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Effect of host plants on parasitization of solenopsis mealybug, *Phenacoccus solenopsis* Tinsley by *Aenasius arizonensis* (Girault) (*Aenasius bambawalei* Hayat) (Hymenoptera: Encyrtidae)

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Abstract
The influence of host plants on parasitization of solenopsis mealybug, *Phenacoccus solenopsis* Tinsley by *Aenasius arizonensis* (Girault) (Hymenoptera: Encyrtidae) was studied under screen house conditions. The experiment was carried out under two conditions *viz*., free choice and no-choice condition on six different mealybug host plants *viz*., *Abutilon indicum* (Linn.), *Parthenium hysterophorus* (Linn.), *Hibiscus rosa-sinensis* (Linn.), *Abelmoschus esculantus* (Linn.), *Solanum melongena* (Linn.), and *Gossypium hirsutum* (Linn.). In both the tests, *A. indicum* was found to be the most preferred plant species for mealybug parasitization with 62.67 and 65.33 percent parasitism under free choice and no choice conditions, respectively. *S. melongena* was found to be least preferred plant species of the parasitoid as mealybug parasitization 42.62 and 48.00 percent under free choice and no choice conditions, respectively. Sex ratio was found female biased and non significant in both the conditions.

Keywords: *Aenasius arizonensis*, *Phenacoccus solenopsis*, host preference, parasitism

1. Introduction
The solenopsis mealybug, *Phenacoccus solenopsis* Tinsley is a polyphagous pest reported to invade 154 plant species belonging to 53 families [1]. Mealybug infestation was recorded in 2006 on *Gossypium hirsutum* (L.) in all the cotton-growing states of India. Severe economic damage to cotton crop was reported in 2007 in cotton growing areas of Punjab and Haryana and low to moderate damage in parts of Maharashtra, Tamil Nadu and Andhra Pradesh [2].
A new nymphal solitary endoparasitoid was found to parasitize solenopsis mealybug in Pakistan [3] and in India [4] belonging to genus *Aenasius*, identified as *Aenasius bambawalei* Hayat (Hymenoptera: Encyrtidae) [6]. Surveys of the cotton growing belt of Haryana showed 37.6 percent and 42.2 percent parasitization on cotton and other alternate host plants in Hisar and Rohtak districts, respectively, during September, 2008 [5]. Its parasitism rate has been documented up to 80% in favorable conditions [7]. Studies have been conducted on the biology and host preference of *A. bambawalei* under laboratory conditions [8-10]. Solenopsis mealybug has also been recorded in serious proportion on a number vegetables, other agricultural crops and weeds. The architecture of plants may either positively or negatively affects the foraging efficiency of predators and parasitoids [11]. Plant architecture can affect natural enemies directly by mediating their host plant choice [12], altering their movement and survival of plant [13], or otherwise modifying their behaviour [14].
Thus, keeping in view the polyphagous nature and economic importance of the pest, the present studies were undertaken to study its parasitization on different host plants by *A. arizonensis* under choice and no choice conditions

2. Materials and Methods
The following study was conducted to determine the effect of different host plants on parasitisation of solenopsis mealybug by *A. arizonensis* in the net/cage house conditions at the Entomological Research Farm and Biocontrol Research Laboratory of the Department of Entomology, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana.

2.1 Host rearing

Small to medium sized potatoes were washed, dried, placed in plastic tubs and left for sprouting under dark conditions. After the sprouts attained an average length of 2.5-3.0 cms they were inoculated with unparasitized field collected solenopsis mealybugs. After ensuring their settling and multiplication the mealybug infested sprouted potatoes were further used for parasitoid rearing. The host culture was maintained at 27±2 ^{0}C and 65±5% relative humidity under laboratory conditions.

2.2 Parasitoid rearing

The parasitoid, *A. arizonensis* was reared on *P. solenopsis* colonies on sprouted potatoes kept in separate glass jars and plastic tubs by placing the field collected mummies (parasitized mealybugs transformed into dark red or brown coloured hard masses after 5-6 days of parasitisation) into the glass jars initially. The mummies formed thereafter were collected and kept separately in glass vials (7.5 x 1 cm) provided with drops of honey solution (50%) on a paper strip as a source of food for the adult parasitoids emerging out of the mummies. The freshly emerged or 24 hrs old adult parasitoids emerging out of the mummies were used in experiments. The parasitoids culture was maintained at 27±2 ^{0}C and 65±5% relative humidity in laboratory conditions.

2.3 Studies on mealybug parasitization

In free choice condition, six host plants *viz.*, *Abutilon indicum* (Linn.), *Parthenium hysterophorus* (Linn.), *Hibiscus rosa-sinensis* (Linn.), *Abelmoschus esculentus* (Linn.), *Solanum melongena* (Linn.) and *Gossypium hirsutum* (Linn.) were raised in pots separately and caged together in a muslin cloth net cage. 50 third instar laboratory reared mealybugs were placed on each host plant in the muslin cloth net cage (4 x 3 x 3 ft.). After ensuring the settling of mealybugs on each plant, the net cage was then introduced with six mated parasitoid females. In no-choice condition, each host plant was raised separately and was kept in separate cylindrical metal frame cage (3ft. ht.; 2ft. dia.) properly covered with muslin cloth to avoid the escape of female parasitoid. 50 third instar laboratory reared mealybugs were placed on the potted host plant in every cage. After ensuring the settling of mealybugs on the plants, each cage was introduced with one mated female parasitoid. Both the experiments were replicated thrice. In both the experiments, after 48 hrs of parasitoid foraging, the mealybugs were collected from the cages, kept separately in petri-dishes and observed for parasitism. The parasitized mealybugs were then reared until the parasitoid emergence. Percent parasitism and sex ratio was recorded under both the conditions. Data obtained were transformed suitably and analyzed using *ANOVA.*

