JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY
84(4), 2011, pp. 249–254

The Nest Architecture of *Diadasia hirta* (Jörgensen) (Apidae: Emphorini) from La Rioja Province, Northwestern Argentina

Laura C. Sarzetti and Jorge F. Genise
CONICET- Museo Argentino de Ciencias Naturales ''Bernardino Rivadavia'', Av. Angel Gallardo 470, Capital Federal, Argentina

ABSTRACT: Nests of *Diadasia hirta* are documented here for the first time. Nests have a cylindrical turret, one vertical principal burrow, cells disposed in linear series, and an oval pollen mass. Almost all observed behavioral traits and nest architecture features resemble those of other species of *Diadasia*. One exceptional behavior observed was pollen removal from the nest.

KEY WORDS: *Diadasia hirta*, ground-nesting bees, nest architecture, Argentina

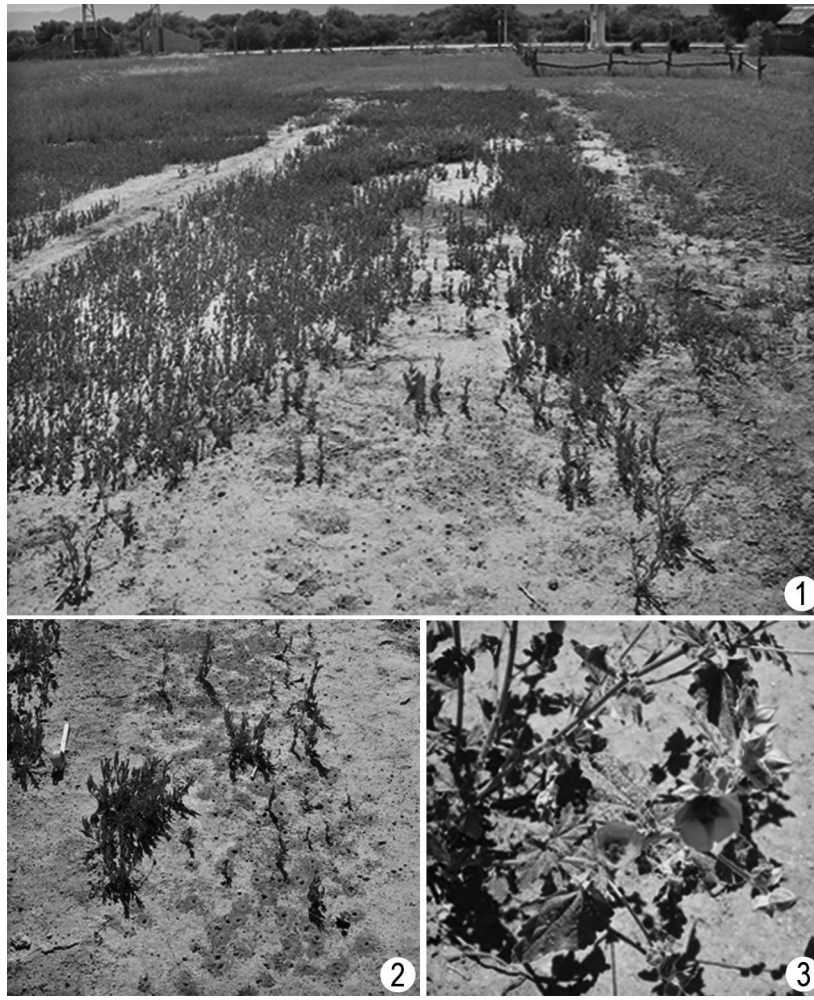
The genus *Diadasia* Patton includes small to large hairy bees, common in arid and semiarid regions from southwestern North America, northern Mexico and western and southern South America. Its species, the most numerous in the tribe Emphorini (Roig-Alsina, 2008), are mainly specialized on pollen of five plant families (Malvaceae, Onagraceae, Cactaceae, Convolvulaceae and Asteraceae) (Sipes and Tepedino, 2005). Knowledge about the biology and nest morphology of *Diadasia* comes mainly from several species in the USA (Linsley and McSwain, 1957; Adlakha, 1969; Snyder *et al.,* 1976; Eickwort *et al.,* 1977; Neff *et al.,* 1982; Ordway, 1987; Neff and Simpson, 1992). However, Janvier (1955) studied some aspects of the biology of *D. baeri* (Vachal) from Bolivia and Perú, and Hazeldine (1996) documented the nest architecture of *D. pereyrae* (Holmberg) and *D. baraderensis* (Holmberg) from Argentina. *Diadasia hirta* (Jörgensen) is distributed in the north-central western region of Argentina (La Rioja and Mendoza provinces) (Jörgensen, 1912) and no previous data exist on its biology or behavior. The objective of this contribution is mainly to describe the nest architecture of *D. hirta.*

