

Biological aspects and mating behavior of *Leucothyreus albopilosus* (Coleoptera: Scarabaeidae)

Kleyton Rezende Ferreira¹, Elias Soares Gomes² & Sérgio Roberto Rodrigues^{3*}

1. Universidade Estadual de Mato Grosso do Sul, Aquidauana, MS Brazil; kleyton.rezende@hotmail.com
2. Universidade Federal da Grande Dourados, Dourados, MS, Brazil; eliasjv_gomes@hotmail.com
3. Universidade Estadual de Mato Grosso do Sul, Cassilândia, MS, Brazil; sergio@uems.br

* Correspondence

Received 18-V-2015. Corrected 05-I-2016. Accepted 05-II-2016.

Abstract: The genus *Leucothyreus* has been linked to some commercial plant crop pests. Eventhough several species have been described for this genus, information about this group is still scarce. This study investigated some biological aspects and mating behavior in *Leucothyreus albopilosus*. Studies were conducted at the State University of Mato Grosso do Sul, in the municipalities of Aquidauana and Cassilândia, MS, Brazil. For biological studies, adults were collected with light traps from February 2011 to February 2012, and for behavior analyses from September to December 2014. Biological studies were undertaken every three days and included the eggs inspection, and the separation of the newly hatched larvae to observe and describe their developmental stages; to monitor larval growth and differentiate larval instars, we measured the larvae cephalic capsule. Life cycle was determined starting from the newly laid eggs until adult death. For mating behavior studies, adults obtained with light traps were taken to the laboratory. As soon as they started flying in the evening, couples were formed and copulation steps were recorded. In the field, we observed that adults were mostly collected during warmer and wetter periods (from August to March). Our results showed that the embryonic period of *L. albopilosus* lasted 20.5 days, the 1st, 2nd and 3rd instars lasted 31.0, 33.1 and 85.6 days, respectively. The pupal stage lasted 20 days, and the egg to adult period was completed in 185.5 days; these results suggest that *L. albopilosus* can be characterized as a univoltine species. Observations of mating behavior in the laboratory showed that, after the sunset, adults projected a small portion of clypeus near the soil surface and flew off seeking a female to mate. The female could accept or reject the male for mating. When the female accepted the male, copulation occurred from 19:00 to 23:00 hours, and lasted 19.45 minutes on average. Sometimes females refused to mate, probably because the male or female were not sexually mature to perform copulation, and there might be a chemical communication between the adults. Adults were observed feeding on ripe bananas (*Musa* sp., Musaceae) and on mangaba flowers (*Hancornia speciosa*, Apocynaceae) in the laboratory. With this work we contributed with the description of mating behavior in the genus *Leucothyreus* and concluded that the biological cycle was completed in less than 200 days. Rev. Biol. Trop. 64 (2): 547-557. Epub 2016 June 01.

Key words: biology, Geniatini, rizophagous insect, Rutelinae, scarab beetle, Scarabaeoidea.

The genus *Leucothyreus* Macleay, 1819 (Melolonthidae, Rutelinae, Geniatini) is represented by 164 species (Jameson, 2008). Investigations of subterranean pest problems have shown that *Leucothyreus* 3rd instar larvae are polyphagous and known in commercial crops of cassava, coffee and grassland for livestock

ruminant system (Pardo-Locarno, Montoya-Lerma, Bellotti, & Schoonhoven, 2005).

Among the species of this genus, larvae of *L. femoratus* (Burmeister 1844) were found associated to roots of grasses and crops in Colombia. Adults of *L. femoratus* have crepuscular or nocturnal habits, defoliating pests in

different crops, and the life-cycle duration is 170.4 days (Pardo-Locarno, Morón, & Montoya-Lerma, 2006; Martínez & Plata-Rueda, 2013; Martínez, Plata-Rueda, Zanuncio, & Serrão, 2013).

In Brazil, there is little information about *Leucothyreus*. Morón (2004) reported the occurrence of 83 species of *Leucothyreus* in various regions in the country. Ronqui and Lopes (2006) collected three species of *Leucothyreus* using a light trap in Northern Paraná State. Oliveira, Zanuncio, Zanuncio and Santos (2001) recorded 14 species of *Leucothyreus* in *Eucalyptus grandis* (W. Hill ex Maiden) (Myrtaceae) plantations in the municipality of Nova Era, Minas Gerais. Puker, Rodrigues, Tiago and Santos (2009) found larvae of *L. dorsalis* (Blanchard 1850) and *Leucothyreus* sp., associated with the root system of *Acrocomia aculeata* (Jacq. Lodd ex Mart.) (Arecaaceae) in Mato Grosso do Sul.

Rodrigues, Puker and Tiago (2010) reported that the life cycle of *L. dorsalis* was completed in 273.5 days, which characterizes this species as univoltine. Adults of *L. alvarengai* (Frey 1976) and *L. aff. semipruinosus* (Ohaus 1917) emerge at the start of the rainy season, when they mate and reproduce. The immature stages complete the life cycle in less than a year (Pereira, Rodrigues, & Morón, 2013).

Puker, Morón, Oliveira Junior and Message (2011) collected adults of *L. albopilosus* (Ohaus 1917) in lesions in trunks of *Eucalyptus citriodora* (Hook.) K. D. Hill and L.A.S. Johnson, and in hives of *Apis mellifera* (Linnaeus 1758) found in propolis layers. Despite the diversity of species and the importance of the genus *Leucothyreus*, little information about this pest group is known. With the aim to contribute to this knowledge, we conducted studies on the biological aspects and mating behavior of *L. albopilosus* (Ohaus 1917), in the municipality of Aquidauana and Cassilândia, Mato Grosso do Sul State, Brazil.