3. Results and discussion

Table 1: Effect of different host plants on mealybug parasitization and sex ratio of *A. arizonensis* under free choice condition

Sr. No	Host plants observed	Mealybug parasitization (%)*	Sex ratio (F:M)
1	*Abutilon indicum*	62.67 (52.33)**	1.15 (1.47)***
2	*Gossypium hirsutum*	55.33 (48.05)	1.21 (1.49)
3	*Hibiscus rosa-sinensis*	52.00 (46.13)	1.30 (1.52)
4	*Parthenium hysterophorous*	50.00 (44.98)	1.50 (1.58)
5	*Abelmoschus esculentus*	48.00 (43.84)	1.06 (1.44)
6	*Solanum melongena*	42.67 (40.76)	1.30 (1.52)
CD (p=0.05)		(2.69)	NS
Se (M)±		(0.86)	(0.03)

*Mean of 3 replications; ** Figures in parenthesis are angular transformed values; *** Figures in parenthesis are √(n+1) values

In the free choice condition (Table 2), parasitism ranged between 42.67 percent and 62.67 percent. Significantly maximum percent parasitism was recorded on *A. indicum* (62.67%). It was followed by on *G. hirsutum* (55.33%) which was significantly higher than on *H. rosa-sinensis* (52.00%). Significantly minimum mealybug parasitization was recorded on *S. melongena* (42.7%) followed by *A. esculentus* (48.00%). The sex ratio obtained was non significant and female biased. Maximum and minimum sex ratio was recorded on *P. hysterophorous* (1.50) and *A. esculentus* (1.06), respectively. Thus, indicating that neither host plant type nor choice conditions have any effect on the sex ratio of the parasitoid, *A. arizonensis*.

Table 2: Effect of different host plants on mealybug parasitization and sex ratio of *A. arizonensis* under no choice condition

Sr. No.	Host plants observed	Mealybug parasitization (%)*	Sex ratio (F:M)
1	*Abutilon indicum*	65.33 (53.94)	1.21 (1.49)
2	*Gossypium hirsutum*	55.33 (48.05)	1.38 (1.54)
3	*Hibiscus rosa-sinensis*	60.00 (50.76)	1.22 (1.49)
4	*Parthenium hysterophorous*	54.67 (47.66)	1.19 (1.48)
5	*Abelmoschus esculentus*	51.33 (45.75)	1.19 (1.48)
6	*Solanum melongena*	48.00 (43.84)	1.25 (1.50)
CD (p=0.05)		(3.38)	NS
Se (M)±		(1.09)	(0.05)

*Mean of 3 replications; ** Figures in parenthesis are angular transformed values; *** Figures in parenthesis are √(n+1) values

In no choice condition (Table 2), parasitization ranged between 48.00 percent and 65.33 percent. Significantly maximum parasitism was recorded on *A. indicum* (65.33%) and it was on par with on *H. rosa-sinensis* (60.00%). It was then followed by on *G. hirsutum* (55.33%) and on *P. hysterophorus* (54.67%). Significantly minimum percent parasitism was recorded on *S. melongena* (48.00%) followed by *A. esculentus* (51.33%). Thus, the results of the present

study indicate that the plant type significantly affect the searching efficiency of the parasitoid, *A. arizonensis*. The sex ratio obtained was non significant and female biased. Maximum and minimum sex ratio was recorded on *G. hirsutum* (1.38) and *A. esculentus* (1.19) and *P. hysterophorous* (1.19), respectively. Thus, indicating that neither host plant type nor choice conditions have any effect on the sex ratio of the parasitoid, *A. arizonensis*.

Host plant species are not only known to affect the population of the insect pest but also known for the performance of the entomophagous insects associated with them. Our finding on the effect of different host plants on the parasitization of solenopsis mealybug by *A. arizonensis* revealed the highest percent parasitism on *A. indicum* in both, under choice (62.67%) and no-choice (65.33%) conditions. The lowest percent parasitism was recorded on *S. melongena* in both, choice (42.67%) and no-choice (48.00%) conditions. Sex ratio was found female biased and no significant differences were exhibited. Our findings are in line with [15] who recorded highest mealybug parasitization on *A. indicum* (94%) followed by cotton (93%), okra (91%), china rose (89%) and egg plant (87%) under field conditions. Our results slightly varied from [16] who reported maximum mealybug parasitism on shoe flower (81.3%) followed by cotton (76.9%), okra (65.5%) and brinjal (<50.0%) under field conditions. The differences in the mealybug parasitization by *A. arizonensis* on different host plants may be due to the differences in biophysical and biochemical composition of the plants [17, 18].

4. Conclusion

It can be concluded from the above study and in light of the above literature that *A. indicum* naturally attracts solenopsis mealybug parasitoid, *A. arizonensis* for parasitization and it is needed to be protected in order to harbour the parasitoid's population. The results of the present study may also be used for conducting inoculative releases against mealybugs in different crops.

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