Note

BIOLOGY OF *Microctonus* sp. (HYMENOPTERA: BRACONIDAE), A PARASITOID OF *Cyrtomon luridus* BOH. (COLEOPTERA: CURCULIONIDAE)

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ABSTRACT: *Cyrtomon luridus* (Boh.), a native insect of wild Solanaceae, has adapted to the medicinal plant *Duboisia* sp., introduced from Australia, causing damages up to 100% mortality. *Microctonus* sp. is the most important natural enemy of *C. luridus* and its potential for biological control was investigated in this work. This study was carried out in Arapongas, Paraná State, Brazil, from 1994 to 1996. Parasitism of *C. luridus* by *Microctonus* sp. was highest from February through June (maximum of 54% in May 1996), when the *C. luridus* adult population was decreasing. The female sex ratio of *Microctonus* sp. under natural conditions was 0.57 to 0.69, which was close to 1 male : 2 female. Production of males occurs parthenogetically (arrhenotoky). In the laboratory, parasitism reached 40% when two adult *C. luridus* were exposed per parasitoid. The number of *Microctonus* sp. adults that emerged per parasitized beetle ranged from 4.7 to 14.2. Larval-pupal viability was 31.7 to 64.8% and the female sex ratio ranged from 0.0 to 0.37, with prevalence of males. The egg-pupal period was 12.7 days and the pupal-adult period was 10.7 days, resulting in a mean life cycle (egg-adult) of 22.4 days for this parasitoid (25ºC, 70% R.H.). This is the first report of a new species of *Microctonus* sp. in *C. luridus*.
Key words: biological control, parasitism, medicinal plant, duboisia

BIOLOGIA DE *Microctonus* sp. (HYMENOPTERA: BRACONIDAE), PARASITÓIDE DE *Cyrtomon luridus* BOH. (COLEOPTERA: CURCULIONIDAE)

RESUMO: *Cyrtomon luridus* (Boh.) é um inseto nativo de solanáceas silvestres e se adaptou à planta medicinal *Duboisia* sp., introduzida da Austrália, causando danos de até 100% de mortalidade. *Microctonus* sp. é o mais importante inimigo natural de *C. luridus* e seu potencial para o controle biológico foi investigado neste trabalho. Os experimentos foram conduzidos em Arapongas, Estado do Paraná, de 1994 a 1996. O parasitismo de *C. luridus*, por *Microctonus* sp. foi maior nos meses de fevereiro a junho (máximo de 54% em maio/96), coincidindo com a diminuição da população de adultos de *C. luridus*. A razão sexual de fêmeas de *Microctonus* sp., em condições naturais, foi de 0,57 a 0,69; sem cópula há produção de machos (partenogênese arrenótoca). Em laboratório, o parasitismo chegou a 40%, quando se ofereciam 2 adultos de *C. luridus* para 1 parasitóide. O número de adultos de *Microctonus* sp. por besouro parasitado variou de 4,7 a 14,2; a viabilidade larval-pupal de 31,7 a 64,8% e a razão sexual de 0 a 0,37, com predominância de machos. O período ovo-adulto foi em média, de 22,4 dias, sendo 12,7 dias para o período ovo-pupa e 10,7 dias para o período pupa-adulto (a 25º C; 70% de U.R). Estes foram os primeiros resultados da biologia desta nova espécie de *Microctonus*, parasitóide com potencial a ser avaliado para o controle biológico de *C. luridus*.
Palavras-chave: controle biológico, parasitismo, planta medicinal, duboisia

INTRODUCTION

Species belonging to the genus *Cyrtomon* occur in Neotropical regions, and in Brazil, *Cyrtomon luridus* (Boheman) has been recorded in the States of Paraná, Santa Catarina and Rio Grande do Sul (Lanteri, 1990). This weevil develops in wild Solanaceae (wild tobacco, coerana, etc.), as well as on cotton and eucalyptus (Sérgio A. Vanin[1]). *C. luridus* is a univoltine insect; its larvae feed on roots and adults consume leaves of plants. It has

[1]Dr. Sérgio A. Vanin - University of São Paulo, personal communication.

adapted to and seriously damages a medicinal plant, *Duboisia* sp. (Solanaceae) (hybrids between *D. myoporoides* and *D. leichhardtii*) (Ohlendorf, 2002), causing up to 100% mortality. Introduced from Australia, this plant is rich in scopolamine, an alkaloid widely used for human and animal health.

