

## POPULATION DYNAMICS OF *Cyrtomon luridus* BOHEMAN (COLEOPTERA: CURCULIONIDAE) ON *Duboisia* sp. (SOLANACEAE) IN BRAZIL

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**ABSTRACT:** *Cyrtomon luridus* (Boheman) has adapted to the medicinal plant *Duboisia* sp., introduced from Australia. Its larvae feed on roots, causing up to 100% mortality damages. The population dynamics and biological cycle were studied to determine future control methods in *Duboisia* sp., in Arapongas, Paraná State, Brazil, from 1993 to 1996. *C. luridus* presented annual life cycle in *Duboisia* sp. under natural conditions. The larval development period was 120 to 150 days, from January to May, reaching an average size of  $19.0 \pm 2.0$  mm in soil depth ranging on  $24.9 \pm 8.6$  cm to  $45.0 \pm 10.0$  cm. The beginning of the pupal phase happened in April. The larval-adult viability ranged on 7.5% to 19.6%. The typical symptoms of attack appeared in an infestation level of 60 larvae per plant. The first adults came out in July, six months after larvae hatching. However, adults came out from soil only in September, at the beginning of the rainy season, reaching the peak of emergency in October, outspreading until January. In laboratory (25°C, 70% R.H.), females longevity averaged  $113.7 \pm 15.2$  days. In this period, laying capacity was  $42.7 \pm 7.9$  egg masses, with  $9.4 \pm 0.61$  eggs each, totaling  $402 \pm 72.9$  eggs per female. Adults *C. luridus* were found parasitized by *Microctonus* sp. (Loan) (Hymenoptera: Braconidae). Solanaceae species *Solanum mauritianum* Scopoli and *Cestrum intermedium* Sendt. were identified as host plants of *C. luridus*.

Key words: *Microctonus*, biological cycle, medicinal plant, control, longevity

## DINÂMICA POPULACIONAL DE *Cyrtomon luridus* BOHEMAN (COLEOPTERA: CURCULIONIDAE) EM *Duboisia* sp. (SOLANACEAE) NO BRASIL

**RESUMO:** *Cyrtomon luridus* (Boheman) adaptou-se à planta medicinal *Duboisia* sp., introduzida da Austrália, na qual causa danos de até 100%. A dinâmica populacional e o ciclo biológico foram estudados de 1993 a 1996, em Arapongas, PR, Brasil, com o objetivo de determinar futuros métodos de controle em *Duboisia* sp.. *C. luridus* apresentou ciclo anual em *Duboisia* sp. em condições naturais. O período de desenvolvimento larval ocorreu em 120 a 150 dias, de janeiro a maio, atingindo o tamanho médio de  $19.0 \pm 2.0$  mm a uma profundidade média no solo de  $24.9 \pm 8.6$  cm a  $45.0 \pm 10.0$  cm. Em abril, foi observado o início da fase pupal. A viabilidade do período larval-adulto variou de 7.5% a 19.6%. Os sintomas típicos de ataque apareceram com o nível de infestação de 60 larvas por planta. Os primeiros adultos surgiram em julho, seis meses após a eclosão das larvas. Entretanto, o início da emergência de adultos do solo foi em setembro, no início da estação chuvosa, atingindo o pico de emergência em outubro, estendendo-se até janeiro. Em laboratório (25°C, 70% UR), a longevidade média das fêmeas foi de  $113.7 \pm 15.2$  dias. Neste período, cada fêmea colocou  $42.7 \pm 7.9$  massas de ovos com  $9.4 \pm 0.61$  ovos cada, totalizando uma média de  $402 \pm 72.9$  ovos por fêmea. Adultos de *C. luridus* foram encontrados parasitados por *Microctonus* sp. (Loan) (Hymenoptera: Braconidae). As espécies de Solanaceae *Solanum mauritianum* Scopoli e *Cestrum intermedium* Sendt. foram encontradas como plantas hospedeiras de *C. luridus*.

