

Parasitising Efficiency of *Chelonus blackburni* Cam. and *Copidosoma koehleri* Blanch. Singly and in Combination Against the Potato Tuber Moth.

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ABSTRACT

Laboratory investigations were conducted to determine the efficiency of the two exotic parasitoids - *Chelonus blackburni* Cam. (Hymenoptera : Braconidae) and *Copidosoma koehleri* Blanch. (Hymenoptera : Encyrtidae) - to parasitise the potato tuber moth (PTM), *Phthorimaea operculella* Zell. (Lepidoptera : Gelechiidae). When exposures of individual species of parasitoid were compared with the combination of both the species, *C. blackburni* reduced PTM survival with a higher percentage of parasitism. Also, in the combination treatments, *C. blackburni* significantly reduced the survival of *C. koehleri* while the latter did not affect the survival of the former. None of the combination treatments were superior to individual exposure using *C. blackburni* with respect to host mortality and overall parasitoid survival. Longevity of adults of *C. blackburni* was markedly reduced in the combination treatments. Also, the number of viable cocoons of *C. blackburni* was maximum in individual exposure. Similarly, the longevity of the adults and number of mummies formed by *C. koehleri* was reduced in the combination treatments when compared to individual exposure.

KEY WORDS : *Phthorimaea operculella*, *Chelonus blackburni*, *Copidosoma koehleri*, exotic parasitoids, parasitising efficiency

The potato tuber moth *Phthorimaea operculella* (Zell.) (Lepidoptera : Gelechiidae) (PTM), is one of the most serious pests of potato in India (Kumar and Nirula, 1967; Butani and Varma, 1976). Two potential exotic parasitoids of PTM, viz., *Chelonus blackburni* Cam. (Hymenoptera : Braconidae), which is a uniparental solitary egg-larval parasitoid and *Copidosoma koehleri* Blanch. (Hymenoptera : Encyrtidae), which is a polyembryonic egg-larval parasitoid were imported into India. Independent field releases and recovery tests have proven the efficiency of *C. blackburni* (Divakar and Pawar, 1979; Chaudhary *et al.*, 1983) and *C. koehleri* (Khandge *et al.*, 1979) as potential bio-control agents. But no detailed pre-introduction studies have been carried out in the laboratory to evaluate the efficiency of these parasitoids either singly or in combination. As both *C. blackburni* and *C. koehleri* prefer 0-1 day old eggs (Planter and Oatman, 1972), there are chances that the combination treatments might affect the survival of the host or parasitoids. Hence, laboratory studies were carried out to compare the various combination treatments with individual exposures, by supplying uniform number of eggs for uniform exposure time.

MATERIALS AND METHODS

The adults of *C. blackburni* and *C. koehleri* of the same age and cultured from PTM eggs were utilised for the experiment. A day old PTM eggs were exposed to the uniparental adults of *C. blackburni* and/or to the mated females of *C. koehleri* in the different treatments (Table 1). The ovipositional requirement was based on the recommendations of Platner and Oatman (1972). In each treatment, 100 PTM eggs were exposed for 3h to 10 parasitoids of *C. blackburni* or 10 mated females of *C. koehleri* as the case may be. The experiment was conducted at $25 \pm 2^\circ \text{C}$ and $60 \pm 2\%$ RH. A set of 100 unparasitised PTM eggs constituted the control. The treatments were replicated four times and observations were taken on the number of PTM adults which survived (per cent host survival), the survival of each parasitoid (the per cent parasitism by each parasitoid) in individual treatments and combination treatments, the total survival of both parasitoids together (overall per cent parasitism by both parasitoids together) in combination treatments (the cocoons of *C. blackburni* and the mummies of *C. koehleri* were taken as a measure of parasite survival), the total developmental period of the parasitoids, the number of *C. koehleri* adults obtained per mummy and their sex ratio and the longevity of the parasitoids and the number of viable cocoons/mummies produced by one adult parasitoid per day.

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RESULTS AND DISCUSSION

The number of PTM adults which survived in the different treatments are given in Table I. All the treatments were significantly superior to control. The control with no parasitoids had maximum survival of PTM (31.0%). Interestingly, the least survival (0.5%) was in the treatment where

vival of one of the parasitoids was reduced, but in no instance did multiparasitism increase host survival above what might have been expected of either parasitoid acting alone. This is in conformity with the observation of Godwin and Odell (1984) on the parasitoids, *Blepharia pratensis* (Meigen) and *Parasetigena sylvestris* (Robineau Desvoidy) (Diptera : Tachinidae) on *Lymantria*

TABLE 1. Parasitising efficiency of *C. blackburni* and *C. koehleri* in individual and combination treatments