MATERIAL AND METHODS

The study was conducted at the Universidade Estadual de Mato Grosso do Sul (UEMS), in the municipalities of Aquidauana (20° 28' S - 55° 48' W) and Cassilândia (19° 06' S - 51°44'03" W), Mato Grosso do Sul, Brazil. The climate in these regions is characterized by dry winters and rainy summers (Aw subtype Köppen, 1948), characteristic of tropical zone with the rainy season lasting from October to March, and the dry season from April to September. In Aquidauana, the average annual temperature is 27 °C and the average annual rainfall is 1 400 mm. In Cassilândia, the average annual temperature is 24.1 °C, and the average annual rainfall is 1 521 mm. The vegetation in these regions is typical of Brazilian Cerrado.

Biological aspects: The studies on the biological aspects were conducted in Aquidauana. Adults of *L. albopilosus* were sampled and collected from February 2011 to February 2012 using a light trap model "Luiz de Queiroz" equipped with a 20 watt fluorescent lamp, and installed between the pasture (*Brachiaria decumbens* (Trin.) Griseb) (Poaceae) and crop areas (soybean, bean, corn, cotton and sugarcane). A single light trap was used to collect live insects. Every day, the light was on from 18:00 h to 6:00 h of the following day, and the *Leucothyreus* species were attracted. This trap type has been used to collect Scarabaeidae as these insects are attracted by light sources (Buss, 2006).

Males and females of *L. albopilosus* were placed in plastic containers (30x19x12 cm, 4 L capacity) with a 5 cm deep soil layer for oviposition and seedlings of *B. decumbens*. The soil was obtained from a pasture area of UEMS and was moistened with manual watering every five days.

Two pairs of adults were isolated per container, which remained in the laboratory at

room temperature. The plastic containers were properly identified with numbers, and covered with polyester veil to provide air circulation. The presence of eggs was checked daily. Because of the lack of data on feeding behavior of *L. albopilosus* adults, we offered a variety of food sources such as leaves, flowers and fruits (guava, cashew, grape, acerola, mangaba, mango and banana). We observed that, adults preferred to feed on banana, therefore, it was used as food source during the experiment.

To measure egg development, oviposited eggs (n= 25) were collected every day and placed in Petri dishes. For this, a layer of 2-3 cm of soil were included in the Petri dishes to receive the eggs. The Petri dishes were then kept in a climatic chamber with controlled temperature (26±2 °C and L:D 12:12 h photoperiod). Every three days, the eggs were inspected and the newly hatched larvae were separated and placed individually in 500 mL plastic pots (containing soil and seedlings of *B. decumbens*) using root as food source (Rodrigues et al., 2010).

The larvae were kept in a temperature-controlled chamber with the same conditions for the eggs. Due to moisture loss and seedlings wilt, the soil was moistened weekly and *B. decumbens* replanted every 15 days to supply roots for the larvae. Each three or four days, the rearing pots were checked and the soil and seedlings of *B. decumbens* were carefully removed to visualize the larvae. This procedure allowed measuring the cephalic capsule. After measuring its width, larval growth and instar change were determined (Rodrigues et al., 2010).

The larvae were white grayish when feeding; however, in the pre-pupal stage, they showed a white color and did not feed on roots of *B. decumbens*. After the pre-pupae were formed, seedlings of *B. decumbens* were no longer supplied. To check the duration of the pupal stage, pupal chambers in the openings were made, allowing the visualization of pupae inside. After emergence, adult couples were kept in plastic containers (30x19x12 cm, 4 L capacity) as described above.

Life cycle was determined starting from newly oviposited eggs until adult death. Longevity and survivorship data from different developmental stages of *L. albopilosus* were recorded.

To monitor larval growth and instars differentiation, we measured the cephalic capsule of larvae at the greatest width, using a digital caliper (precision 0.05 mm) at intervals of 3 to 4 days (Rodrigues et al., 2010). The length and width of eggs, larvae and pupae were measured with a digital caliper and the weight was obtained with an analytical balance (precision 0.0001 gram). Some adults of *L. albopilosus* collected with light trap were measured, sexed, subsequently killed and kept in an oven for 48 hours (60±5 °C) and then weighed (Silva & Grützmacher, 1996).

Mating behavior: Studies on mating behavior were conducted in Cassilândia. Adults of *L. albopilosus* were collected daily with a light trap model “Luiz de Queiroz”, from September to November 2014. The insects were transported to the entomology laboratory, sexed and individually sampled in plastic containers of 500 mL filled with 250 mL of soil and covered with voile veil. Observations of mating behavior started at 17:00 hours.

In the laboratory, we initiated the observations of mating behaviors as adults of *L. albopilosus* flew off. Couples were formed and carefully sampled in plastic recipients (1 L capacity) with 1/3 of its volume filled with soil to observe the mating behavior. We observed the behavior of 40 couples of *L. albopilosus* during the experimental period.

Fruit pieces, leaves and flowers of various vegetable species were provided to adults to investigate their food preference. The room used to observe mating was kept in the dark, according to the methodology presented in Facundo, Linn, Villani and Roelofs (1999). To visualize and register the mating behavior of males and females of *L. albopilosus*, we used a Canon® camera, model SX 160 IS.