Cyrtomon luridus adults collected from *Duboisia* sp., in Arapongas, Paraná State, were found parasitized by the braconid wasp, *Microctonus* sp. (Hymenoptera: Braconidae). Species of this genus are known as solitary endoparasitoids of adult weevils of the genera *Hypera* and *Sitona* (Morales & Hower, 1981, Goldson et al., 1990), *Listronotus* (Goldson et al., 1992), *Trichobaris* (Cuda & Burke, 1991) and possibly *Naupactus* and *Pantomorus* (Gravena et al., 1992). Because this weevil causes extensive damage to *Duboisia* sp., research was undertaken to investigate the biology and ecology of *Microctonus* sp. in the aim to evaluate its potential for the biological control of *C. luridus*.

MATERIAL AND METHODS

Adults of *C. luridus* were collected in the field from *Duboisia* sp., from February 1994 to June 1996, in Arapongas, PR, Brazil (23º21'21'' S; 51º29'27'' W). Individual insects were placed in rearing containers (200-mL plastic cups), covered with plastic (PVC) film, along with *Duboisia* sp. leaves as a food source. The containers were maintained in the laboratory (25 ± 2°C.; R.H. 70 ± 10%; 12h photo phase), to determine the degree of parasitism. The female sex ratio [s.r. = females / (males + females)] of *Microctonus* sp. that emerged from the adult weevils was calculated.

Parasitoids and adults of *C. luridus* were maintained in the same *Duboisia* sp. containers described above. They were exposed to adult *Microctonus* sp. to determine the parasitism rates. In this case, the ratio of adult *C. luridus* per *Microctonus* sp. female ranged from 1 to 3, with continuous host exposure until death of the parasitoid occurred. The number of replications ranged from 20 to 184, depending on the number of parasitoids available.

Larva-pupal viability, number of parasitoids that emerged per parasitized beetle, female sex ratio in the laboratory and the duration of the life cycle (egg to adult) in *Microctonus* sp., were obtained by examining progeny daily. The superparasitism or polyembriony were not the object of this study. The type of reproduction of *Microctonus* sp. was determined by examining the sex ratio of progeny of previously mated (during 24h) or unmated females with 30 replications, and data presented as average ± standard deviation.

RESULTS AND DISCUSSION

The rate of parasitism of *C. luridus* by *Microctonus* sp. under field conditions ranged from 0 to 54%, from February 1994 to June 1996. Parasitism rates were higher from February to June, when adult populations of *C. luridus* on *Duboisia* sp. were low, compared to October to January (Figure 1). The highest parasitism rate occurred in May 1996 (54%), in areas with taller plants (about 2.0 m) and fully developed foliage, which apparently is a preferred habitat of *Microctonus* sp. The best time to introduce the parasitoid probably depends on the development stage of *Duboisia*, which was not investigated in this study. However, at the final phase of emergence of adult *C. luridus*, the parasitism rate was not high enough to avoid economic damage to *Duboisia* sp. If this parasitoid is to be mass-reared in the laboratory, it probably should be released in the field in September, when adults begin to emerge, in order to maximize the degree of control. In isolated areas containing trap plants left as refuges for the weevils to be controlled with insecticides, there was no parasitism. Therefore, parasitoid releases should be avoided in areas subjected to chemical control practices.

