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ABUNDANCE OF *CHLAMYDASTIS PLATYSPORA* (ELACHISTIDAE) ON ITS HOST PLANT *ROUPALA MONTANA* (PROTEACEAE) IN RELATION TO LEAF PHENOLOGY

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ABSTRACT. *Chlamydastis platyspora* (Elachistidae) is a bivoltine species whose larva is a specialist on *Roupala montana* Aubl. (Proteaceae), a common tree in the cerrado. We studied the presence of larvae in relation to leaf phenology of its host plant in the cerrado sensu stricto (savannah-like vegetation) of the Field Station Água Limpa, belonging to the University of Brasilia, Federal District, Brazil. We examined 3600 plants in an area of 16.2 ha between November 1999 and October 2000. The host plant produces leaves asynchronously during the year, and individuals present one of three leaf phenological phases at a given time: (1) new leaves only, (2) mature leaves only and (3) both mature and old leaves. Larvae were found on 273 of the examined plants. Larvae were encountered between January and March (first generation) and were found only on plants of the third phenological group. Larvae were also encountered between June and October (second generation) and occurred predominantly on the third group. Although the host plant has a high abundance in the cerrado area the presence of larvae of *C. platyspora* is apparently limited by the abundance of plants that simultaneously have mature and old leaves.

Additional key words: Brazil, caterpillar, cerrado, feeding specialist.

The center of distribution of the family Proteaceae is South Africa and Australia. This family contains 72 genera and about 1400 species but only three genera occur in Brazil: *Grevillea*, *Euplassa* and *Roupala* (Joly 1993, Mendonça et al. 1998). The species of *Roupala* occur mainly in the cerrado, but also are found in other biomes, such as the Atlantic forest.

Roupala montana Aubl. is common in the cerrado sensu stricto and is found from the APA of Curiaú (Amapá) (00°20′N 51°03′W) to Jaguariaíva (Paraná) (24°09′S 50°18′W) (Ratter et al. 2000). The highest production of leaves of *R. montana* in the cerrado of central Brazil occurs during September and October, a transitional period from dry to wet season (Franco 1998). However, leaf production may occur in some individuals during the whole year, corresponding to the pattern found in several woody species of the cerrado (Morais et al. 1995).

In a study conducted in a cerrado near Brasília in central Brazil, Diniz & Morais (1995) showed that *Chlamydastis platyspora* (Meyrick, 1932) (Elachistidae) was locally restricted to *R. montana*. *Chlamydastis platyspora* is bivoltine and its first generation occurs between November and April and its second between May and October (Bendicho-Lopez 2000). In spite of *R. montana* being common in the cerrado near Brasilia (Ratter 1980), the larvae of this moth are not found in great numbers, or with high frequency (Diniz et al. 2001). Since resources may be concentrated both in time and space plant phenology may affect the dispersion of herbivores (Solomon 1981). The objective of the present study was: to quantify the abundance of larvae of *C. playtspora* in relation to plant leaf phenology.

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MATERIALS AND METHODS

Study area and its host plants. The study area, a cerrado sensu stricto, was located on the Field Station Fazenda Água Limpa (15°55′S, 47°55′W) of the University of Brasilia, Federal District, Brazil, at 1100 m in elevation. This region has two well-defined seasons, a dry one from May to September and a wet one from October to April (Fig. 1A).

Sampling took place three times per month over 12 months from November 1999 to October 2000. Over the study period we inspected 3600 individuals (300 per month) of *R. montana* in an area of approximately 16 ha. All individuals inspected were between 0.5 and 1.5 m in height and there was no repetition of individuals over the sampling period. As *C. platyspora* is bivoltine this period comprised both generations. The first generation occurs in the wet season and the second occurs during the transition period from the end of the dry season to the beginning of the wet season (Bendicho-Lopez 2000). On each collection date, 100 individuals of *R. montana* were surveyed for the presence of larva of *C. playtspora*. When encountered, the developmental stage of each larva was recorded and an evaluation of the phenological stage of the leaves on the individual was also made. Detailed information on the identification of the developmental stages of the larvae is given in Bendicho-Lopez & Diniz (in press). The phenological stage of the leaves was based on the density of trichomes on their abaxial surface. This characteristic was used as indicator of the relative age of the leaves, classifying them into three categories:

