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FIELD INCIDENCE OF MEALYBUGS AND ITS PARASITIZATION BY ENCYRTIDS IN VARIOUS CROP ECOSYSTEMS

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Abstract

Field incidence of mealybugs and its parasitization by encyrtids were carried out at Annamalainagar during two subsequent years 2008 and 2009 on cotton, sunflower, brinjal, tomato, bhendi, mesta, guava and china rose. The results revealed that *Phenacoccus solenopsis* incidence was high on *Gossypium hirsutum* (55.10) and *Hibiscus rosa-sinensis* (59.20) during August, 2009. Its parasitoid *Aenasius bambawalei* was recorded with high per cent parasitism on *G. hirsutum* (August, 2008) and *H. rosa-sinensis* (July, 2009). *Ferrisia virgata* population on *G. hirsutum* was more during August than next two months of 2009 and the per cent parasitization of *Aenasius advena* also followed similar trends as *F. virgata* during August and consecutive two months. On *Psidium guajava*, parasitization by *Blepyrus insularis* was found only during August of 2009; *F. virgata* population was highest (17.80) in July 2009; per cent parasitization by *A. advena* also followed the similar trends. *Maconellicoccus hirsutus* population on *Abelmoschus esculentus* decreased steadily from July to September 2009; per cent parasitization by *Anagyrus dactylopii* was the lowest (3.52) in July and the highest in August (25.00); parasitization by *A. chrysos* was found only during July and was very low (1.41). *Coccidohystrix insolita* population on *Solanum melongena* was high during both July, 2008 and 2009 and per cent parasitization of *Leptomastix nigrocincta* was less during the same period of both years.

Key words : Field incidence, mealybugs, encyrtids, different crop ecosystems, parasitization per cent.

Introduction

Green revolution has no doubt led to increased world food supplies, but at the same time, it has caused several ecological, environmental and socioeconomic problems. Green revolution technology relied on the use of dwarf and semi dwarf high-yielding varieties of crops, increased use of agrochemicals and irrigation. All these practices favoured the build-up of crop pests, with the result that the intensity of several pests has increased, many minor pests have assumed the status of major pests and several new pest problems have appeared in certain regions. In addition, the misuse and overuse of pesticides has lead to problems of pesticide resistance, resurgence and contamination of different components of the environment. Inspite of a variety of management practices applied against pests, crop losses have consistently shown an increasing trend (Dhaliwal and Koul, 2010). The introduction of gene technology has added a new dimension to pest management. There are varied claims and counter-claims about the potential of gene technology in shaping the crop protection scenario in the twenty-first century (Dhaliwal, 2008 and James, 2009). Additionally, the climate change also exerts an intense effect on the pest problems.

Mealybugs once considered as minor pests have assumed the major pest status due to their polyphagous nature coupled with high reproductive capacity with short life cycle which is more favoured due to prolonged drought and quick dispersal through wind, seeds and planting materials (Suresh *et al.*, 2010).

In recent years number of insect species have become resistant to an increasing number of insecticides (Knight and Norton, 1989). The increasing public awareness on dangers of pesticide use demands for safer products or pest control strategies. In this context, use of natural enemies to manage agricultural pests appears to be an option (Noyes and Hayat, 1994). Of the natural enemies used in insect pest management, the parasitic Hymenopterans have been the most successful biocontrol agents (Noyes, 1985 and Greathead, 1986).

Materials and Methods

In Cuddalore district, studies on field incidence of mealybugs and its parasitization by encyrtids were carried out at Annamalainagar during two subsequent years 2008 and 2009 on cotton, sunflower, brinjal, tomato, bhendi, mesta, guava and china rose. Observations were made by selecting ten plants randomly in each mealybug infested field once a week (four counts / month) during different cropping seasons. In each plant, five twigs of 15cm long terminal shoots along with mealybugs were collected and placed in individual polythene covers and taken to the laboratory. Twigs brought to the laboratory were observed under a stereozoom microscope (Stemi DV4, Zeiss) at 10X magnification and the number of mealybugs (2^{nd}, 3^{rd} instar nymphs and adult females) were counted. Then the twigs were kept in glass containers (15cm long and 10cm dia) covered with khadda cloth, incubated (32±2°C, 65±5 per cent RH), observed daily for the emergence of parasitoids and per cent parasitism was estimated by using the formula given below.

$$\text{Per cent parasitism} = \frac{\text{Number of encyrtids emerged} \times 100}{\text{Total number of mealybugs}}$$

