J. Biol. Control, 16(1): 15-18, 2002

A modified method for rearing *Cotesia plutellae* Kurdyumov (Hymenoptera: Braconidae), a larval endoparasitoid on diamondback moth

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ABSTRACT: **Studies conducted to determine the optimum conditions for mass production of *Cotesia plutellae* Kurdj. (Hymenoptera: Braconidae) revealed that host: parasitoid ratio of 100 second instar larvae: one-day old female of the parasitoid and rearing the parasitized larvae at 30°C and 75 percent relative humidity were the conducive conditions. The extent of parasitisation was 90.6 percent and duration of development was 12 days.**

KEY WORDS: *Cotesia plutellae* Kurdj, host age, host density, mass production, optimum condition

Cotesia plutellae Kurdj. is an important larval endoparasitoid of the diamondback moth (DBM) and has been reported exerting varying degrees of control, 16-52 percent in Bangalore (Jayarathnam, 1977) to 71.7 percent in Gujarat (Yadav *et al.*, 1975) under natural conditions. Extent of parasitization can be increased through monitored augmentative releases of the parasitoid, which involves large scale and rapid multiplication. Hence, an attempt was made to refine the rearing technique of *C. plutellae* so as to maximize production within limited resources by determining optimum host stage and density, and suitable rearing temperature and relative humidity.

MATERIALS AND METHODS

Cotesia plutellae was multiplied in the laboratory on DBM following the procedure given by Anon (1994).

Influence of temperature and relative humidity on the development of *C. plutellae*

About 50 second instar DBM larvae were kept for parasitisation by *C. plutellae* for 24h. Later each larva was shifted to a vial (7x2cm) containing a small piece of cabbage leaf and the mouth of vial was covered by muslin cloth and fastened with rubber band.

A set of three desiccators was prepared so as to create 60, 75 and 90 percent relative humidity with standard solutions of NH_4NO_3, NaCl and KNO_3, respectively. In each desiccator 15vials containing parasitized larvae (5larvae per replicate) were transferred and these desiccators were shifted to the B. O. D. incubator maintained at 25°C. Similar sets were exposed to 30 and 35°C. Observations were made on egg plus larval period, pupal period,

total developmental period and adult longevity with and without honey.

Influence of host age on parasitization and longevity

Fifteen DBM larvae of each of the four instars were exposed to the parasitoid for 24h, with five larvae for each replication. The parasitised larvae were reared on cabbage leaves in plastic boxes at 30°C. Observations were made on number of cocoons formed and duration of development (egg + larval and pupal period) by keeping five parasitised larvae seperately in vials, and adult longevity with and without food by providing small cotton wad dipped in ten per cent honey solution.

Optimization of host density

The experiment comprised exposure of second instar larvae in batches of 25, 50, 75, 100, 125, 150 and 175 to one day old *Cotesia* female in three replications. Rearing was done at 30°C and observations were made on the number of cocoons formed, adult emergence and adult longevity with and without honey. The data obtained from these experiments were subjected to completely randomized design one factor analysis (after arcsine transformation of percentages) and the means were separated by Duncan multiple range test.

RESULTS AND DISCUSSION

Influence of temperature and relative humidity on the development of *C. plutellae*

In the temperature range of 25°C to 35°C, and relative humidity of 60 to 90 per cent, the optimum zone of development lies at 30°C while humidity has no apparent effect (Table 1). The egg plus larval period lasted for 8.93 days at 25°C and 5.64 days at 30°C. Similarly, the pupal period as well as total developmental period was maximum at 25°C and minimum at 35°C. The total developmental period was 13.7-13.9 days at 25°C, 10.67-10.70 days at 30°C and 7.93-7.97 days at 35°C. This is in agreement with the reports of Mirok *et al.* (1997), who observed the developmental period to be 14.17 and 10.35 days at 25°C and 30°C, respectively.

Table 1. Optimum conditions for the production of *C. plutellae*

Temperature (°C)	RH (%)	Egg + Larval period (days)	Pupal (days) period	Total development period (days)	Adult longevity (days)	
					With honey	Without honey
25°C	60	8.7^{a}	5.20^{a}	13.90^{a}	12.93^{a}	5.87^{a}
	75	8.63^{ab}	5.23^{a}	13.87^{a}	13.07^{a}	5.22^{a}
	90	8.93^{a}	4.93^{a}	13.70^{a}	12.93^{a}	5.87^{a}
30°C	60	7.70^{a}	3.00^{b}	10.70^{b}	11.87^{a}	5.30^{b}
	75	7.67^{c}	3.00^{b}	10.67^{b}	12.00^{a}	5.23^{b}
	90	7.82^{bc}	2.87^{bc}	10.67^{b}	11.80^{a}	5.20^{b}
35°C	60	5.98^{d}	2.19^{d}	7.97^{c}	6.00^{b}	3.80^{c}
	75	5.64^{d}	2.33^{d}	7.93^{c}	6.13^{b}	3.87^{c}
	90	5.72^{d}	2.23^{d}	7.93^{c}	5.93^{b}	3.82^{c}

Means in the column followed by same letters do not differ significantly by DMRT (P=0.01).