Palavras-chave: *Microctonus*, ciclo biológico, planta medicinal, controle, longevidade

### INTRODUCTION

Six species of the genus *Cyrtomon* (Coleoptera, Curculionidae, Naupactini) occur in Neotropical regions. Within Brazil, *Cyrtomon luridus* (Boheman) was recorded in the States of Paraná, Santa Catarina and Rio Grande do

Sul, and *Cyrtomon gibber* (Boheman) was recorded in São Paulo, Minas Gerais and Rio de Janeiro (Lanteri, 1990). These species develop in wild Solanaceae, as well as on cotton and eucalyptus (Sérgio A. Vanin – University of São Paulo, personal communication) and alfalfa (Lanteri et al., 1994). *C. luridus* is a rootworm. Its larvae feed on the roots

in the soil, and adults feed on plant leaves. It has adapted to, and seriously damages the medicinal plant, *Duboisia* sp. (Solanaceae) (hybrid between *Duboisia myoporoides* F. Muell and *Duboisia leichhardtii* R. Brown) (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.

Although *C. luridus* is not considered an important pest for other commercial crops in Brazil, its potential to become a pest must be evaluated. For instance, other Naupactini species, genus *Naupactus* and *Pantomorus*, closely related to *Cyrtomon*, are considered important pests in Brazilian citrus (Gravena et al., 1992; Guedes, 2003). Because *C. luridus* causes extensive damage to *Duboisia* sp., research was undertaken to investigate its population dynamics and biology, aiming to determine future control methods on *Duboisia* sp.

## MATERIAL AND METHODS

Field and laboratory studies were carried out on *Duboisia* sp. plantations, from 1993 to 1996, in Arapongas, northern Paraná State, Brazil (23°24' 27" S; 51°21' 55" W). A laboratory broadstock (25 ± 2°C and 70 ± 10 % R.H.) was maintained to provide larvae and eggs. Adult *C. luridus* collected in the field from *Duboisia* sp. were placed in groups of 10-15 in rearing containers (200 mm height × 100 mm diameter PVC tubes), along with *Duboisia* sp. leaves as a food source.

The larval development in the soil was evaluated in January 1995, when 30, 12-months old *Duboisia* sp. plants were infested with 40 newly-hatched, first instar *C. luridus* larvae, reared in laboratory. Plants were kept inside individual nylon mesh cages (1.80 × 1.80 × 1.80 m), to isolate them from natural infestation of *C. luridus*. Five plants were pulled out of the soil monthly during six months after infestation, and larvae length (mm) and soil depth (cm) were measured. The number of larvae, pupae and adults in the soil were also evaluated, and data presented as average ± standard deviation.

Signals of *C. luridus* infestation and larval-adult viability were studied under field conditions, in January 1995, when 12-months old *Duboisia* sp. plants were inoculated with either 10, 20, 40 or 60 newly hatched first-instar *C. luridus* larvae per plant (n = 5), in a totally randomized experimental design. Plants were isolated from natural infestation as described. Evaluations were made based on typical signals of attack (yellowish and leaf fall), and by counting the number of adults that emerged from each plant. These results were also used to determine the mean larval-adult viability under field conditions, data presented as average ± standard deviation.

The emergence period and the soil emergence rate of adults *C. luridus* on *Duboisia* sp. was studied under field conditions from August 1995 to January 1996. Ten, 24-

month old *Duboisia* sp. plants naturally infested, were cut at soil level and immediately covered with a nylon mesh cage (1.40 × 1.80 × 0.20 m). Adults emerging from those 10 plants were collected in a daily basic basis and the emergence period was determined, according to the rainfall.

The fluctuation of adults on foliage and search behavior of adult *C. luridus* on *Duboisia* sp. foliage was monitored under field conditions from 1993 to 1995, by inspecting 1% of plants fortnightly for one minute each. The mean adult number per 1000 plants was calculated monthly and adult samples were maintained in the laboratory for observations on occurrence of parasitism. The *C. luridus* search behavior was studied in field condition, adults being observed to be flier or walker during this period.

