Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [2] 2017: 211-214
©2017 Academy for Environment and Life Sciences, India
Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Preference of host stages and parasitic efficiency of *Aenasius bambawalei* Hayat on mealy bug, *Phenacoccus solenopsis* Tinsley

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ABSTRACT
The results on host stage preference shows that A. bambawalei could not parasitised 1st instar stage of P. solenopsis. Maximum percentage of parasitisation of mealybugs reared on cotton was observed in adult host stage 93.92 per cent followed by IIIrd instar 84.32, IInd instar 41.92 per cent respectively. However, on okra it was exhibited in adult host 92.80, IIIrd instar 88.80, IInd instar 42.56 per cent respectively. On potato, it was noticed in adult host 89.44, IIIrd instar 87.84, IInd instar 40.80 per cent respectively. Similarly on China rose, adult host recorded 91.04, IIIrd instar 90.08, IInd instar 42.08 per cent respectively. Thus it is concluded that adult host stage of P. solenopsis is most preferred host stage for parasitisation by A. bambawalei. The results also exhibited that parasitic efficiency of A. bambawalei on P. solenopsis was varied from 30.00 to 66.67 per cent (average 49.00 ± 2.05 per cent).
Key word: *Aenasius bambawalei, host stage preference, cotton, okra, potato, China rose.*

Received 18.07.2017 Revised 15.08.2017 Accepted 29.08.2017

INTRODUCTION

Mealybug, *Phenacoccus solenopsis* Tinsley (Homoptera: Pseudococcidae) has been recently emerged as an invasive insect-pest in Asia reported at 35 localities in various ecological zones of the globe. It constitute second largest family of scale insects with more than 2,000 described species and 290 genera (Ben-Dov, 2006). Worldwide, mealybug damages more than 180 plant taxa in 52 families (Ben-Dov *et al*., 2009). The *solenopsis* mealybug infest relatively wide variety of host plants including species of economically important families such as Malvaceae, Solanaceae, Asteraceae, Euphorbiaceae, Amaranthaceae and Cucurbitaceae (Arif *et al*., 2009). Significant economic damage was determined to occur on cotton [*Gossypium* spp.], brinjal [*Solanum melongena*], okra [*Abelmoschus esculentus*], tomato [*Solanum lycopersicum*], sesame [*Sesamum indicum*], sunflower [*Helianthus annuus*] and China rose [*Hibiscus rosa-sinensis*] (Sharma, 2007; Arif *et al*., 2009; Jagadish *et al*., 2009). This solenopsis species of mealybug was found to feed on more than 194 host plants across India (Vennila *et al*., 2011). It caused a loss of several lakhs of rupees to cotton growers in India alone (Mani and Shivaraju, 2016). Climatic variables, especially temperature and rainfall patterns are known to play key role in population dynamics and local abundance of *P. solenopsis.* Internal solitary parasitoid *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae) plays a significant role in controlling the mealybug population (Hayat, 2009; Ashfaq et al., 2010; Fand, Gautam & Suroshe, 2011). Field investigation showed that the parasitization rate of *A. bambawalei* ranged from 50% to 62% (Dhawan et al., 2007; Prasad et al., 2011; Rishi et al., 2009; Tanwar et al., 2011). A. bambawalei is adaptable to strict environmental conditions and survives in a temperature range from 2 ^{0}C to 45 ^{0}C (Nagrare et al., 2011). Indeed, it is a natural enemy from tropical areas, such as India and Pakistan (Fand & Suroshe, 2015) and China.

Many studies have revealed that parasitisim can impact on the development, fecundity and population growth of the host (Lin and Ives, 2003; He *et al.,* 2005). Hence the choice of host stage is an important factor in progeny fitness of parasitoids (Hagvar and Hofsvang, 1991). Usually, parasitoids fitness is positively correlated with host size especially for females (King, 1993).The present study was conducted to determine the development and host stage preference of mealy bug parasitoid *Aenasius bambawalei,* on cotton mealybug *Phenacoccus solenopsis*.

