

**DATA ON NESTING AND PREIMAGINAL DEVELOPMENT
IN TWO MEXICAN SPECIES OF *ATAENIUS* HAROLD, 1867
(COLEOPTERA, SCARABAEOIDEA, APHODIIDAE; EUPARIINAE)**

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ABSTRACT. This study describes the ovipositing behavior of *Ataenius sculptor* Harold and *A. apicalis* Hinton under controlled conditions of temperature and humidity. Both species laid groups of eggs in cavities prepared by females in soil or between dung pats and soil. *A. sculptor* laid 16 to 18 eggs per clutch and *A. apicalis* 16 eggs. The larval period of *A. sculptor*, lasted about four weeks. Third-instar larvae burrowed into soil and elaborated cavities to pupate. The pupal period lasted one week. The *A. sculptor* second generation matured for almost two months before beginning to oviposit. In *A. apicalis*, preimaginal development lasted from four to five weeks with the larval period almost three weeks. Third-instar larvae also buried themselves before pupation and showed a pupal period of approximately two weeks.

KEY WORDS: preimaginal development, *Ataenius*, Coleoptera, Aphodiidae, dung beetles, Mexico.

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RESUMEN. Se describe el comportamiento de oviposición de *Ataenius sculptor* Harold y *A. apicalis* Hinton, bajo condiciones controladas de temperatura y humedad. Las dos especies depositan grupos de huevos en cavidades preparadas por las hembras en la tierra o entre el estiércol y la tierra. *A. sculptor* pone de 16 a 18 huevos por puesta, y *Ataenius apicalis* pone 16 huevos. En *A. sculptor*, el desarrollo preimaginal dura poco más de cinco semanas. El periodo larval dura casi cuatro semanas. Las larvas del tercer estadio se entierran y elaboran una cavidad para pupar. El periodo pupal dura casi una semana. La segunda generación de *A. sculptor* tarda en madurar casi dos meses antes de iniciar la oviposición. En *A. apicalis* el desarrollo preimaginal tarda de cuatro a cinco semanas y el periodo larval tarda casi tres semanas. Las larvas de tercer estadio también se entierran antes de pupar y el periodo pupal dura aproximadamente dos semanas.

PALABRAS CLAVE: Desarrollo preimaginal, *Ataenius*, Coleoptera, Aphodiidae, escarabajos, México.

The genus *Ataenius* Harold, 1867 (Aphodiidae: Eupariinae) includes 320 species throughout the world, 228 of them found in America (Dellacasa, 1987). In Mexico, 59 species have been cited, 22 of them for the State of Veracruz (Deloya, 1994). There are few published studies

on the biology and life cycles on *Ataenius* species. Phenology and reproductive cycles have been described for only for *A. cognatus* (Hoffmann, 1935) and *A. spretulus* (Wegner and Niemczyk, 1981). Some data are available on preimaginal development in *A. cognatus*, *A.*

opatrinus, *A. picinus*, *A. platenis*, *A. simulator* and *A. strigicauda* (Hoffmann, 1935; Verdú and Galante, 1999). The reproductive apparatus has been described for two Mexican species, *A. sculptor* and *A. apicalis* (Martínez *et al.*, 2001), along with phenology and reproductive cycles (Martínez and Cruz, 2002) and the effects of different pasturage and livestock management approaches on populations of these beetles (Martínez *et al.*, 2000). To better understand the biology of these two *Ataenius* species, the present research focused on nesting behavior and duration of larval stages, as observed under controlled conditions of temperature and humidity.

MATERIALS AND METHODS

Ataenius sculptor and *A. apicalis* individuals were collected between July and September 1999 from cow dung samples taken at Rancho Los Lirios (19°33'13" N, 96°23'31" W), near the town of Actopan, Veracruz, Mexico. Adults were taken to an insectarium and maintained at 27 °C of temperature, 70% relative humidity, 14 h photoperiod, and fed with cow dung once a week. Adults do not show sexual dimorphism and, were placed in terraria at random. Terraria consisted of plastic containers (10 cm in diameter and 6 cm in height), with a top having a center hole 5 cm in diameter covered by a thin net. Of the 20 terraria, 8 each contained 32 individuals of *A. sculptor*, while 12 each contained 20 individuals of *A. apicalis*.

Weekly observations were made of the number of mature and immature individuals and eggs laid per clutch and their positions within the terraria. Some eggs, larvae at each stage, and pupae were fixed in AFATD (ethanol 96°, formol, trichloroacetic acid, and dimethyl sulfoxide) and preserved in 70° alcohol. Measurements were taken of the lengths of eggs, larvae, pupae, and teneral adults. Width of head capsule of the three larval stages was measured. For each

measurement, means, standard deviations, and minimum and maximum values were obtained.

RESULTS

***Ataenius sculptor*.** In *A. sculptor* eggs were laid in oval cavities (5 mm at greatest diameter), that the female had formed and compacted inside the soil. The cavity placement varied from a location between dung pat and soil to between 0.5 and 2.0 cm of depth level. In some cases, eggs were laid within the dung pat itself in cavities made among the straws in somewhat drier dung. Each clutch consisted of 16 to 18 eggs that could be easily separated. Egg length varied from 0.63 to 0.79 mm.