Study Area

The field studies were conducted at Vinchina locality (La Rioja province, Argentina) (28°49′07″S, 68°11′26″W). Observations on the biology and construction of nests were carried out during 24 to 30 November 2008 and throughout 3 to 5 February 2009.

The nesting site was a formerly plowed open area of less than 100 m^2 (Fig. 1). The soil surface was flat, devoid of rocks, compact and consolidated. It was composed principally of fine sand to silt bridged by sparse clayish material. The vegetation was sparse and composed basically of shrubs of Asteraceae, 10 to 20 cm tall (Fig. 1), grasses around the nesting site, and some plants of *Sphaeralcea* (Malvaceae) (Fig. 3). Four nest aggregations of about 2 m × 1.5 m were observed. These aggregations were composed only of *D. hirta* nests. A total of 9 nests were excavated and studied (Fig. 2). Bees collected (N: 8) are deposited in the entomological collections of the Museo Argentino de Ciencias Naturales ''Bernardino Rivadavia'' (MACN-En),

Accepted 18 November 2010; Received 29 November 2010



Figs. 1–3. 1, Nesting site at Vinchina Locality, La Rioja Province. 2. One nest aggregation. 3. *Sphaeralcea* sp. near nesting site.

Buenos Aires (Argentina) and in the Museo Municipal de Ciencias Naturales "Lorenzo Scaglia" (MMPE) (Mar del Plata, Buenos Aires, Argentina). No plant specimens were collected.

Observations

Activity

During November, bees were observed digging and provisioning nests at the mornings after 8:30 AM and until 12 PM and in the afternoons they returned to the nesting site after 4 PM until 7 PM. The bees coming with pollen stay inside nests for about 1 to 5 minutes. In all studied nests were found eggs or young larvae. When we visited the nesting site again during February 2009 no signs of bee activity were observed. Bombyliids were observed flying over *D. hirta* nesting site. However, no evidence of parasitism was detected inside the cells.