MATERIAL AND METHODS

The present investigation entitled, "Host stage preference and parasitic efficiency of *Aenasius bambawalei* Hayat on mealy bug, *Phenacoccus solenopsis* Tinsley" was carried out at Bio-control Laboratory, Dept. of Agril. Entomology, College of Agriculture, Latur (MS) during 2015-16.

Rearing of *A. bambawalei* on *P. solenopsis* reared on different host plants

The culture of *A. bambawalei* was initially obtained from parasitised mealybugs infesting Hibiscus or China rose plants. The parasitoids were released carefully and mass multiplied on mealybugs reared on different host plants *viz*., cotton, okra, potato and China rose under laboratory conditions at 27 ^{0}C temperature and 50-60 per cent RH. A care was taken to cover all the host plants with iron cage separately. The parasitoids emerged out from field collected cocoons parasitised full-grown nymphs and adults of mealybug in the cage. These parasitised mealybugs turned in to brown colour cocoons or mummies. Within a week the adults of *A. bambawalei* emerged out from the pupae. The emerged adults were provided with 50 per cent honey solution soaked in cotton swab as a source of food in each cage. In this way large numbers of *A. bambawalei* were obtained for conducting different aspects of studies.

Host stage preference *A. bambawalei* on *P. solenopsis* reared on different host plants.

Experiment was initiated by collecting parasitised pupae or mummies from cotton, okra, potato and China rose host plants and placed them in Petri dishes separately until adult emergence. Newly emerged adults were collected in another Petri dish and kept them for 24 hours to ensure mating. The adults were provided with 50 per cent honey solution soaked in cotton swab as a source of food inside the Petri dish.

Four host stages including three nymphal (I, II and III) and adult were used in this experiment. Five mealybugs of each instar were released on fresh leaves of host plants in Petri dish. Then mated female of *A. bambawalei* was introduced individually into a Petri dish containing a mealybug infested leaf. After 24 hours of exposure, female of *A. bambawalei* was removed from Petri dish and mealybugs of each stage were separated. Every day, this pair of parasitoid was collected and released on mixed population mealybugs (I, II, III and adult stage) on fresh host leaves until death of parasitoid. The exposed mealybugs were examined up to 10 days for mummy formation. The total mummified bodies were counted and per cent mummy formation in each instar of *P. solenopsis* was calculated. The experiment was repeated five times.

Parasitic efficiency of *A. bambawalei* on *P. solenopsis*

Thirty healthy mealybugs of different instars were selected from laboratory maintained culture and released on host plant leaves in Petri dish. Thirty such Petri dishes were taken. A newly emerged pair of *A. bambawalei* was released in Petri dish for parasitisation. The adults were provided with 50 per cent honey solution soaked in cotton swab as a source of food inside the Petri dish. Fresh leaves were provided as food for mealybugs every day in the morning. The mealybugs were reared up to the death and extent of parasitism was worked out on the basis of formation of pupae in Petri dish.

RESULTS AND DISCUSSION

The results on the host stage preference revealed that *A. bambawalei* could not parasitised 1st instar stage of *P. solenopsis* reared on different host plants. (Table 1 and Fig. 1) The maximum percentage of parasitisation of mealybugs reared on cotton was observed in adult host (93.92 per cent) followed by IIIrd instar (84.32 per cent) and IInd instar (41.92 per cent). However, the highest percentage of parasitisation of mealybugs reared on okra was exhibited in adult host (92.80 per cent) followed by IIIrd instar (88.80 per cent) and IInd instar (42.56 per cent). On potato, the maximum percentage of parasitisation of mealybugs was noticed in adult host (89.44 per cent) followed by IIIrd instar (87.84 per cent) and IInd instar (40.80 per cent). Similarly on China rose, adult host recorded maximum percentage of parasitisation of mealybugs (91.04 per cent) followed by IIIrd instar (90.08 per cent) and IInd instar (42.08 per cent). Thus it is concluded that adult host stage of *P. solenopsis* is most preferred host stage for parasitisation by *A. bambawalei.*

The data recorded on per cent parasitisation (Table 2 and Fig. 2) of mealybug, *P. solenopsis* due to *A. bambawalei* revealed that the extent of parasitism was ranged from 30.00 to 66.67 per cent with an average of 49.00 ± 2.05 per cent.