New leaves—expanding leaves or recently expanded leaves still totally covered by trichomes on both surfaces. This stage lasts for less than seven weeks (Fig. 2A);

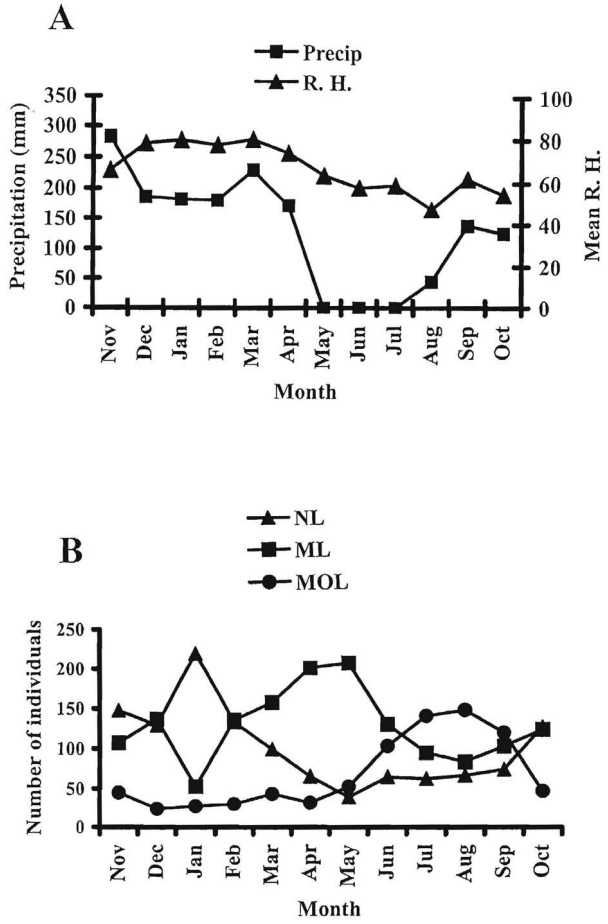

FIG. 1. Mean monthly precipitation and relative humidity during the study period and leaf phenology of the host plant. **A,** Mean monthly precipitation (Precip) and relative humidity (R.H.) (Nov/1999–Oct/2000), data from the IBGE Meteorological Station, Brasília; **B,** Variation in foliar phenophases of the individuals examined of *Roupala montana*. NL = new leaves, ML = mature leaves, MOL = mature and old leaves.

Mature leaves—expanded leaves, which had already begun to lose their trichomes. This stage lasts between eight and nine months (Fig. 2B);

Old leaves—leaves lacking trichomes. This stage lasts for up to two months (Fig. 2C).

Individuals of *R. montana* were classified in three phenological groups: (1) plants with all new leaves (NL), (2) plants with only mature leaves (ML) and (3) plants with mature and old leaves at the same time (MOL).

To compare the residence period and the development time of a larva on its host we followed the development of larvae on marked host plants. The residence period and development time of larvae in the first generation was studied using eggs or first instar larvae found on 15 individuals of *R. montana* in January. These larvae were observed twice a week through the pupal state until the emergence of the adults. This procedure was repeated in June using larvae found on another 15 individuals of *R. montana* to accompany the residence period and development of larvae from the second generation.