Treatments	% PTM survival	% parasitism by <i>C. blackburni</i>	% parasitism by <i>C. Koehleri</i>	Overall % parasitism	<i>C. blackburni</i>		
					Total developmental time (in days) (Mean)	Longevity of adults (in days) (Mean)	Number of viable cocoons formed per adult per day (Mean)
Unparasitised control	31.0 ^a	-	-	-	-	-	-
<i>C. blackburni</i> alone for 3 h	1.3 ^{cd}	33.3	-	33.3 ^a	25.0	23.3 ^a	17.3 ^a
<i>C. koehleri</i> alone for 3 h	12.0 ^b	-	18.3 ^a	18.3 ^b	-	-	-
<i>C. blackburni</i> for 3 h and then to <i>C. koehleri</i> for 3 h	0.5 ^d	31.5	0.5 ^b	29.8 ^a	26.5	13.0 ^b	6.8 ^c
<i>C. koehleri</i> for 3 h and then <i>C. blackburni</i> for 3 h	4.3 ^c	32.0	0.5 ^b	32.5 ^a	25.0	15.0 ^b	7.7 ^{bc}
<i>C. blackburni</i> and <i>C. koehleri</i> together for 3 h	2.0 ^{cd}	36.3	1.3 ^b	37.5 ^a	25.3	16.7 ^b	12.65 ^{ab}

Values in a column followed by the same alphabet are not significantly different ($p = 0.05$) by L.S.D

C. blackburni was used before *C. koehleri* which was however, on par with exposure to *C. blackburni* alone and a mixture of both (1.3 and 2.0% respectively). However, *C. koehleri* parasitisation was significantly inferior to the other treatments as 12.0% host survival was recorded. This implied that *C. blackburni* is more efficient in reducing host survival and does not seem to be affected by combination with *C. koehleri*. The data on parasite survival showed that combination with *C. koehleri* (irrespective of the sequence) could not provide significant reduction in the survival of *C. blackburni* (Table 1). However, the reverse seemed to be true in case of *C. koehleri* as the survival of this parasitoid was significantly reduced by combination with *C. blackburni* in all the three combination treatments.

The data on host and parasitoid survival showed that in combination treatment, the sur-

dispar (L.) (Lepidoptera : Lymantridae). In individual exposures, per cent parasitism obtained in case of *C. koehleri* (24.88) was lower than that of *C. blackburni* (35.2). The overall parasitism obtained by the two parasitoids in combination were statistically on par with per cent parasitism obtained by *C. blackburni* acting alone, but were significantly higher than the per cent parasitism obtained by *C. koehleri* acting alone.

The total developmental time of *C. blackburni* showed no significant difference among the different treatments. However, adult longevity and number of cocoons produced was highest in the adults obtained from the individual exposures and significantly lower in the combination treatments except the treatment consisting of the mixture of both in which the cocoons produced was on par with that of *C. blackburni*. (Table 1) This further justifies the efficiency of *C. blackburni* when ex-

TABLE 2. Developmental time, number of adults per mummy, sex-ratio, longevity and number of mummies formed by *C. koehleri*

Treatments	Mean developmental time (in days)	Mean no. of adults per mummy	Sex ratio (male : female)	Mean longevity of (in days)	Mean longevity of (in days)	Mean no. of viable mummies formed by one adult per day
<i>C. koehleri</i> alone	30	41.0	1 : 2.2	11.5	12.8	13.8
<i>C. blackburni</i> then to <i>C. koehleri</i>	33	33.0	1 : 3.5	8.3	10.8	12.7
<i>C. koehleri</i> then to <i>C. blackburni</i>	33	36.7	1 : 2.4	7.7	7.4	4.5
<i>C. blackburni</i> and <i>C. koehleri</i> together	30	45.3	1 : 1.3	6.6	11.7	9.0

posed singly.

Table 2 gives the total developmental time for *C. koehleri*, the number of adults obtained per mummy, sex ratio, longevity of adult parasitoid and number of viable mummies obtained per parasitoid per day from the different treatments. The developmental time, number of adults per mummy and the sex ratio (male : female) ranged from 30 to 33 days, 33 to 45.3 adults and 1:1.3 to 1:3.5 respectively. Longevity of the males and females and the number of viable mummies formed were found to be highest in the individual exposures compared to the combination sets. Very few mummies were obtained from the combination treatments (Table 1) and therefore, the data in Table 2 were not amenable to analysis of variance and the mean values are given.

The reduction in PTM survival and the high per cent parasitism obtained when *C. blackburni* was exposed alone and from the adverse effect of *C. blackburni* on the survival of *C. koehleri*, it may be concluded that *C. blackburni* is a more efficient parasitoid. It also shows that though *C. koehleri* is quite effective in individual exposure with a high return from each mummy, it is likely to be less effective when *C. blackburni* is present. The present study would form a useful prelude to field release studies.

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