CONCLUSION

The 3rd instar and adult (female mealybug) host stages were the most preferred host stages of *P. solenopsis* for mass-rearing of *A. bambawalei* in bio-control programme it produces more female progeny of the best fitness as compared to the other two stages (1st and 2nd) of the mealybugs. The host specificity of *A. bambawalei* was directly proportional to the size of host.

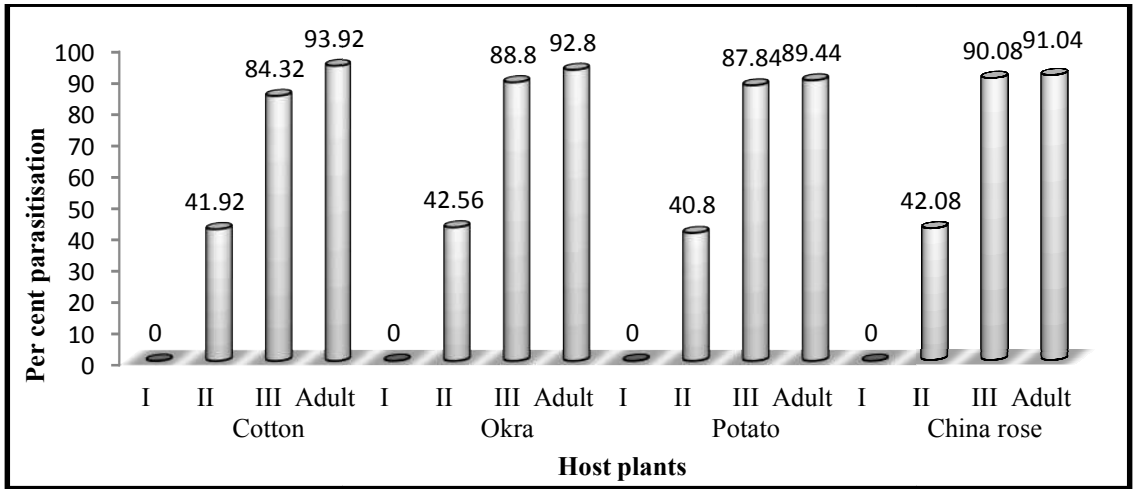

Fig.1. Host stage preference by *A. bambawalei* on *P. solenopsis* reared on different host plants