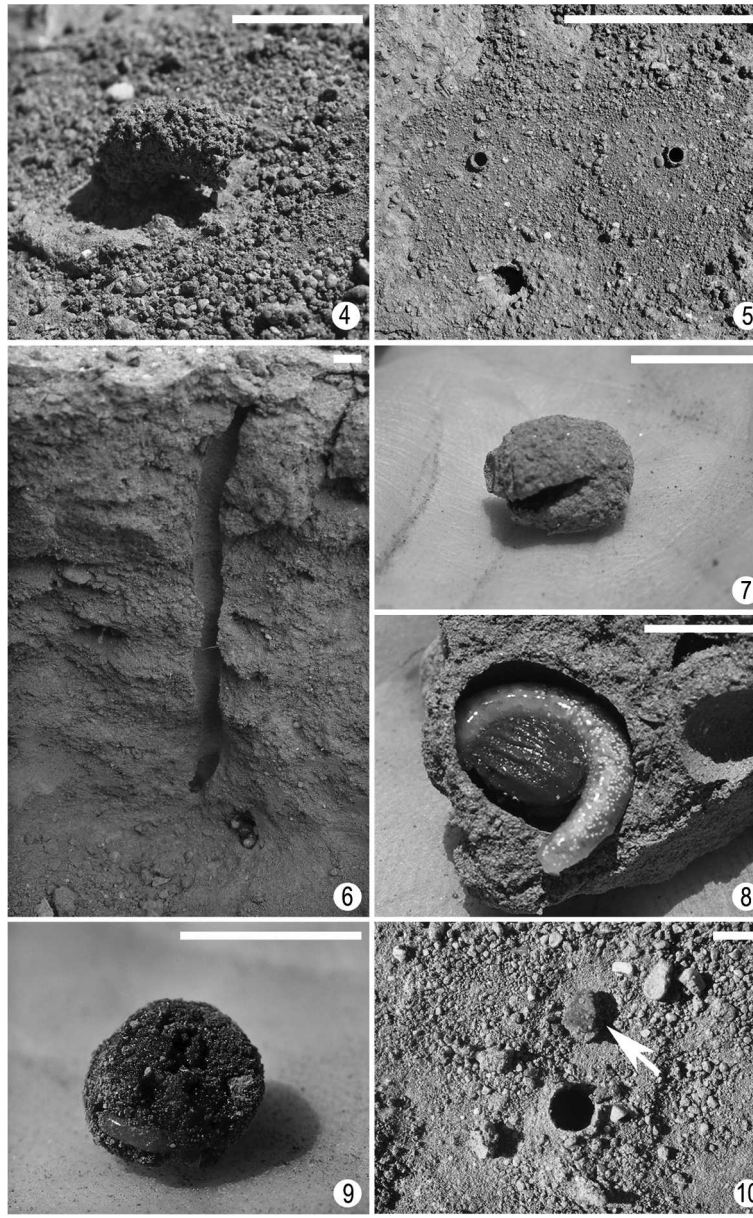
Architecture of the Nest

Entrance of nests showed a cylindrical turret or chimney, 10 mm long and 5 mm wide in average (N: 12), mostly horizontal laying on the soil, and in some cases showing a vertical section 1 to 2 mm long (N: 12), which then bends to become horizontal (Fig. 4). These turrets were constructed with small pellets and clasts, probably coming from the first stages of tunnel excavation. The openings of the turrets were often oriented northwards. Frequently the horizontal parts of the turrets were broken, leaving a short vertical chimney (Fig. 5). These broken turrets were not repaired or replaced. Further excavated material was deposited either following a half moon arrangement near the chimney entrances, when they were complete, or in a circular tumulus around the small broken chimneys (Fig. 5). Nests were composed of a vertical principal burrow with some portions gently sinuous (Fig. 6). These burrows averaged 5 mm in diameter and 8 cm to 11 cm in length (N: 9), where soil became harder.

The lowest part of the main burrow always ends in a cell. They also exhibited 1–4 short branches (2–3 mm long) diverging from the principal burrow in any direction, ending in one cell or a series of 2 or 3 cells. In all, nests contained from 3 to 10 cells (N: 9), about 7 mm long and 5 mm in diameter on average (N: 15), orientated at an obtuse angle with the principal burrow (Fig. 11). In each nest, the cells were located at approximately the same soil depth. The cells contained a moist, oval pollen mass, and an egg or a young larva. The cells with an egg had a smooth pollen mass 5 mm long $\times$ 4 mm in average ($N = 5$) wide and the egg was located beneath it in a long narrow depression (Fig. 9). The egg is elongate and whitish. Some pollen masses show a striated pattern and a larva orientated parallel to the long axis (Fig. 8). Two pollen masses of *D. hirta* were analyzed in the laboratory and were composed almost entirely (95%) of pollen of Malvaceae (Seoane, pers. comm.), probably of the genus *Sphaeralcea* because this plant was the only representative of the family in the study area. One female was seen extracting pollen from inside the nest and dropped it on the soil next to the entrance (Fig. 10). Complete cells could be removed from the soil indicating that the cell wall was harder than the substrate (Fig. 7). They had an opaque and smooth inner surface. A test with water demonstrated that this inner surface is not completely waterproof, because it slowly absorbed the droplet. Some cells, probably with prepupae also had the inner wall covered with a green fecal layer arranged in thin strips. The cell closure was 1 mm thick, with a spiral pattern on the inside but smooth exteriorly. Lateral burrows ending in completed cells were filled with packed soil. In complete nests, the main tunnel remained unfilled whereas the entrance was closed with a concave plate-like plug at 3 cm from soil surface. The tunnel over the plug was filled with loose soil material coming from the dismantled turret.

