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Parasitizing potential of parasitoid (*Aenasius bambawalei*) on mealybug (*Phenacoccus solenopsis*) in cotton (*Gossypium* spp) and weed plants*

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Natural and applied biological control tactics are important in successful management of pest populations. It is well known that natural enemies of insect pests play a key role in biotic balance, reducing levels of pest population below economic injury level. Most of the synthetic chemicals decimate beneficial parasitoids and predators. The value of biocontrol is now well recognized, particularly in the context of environmental protection as well as sustainable pest management strategy (Ignacimuthu and Jayaraj 2003). An exotic species of mealybug, *Phenacoccus solenopsis* Tinsley has been found to infest cotton crop in India during the last three years (Saini and Ram 2008; Dhawan *et al*. 2009; Nagrare *et al*. 2009). Plants infested with *P. solenopsis* produce fewer bolls of smaller size with bad opening which ultimately adversely affects the yield with 44.21% reduction in seed cotton (Dhawan *et al.* 2007). For the control of this mealybug, various insecticides have been tested (Saini and Ram 2008; Dhawan *et al*. 2008; 2009a). However, because of its polyphagous nature, it withstands wide range of low and high temperature under Haryana and in Punjab (Dhawan and Saini 2009) on different host plants round the year. During last year, a nymphal parasitoid, *Aenasius* sp. of *P. solenopsis* on cotton, which now named as *Aenasius bambawalei* Hayat (Encyrtidae: Hymenoptera) (Hayat 2009) has been earlier reported by Tanwar *et al*. (2008). The mealybug parasitization by *A. bambawalei* during 2008 was quite high, being 37.6 and 47.2% in Hisar and Rohtak districts of Haryana. It is also reported from some alternate host plants, like Kangibuti (*Abutilon indicum* L.), (*Datura metel* L.), congress weed (*Parthenium hysterophorus* L.), mesta (*Hibiscus rosa-sinensis* L.) and (*Achyranthes aspera* L.) (Ram *et al.* 2009), and on tomato (Mohindru *et al.* 2009). The same parasitoid has also been reported on *P. solenopsis* infesting cotton as well as other alternate hosts in Punjab during 2009. The mealybugs parasitized by *A. bambawalei* are transformed into dark reddish-brown mummies. Keeping this in view, the present study has been planned to study the extent of mealybug parasitization by *A. bambawalei* in cotton and other alternate hosts.

For recording the intensity of parasitized *P. solenopsis* by *A. bambawalei* in cotton, data were collected from five cotton growing districts of Punjab, viz Mansa, Ferozepur, Bathinda, Faridkot and Barnala during September 2009. In addition to this, the population of *P. solenopsis* on its alternate hosts, ie congress grass, *P. hysterophorus*, kangi buti, *A. indicum* and pilli buti, *Sida acuta* Burm.f. were also examined. In each district, 10 villages were selected randomly to record the number of parasitized mealybugs. From each village, 10 mealybug infested plants from each host were examined. Hundred mealybugs from each host were observed to find out the number of parasitized mealybugs with *A. bambawalei* which were characterized by development into brown coloured mummies. The per cent parasitization was worked out and the data were subjected to analysis of variance (Snedecor and Cochran 1967).

Perusal of data (Table 1) recorded from infested cotton as well as alternate weed hosts in five districts of Punjab during September 2009, the parasitized mealybugs in Mansa district varied from 44.58 to 57.11%, being highest in kangi buti but remained at par among other weed hosts. In cotton, the per cent parasitization of mealy bug by *A. bambawalei* was 44.58%, which differed significantly from other host plants. Similarly in Ferozepur district, the percentage varied from 33.06 to 34.74% but there was no significant difference among each other. Almost similar trend was observed in rest of three districts, ie Muktsar, Faridkot and Barnala having the values from 43.14 to 50.58, 21.81 to 30.76 and 44.98 to 55.87%, respectively, and remained at par among different host plants in each district. On the basis of overall analysis, the percentage parasitized mealybugs varied from 40.69 to 43.53% with no significant differences among each other. The highest (43.53%) parasitization of mealybugs by *A. bambawalei* was observed in kangi buti weed and lowest

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Table 1 Per cent parasitization of *P. solenopsis* by *A. bambawalei* on cotton and other host plants