Results and Discussion

Phenacoccus solenopsis

Encyrtids, *Aenasius bambawalei* and *Anagyrus kamali* parasitized *P. solenopsis* on *G. hirsutum* and *H. rosa-sinensis*. But *Anagyrus kamali* could not be recovered from *P. solenopsis* on *Abelmoschus esculentus*, *Helianthus annuus*, *Hibiscus cannabinus*, *Lycopersicon esculentum* and *Solanum melongena*. This might be due to some plant specific compounds that deterred *Anagyrus kamali* or extensive surveys might result in recovery of *Anagyrus kamali. Phenacoccus solenopsis* population on *G. hirsutum* was maximum (55.10) during August, 2009 and minimum (11.40) during October, 2009 when compared to the same months during 2008 (table 1). Per cent parasitization of *A. bambawalei* was more (24.78) during August and less (9.48) during October, 2008 as compared to 2009. Per cent parasitization by *Anagyrus kamali* was found only during July, 2008 (1.76) and 2009 (1.44) and it was absent in subsequent three months. During July, 2008 and 2009, *P. solenopsis* population on *A. esculentus* was more than August and September (table 1). Highest per cent parasitization of *A. bambawalei* was recorded during July of both the years. On *Helianthus annuus*, *P. solenopsis* population was 27.90, 43.50 and 5.60, 8.10 during August (2008, 2009) and October (2008, 2009) respectively. Its parasitization by *A. bambawalei* was 15.05, 9.66 and 8.93, 6.17 again during the same period (table 1). *Phenacoccus solenopsis* population on *Hibiscus cannabinus* was maximum during September of both the years. During August, population was low during 2008 and 2009 (table 1). Per cent parasitization of *A. bambawalei* was the highest during August, 2008 than September, 2009. But, it was the lowest during October of both the years. The mealybug population was high, inspite of intermittent monsoon showers because of peak vegetative stage of the crop.

Eventhough, *H. rosa-sinensis* is not a cultivated crop, it was included in the study because it served as major host for *P. solenopsis* population throughout the year at Annamalainagar and was present around all the crops studied. Earlier reports of Aheer *et al*. (2009), Arif *et al*. (2009), Prishanthini and Laxmi (2009) and Vennila *et al*. (2010) also recorded *H. rosa-sinensis* as one of the major host plant of *P. solenopsis*.

Highest *P. solenopsis* population on *H. rosa-sinensis* was recorded during August, 2009 and lowest population during October, 2008 (table 1). During July and September, population was moderate during both the years. Per cent parasitization of *A. bambawalei* was highest during July, 2009 and lowest during September, 2008. Per cent parasitization by *Anagyrus kamali* was found only during July, 2008 and 2009 and it was absent in subsequent three months. Similarly, Abbas *et al*. (2010) also recorded Cotton and China rose as the top two preferred host–plant species by *P. solenopsis*. *Phenacoccus solenopsis* population on *Lycopersicon esculentum* was high during July, 2009 than other months of 2008 and 2009 (table 1). Per cent parasitization of *A. bambawalei* was maximum in 2008 than 2009 during July and August. *Phenacoccus solenopsis* population on *Solanum melongena* was high during July of 2008 and 2009 than August and September (table 1). Per cent parasitization of *A. bambawalei* was higher during July of 2008 than 2009.

Economical damage was observed on cotton, brinjal, okra, tomato, sesame, sunflower and china rose with plant death in severe conditions due to *Phenacoccus solenopsis* in Pakistan (Arif *et al*., 2009). In India, although the economic damage was noticed on the dominantly cultivated upland cotton *Gossypium hirsutum* L. and its hybrids followed by desi cotton *G. arboreum*, *P. solenopsis* has several host plants belonging to various categories *viz*., cereals, pulses, oilseeds, vegetables, ornamentals, weeds and fruits (Vennila *et al*., 2010). In the present study, *A. bambawalei* is reported as the major parasitoid of *P. solenopsis*. However Ashmead (1902) and Kerrich (1967) reported *Chalcaspis phenacocci*

Table 1: Field incidence of *Phenacoccus solenopsis* and its parasitization by encyrtids (2008 & 2009)