The parasitism pattern observed in Brazil is typical of *Microctonus* sp. In New Zealand, Goldson et al. (1990) found 85-100% infestation by *Microctonus aethiopoides* (Loan) in beetles remaining from an annual generation of *Sitona discoideus* (Gyllenhal), with minimal parasitism when new beetles emerged. The lack of oviposition by the parasitoid during the winter (overwintering diapause) resulted in minimal parasitism in August and September. In addition, Goldson et al. (1998) observed in New Zealand three generations per year of *Microctonus hyperodae* (Loan), which were produced in *Listronotus bonariensis* (Kuschel) after diapause in September. In this case, the maximum parasitism rate reached 90% in March, decreasing rapidly in April, with the appearance of new adults from neighboring fields free of parasitoids. This conclusion supports the suggestion to release *Microctonus* sp. in September to control *C. luridus*. However, more studies are necessary. In contrast, Copley & Grant (1998) observed

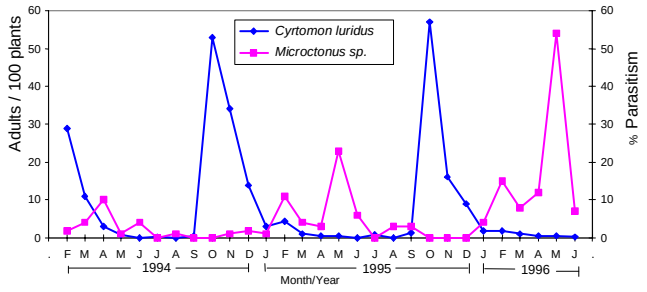

Figure 1 - The parasitism rates of *Microctonus* sp. in the *Cyrtomon luridus* population on *Duboisia* sp. under field conditions.

poor colonization by *M. aethiopoides* introduced for the control of *Hypera postica* (Gyllenhal) in alfalfa fields in Tennessee, USA. Barratt et al. (1997) obtained only a maximum parasitism rate of 6.0% in *Sitona lepidus* (Gyllenhal) by *M. aethiopoides* or *M. hyperodae* in laboratory cage tests, indicating that these species would be ineffective for the biological control of this pest in New Zealand pastures.

The sex ratio of *Microctonus* sp. under natural conditions was from 0.57 ± 0.11 to 0.69 ± 0.10, which is close to 1 male : 2 female, very close to 0.60-0.65 found in the nature in *M. aethiops* (Nees) (= *aethiopoides* Loan) by Fusco & Hower (1974). In the laboratory, the sex ratio ranged from 0.16 ± 0.13 to 0.37 ± 0.13 (Table 1), with a predominance of male parasitoids. Therefore, rearing conditions were probably inadequate for normal mating or the continuous oviposition produced more males, as demonstrated by Fusco & Hower (1974). Beetles parasitized by unfertilized females of *Microctonus* sp. produced only males. Therefore, reproduction in *Microctonus* sp. can be sexual or by arrhenotokous parthenogenesis, a common occurrence in hymenoptera.

The maximum parasitism rate in the laboratory was 40% in May/95 (Table 2), when two adults *C. luridus* were placed with one female *Microctonus* sp. in each rearing chamber. However, parasitism rates of 30.7, 19.5 and 20.7% were obtained in July/95 with the same 2:1 ratio. In general, the percentage of parasitism for this host/parasitoid ratio was higher than that obtained with 1:1 (33% and 32%, respectively) or 3:1 (19%), both of them resulting in a low level of parasitism. In all cases, *C. luridus* attempted to avoid attack by the parasitoid by moving the last pair of legs. Premature mortality of the infested beetles also was observed. Premature mortality is a typical result from superparasitism, which is common in arrhenotokous parasitoids, but it was not the object of this study. However, premature mortality also can be caused by bacterial transmission from the invasion of pathogens in the wounds produced by *Microctonus* oviposition (Jackson & McNeill, 1998).

Overall, parasitism of *C. luridus* by *Microctonus* sp. in this study was lower than results found by other authors, who investigated different species and host/ parasitoid densities. In the New Zealand, the mean parasitism rate of *L. bonariensis* by *Microctonus hyperodae* was 58.7% (Goldson et al., 1993), with a ratio of 40 beetles : 1 female parasitoid. Fusco & Hower (1974) found a maximum parasitism of 51.6% when *Hypera postica* was parasitized by *M. aethiops* with 50:1 ratio, with a low percentage of premature mortality.