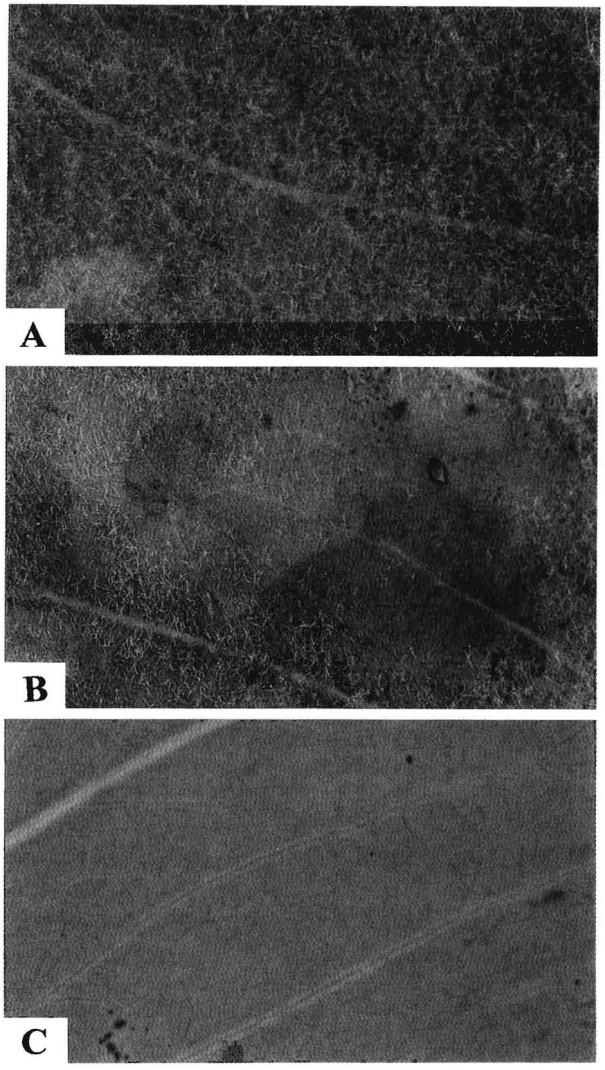

FIG. 2. Relative age of *Roupala montana* leaves showing the abaxial face: **A,** New leaves; **B,** Mature leaves and **C,** Old leaves.

Statistical analyses were done using Statistix 7 (Analytical Software 2000).

RESULTS

Leaf phenology of *Roupala montana*. January, middle of the wet season, had the largest proportion of plants with new leaves; while the maximum level for mature leaves was May (beginning of the dry season). Also at the beginning of May, there was an increase in the number of plants of the group mature and old leaves with the maximum number recorded in August (Fig. 1B).

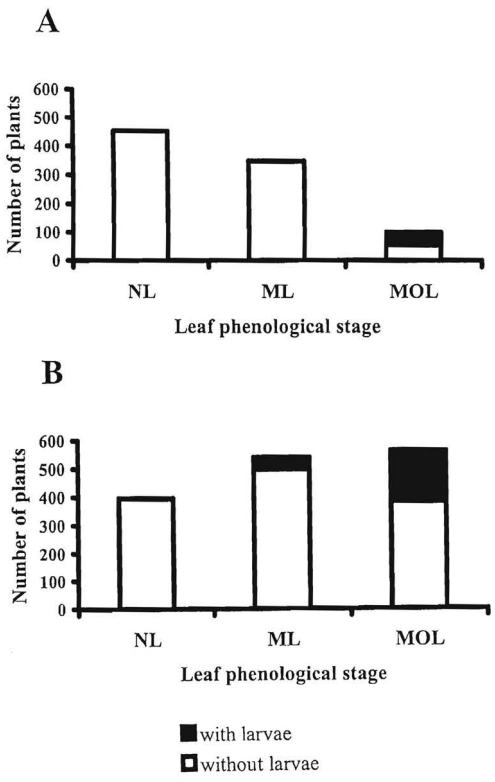

FIG. 3. Abundance of larvae of *Chlamydastis platyspora* found on leaves of *Roupala montana* in different phenological categories in a cerrado in central Brazil. NL = new leaves, ML = mature leaves, MOL = mature and old leaves. **A,** First generation (January to March); **B,** Second generation (June to October).

Over the whole year the phenological phase with highest frequency was ML (37%), NL was next (36%) and the least abundant was MOL (27%). There was a significant difference among these values ($\chi^2 = 18.79$, $p = 0.0001$).