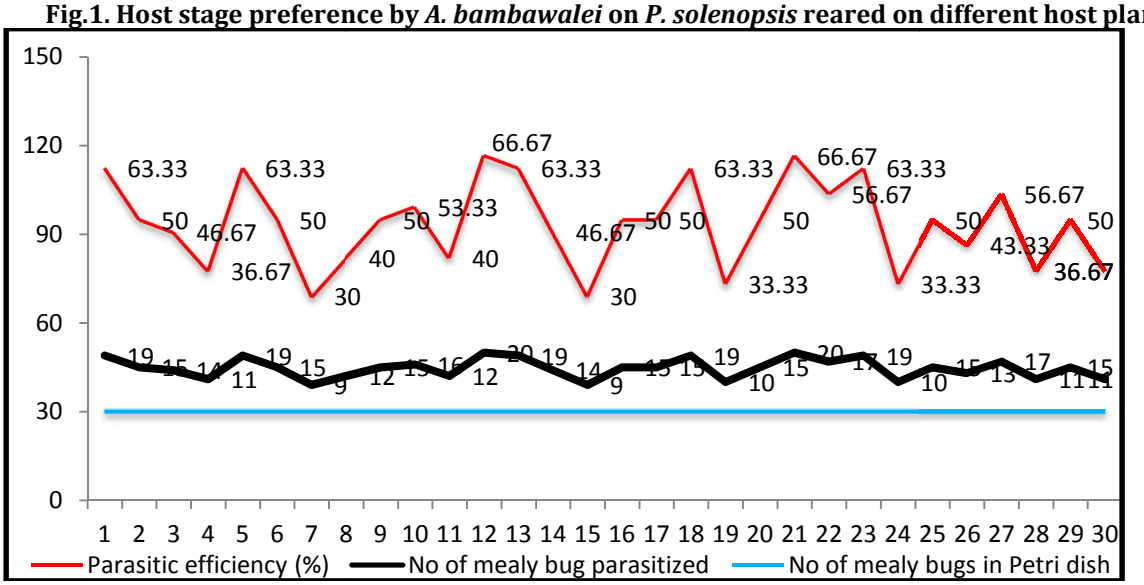

Fig.2. Parasitic efficiency of *A. bambawalei* on *P. solenopsis*

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No. of parasitised hosts																
No. Obsd.	**Cotton**				**Okra**				**Potato**				**China rose**			
	Host instars			Adult	Host instars			Adult	Host instars			Adult	Host instars			Adult
	I	II	III		I	II	III		I	II	III		I	II	III	
1	0	9.80	21.00	25.00	0	8.00	22.80	24.20	0	10.80	23.80	23.20	0	8.20	23.20	21.20
2	0	10.20	21.40	23.20	0	10.00	20.40	23.20	0	10.80	19.40	22.00	0	10.00	23.60	21.80
3	0	8.20	22.00	21.00	0	12.00	22.80	22.20	0	10.00	21.20	20.20	0	12.20	20.20	23.20
4	0	12.20	20.00	24.20	0	13.00	21.00	23.20	0	10.20	24.20	22.20	0	9..00	22.40	23.40
5	0	12.00	21.00	24.00	0	10.20	24.00	23.20	0	9.20	21.20	24.20	0	13.20	23.20	24.20
Total	0	52.40	105.40	117.40	0	53.20	111.00	116.00	0	51.00	109.80	111.80	0	52.60	112.60	113.80
Mean	0	10.48	21.08	23.48	0	10.64	22.20	23.20	0	10.20	21.96	22.36	0	10.52	22.52	22.76
S.E. ± (m)	0	0.18	0.11	0.42	0	0.09	0.22	0.20	0	0.18	0.21	0.228	0	0.15	0.22	0.253
C.D.	0	0.53	0.32	1.24	0	0.26	0.65	0.59	0	0.53	0.62	0.6726	0	0.46	0.65	0.746
C.V.	0	3.82	1.16	4.00	0	1.88	2.21	1.93	0	3.92	2.14	2.28	0	3.29	2.18	2.49
Per cent parasitisation	**0**	**41.92**	**84.32**	**93.92**	**0**	**42.56**	**88.80**	**92.80**	**0**	**40.80**	**87.84**	**89.44**	**0**	**42.08**	**90.08**	**91.04**

Table 1: Host stage preference by *A. Bambawalei* on *P. solenopsis* reared on different host plants

Sr. No.	No of mealybugs in Petri dish	No of mealybug parasitised	Parasitic efficiency (per cent)	Sr. No.	No of mealybugs in Petri dish	No of mealybug parasitised	Parasitic efficiency (per cent)
1	30	19	63.33	16	30	15	50.00
2	30	15	50.00	17	30	15	50.00
3	30	14	46.67	18	30	19	63.33
4	30	11	36.67	19	30	10	33.33
5	30	19	63.33	20	30	15	50.00
6	30	15	50.00	21	30	20	66.67
7	30	09	30.00	22	30	17	56.67
8	30	12	40.00	23	30	19	63.33
9	30	15	50.00	24	30	10	33.33
10	30	16	53.33	25	30	15	50.00
11	30	12	40.00	26	30	13	43.33
12	30	20	66.67	27	30	17	56.67
13	30	19	63.33	28	30	11	36.67
14	30	14	46.67	29	30	15	50.00
15	30	09	30.00	30	30	11	36.67
						Mean	**49.00 ± 2.05**

Table 2: Parasitic efficiency of *A. bambawalei* on *P. solenopsis*

CITATION OF THIS ARTICLE

Savde V.G., Bokan S.C. and Sanjekar M.B. . Preference of host stages and parasitic efficiency of *Aenasius bambawalei* Hayat on mealy bug, *Phenacoccus solenopsis* Tinsley . Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 2, 2017: 211-214