Discussion

Sipes and Wolf (2001) stated that the genus *Diadasia* is a monophyletic group based on molecular phylogeny. *D. hirta* and *D. baeri* probably are closely related, and together with *D. chilensis* (Spinola), *D. pereyrae* (Holmberg) and *D. ochracea* (Cockerell) would form a separate well-supported monophyletic clade, different from the one including exclusively the North American species (Sipes and Wolf, 2001). *D. baeri* is a South American bee that inhabits Andean areas from Chile,



Figs. 4–10. 4. Cylindrical turret formed with pellets and fragment of rocks, scale: 10 mm. 5. Two circular tumuli around broken turrets, scale: 50 mm. 6. General view of one nest showing the vertical main burrow and one cell with larva, scale: 5 mm. 7. Complete cell removed from the soil, scale: 5 mm. 8. Cell with striated pollen mass because of feeding behavior of the larva, scale: 5 mm. 9. Oval pollen mass with elongate egg in beneath position, scale: 5 mm. 10. View of one entrance nest showing pollen removed from the nest (arrow), scale: 5 mm.

Bolivia, Peru and Argentina (Janvier, 1955; Roig-Alsina, 2007). There are only some isolated data on its nesting behavior (Janvier, 1955).

The nests of *D. hirta* and *D. baeri* share the vertical principal burrow, cells arranged in series and oval pollen masses (Janvier, 1955). The host plant of *D. baeri*

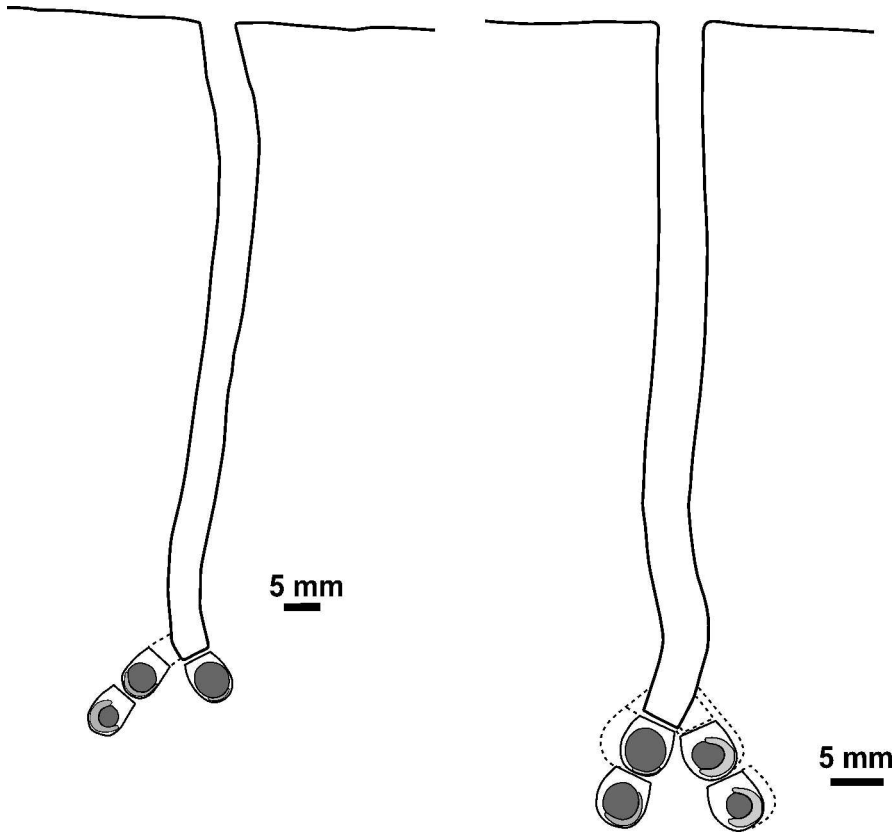


Fig. 11. Typical architecture of two nests of *Diadasia hirta*. Younger cells close to principal burrows contain oval pollen masses (gray ovals) with egg. Older cells have pollen masses and growing larvae, scale: 5 mm.