In September 1995, recently-emerged, adult *C. luridus* (n = 65 pairs) from the field, were maintained individually (1 male + 1 female) in rearing containers (25 ± 2°C and 70 ± 10 % R.H.), along with *Duboisia* sp. leaves as a food source, renewed every two days. The pre-oviposition period, egg laying capacity and the female longevity were evaluated till the death, and data presented as average ± standard deviation. The alternative host plants for *C. luridus* were investigated in the neighboring areas of the *Duboisia* sp. plantation. Wild Solanaceae plants were inspected monthly in 1994 to find *C. luridus* larvae in the roots or adults in the leaves, to determine the alternative hosts for *C. luridus* in the forest.

## RESULTS AND DISCUSSION

The larval mean size was 3.0 ± 1.31 mm in February, 30 days after infestation, and reached 19.0 ± 2.0 mm in May, 150 days after infestation, before pupal stage. Larvae were found in soil depth ranging on 24.9 ± 7.18 cm in the beginning to 45.0 ± 10.0 cm at the end of development (Figure 1). The pupal phase started in April, 90 days after infestation, when the first pupa was found, and reached a peak in June. The first adults *C. luridus* appeared in the soil in July, 180 days after infestation, similar to *Naupactus cervinus* Boheman in citrus, in which egg to adult period ranged from 162 to 240 days (Guedes, 2003).

Table 1 - Adult *C. luridus* emergence, after inoculation with larvae on *Duboisia* sp., at different rates, under field conditions.

Infestation rate (larvae per plant)	n	Mean ± SD	Min.	Max.	Larval-adult viability %
10	5	1.4 ± 1.14	0	3	14.0
20	5	3.6 ± 1.67	2	6	18.0
40	5	7.6 ± 3.21	4	12	19.0
60	5	11.8 ± 4.76	7	19	19.7

The typical signals of attack (yellowish and leaf fall) appeared only in one plant, in the most infested level (60 larvae per plant). In this infestation level, an average  $11.8 \pm 4.76$  adult beetles emerged in September, 270 days after infestation (Table 1). Larval-adult viability ranged from 14.0% (10 larvae per plant) to 19.7% (60 larvae per plant), with 17.7% in average, indicating a high larval-pupa mortality. Although the cause of high mortality was not studied in this work, Barker (1988) found 66% mean larval mortality of *Listronotus bonariensis* (Kuschel) caused by desiccation of first-instars larvae and by competition among 2<sup>nd</sup> instars larvae searching for the best food (Barker et al., 1989a).

The first adult *C. luridus* emerged in September, at the beginning of the rainy season, with peak of emergence during the first half of October, continuing until January at a lower rate (Figure 2). The same was observed by Guedes (2003) for *Naupactus* species on *Citrus* sp., in Brazil. The higher emergence rate was observed at high humidity levels, after rains, as observed in October; short dry periods decreased the emergence rate, as observed in November. In this study, an average 59.4 adults emerged per plant from September 1995 to January 1996. As pupal phase peak was found to be June, this is probably the *C. luridus* diapause phase.

The methodology used in this work did not allow determining the permanence of adult *C. luridus* in the soil, after the emergence from the pupal phase. However, this behavior is typical of Naupactini species and low soil mois-

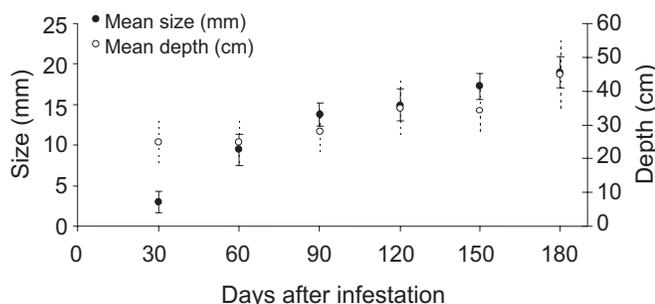


Figure 1 - Mean size and mean depth in the soil of *C. luridus* larvae infesting *Duboisia* sp., measured monthly after artificial infestation in the field, from January to July.