Mirok *et al.* (1997) observed the average longevity of females of *C. Plutellae* to be 13.7 and 7.87 days at 25 and 30°C, respectively. In contrast, during the present investigations, adult longevity did not differ significantly at 25°C and 30°C. It ranged from 11.8 to 13.07 days. However, the longevity at 35°C was significantly less (5.39 to 6.14 days). Similar trend was observed for adult longevity without honey. Although the biological characteristics were not affected by relative humidity, 90 percent relative humidity was found to be too high and 60 percent relative humidity, too low to maintain the culture. Taking above facts into account, 30°C and 75 per cent relative humidity are considered favourable for the mass production of *C. plutellae.*

Influence of host age on parasitism and longevity of *C. plutellae* adults

The exposure of four larval instars of the DBM to *C. plutellae* revealed acceptability of all instars by the parsitoid. However, second instar larvae were the most preferred ones, followed by third and first instar (Table 2). Results of the present investigation were in accordance with the earlier workers who reported the preference of second instar although it accepts all the stages (Delucchi *et al.*, 1954; Anonymous, 1987). The egg plus larval period of the parasitoid decreased significantly from 8.16 to 5.96 days with the increase in the host age but the pupal period was not affected. Consequently, duration of development declined from 11.6 days to 9.6 days when fourth instar larvae were exposed in comparison to the exposure of first instar larvae. This hastening of *C. plutellae* development, in the later host instars may be due to the increased food availability to the parasitoid as compared to that of earlier instars as described by Salt (1964). However, longevity of the adult parasitoid was not affected (11.4-11.7 and 5.7-6 days for honey fed and unfed female).

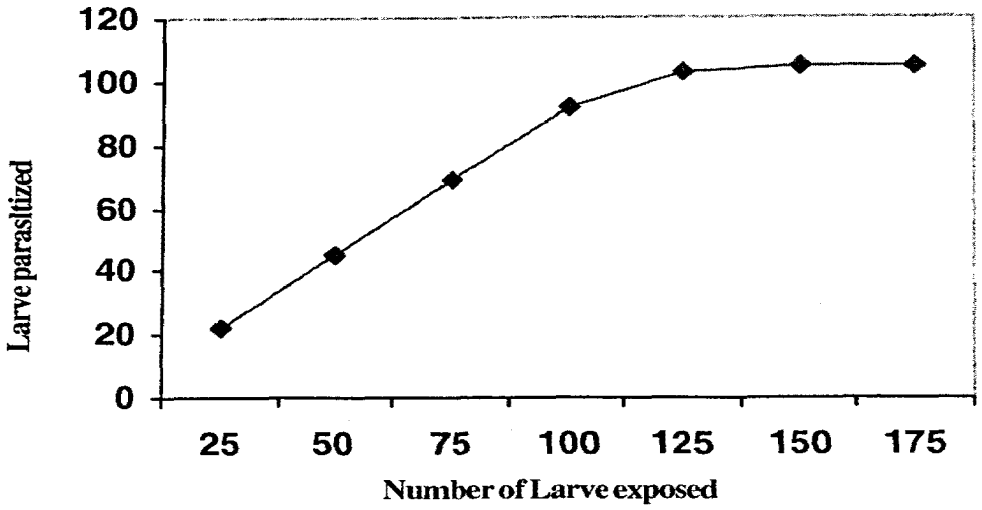
Optimization of host density

As the host density increased from 25 to 125, the number of larvae parasitized also increased significantly from 22.3 to 103 (Fig.1). With the further increase in larval density, the number parasitised did not increase, indicating its parasitization capacity as 105 larvae. However, the percent parasitism started decreasing from 100 larvae per female treatment proving it to be the optimum host density per female parasitoid. Anon (1994) observed the fecundity of *C. plutellae* to range from 100-150 eggs, while Delucchi *et al.* (1954) found it to be 85. The percent adult emergence (98.5-100%) and adult longevity with (10.8-11.6 days) and without honey (4.7-5.0 days) were not affected.

Table 2. Influence of host age on parasitism, developmental period and longevity of *C. plutellae* adults

Host stage	Parasitism (%)	Egg+larval	Pupal period (days)	Total development period (days)	Adult longevity (days)
I instar	70.7^{b}	8.16^{a}	3.48^{ab}	11.60^{a}	6.09
II instar	90.7^{a}	7.44^{b}	3.52^{ab}	10.96^{b}	8.27
III instar	76.0^{b}	7.00^{c}	3.44^{b}	10.44^{c}	7.28
IV instar	60.0^{c}	5.96^{d}	3.60^{a}	9.60^{d}	3.4

Means in the column followed by same letters do not differ significantly by DMRT (P=0.01).



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