The flight time was observed from October 30th to November 2nd 2014, and we used two

light traps to assess the flight behavior of *L. albopilosus*. The light traps were installed in a pasture area with *B. decumbens* and were activated from 18:00 to 6:00 hours of the following day to collect adults. The traps remained 150 meters far from each other and were inspected every 60 minutes when captured insects were collected. Data on flight time were converted into square root of $x + 1$, submitted to variance analysis (ANOVA) and the means were obtained and compared with the Scott-Knott test ($P < 0.01$) using ASSISTAT software (Silva & Azevedo, 2002). Data on average temperature ($^{\circ}\text{C}$) and solar radiation (KJ/m^2) in Casilândia, MS were obtained from the Instituto Nacional de Meteorologia (INMET).

Adults of *L. albopilosus* were identified by Dr. Miguel Angel Morón, Institute of Ecology, Xalapa, Veracruz, Mexico (IEXA). Twenty adult specimens were mounted and deposited in the insect collection of the Entomology Laboratory at UEMS and eight in the Institute of Ecology, Xalapa, Veracruz, Mexico.

RESULTS

Biological aspects: In 2011, 87 adults were collected with the light trap in February, March, August, September, October, November and December. In 2012, 10 adults were collected in January and February (Fig. 1). In August and September, temperature and humidity increased in the field and adults began to be collected.

In laboratory, females laid eggs in April. The egg stage lasted 20.5 days on average.

The newly laid eggs were white, elliptic and the average size was 1.3 mm long x 1.2 mm wide with 0.0018 g weight (Table 1 and Table 2) (Fig. 2).

The first instar lasted 31.0 days between April and May, the average size was 3.8 mm long x 1.1 mm wide at thorax with 0.014 g weight. The mean cephalic capsule width was 1.32 mm. The second instar occurred in late May and lasted until early July, totaling 33.1 days. The average size was 13.7 mm length x 2.9 mm thorax width and 0.092 g weight. The mean cephalic capsule width was 2.13 mm (Table 1 and Table 2) (Fig. 2). The third instar larva lasted 85.6 days between July and October and the average size was 20.0 mm length x 4.2 mm thorax width with 0.29 g weight. The mean cephalic capsule width was 3.14 mm (Table 1 and Table 2) (Fig. 2).

Pre-pupae were observed from September to October (Fig. 2). The larvae of *L. albopilosus* constructed a chamber to develop the larval-pupal stage until emergence of adults. The pupal chamber was built with soil and saliva and was not easily undone by manipulating the soil, which gave a protective environment for the pupae. The larval stage of *L. albopilosus* lasted 144.5 days (Table 1). The weight of the larvae increased 20.7 times from the 1st to the 3rd instars. The pupae developed from late September until late November (Fig. 2) and lasted 20.0 days (Table 1) with average size 13.5 mm length x 6.5 mm of thorax width and 0.182 g weight (Table 2). The pupae were yellow.

Adults emerged from November to December (Fig. 2). Males had forelegs with

TABLE 1
Duration (Mean \pm SE) of developmental stages of *Leucothyreus albopilosus*, under laboratory conditions (26 ± 2 $^{\circ}\text{C}$, 12: 12 h photoperiod)

Stage	Duration (days)	Range (days)	Individuals (n)
Egg	20.5 \pm 1.50	19-22	26
1 st instar	31.0 \pm 0.89	29-33	24
2 nd instar	33.1 \pm 1.55	30-38	08
3 rd instar	85.6 \pm 4.53	57-117	06
Larva	144.5 \pm 3.47	131-156	06
Pupa	20.0 \pm 3.94	14-39	06
Egg to adult	185.5 \pm 9.60	174-214	04

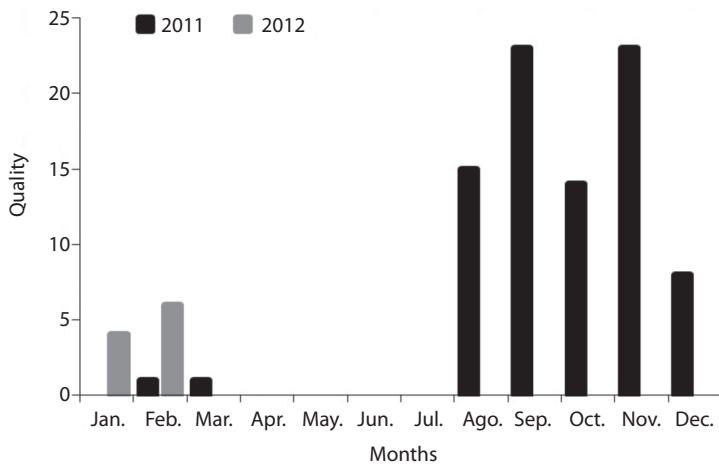


Fig. 1. Adults of *Leucothyreus albopilosus* captured using light traps from February 2011 to February 2012 in the municipality of Aquidauana, Mato Grosso do Sul State, Brazil.