Host plant	Number of mealybug examined	Districts					Overall mean per cent parasitization
		Mansa	Ferozepur	Muktsar	Faridkot	Barnala	
Cotton (*Gossypium hirsutum*)	100	44.58 (41.87)	34.06 (34.95)	43.14 (40.87)	25.78 (30.27)	55.87 (48.52)	40.69 (39.30)
Congress weed (*Parthenium hysterophorus*)	100	52.22 (46.28)	34.74 (35.58)	43.17 (41.02)	21.81 (27.47)	53.40 (47.10)	41.07 (39.49)
Kangi buti (*Abutilon indicum*)	100	57.12 (49.11)	33.06 (34.47)	50.58 (45.32)	30.76 (33.24)	46.12 (42.60)	43.53 (40.95)
Pilli buti(*Sida acuta*)	100	52.11 (46.21)	33.81 (32.38)	49.92 (44.93)	27.45 (31.03)	44.98 (42.09)	41.65 (39.33)
CD (P = 0.05)		(3.86)	(NS)	(NS)	(NS)	(NS)	(NS)
Mean of all host plants		51.51 (45.58)	33.92 (30.02)	46.70 (41.33)	26.45 (23.41)	50.09 (44.33)	

Figures in brackets are arcsine transformed values
CD for district wise (P = 0.05) is 3.55.

(40.69%) in cotton. This may be due to the application of insecticides in cotton crop for the management of sucking pests, ie jassids, whitefly and mealybug. Irrespective of host plants, when data analyzed on the basis of districts, the highest mealybugs parasitization of 51.51% was observed in Mansa district, but it remained at par with Barnala with 50.09% parasitization of mealybugs recorded. On the other hand, significant lowest per cent parasitization was observed in Faridkot (25.45%). Ferozepur and Muktsar districts recorded 33.92 and 46.70% parasitization, respectively, and differed significantly from each other.

Similar parasitization was observed by Ram *et al.* (2009) who recorded 37.6 and 47.0% mean mealybug parasitization by *A. bambawalei* from cotton and other host plants during September 2008 in Hisar and Rohtak districts of Haryana. Similarly, Tanwar *et al.* (2008) recorded 20 to 70% parasitization of *P. solenopsis* by *Aenasius* sp. on cotton and other host plants. Amutha *et al.* (2009) also reported 10 to 45% field parasitism by *Aenasius* sp. on cotton, 5 to 65% on *A. indicum*, and 5 to 30% on *P. hysterophorus*. In our study, the parasitism by *A. bambawalei* was 25.78 to 55.87% on cotton, 30.76 to 57.12% on *A. indicum*, 21.81 to 53.40% on *P. hysterophorous* and 27.45 to 52.11% on *S. acuta.* Mohindru *et al.* (2009) also reported up to 30.02% parasitism in *P. solenopsis* by the same parasitoid (*Aenasius* sp.) in another host plant, ie tomato. It can be concluded from the above study and in light of the available literature that *A. bambawalei* can cause high natural parasitization of mealybug, (*P. solenopsis*) on cotton as well as on other hosts. This parasitoid has an excellent searching ability, as isolated and scattered mealybugs were also effectively parasitized and can also reared easily in the laboratory. These characteristics make it an ideal parasitoid for exploitation in biological control of Solenopsis mealybug. Therefore, there is a need to develop some strategies to preserve this natural enemy on large scale either by adopting integrated pest management programmes or by spraying insecticides safer to this natural enemy in the field.

SUMMARY

The present study had been planned to study the extent of mealybug parasitization by *A. bambawalei* in cotton and other alternate hosts. Data were collected from five cotton growing districts of Punjab, viz Mansa, Ferozepur, Bathinda, Faridkot and Barnala during September 2009. In addition to this, the population of *P. solenopsis* on its alternate hosts, i e congress weed, kangi buti, and pilli buti, were also examined. The overall percentage parasitized mealybugs varied from 40.69 to 43.53% with no significant differences among each other. The highest (43.53%) parasitization of mealybugs by *A. bambawalei* was observed in kangi buti weed and lowest (40.69%) in cotton. On the basis of host plants, the parasitism by *A. bambawalei* on cotton was 25.78 to 55.87%, 30.76 to 57.12% on kangi buti, 21.81 to 53.40% on congress grass and 27.45 to 52.11% on pilli butti. It was concluded from the above study that *A. bambawalei* can cause high natural parasitization of mealybug on cotton as well as on other hosts of *P. solenopsis.*

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