Larval phenology and relationship with *R. montana*. Overall we found 475 larvae on 273 of the 3600 examined plants (7.58%). Among the plants used by the larvae, 4 (2%) belonged to the group with only NL, 43 (19%) on plants with OL and 226 (79%) occurred on plants MOL group. Larvae of *C. platyspora* were found in only 8 of 12 months and there was no overlap between the two generations. First instar larvae of the first generation were found in January and developed until March, when they passed to the pupal stage. The second larval generation began in June and extended into October. Thus, the larval phase was longer in the dry season than in the wet season. In the first generation, 70 larvae were found on 46 of the 900 inspected plants (5.1%) and all individuals with larvae were members of the third phenological group (Fig. 3A). In the period of the second generation, 405 larvae were found on 227 of 1500 examined plants (15.1%) and were present on all three phenological groups (Fig. 3B). A test of proportions showed a significant difference in the proportion of plants with larvae between generations ($z = -7.42$, $p = 0.000$). Also the abundance of larvae differed among the three leaf phenophases in both the first ($\chi^2 = 45.75$; $p = 0.000$) and second ($\chi^2 = 115.72$; $p = 0.000$) generations.

All monitored larvae used in the study of residence period and development time, from the first to the last instars, remained on their monitored plants. In both trials, all of the monitored plants belonged to the MOL phenological group.

DISCUSSION

Larvae of *C. platyspora* used the MOL phenological group of plants with the highest frequency. Therefore, for this species the results do not corroborate what is common for insect herbivores of moist tropical forests, namely that the majority use new leaves (Coley & Barone 1996).

Herbivores that can use old leaves, with low nutritional quality, may be able to take advantage of a period of low predator density (Moran & Hamilton 1980). They also avoid physical defenses such as leaf trichomes that are present on new leaves (Pullin & Gilbert 1989, Paleari & Santos 1998). As reported by Morais et al. (1999) previous studies in the cerrado have shown a lower density of predators and parasitoids during the dry season.

The nutritional quality of leaves varies among species and over their life cycle, and young leaves generally have a higher content of nitrogen and water than mature ones, which are more fibrous. Marquis et al. (2001) showed these trends for 25 plant species in the cerrado. Herbivores are affected by nutritional quality, by the content of water and fiber, and by leaf toughness (Coley & Barone 1996). Mature and old leaves used by larvae of the first generation are physiologically "younger" than those used by the larvae of the second generation since these leaves have been produced more recently. The leaves used by the second generation could have a lower nutritional content and this could have an influence on the duration of the larval development. Foliar analyses of *R. montana* (Medeiros & Haridasan 1985) showed higher concentrations of K and P and lower concentrations of Al, Mg and Ca in younger leaves compared to older leaves. Additionally, the larvae that develop in the dry season face more extreme climatic conditions, such as the absence of rain, and low relative humidity, as well as the lowest temperatures of the year.

The slower larval development observed in the dry season versus the wet season is not exclusive to *C. platyspora*. In the same study area, similar growth rates were

recorded for larvae of *Cerconota achatina* (Zeller) (Elachistidae), which feeds on *Byrsonima coccolobifolia, B. pachyphylla* (=*B. crassa*) and *B. verbascifolia* (Malphigiaceae). Generally, larvae of this species collected in the dry season and raised in the laboratory took twice the time to develop as those collected during the wet season (Morais et al. 1999). Here abiotic variability was reduced so differences were due to differences in leaf quality.

The number of larvae in the second generation was seven times higher than that of the first generation. This result is similar to that in another study of *C. platyspora* larva on *R. montana* done by another collector (B. Cabral, unpublished). These results obtained for *C. platyspora* coincided with the seasonal pattern of the lepidopteran larvae established for the cerrado by Morais et al. (1999), who showed a largest proportion of plants with larvae in May to July (dry season).

Our results showed the close relationship of *C. platyspora* larvae with leaf phenology of *R. montana*. This association appears to affect the size of the populations of both generations and can explain the low occurrence of larvae on its host plant, in spite of the high local density of *R. montana*. The limiting resource are plants belonging to the third phenological group (mature and old leaves) at the time of oviposition (May and December). Thus, the proportion of individuals of *R. montana* bearing different leaf phenophases can explain the low occurrence of this specialist larva in the cerrado.

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