The mean number of adult *Microctonus* sp. that emerged from each parasitized *C. luridus* ranged from 4.7 ± 1.9 to 14.2 ± 8.0, corresponding to a larva-pupa viability from 31.7 ± 9.9 % to 64.8 ± 20.4 % (Table 1). The larvae of *Microctonus* sp. change into pupae protected by cocoons, after they leave the beetles. The mean duration of the full cycle (egg-adult) was 22.4 ± 1.1 days, including 11 to 14 days (mean of 12.7 ± 1.1 days) for the egg-pupa period, and 9 to 13 days (mean 10.7 ± 0.95 days) for the pupa-adult period. These values were very close to those found by Goldson et al. (1993), who reported a life cycle of 22.4 days for *M. hyperodae* raised on *L. bonariensis*, although variations in fecundity can be different according to habitats, exposure to the host and genetically distinct populations (Phillips et al., 1996; Winder et al., 1997).

Difficulties with mass rearing of *Microctonus* sp. for release in the field are the main limiting factor for using this parasitoid for augmentative biological control of *C. luridus*. An artificial diet for *C. luridus* would facilitate the rearing of this parasitoid. Also, a successful biological control program with *Microctonus* sp. may depend on the timing of release (at the time of the first appearance of *C. luridus* adults) (Figure 1).

Table 1 - Biological parameters of *Microctonus* sp. reared on *Cyrtomon luridus* (25±2ºC.; R.H. 70±10%; photoperiod 12 L: 12 D).

Origin of the parasitoid	Date	% parasitism	Adults of Microctonus sp. / parasitized beetle	Pupa-larva Viability	Female Sex Ratio	Beetles: parasitoid ratio
		%		%		
laboratory	March/95	19.0	8.5 ± 2.5	45.0 ± 10.5	0.37 ± 0.13	3 : 1 n[1] = 184
laboratory(virgin females)	March/95	33.0	14.2 ± 8.04	63.3 ± 17.8	0.0	1 : 1 n = 30
laboratory	May/95	32.0	8.1 ± 3.5	45.3 ± 13.7	0.22 ± 0.18	1 : 1 n = 50
laboratory	May/95	40.0	8.4 ± 2.7	64.8 ± 20.4	0.23 ± 0.15	2 : 1 n = 20
laboratory	May/95	30.7	4.7 ± 1.9	31.7 ± 9.9	0.21 ± 0.12	2 : 1 n = 75
laboratory	June/95	19.5	7.8 ± 2.5	44.7 ± 9.8	0.16 ± 0.09	2 : 1 n = 136
laboratory	July/95	20.7	9.7 ± 2.7	47.8 ± 7.6	0.34 ± 0.1	2 : 1 n = 138
field	March/95	--	12.7 ± 4.51	59.6 ± 12.1	0.61 ± 0.13	n = 27
field	May/95	--	6.3 ± 2.5	41.7 ± 11.3	0.57 ± 0.11	n = 40
field	July/95	--	11.0 ± 4.1	50.7 ± 11.6	0.69 ± 0.10	n = 25

[1]n = number of observations.

Table 2 - Parasitism of *Cyrtomon luridus* by *Microctonus* sp., at different host : parasitoid ratios, under laboratory conditions. (25 ± 2ºC; R.H. 70 ± 10 %; photoperiod 12 L: 12 D).

Ratio Pest : parasitoid	Parasitism	Replications	Date
	%	n	
3 beetles : 1 female	19.0	184	March/95
2 beetles : 1 female	40.0	20	May/95
2 beetles : 1 female	30.7	75	May/95
2 beetles : 1 female	19.5	136	June/95
2 beetles : 1 female	20.7	138	July/95
1 beetles : 1 female	33.0	30	March/95
1 beetles : 1 female	32.0	50	May/95

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