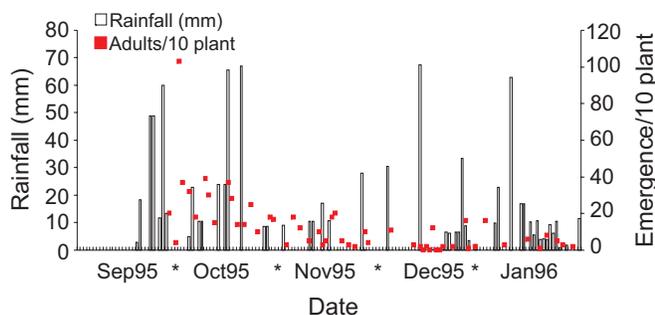


Figure 2 - Emergence of *C. luridus* adults from *Duboisia* sp. and rainfall from September 1995 to January 1996.

ture can delay larval development, and lead to desiccation, death, and difficulties to move in the soil (Silveira Neto et al., 1976; Loiacono & Marvaldi, 1994; Guedes, 2003).

Adult *C. luridus* were easily found on the top of foliage branches and leaves of *Duboisia* sp., mainly from October to April, and quite rarely from May to September. The population fluctuation of adult weevils on *Duboisia* sp. foliage, measured from 1993 to 1996, associated with the survey of the different phases in the soil, demonstrated that *C. luridus* has an annual life cycle (univoltine) (Figure 3), like do most of Naupactini in Argentina (Lanteri et al., 1994), Uruguay (Alzugaray et al., 1998), USA (Florida), and Antilles (Woodruff, 1985). Adult *C. luridus* collected in the field and kept in the laboratory were found parasitized by *Microctonus* sp. (Loan) (Hymenoptera: Braconidae) up to 54% (Tironi et al., 2004).

Adult *C. luridus* were found to be good walkers on soil surface, searching for food and not for mating, as described for *L. bonariensis* (Barker et al., 1989b; Goldson, 1981; Goldson et al., 1999). Flights of *C. luridus* were observed to be very short, only few meters, indicating that this insect is not a good flier, as is the genus *Naupactus*, which is incapable of flying due to poorly-developed metathoracic wings and fused wing covers (Lanteri & Marvaldi 1995).

The pre-oviposition period was  $24.0 \pm 2.8$  days, indicating the need of feeding and also mating before egg laying start. In comparison to other Naupactini species, the period was longer than *N. cervinus* (11.6 days) and *Naupactus versatilis* Hustache (6.7 days), as described by Guedes (2003) on citrus. Although usually reported for Naupactini species (Lanteri & Normark, 1995; Lanteri & Marvaldi, 1995), parthenogenesis was not observed for *C. luridus* in this work.

The egg-phase period of *C. luridus* was 25 to 30 days and was observed that larvae prefer higher moisture to eclose. In comparison, Guedes (2003) found 22.4 and 23.5 days for *N. cervinus* and *N. versatilis*, respectively, and closed to *Naupactus* sp. (Zehnder, 1997).

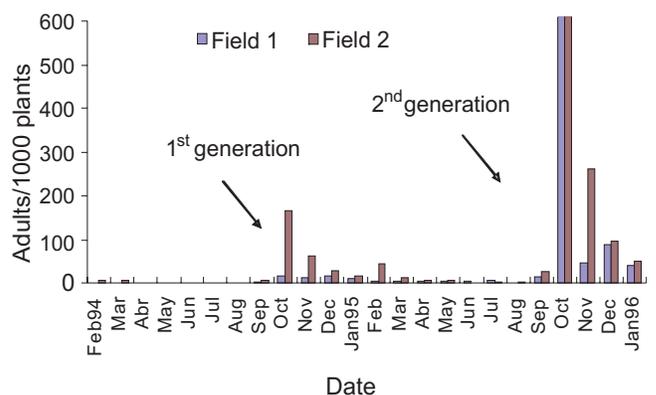


Figure 3 - Population fluctuations of adult *C. luridus* on *Duboisia* sp., from February 1994 to January 1996, in the field (planted in 1993).