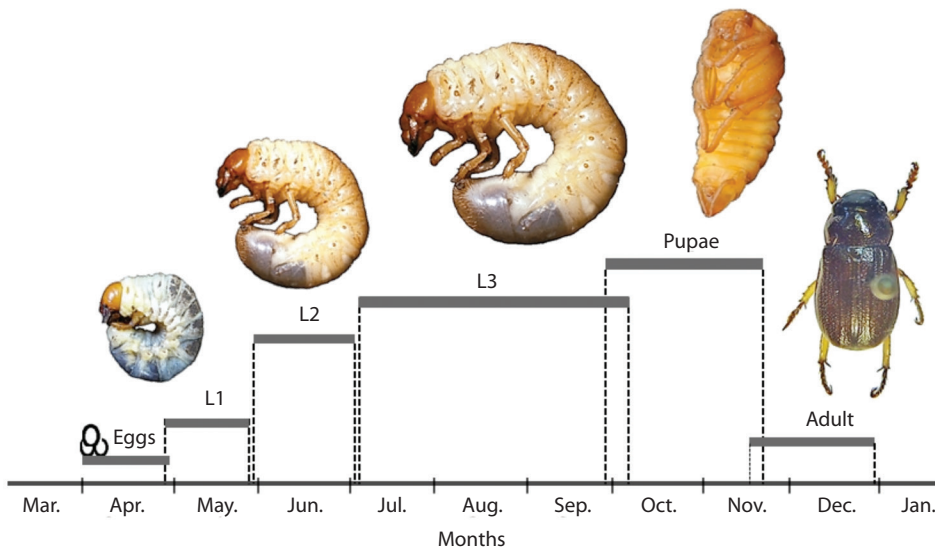


Fig. 2. Seasonality of the life stages of *Leucothyreus albopilosus* in plastic containers with soil and seedlings of *Brachiaria decumbens* under laboratory conditions ($26\pm 2^{\circ}\text{C}$, 12: 12 photoperiod). (L1= 1st instar, L2= 2nd instar and L3= 3rd instar).

dilated tarsomere. The average female size was 12.2 mm length x 5.9 mm wide with 0.077 g weight, while average male size was 11.7 mm length x 5.4 mm wide with 0.080 g (Table 2). The egg to adult life cycle of *L. albopilosus* lasted 185.5 days (Table 1).

Mating behavior: Adults of *L. albopilosus* remained sheltered in the soil during

the day. At dusk, male insects projected of a small part of the clypeus out of the soil surface between 17:25 and 19:50 hours, and remained in that position for 23.25 ± 7.07 (10-36) minutes ($n= 80$). Afterwards, they completely emerged from the soil and flew off for 25.5 ± 8.08 (12-41) minutes ($n= 80$) on average. After the first flight, adults slightly moved from one point to another or remained immobile in the

TABLE 2
Mean (\pm SE) length, width and weight of the developmental stages of *Leucothyreus albopilosus* under laboratory conditions (26 ± 2 °C, 12: 12 h photoperiod)

Stage	Length (mm)		Width (mm)		Weight (g)	
	Mean	Range	Mean	Range	Mean	Range
Egg	1.3 \pm 0.03	1.2-1.4	1.2 \pm 0.07	0.9-1.3	0.0018 \pm 0.001	0.0016-0.002
1 st instar	3.8 \pm 0.10	3.7-3.9	1.1 \pm 0.10	1.0-1.2	0.014 \pm 0.001	0.014-0.074
2 nd instar	13.7 \pm 0.00	13.7-13.7	2.9 \pm 0.28	2.2-3.8	0.092 \pm 0.001	0.023-0.2
3 rd instar	20.0 \pm 0.64	15.7-22.9	4.2 \pm 0.18	3.1-5.2	0.29 \pm 0.001	0.129-0.392
Pupa	13.5 \pm 0.31	12.7-14.2	6.5 \pm 0.29	5.9-7.3	0.182 \pm 0.01	0.152-0.214
Adult ♂	11.7 \pm 0.12	11.5-11.8	5.4 \pm 0.20	5.1-5.8	0.077 \pm 0.01	0.058-0.087
Adult ♀	12.2 \pm 0.22	11.8-12.5	5.9 \pm 0.37	5.7-6.3	0.080 \pm 0.00	0.072-0.088

containers. Couples were formed and the mating activity proceeded.

During the *L. albopilosus* couple formation; we observed the stages that involved the mating behavior. From 40 couples formed, 29 couples did not mate and they kept moving around the soil, feeding or immersing into the soil. In 11 couples, the approach between male and female occurred. The male touched the final back parts of the female body with its protarsus and antennae (Fig. 3), at this moment, some chemical recognition may have occurred between both.

Then, the male held the female with the pairs of legs, and positioned the posterior part of its body next to the female *pygidium* and inserted the *aedeagus* to begin copulation. Copulations were observed from 19:00 to 23:00 hours and lasted 19.45 ± 3.08 (16-25) minutes (n= 9) on average. During the process, some females moved on the soil (n= 4) while others remained immobile (n= 5). After copulation, the male retracted its *aedeagus* in 13.89 ± 3.92 (8-17) seconds on average. After retracting the *aedeagus*, the male get off the female and moved around on the ground (n= 7), or flew off (n= 2), diverging from the female.

For two insect couples, the male approached and touched the female's posterior part. Next, the male held the female with the pairs of legs. At that particular moment, the female walked rapidly, elevated its elytra and rolled on the soil, managing to move away from the male (n= 2).

From a variety of food source such as flowers, leaves, and fruits offered to adults of *L. albopilosus*, banana fruits (*Musa* sp., Musaceae) and flowers of mangaba (*Hancornia speciosa* Gomes) (Apocynaceae) were preferred by adults of *L. albopilosus*.