Crop	Month#	Mean no. mealybugs/ five twigs ± SD*		Per cent parasitization by *Aenasius bambawalei**		Per cent parasitization by *Anagyrus kamali**	
		2008	2009	2008	2009	2008	2009
Gossypium hirsutum	July	34.10±8.58	34.70±8.68	12.32	8.65	1.76	1.44
	August	45.60±7.04	55.10±7.53	24.78	15.25	-	-
	September	24.90±6.47	15.10±3.11	16.06	21.85	-	-
	October	11.60±2.88	11.40±2.76	9.48	10.53	-	-
Abelmoschus esculentus	July	28.00±7.96	44.80±8.61	15.00	6.25	-	-
	August	12.70±7.13	19.70±3.50	11.81	5.08	-	-
	September	9.00±2.79	8.80±3.08	4.44	5.68	-	-
Helianthus annuus	August	27.90±11.41	43.50±6.54	15.05	9.66	-	-
	September	13.30±4.76	16.10±4.95	14.29	8.07	-	-
	October	5.60±2.27	8.10±2.02	8.93	6.17	-	-
Hibiscus cannabinus	August	8.50±2.80	9.90±3.48	16.12	7.07	-	-
	September	16.80±6.81	17.80±9.11	12.5	11.24	-	-
	October	12.90±2.23	13.70±2.06	4.65	6.57	-	-
Hibiscus rosa -sinensis	July	16.20±6.88	30.60±4.30	48.77	50.98	4.32	3.27
	August	55.60±8.78	59.20±10.96	12.59	39.36	-	-
	September	11.10±3.63	27.40±4.06	6.31	11.68	-	-
	October	6.20±2.30	8.10±3.07	11.29	7.41	-	-
Lycopersicon esculentum	July	20.20±6.63	28.80±6.01	20.30	13.89	-	-
	August	9.50±2.80	11.00±3.59	16.84	13.64	-	-
	September	7.50±2.95	3.90±1.79	12.00	15.38	-	-
Solanum melongena	July	13.40±3.89	32.60±4.90	14.18	7.98	-	-
	August	6.40±1.43	23.00±6.93	12.19	13.48	-	-
	September	4.40±1.78	6.40±1.65	9.09	9.38	-	-

*Mean of ten plants. #Mean of four counts. Mean values followed by standard deviation.

and *Chalcaspis arizonensis* as the parasitoids of *P. solenopsis* from USA, respectively. In India, literature pertaining to parasitoids on *P. solenopsis* is only limited as *A. bambawalei* was also reported very recently in 2009.

Ferrisia virgata

Aenasius advena and *Blepyrus insularis* parasitized *F. virgata* on *G. hirsutum* and *Blepyrus insularis* could not be recovered from *F. virgata* on *P. guajava*. In 2009, *F. virgata* population and per cent parasitization by *A. advena* was 34.60 (August), 10.30 (October) and 12.43 (August), 5.83 (October), respectively (table 2). Parasitization by *Blepyrus insularis* was found only during August of 2009 and nil during other months. On *P. guajava*, *F. virgata* population was highest in July and lowest in September during both the years (table 2). Per cent parasitization by *A. advena* also followed the similar trends during both the years as mealybug population. Balakrishnan *et al*. (1991) reported that *F. virgata* on coffee, *Erythrina lithosperma*, *Euphorbia pulcherrima* and *Leucaena leucocephala* were parasitized by *Aenasius advena*, *Anagyrus qadrii* and *Blepyrus insularis* 0.4, 1.4 and 25.1 per cent, respectively. *Blepyrus insularis* was reported on *Ferrisia virgata* on *Mangifera indica* by (Hayat, 1999) and on the same pest on cashew and arabica coffee by Noyes (2000).

Maconellicoccus hirsutus

Maconellicoccus hirsutus population on *A. esculentus* decreased steadily from July to September 2009 (table 3). Encyrtids, *A. dactylopii* and *A. chrysos* parasitized *M. hirsutus*. In 2009, *M. hirsutus* population was 14.20 (July) and its parasitization by *Anagyrus*

Table 2 : Field incidence of *Ferrisia virgata* and its parasitization by encyrtids (2008 & 2009)

Crop	Month#	Mean no. mealybugs/ five twigs ± SD*		Per cent parasitization by *Aenasius advena**		Per cent parasitization by *Blepyrus insularis**	
		2008	2009	2008	2009	2008	2009
Gossypium hirsutum	July	-	20.30±4.35	-	5.91	-	-
	August	-	34.60±11.70	-	12.43	-	1.16
	September	-	12.10±2.18	-	6.61	-	-
	October	-	10.30±2.83	-	5.83	-	-
Psidium guajava	July	17.10±6.56	17.80±5.01	12.28	7.87	-	-
	August	9.90±2.64	8.00±2.40	7.07	7.50	-	-
	September	2.80±1.55	1.60±1.51	0.00	0.00	-	-

*Mean of ten plants. #Mean of four counts. Mean values followed by standard deviation.

Table 3 : Field incidence of *Maconellicoccus hirsutus* and its parasitization by encyrtids on *Abelmoschus esculentus* (2009).

Month#	Mean no. mealybugs/ five twigs ±SD*	Per cent parasitization by *Anagyrus dactylopii**	Per cent parasitization by *Anagyrus chrysos**
July	14.20±6.30	3.52	1.41
August	10.80±3.61	25.00	-
September	4.00±2.31	7.50	-

*Mean of ten plants. #Mean of four counts.
Mean values followed by standard deviation.