The *C. luridus* oviposition last 16 weeks, peaking on seven to 12 weeks after emergence (Figure 4). Female longevity was  $113.7 \pm 15.2$  days in average. In this period, the egg-laying capacity was  $42.7 \pm 7.9$  egg masses, with  $9.4 \pm 0.61$  eggs per mass ( $n = 200$ ), totaling  $402 \pm 72.9$  eggs per female.

Masaki & Kadoi (1997) for *Pantomorus cervinus* (Boheman), found a mean of 1238, 1004 and 416 eggs laid per female on *Arachis hypogaea* L., *Rubus* sp. (Tourn.) and *Citrus natsudaidai* Haiata respectively, and mean longevities of 136, 116 and 86 days on these same plant species, respectively. In this case, the number of eggs per female and the longevity were more influenced by the plant on which the adults fed than on the host roots on which the larvae developed, in agreement with Ottens & Todd (1979) and Guedes (2003), for *Naupactus* species. In addition, *Pantomorus viridisquamosus* (Boheman), when fed on leaves of *Trifolium repens* L. (Fabaceae) and *Taraxacum officinale* L. (Asteraceae), began oviposition after 63-69 days, laying 164 eggs in 90 days, with adult longevity of 102 to 240 days (Loiácono & Diaz, 1995).

Effects of density and temperature on the *C. luridus* oviposition were not studied in this work. However, McNeill et al. (1998) found significant decline in the number of eggs per plant produced by *L. bonariensis*, with increased adult densities, which are in turn affected by temperature.

Two wild Solanaceae species were found as alternative host plants of *C. luridus*, on the edge of *Duboisia* sp. plantations. *C. luridus* larvae were found mainly in the roots of *Solanum mauritianum* Scopoli, locally known as “fumo-bravo” or “capoeira-branca”, and the second species was *Cestrum intermedium* Sendt., known as “coerana”. These perennial plant species are widely distributed throughout Paraná state and seems to be important for the survival of *C. luridus* in the native forests. Curculionids attacking medicinal plants were re-

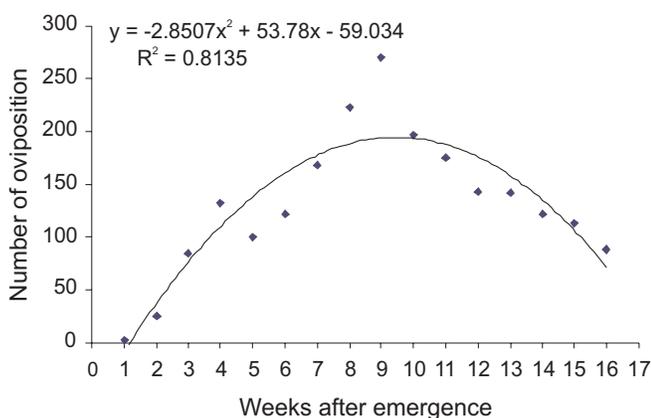


Figure 4 - Oviposition period of *C. luridus*, under laboratory conditions, after emergence in the field ( $n = 65$  pairs). Temperature  $25 \pm 2^\circ\text{C}$  e RH  $70 \pm 10\%$ .

ported by Martin (1999), who found *Pantomorus cervinus* on *Solanum aviculare* and *Solanum laciniatum*, plants known in New Zealand as poroporo, utilized for the extraction of solasodine.

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