Regarding flight time in the field, adults were collected with a light trap from 19:00 to 5:00 hours on the following day (Fig. 3). At 18:00 hours, solar radiation was 1 072.02 KJ/m², and decreased to 145.072 KJ/m² until 19:00 hours. Afterward, adults initiated flight activities (Fig. 4). From 20:00 to 22:00 hours we obtained the highest average numbers of adults of *L. albopilosus*, differing statistically from the average number of adults collected in other periods. The average temperature varied between 33 to 21 °C during the flight time of adults in the field (Fig. 4).

DISCUSSION

The emergence of adults of *L. albopilosus* occurred from November to December, which is a hot and humid period in the region of Aquidauana, Mato Grosso do Sul State, Brazil. This species showed a similar occurrence with other species *Leucothyreus* in this region. Puker et al. (2011) recorded the occurrence of *L. albopilosus* in January, in the municipality of Mundo Novo, Mato Grosso do Sul. Adults of *L. dorsalis* were observed from September to December and from January to March (Rodrigues et al., 2010).

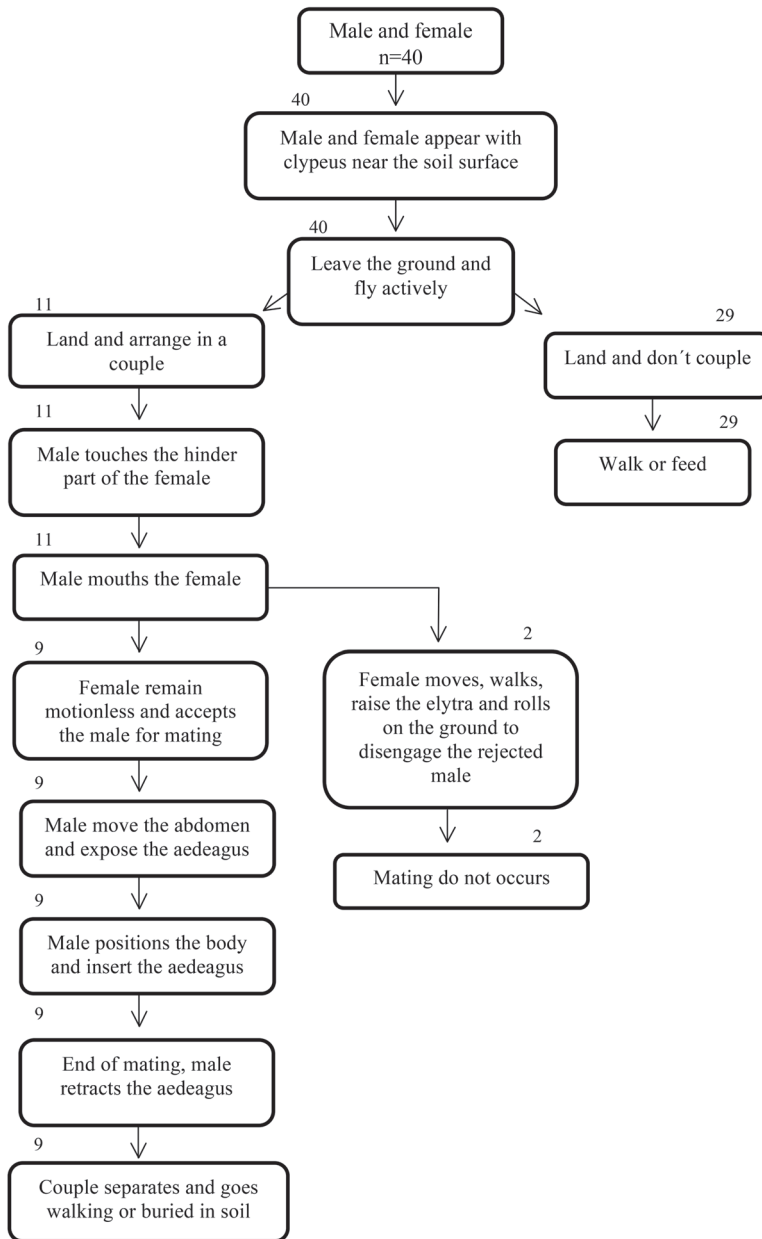


Fig. 3. Ethogram of mating behavior of *Leucothyreus albopilosus* (n=40 couples) in the laboratory. Numbers above behavioral descriptions represent data that progressed to a subsequent step in the mating behavior sequence.

During the flying period, female adults oviposited and eggs were observed. Some females built small chambers in the soil where one or more eggs were laid to promote a protection system for the eggs until larvae eclosion, as observed for *L. dorsalis* (Rodrigues

et al., 2010) and *L. ambrosius* Blanchard 1850 (Gomes, Rodrigues, & Morón, 2014).

Eggs of *L. albopilosus* lasted 20.5 days, were white and were laid individually on the ground near each other. For *L. dorsalis*, the eggs were white and the embryonic period

