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Life cycle, Host Stage Suitability and Pesticide Susceptibility of the Grape Mealybug Parasitoid, *Allotropa japonica* sp. n.

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ABSTRACT

***Allotropa japonica* sp. n., a Platygasterid parasitoid of *Maconellicoccus* hirsutus (Green) completed its life cycle in 25.5 days at 25.5°C. It oviposited on all three nymphal stages and on the adult female mealybugs. The second and third nymphal stages (10-15 days old) were found suitable to breed the parasitoid since the number of parasitoids emerging was greater, and ratio of female to male was also higher in these nymphal instars. Adult parasitoids were highly susceptible to monocrotophos, dichlorvos, dimethoate, oxydemeton methyl, methyl parathion, diazinon, chlorpyriphos, phosalone, quinalphos, fenthion and carbaryl. But the acaricides and fungicides (dicofol, copper oxychloride, mancozeb, captafol, carbendazim, Bordeaux mixture) except sulphur proved less harmful to the parasitoid.**

KEY WORDS: *Allotropa japonica* sp.n., *Maconellicoccus hirsutus*, pesticide susceptibility, life cycle, host stage suitability

During the search for the natural enemies of the pink mealybug, *Maconellicoccus hirsutus* (Green), two species under the genus *Allotropa* (Platygasteridae, Hymenoptera) have been reported in India. *Allotropa citri* Mues., was reared from *M. hirsutus* by Rao (1967), while *Allotropa japonica* sp.n. was recorded by Mani *et al.* (1987). The biology and host stage suitability of *A. japonica* sp.n. and its susceptibility to different pesticides are described in this paper.

MATERIALS AND METHODS

The culture of *M. hirsutus* was maintained on pumpkin fruits and the parasitoid was reared as suggested by Clancy (1944) for *Allotropa burrelli* Mues. A total of 300 adult parasitoids was released in a wooden cage (30x30x30 cm) in which a pumpkin infested with 500 mealybugs was kept. After six hours of exposure, all the parasitoids were removed from the cage. About 20-40 mealybugs were dissected daily until pupation to determine the incubation and larval period of the parasitoid. Fifty freshly emerged adults were held in glass vials (10x2.5 cm) streaked with honey for adult feeding. Mortality was recorded until all the adults died and the longevity was computed.

Mealybug-colonised pumpkin fruits were kept in wooden cages (30 x 30 x 30 cm) to determine the host stage suitability. Different nymphal stages and adult females were exposed seperately to 50 mated female parasitoids for a period of 24 h in wooden cages, and replicated six times. Based on the recovery of adults, the total developmental period (egg to adult) of the parasitoid on each stage exposed was worked out. The studies on life cycle and host stage suitability were conducted at 25 ± 1° C and 60-70% RH.

One set of experiments was conducted with 11 commonly used insecticides. In another test, 10 fungicides/acaricides were evaluated (Table 1). An untreated check was maintained in both the experiments to correct the mortality in the treatments. Each pesticide was sprayed on potted grapevine infested with mealybugs. Three leaves from each treated plant were randomly removed, and held individually in clean glass vials (15 x 2.5 cm). In each of these vials, 20 adult parasitoids were released and provided with honey streak on inner sides of glass vial. The mouth of the vial was covered with cotton plug. Mortality of adults was recorded 1, 3, 6 and 24 h after exposure. Moribund adults were also considered as dead.

The data with percentages were converted into corresponding angles for statistical analysis. Zero values were converted to 0.01. The data on the number of parasitoids emerged were analysed statistically after transforming the values into $\sqrt{(x+0.5}$.

RESULTS AND DISCUSSION

Freshly laid eggs of *A. japonica* sp.n. were very small, elongated, whitish and transparent. They became more or less spherical after 24 h. Incubation period ranged 4 to 6 days, the average

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TABLE 1. Suitability of different stages of *M. hirsutus* for *A. japonica*

Host stage	Age (days)	Development of the parasitoid (days)	No. of parasitoids emerged*	Sex ratio
First instar	5	26.40	151[b]	1 : 0.66
Second instar	10	25.75	170[b]	1 : 2.00
Third instar	15	25.30	238[a]	1 : 3.58
Adult	20	24.30	49[c]	1 : 4.21

*Differences between the means significant (p = 0.05) by L.S.D.
Means followed by similar letters are not different statistically (P=0.05) by L.S.D

being 5.5 ± 0.53 days. However, Clancy (1944) reported 9.5 days as incubation period for *A. burrelli*. Usually one to three eggs were found in a parasitised mealybug. Larval development was completed in 4-6 days, the average being 5 ± 0.67. This is in agreement with Clancy (1944) who recorded 6.5 days in *A. burrelli* . *Larval stage of A. japonica* sp.n. was similar to any other Platygasterid as described by Clancy (1944) that there was but one larval instar with 10 body segments. Prepupal and pupal periods lasted for 2-3 days (average 2.3 ± 0.48) and 12.90 ± 0.88 days respectively. The pupal development of *A. japonica* was comparable to *A. burrelli* (Clancy, 1944). The total life cycle of *A. japonica* sp. n. was completed in 25.5 ± 1.08 days. However *A. burrelli* took 26-38 days (Clancy, 1944) while *A. utilis* took 36 days (Gilliat, 1939). Adults were small and short-lived. Longevity of adults ranged from 7 to 11 days, average being 8.6 days. Males had long hirsute moniliform antennae while the females had shorter and distinctly clavate antennae. Mating and oviposition took place readily. Adults exhibited a very good searching capacity.