Coccidohystrix insolita

During the month of July, *Coccidohystrix insolita* population was 36.30 and 27.00 in 2008 and 2009 respectively and its parasitization by *L. nigrocincta* during September was 3.03 and 2.25 in 2008 and 2009, respectively. Its parasitization by other encyrtids was nil during both the years (table 4). *Leptomastix nigrocincta* was reported on *C. insolita* by Sankaran (1959) and by Rawat and Modi (1968, 1969) on *C. insolita* on *S. melongena,* tomato, gooseberry = *Physalis peruviana*. These findings are in conformity with the present results.

Table 4 : Field incidence of *Coccidohystrix insolita* and its parasitization by encyrtids on *Solanum melongena* (2008 & 2009).

Month#	Mean no. mealybugs/ five twigs ± SD*		Per cent parasitization by *Leptomastix nigrocincta**		Per cent parasitization by other encyrtids*	
	2008	2009	2008	2009	2008	2009
July	36.30±11.80	27.00±3.65	2.20	1.85	-	-
August	23.70±8.18	19.20±5.14	2.53	2.08	-	-
September	6.60±2.01	8.90±2.96	3.03	2.25	-	-

*Mean of ten plants. #Mean of four counts. Mean values followed by standard deviation.

dactylopii was 25.00 (August). Its parasitization by *Anagyrus chrysos* was 1.41 and nil during July and other months respectively. Noyes and Hayat (1994) reported *A. dactylopii* on *M. hirsutus*. Azam (1983) also found that the active period of *M. hirsutus* was during June-August and October-March on grapes around Hyderabad as also inferred by Rao *et al.* (1993), who reported that tukra incidence due to *M. hirsutus* in West Bengal was greatest during summer and monsoon periods, when high temperature (above 30°C) and high humidity (above 70 per cent) prevailed in that area, supported by intermittent pre-monsoon and monsoon rains.

On cotton, bhendi, sunflower, mesta, china rose, tomato, brinjal and guava raised in Annamalainagar, a gradual buildup of majority of mealybug and encyrtid population was observed during July, August and slow decline during September, October due to monsoon showers. This is in accordance with Arif *et al*. (2011). Shree and Boraiah (1988) also reported that on mulberry, mealybug incidence was lower during the monsoon period due to heavy rain which washes away the pest. Overall increase in population of mealybug was found during 2009 as compared to 2008. This was due to increase in temperature, decrease in relative humidity and rainfall.

The results of the present study agree with the findings of Suresh (1994), who reported that a significant negative correlation was found between the maximum temperature and the population of *Cerococcus*. For every one unit increase of minimum temperature, there was an increase of 0.77 unit of the mealybug population and likewise a unit increase in morning relative humidity resulted in decrease in mealybug population by 0.75 units (Suresh *et al*., 2010).

In the present study, it was found that mealybug population fluctuated both because of weather parameters and plant hosts. This is similar to the reports of Suresh *et al*. (2010), who found that *Paracoccus marginatus* was positively correlated with maximum temperature on *Plumeria alba*. However, it was positively correlated with minimum temperature on *Carica papaya, Jatropha curcas* and *Psidium guajava*.

Parasitization per cent of encyrtids was low in all the crops except china rose because of pesticidal sprays in the fields surveyed. This is accordance with Arif *et al*. (2011), who stated that the parasitoid *A. bambawalei* incidence was invariably low on cotton up to August, mainly due to insecticidal sprays. Then, its population increased gradually and persisted at high levels in November (38.6 per cent), December (48.0 per cent) and January (44.1 per cent). Also, Solangi and Mahmood (2011) reported that in the fields where scheduled spraying of insecticides was made, it impacted on the *A. bambawalei* and the *P. solenopsis* became serious because of disruption of natural control. On the whole, when mealybug population increased, the per cent parasitization by encyrtids also increased in different crop ecosystems and vice versa but with few exceptions. This might be due to weather parameters, crop stage and sudden population increase of host. Similar results were reported by Vennila *et al*. (2010), who pointed out that the reason for high and low parasitization levels might be due to increasing proportion of G4 plants in the fields. At Annamalainagar, weeds from families Asteraceae, Solanaceae Euphorbiaceae and Portulacaceae were found to harbor more *P. solenopsis* and among the weed plants *Abutilon indicum* (L.) Sweet. was loaded with *P. solenopsis* population throughout the year (table 4). Vennila *et al*. (2010) reported that weeds dominated as major hosts of *P. solenopsis*. They also indicated that plant species from families *viz*., Asteraceae (Compositae), Leguminaceae, Malvaceae and Solanaceae constituted nearly 50 per cent of the host plants of *P. solenopsis* and concluded that occurrence of *P. solenopsis* on large number of weed hosts signified the importance of weed management in containing the spread of the pest.

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