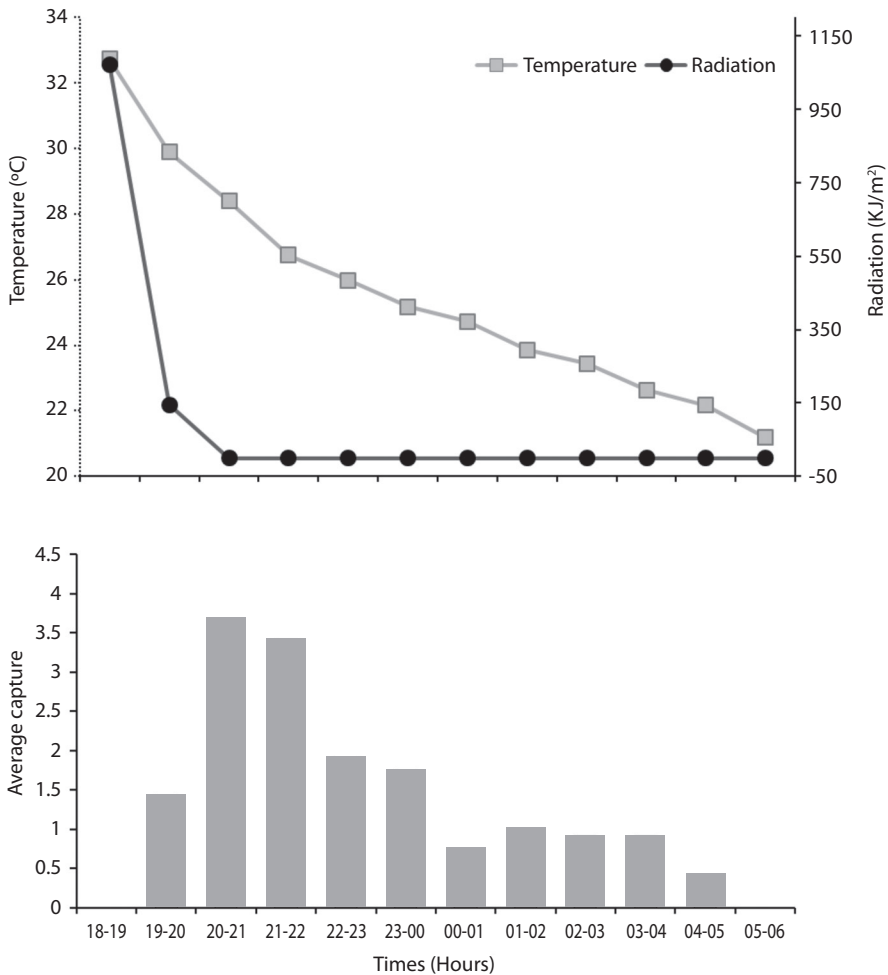


Fig. 4. Average temperature (°C) and radiation (KJ/m²) obtained from the weather station (INMET) in Cassilândia, MS, Brazil, from October 30th to November 2nd 2014. Adults of *Leucothyreus albopilosus* collected with a light trap in the same period. Bars with the same letter are not statistically different (\pm SD) ($P < 0.05$, Scott-Knott test).

lasted 15.5 days (Rodrigues et al., 2010). The embryonic period of *L. femoratus* was 8.73 days (Martínez & Plata-Rueda, 2013), while the embryonic period of *L. albopilosus* was longer than that observed for *L. dorsalis* and *L. femoratus*.

The larvae of *L. albopilosus*, reared in laboratory, fed on roots of *B. decumbens* and, completed their biological cycle. Larvae of *L. dorsalis*, *L. alvarengai*, *L. aff. semipruinosus* and *L. ambrosius* have been also reared in laboratory and fed on roots of *B. decumbens*

(Rodrigues et al., 2010; Pereira et al., 2013; Gomes et al., 2014).

Pardo-Locarno et al. (2006) reported that *L. femoratus* could feed on roots of *Steinichisma laxa* (Sw) Zuloaga (Poaceae) in grassland. Martínez & Plata-Rueda (2013) reared larvae of *L. femoratus* that fed on corn roots. Pardo-Locarno et al. (2005) found *Leucothyreus* sp. feeding on grass pastures, cassava and coffee roots in forest areas. Puker et al. (2009) collected larvae of *L. dorsalis* and *Leucothyreus* sp. feeding on macaw palm trees, *A.*

aculeata. Pereira et al. (2013) found larvae of *L. alvarengai* and *L. aff. semipruinosus* feeding on roots of soybean and corn in Tangará da Serra, MT, Brazil.

The egg-to-adult period of *L. albopilosus* (185.5 days) fell within the range values reported for other species of *Leucothyreus* in the region. Development of *L. dorsalis* was determined at 273.5 days (Rodrigues et al., 2010). The egg-to-adult period for *Leucothyreus alvarengai* and *L. aff. semipruinosus*, was shorter than one year (Pereira et al., 2013) and 170.4 days for *L. femoratus* (Martínez & Plata-Rueda, 2013), characterizing them as univoltine species.

The third instar larvae achieved the prepupa stage the developmental stages of *L. albopilosus* during the drier and colder period of the year, between July and September. Normally, in this stage, the larvae built chambers in the soil where they remained safe, reaching the pupal phase and adulthood afterward. The prepupae of *L. alvarengai*, *L. aff. semipruinosus* and *L. ambrosius* also remained safe in the soil inside chambers during dry and cold period of the year (Pereira et al., 2013; Gomes et al., 2014). Sexual dimorphism of *L. albopilosus* was also reported by Puker et al. (2011) and dilated tarsomere were observed in male forelegs.

Normally, when adults emerge at the beginning of the rainy season, flight activity occurs and the reproductive period is initiated. Under laboratory conditions, we observed that *L. albopilosus* emerged from the soil and kept flight activities for 19.45 minutes on average. This flight time was probably related to adult dispersion or localization of a partner of the opposite sex available to mate. According to Rodrigues, Gomes and Bento (2014) adults of *Anomala testaceipennis* Blanchard 1856 (Rutelinae) emerge from soil and fly actively for 16.6 ± 2.3 minutes, form couples and copulate.