A. japonica sp.n. developed and emerged successfully on all the four stages of *M. hirsutus*. However, the total number of parasitoids produced from adult stage was very low when compared with other stages indicating the least preference of adult mealybugs by the parasitoid. A maximum of 238.16 parasitoids was obtained when third instar nymphs of 15 days-old were offered to *A. japonica* sp. n. for parasitisation (Table 1). Developmental time of the parasitoid ranged from 24 to 28 days on the different stages of *M. hirsutus*. However, the age of the mealybug did not affect the duration of parasitoid development significantly (Table 1). Similar result with another parasitoid, *Anagyrus pseudococci* (Gir.) was reported by Chandler *et al.* (1980).

The parasitised first nymphal instar produced 60.16% male parasitoids . On the other hand, all the later stages of M. hirsutus produced predominantly female parasitoids (Table 1). Similar trend in the sex ratio was observed in *A. pseudococci*. (Chandler *et al.*, 1980). Based on the above results, it is concluded that third instar nymph of *M. hirsutus* is suitable for the breeding of *A. japonica* sp. n. This is in agreement with Clancy (1944) who had also reported the preference of half grown mealybug *Pseudococcus comstocki* (Kuw.) by *A. burrelli*.

All the insecticides proved detrimental to the parasitoids. In the case of phosalone, there was 13.3% mortality for 1 h exposure, 76.7% mortality after 3 h of exposure and 100% mortality after 24 h exposure. Monocrotophos, dichlorvos, oxydemeton methyl, diazinon, chlorpyriphos, quinalphos, fenthion and carbaryl caused 100% mortality after 1 h of exposure. Dimethoate inflicted 76.7% mortality in 1 h of exposure. In all the teatments, 100% mortality of parasitoids was observed after 6 and 24 h of exposure (Table 2). All the fungicides/acaricides included in the present study did not have any adverse effect on the adult parasitoids after 1, 3 and 6 h of exposure. However, sulphur inflicted 83.3% mortality after 24 h of exposure. Bartlett (1963) reported that sulphur had shown high toxicity to the adults of Aphytis lignanensis Compere as observed in the present study. The remaining chemicals produced less than 10% mortality except copper oxychloride (Blue Copper) which caused 13.3% mortality after 24 h exposure (Table 2).

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TABLE 2. Effect of different pesticides on the adults of *A. japonica*

Insecticide	% Adult mortality after 1 h	% Adult mortality after 3 h	Fungicide	% Adult mortality after 24 h
Monocrotophos (0.05%) (Nuvacron 40 EC)	100 [c]	100 [b]	Dicofol (0.05%) (Kelthane 18.5 EC)	0.0 [a]
Dichlorvos (0.20%) (Nuvan 100 EC)	100 [c]	100 [b]	Sulphur(0.30%) (Sulfex 80 WP)	86.7 [e]
Dimethoate (0.05%) (Rogor 30 EC)	76.7 [b]	100 [b]	Copper oxychloride (0.30%) (Blue copper 50% WP)	13.3 [d]
Oxydemeton methyl (0.05%) (Metasystox 25 EC)	100 [c]	100 [b]	Mancozeb (0.20%) (Dithane M.45 75% WP)	6.7 [bc]
Methyl parathion (0.10%) (Metacid 50 EC)	100 [c]	100 [b]	Captafol (0.20%) (Foltaf 80 WP)	3.3 [abc]
Diazinon (0.05%) (Delzinon 20 EC)	100 [c]	100 [b]	Copper oxychloride (0.30%) (Fytolon 50 WP)	1.7 [ab]
Chlorpyriphos (0.05%) (Coroban 20 EC)	100 [c]	100 [b]	Carbendazim (0.10%) (Bavistin 50 WP)	1.7 [ab]
Phosalone (0.07%) (Zolone 35 EC)	13.3 [a]	76.7 [a]	Copper oxychloride (0.30%) (Blitox 80% WP)	0.0 [a]
Quinalphos (0.05%) (Ekalux 25 EC)	100 [c]	100 [b]	Bordeaux mixture (1.00%)	3.3 [abc]
Fenthion (0.10%) (Lebaycid 1000)	100 [c]	100 [b]	Copper oxychloride (0.30%) (Difolatan 80 WP)	5.0 [abcd]
Carbaryl (0.10%) (Sevin 50 WP)	100 [c]	100 [b]		

In a column, means followed by same letters are not different statistically (p = 0.05) by L.S.D.

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