharif* and 89 per cent during *rabi* (Figures 1 and 2). Similarly, leafhopper population

Table 3. Correlation between sucking pests and predatory coccinellids in bitter gourd with weather parameters during *kharif,* 2014

Weather parameters	Aphids	Thrips	Leaf hoppers	Whitefly	Predatory coccinellids
Maximum tem. (°C)	0.085	-0.22	-0.10	0.39	-0.22
Minimum tem. (°C)	-0.49	-0.01	0.24	0.05	-0.73**
Maximum RH (%)	-0.05	-0.08	-0.04	-0.35	-0.30
Minimum RH (%)	-0.40	-0.39	0.09	-0.12	-0.61*
Rainfall (mm)	-0.05	-0.03	-0.29	0.23	0.61

**Correlation is significant at P ≤ 0.01 level (2-tailed); *.Correlation is significant at the P ≤ 0.05 level (2-tailed)

Table 4. Correlation between sucking pests and predatory coccinellids in bitter gourd with weather parameters during *rabi*, 2014 - 15

Weather parameters	Aphids	Thrips	Leaf hoppers	Whitefly	Predatory coccinellids
Maximum tem. (°C)	0.85**	0.089	0.62**	-0.20	0.86**
Minimum tem. (°C)	-0.77**	-0.25	-0.83**	0.34	-0.80**
Maximum RH (%)	-0.86**	-0.03	-0.57*	0.29	-0.77**
Minimum RH (%)	-0.79**	-0.25	-0.78**	0.36	-0.74**
Rainfall (mm)	-	-	-	-	-

**Correlation is significant at P ≤ 0.01 level (2-tailed); *.Correlation is significant at the P ≤ 0.05 level (2-tailed)

Table 5. Correlation between aphids, leafhoppers, thrips and whitefly numbers with predatory coccinellids during *kharif,* 2014

	Correlation	Regression equation	R^2 value
Aphids Vs. Predatory coccinellids	0.69*	Y = 0.06 + 0.22 Aphids	0.47
Leafhoppers Vs Predatory coccinellids	-0.28	Y = 0.20 - 0.07 Leafhoppers	0.08
Whitefly Vs Predatory coccinellids	0.26	Y = 0.08 + 0.23 Thrips	0.07
Thrips Vs Predatory coccinellids	0.12	Y = 0.11 + 0.06 Whitefly	0.015

**Correlation is significant at P ≤ 0.01 level (2-tailed); sucking pests numbers/3 leaves/plant with predatory coccinellids per plant

Table 6. Correlation between aphids, leafhoppers, thrips and whitefly with predatory coccinellids during *rabi,* 2014-15

	Correlation	Regression equation	R^2 value
Aphids Vs. Predatory coccinellids	0.94*	Y = 0.12 + 0.09 Aphids	0.89
Leafhoppers Vs Predatory coccinellids	0.81*	Y = -0.17 + 0.39 Leafhoppers	0.66
Whitefly Vs Predatory coccinellids	0.18	Y = 0.33 + 0.09 Thrips	0.03
Thrips Vs Predatory coccinellids	-0.26	Y = 0.55 - 0.62 Whitefly	0.06

**Correlation is significant at P ≤ 0.01 level (2-tailed); sucking pests numbers/3 leaves/plant with predatory coccinellids per plant

during *kharif* season was negatively correlated with the predatory coccinellids (r = -0.28).

Similarly, during *rabi* season the pest population was significantly and positively correlated with predatory coccinellids population (r = 0.81) (Tables 5 and 6). The multiple linear regression equation suggests that the incidence of predatory coccinellid population on bitter gourd crop was influenced by 8 per cent due to leafhopper during *kharif* and 66 per cent during *rabi* (Figs. 1 and 2). During *kharif* season the thrips population was positively correlated with the predatory coccinellids population (r = 0.12). Similarly, during *rabi* season the pest population was negatively correlated with predatory coccinellids population (r = -0.26) (Tables 5 and 6). The multiple linear regression equation suggests that the incidence of predatory coccinellids population on bitter gourd crop was influenced by thrips to the extent of 1.5 per cent during *kharif* and 6 per cent during *rabi*, by thrips population (Figs. 1 and 2). During *kharif* season the thrips population was positively correlated with the predatory coccinellids population (r = 0.12). During *rabi* season the pest population was negatively correlated with predatory coccinellids population (r = -0.26) (Tables 5 and 6). The multiple linear regression equation suggests that the numbers of predatory coccinellid beetles on bitter gourd crop was influenced by thrips to an extent of 1.5 per cent during *kharif* and 6 per cent during *rabi* (Figs. 1 and 2). From the above results, it is confirmed that the numbers of predatory coccinellids was influenced by increasing population of sucking insect pests especially aphids and leafhoppers. The above results are similar with the findings of Solangi *et al*. (2008).

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