Adults of *Anomala orientalis* (Waterhouse 1875) (Rutelinae) emerge from the soil, but do not fly, and females expose the abdomen on the soil surface, and perform the calling behavior, when sexual pheromone is probably

released, attracting males to copulate (Facundo et al., 1999). For *L. albopilosus*, we did not detect evidences or any behavior of male or female that indicated that sexual pheromone was being released.

Some females of *L. albopilosus* refused to copulate, possibly these females had already copulated or recognized that the males were not mature to perform copulation. For *A. testaceipennis*, Rodrigues et al. (2014) verified that females also refused males to copulate. Similarly, Fávila (1988) studied the mating behavior of *Canthon cyanellus cyanellus* LeConte 1859 (Scarabaeidae, Scarabaeinae) and found differences in sexual maturity between males and females, considered one of the factors that makes females to refuse males to mate.

The mating period of *L. albopilosus* occurred from 19:00 to 23:00 hours. Martínez et al. (2013) verified that the mating period of *L. femoratus* occurred between 20:00 and 23:00 hours. We also observed that males and females copulated several times.

The flight time of *L. albopilosus* is similar to observations reported by Rodrigues et al. (2010) that verified that adults of *L. dorsalis* are collected with a light trap from 19:00 to 5:30 hours of the following day. Adults of *Anomala testaceipennis* were collected with a light trap from 18:00 to 6:00 hours of the following day (Rodrigues et al., 2014).

Adults of *L. albopilosus* fed on banana fruits (*Musa* sp., Musaceae) and mangaba flowers (*Hancornia speciosa* Gomes) (Apocynaceae) in the laboratory. According to Martínez & Plata-Rueda (2013), adults of *L. femoratus* fed on palm leaves (*Elaeis guineenses* Jacquin (Arecales, Arecaceae)).

This work contributed with the description of the mating behavior of the genus *Leucothyreus*, and concluded that the biological cycle was completed in less than 200 days. The data obtained and presented in this work is extremely important for the next research to be undertaken. The study of sex pheromones in this species may be one of the topics to be considered, and may serve as a model for other species of this important genus *Leucothyreus*.

ACKNOWLEDGMENTS

Kleyton R. Ferreira was granted a scholarship from CAPES. Sergio R. Rodrigues was granted financial support from CNPq (305260/2014-6). The authors wish to thank Fundação de Apoio ao Desenvolvimento do Ensino, Ciência e Tecnologia do Estado de Mato Grosso do Sul FUNDECT (Brasil) for the financial support.

RESUMEN

Aspectos biológicos y comportamiento de apareamiento de *Leucothyreus albopilosus* (Coleoptera: Scarabaeidae). En el género *Leucothyreus* se describen varias especies, sin embargo, hay poca información sobre este grupo. El presente trabajo tuvo por objetivo estudiar los aspectos biológicos y el comportamiento de copula de *Leucothyreus albopilosus*. Los estudios se realizaron en la Universidade Estadual de Mato Grosso do Sul, en los municipios de Aquidauana y Cassilândia, MS, Brasil. Fueron recolectados adultos con trampa de luz desde febrero 2011 hasta febrero 2012 para realizar estudios biológicos y desde septiembre hasta diciembre de 2014 para estudios de comportamiento. Para los estudios biológicos, se inspeccionaron los huevos cada tres días, y cuando las larvas eclosionaban, eran separadas para monitorear su desarrollo. Para supervisar el desarrollo y diferenciar las etapas larvianas fueron medidas las cápsulas cefálicas de las mismas. El ciclo de vida se determinó a partir de la ovoposición hasta la muerte de los adultos. Para realizar los estudios del comportamiento de la cópula, los adultos obtenidos con trampas de luz fueron llevados al laboratorio, y al atardecer cuando iniciaron el vuelo, se formaron parejas, permitiendo observar y registrar los pasos que involucran este comportamiento. En campo, se observó que los adultos fueron recolectados principalmente en los períodos más calientes y húmedos entre los meses de agosto y marzo. El período embrionario de *L. albopilosus* duró 20.5 días. La primera, segunda y tercera etapa duraron 31.0, 33.1 y 85.6 días, respectivamente. La etapa de pupa duró 20 días y el período desde huevo hasta adulto fue completado en 185.5 días. Estos resultados sugieren que *L. albopilosus* puede ser caracterizado como una especie univoltina. Con respecto al comportamiento de copula en el laboratorio, al iniciar la noche, los adultos primeramente proyectan una pequeña porción del clipeo próximo a la superficie del suelo, en seguida realizan el vuelo buscando una hembra para iniciar la cópula. La hembra puede aceptar o no al macho para realizar la cópula. Cuando la hembra aceptó al macho para la copula, esta ocurrió desde 19:00 hasta las 23:00 horas durante 19.45 minutos en promedio. Cuando la hembra rechazó al macho para la copula, se debió probablemente a que ella o el no estaban maduros sexualmente, ocurriendo

un reconocimiento químico entre ellos. Se observó en el laboratorio que los adultos se alimentaban de plátanos maduros (*Musa* sp., Musaceae) y flores de mangabeira (*Hancornia speciosa*, Apocynaceae). En este trabajo se concluye que el ciclo biológico se completa en menos de un año y se describen las primeras etapas del comportamiento de copula del género *Leucothyreus*.

Palabras clave: biología, Geniatiini, insectos rizófagos, Rutelinae, escarabajos, Scarabaeoidea.