Preimaginal development lasted a little more than five weeks. The larval period lasted about four weeks. First and second-instar larvae were found mostly in dung, only occasionally at the border of dung. Head capsule width varied significantly ($F_{[2,56]} = 1969.56$ $P < 0.0001$) according to development stage (Table 1). Before pupating third-instar larvae, went to the bottom of the terrarium (3 cm of soil), where they dug a cavity by compacting the earth and separating it from the container wall. The period from pupa to teneral adult lasted one week; during this period the pupae reburied themselves quickly by means of undulating movements (especially of the posterior part of the body) when they were disturbed during observations. Newly emerged teneral adults remained at the bottom of the terraria during the week. During this period cuticle changes from a reddish brown coloration to black, by this time they were already on the surface of the soil looking for food.

The seven adults that emerged produced a second generation. Females were sexually mature at almost two months after emergence, when they began to oviposit. Second generation *A. sculptor* individuals survived only to the pupal stage.

Table 1

Morphological Variations in *Ataenius sculptor* eggs, larvae, pupae, and teneral adults.

Development Stage	No. ind.	Length (mm)		Width of Head Capsule (mm)	
		Min-Max	$\bar{x} \pm sd$	Min-Max	$\bar{x} \pm sd$
Egg	10	0.63 - 0.79	0.70 ± 0.06		
Stage 1 Larvae	25	0.80 - 1.40	1.00 ± 0.20	0.46 - 0.63	0.52 ± 0.03
Stage 2 Larvae	18	1.40 - 2.50	2.20 ± 0.30	0.69 - 0.93	0.84 ± 0.05
Stage 3 Larvae	16	2.50 - 3.80	3.40 ± 0.40	1.30 - 1.42	1.24 ± 0.36
Pupa	8	3.81 - 5.56	4.81 ± 0.57		
Teneral Adult	3	5.06 - 5.43	5.26 ± 0.19		

Ataenius apicalis. *A. apicalis* oviposited in ovoid cavities (5 mm width), located mostly interface of dung and soil, although sometimes inside of the dung. Often, eggs were found dispersed in the ground, perhaps due to the fragility of the cavities or the loose joining of the eggs. Each clutch consisted of 16 eggs, which measured from 0.65 to 0.70 mm in length.

Preimaginal development lasted from 4 to 5 weeks. The larval period lasted almost three weeks. First and second-instar larvae were always found within the dung or at the interface of dung and soil. Third-instar larvae also buried themselves at the bottom of the terrarium before pupating. Time from the beginning of pupation to teneral adult was approximately two weeks.

DISCUSSION

Female ovipositing behavior of the two *Ataenius* species studied was similar. Both species dig a cavity in which they deposited their eggs. There were some differences in the oviposition site: *A. sculptor* generally oviposited in cavities dug inside the soil, while *A. apicalis* preferred the interface between dung and soil. In *A. spretulus*, eggs are laid in cavities dug under grass among the roots (Wegner and Niemczyk, 1981).

It seems that this type of ovipositing behavior in a cavity dug by the female is characteristic of *Ataenius* species; this behavior is not known for other eupariines species. Much more is known about ovipositing behavior in Aphodiinae, especially for the genus *Aphodius* (Yoshida and Takakura, 1992; Yoshida, 1994; Gittings and Giller, 1997; Vitner, 1998).

Both larvae and adults of *A. sculptor* and *A. apicalis* are coprophagous. In other *Ataenius* species larvae feed on humus or roots; few feed on or are attracted to dung, although adults sometimes can be found in dung (Wegner and Niemczyk, 1981; Verdú and Galante, 1999).

The number of eggs oviposited by *A. apicalis* and *A. sculptor* varies from 16 to 18. *A. spretulus* is known to lay from 11 to 12 eggs per clutch (Wegner and Niemczyk, 1981). It may be that further variations are seen in numbers of eggs laid by other Eupariinae species. Among *Aphodius* Harold (Aphodiinae), some species lay just one egg, while others species lay from 4 to 16 eggs per clutch. Few *Aphodius* species lay more than 16 eggs like *A. (Acrossus) depressus* (Kugelann), lays up to 18 eggs per clutch (Gittings and Giller, 1997) and *A. (Trichaphodius) opisthius* Bates, lays from 15 to 18 eggs under

laboratory conditions (Martínez and Alvarado, 2001).

Preimaginal development time was very similar between the two *Ataenius* species studied under the controlled conditions of temperature and humidity used here. Duration of the *A. sculptor* larval period is similar to that of *A. strigicauda* Bates (Verdú and Galante, 1999), while the pupal development period in both *A. apicalis* and *A. sculptor* was observed to be close to that of *A. cognatus* under field conditions (Hoffmann, 1935).

Preimaginal development times are well known for various *Aphodius* species. Those that have a preimaginal development time of 4 to 6 weeks (like that observed in the two *Ataenius* species studied here) include *Aphodius (Acrosus) rufipes* (Linnaeus), *A. (Aphodius) fimetarius* (Linnaeus), *A. (Colobopterus) apicalis* Harold, *A. (C.) erraticus* (Linnaeus), *A. (C.) haroldianus* Balthasar, *A. (Eupleurus) subterraneus* (Linnaeus), *A. (Nobius) bonnairei* Reitter, *A. (Otophorus) haemorrhoidalis* (Linnaeus), *A. (Teuchestes) fossor* (Linnaeus), and *A. (Trichaphodielus) brasiliensis* Castelnau (Christensen and Dobson, 1977; Rojewski, 1983; Kim and Lumaret, 1986; Yasuda, 1987; Galante, 1990; Verdú and Galante, 1997; Vitner, 1998).

The pupal behavior in *A. sculptor* and *A. apicalis* of burial and elaboration of a cavity or cell in the soil has been observed only in *A. cognatus* (Hoffmann, 1935). The greatest depth of pupal burial is not known for *Ataenius* species in the field, although it might reach the 12.5 cm observed for *A. cognatus* under natural conditions.

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