REFERENCES

- Buss, E. A. (2006) Flight activity and relative abundance of phytophagous scarabs (Coleoptera: Scarabaeoidea) from two locations in Florida. *Florida Entomologist*, 89, 32-40.
- Facundo, H. T., Linn, C. E., Villani, M. G., & Roelofs, W. L. (1999). Emergence, mating, and postmating behaviors of the oriental beetle (Coleoptera: Scarabaeidae). *Journal of Insect Behavior*, 12, 175-192.
- Fávila, M. E. (1988). Comportamiento durante el período de maduración gonádica em um escarabajo rodador (Coleoptera: Scarabaeidae; Scarabaeinae). *Folia Entomológica Mexicana*, 76, 55-64.
- Gomes, E. S., Rodrigues, S. R., & Morón, M. A. (2014). Biological aspects of *Leucothyreus ambrosius* Blanchard (Coleoptera, Melolonthidae, Rutelinae). *Revista Brasileira de Entomologia*, 58, 198-202.
- Jameson, M. L. (2008). Review of the genus *Microchilus* Blanchard (Coleoptera: Scarabaeidae: Rutelinae: Geniatiini). *Insecta Mundi*, 25, 1-14.
- Köpen, W. (1948) *Climatologia: Con um estudio de los climas de la tierra*. México: Fondo de Cultura Económica.
- Martínez, L. C., & Plata-Rueda, A. (2013). Some biological aspects of *Leucothyreus femoratus* (Burmeister) (Coleoptera, Scarabaeidae), in oil palm plantations from Colombia. *Journal of Entomological and Acarological Research*, 45, 27-32.
- Martínez, L. C., Plata-Rueda, A., Zanuncio, J. C., & Serrão, J. E. (2013). *Leucothyreus femoratus* (Coleoptera: Scarabaeidae): Feeding and behavioral activities as an oil palm defoliator. *Florida Entomologist*, 96, 55-63.
- Morón, M. A. (2004). Melolonthídeos edafícolas. In J. R. Salvadori, C. J. Ávila, & M. T. B. Silva (Eds.), *Pragas de solo no Brasil* (pp. 133-166). Passo Fundo: Embrapa Trigo; Dourados: Embrapa Agropecuária Oeste; Cruz Alta: Fundacep Fecotrigo.
- Oliveira, H. G., Zanuncio, T. V., Zanuncio, J. C., & Santos, G. P. (2001). Coleópteros associados à

- Eucaliptocultura na região de Nova Era, Minas Gerais, Brasil. *Floresta e Ambiente*, 8, 52-60.
- Pardo-Locarno, L. C., Montoya-Lerma, J., Bellotti, A. C., & Schoonhoven, A. V. (2005). Structure and composition of the white grub complex (Coleoptera: Scarabaeidae) in agroecological systems of northern Cauca, Colombia. *Florida Entomologist*, 88, 355-363.
- Pardo-Locarno, L. C., Morón, M. A., & Montoya-Lerma, J. (2006). Descripción de los estados inmaduros de *Leucothyreus femoratus* Burmeister (Coleoptera: Melolonthidae: Rutelinae: Geniatini) con notas sobre su biología e importancia agrícola en Colombia. *Folia Entomológica Mexicana*, 45, 179-193.
- Pereira, A. F., Rodrigues, S. R., & Morón, M. A. (2013). Biological aspects of *Leucothyreus alvarengai* Frey and *Leucothyreus* aff. *semipruinosus* Ohaus (Coleoptera, Melolonthidae, Rutelinae) in crop succession at central Brazil. *Revista Brasileira de Entomologia*, 57, 323-328.
- Puker, A., Rodrigues, S. R., Tiago, E. F., & Santos, W. T. (2009). Espécies de Scarabaeidae fitófagos (Insecta: Coleoptera) associadas ao sistema radicular de *Acrocomia aculeata* (Jacq.) Lodd. ex Mart. (Arecaceae). *Biota Neotropica*, 9, 105-109.
- Puker, A., Morón, M. A., Oliveira Junior, O., & Message, D. (2011). First Record of *Leucothyreus albopilosus* (Coleoptera: Scarabaeidae: Rutelinae: Geniatini) in lesions on stem of *Eucalytus citriodora* and beehives of *Apis mellifera*. *Entomological Science*, 14, 230-233.
- Rodrigues, S. R., Puker, A., & Tiago, E. F. (2010). Aspectos biológicos de *Leucothyreus dorsalis* Blanchard (Coleoptera, Scarabaeidae, Rutelinae). *Revista Brasileira de Entomologia*, 54, 431-435.
- Rodrigues, S. R., Gomes, E. S., & Bento, J. M. S. (2014). Sexual dimorphism and mating behavior in *Anomala testaceipennis*. *Journal of Insect Science*, 14, 1-5.
- Ronqui, D. C., & Lopes, J. (2006). Composição e diversidade de Scarabaeoidea (Coleoptera) atraídos por armadilha de luz em área rural no norte do Paraná, Brasil. *Iheringia série Zoologia*, 96, 103-108.
- Silva, F. A. Z. & Azevedo, C. A. V. (2002). Versão do programa computacional Assistat para o sistema operacional Windows. *Revista Brasileira de Produtos Agroindustriais*, 4, 71-78.
- Silva, M. T. B. & Grützmacher, A. D. (1996) Biometria de *Diloboderus abderus* (Sturm) (Coleoptera: Melolonthidae) coletado em solo manejado no sistema de plantio direto. *Anais da Sociedade Entomológica do Brasil*, 25, 377-382.