is unknown, whereas *D. hirta*, *D. pereyrae*, *D. ochracea* and *D. chilensis* are known to be pollinators of *Spheralceae*. Comparing *D. hirta* with the remaining South American species, almost all described behavioral features are similar, with a few exceptions. The egg is in an upper position on the food mass in *D. baeri* and *D. chilensis* (Claude-Joseph, 1926; Janvier, 1955). *D. pereyrae* nest in vertical banks (Hazeldine, 1996). The turret is absent in nests of the Argentinian species *D. pereyrae* and *D. baraderensis* (Hazeldine, 1996).The pollen mass with a striation pattern was observed in *D. hirta* and other North American species studied by Linsley and McSwain (1957) (Fig. 7). These authors suggested that while the larva is feeding, it moves around the pollen mass channeling the surface. After this, the larva defecated on the inner wall of the cell leaving a green layer, as also noted for *D. hirta*. The females of the North American *D. consociata* Timberlake were seen extracting dirt material from the principal burrow (Linsley *et al.,* 1952). A similar but not identical behavior was noted in one female of *D. hirta*, which removed pollen from the nest (Fig. 10). This character was not documented formally in other species of *Diadasia*, but was recorded also in *Ptilothrix relata* (Hazeldine, 1996) and in the same publication, the author mentioned a similar behavior for *Diadasia distincta*.

As predicted by Hazeldine (1996), almost all behavioral features described here for *Diadasia hirta* are similar to those described for other species of the genus and even

for species of other genera of Emphorini, and as such they seem to be not useful for systematic purposes within this tribe.

Acknowledgements

We thank Juan Farina and Daniel Speranza for assistance during the field work, Arturo Roig-Alsina for identification of the specimens of *D. hirta*, Liliana Seoane for the identification of pollen, and Mirta Gonzalez for the identification of soil composition. Field activities were supported by grants PIP 6023 from CONICET (to Ricardo N. Melchor), and PICT 13286 from ANPCyT (to Jorge F. Genise).

Literature Cited

Adlakha, R. L. 1969. A systematic revision of the bee genus *Diadasia* Patton in America north of Mexico (Hymenoptera: Anthophoridae). Ph.D. thesis, University of California at Davis, 188 pp.

Claude-Joseph, F. 1926. Recherches biologique sur les Hyménoptéres du Chili. Annales des Sciences Naturelles, Zoologie 9:113–268.

Eickwort, G. C., K. R. Eickwort, and E. G. Linsely. 1977. Observations on nest aggregations of the bees *Diadasia olivaceae* and *D. diminuta* (Hymenoptera: Anthoporidae). Journal of the Kansas Entomolological Society 50:1–17.

Hazeldine, P. L. 1996. Comportamiento de nidificación de cuatro especies de *Ptilotrix* Smith (Apidae: Emphorini). Physis 54:27–41.

Hazeldine, P. L. 1997. Comportamiento de nidificación de dos especies de *Diadasia* Patton (Apidae, Emphorini). Physis 54:43–48.

Janvier, H. 1955. Le nid et la nidification chez quelques abeilles des Andes tropicales. Annales des Sciences Naturelles, Zoologie 17:311–349.

Jörgensen, P. 1912. Revision der Apiden der Provinz Mendoza, Republica Argentina (Hym.). Zool. Jahrb. Abt. Syst. Geogr. Biol. Tiere 32:89–162.

Linsley, E. G., J. W. MacSwain, and R. F. Smith. 1952. The bionomics of *Diadasia consociata* Timberlake and some biological relationship of Emphorini and Antophorine bees (Hymenoptera, Anthophoridae). University of California Publications in Entomology 9:267–290.

Linsley, E. G., and J. W. MacSwain. 1957. The nesting habits, flower relationships, and parasites of some North American species of *Diadasia* (Hymenoptera, Antophoridae). The Wasman Journal of Biology 15:199–235.

Neff, J. L., B. B. Simpson, and J. L. Dorr. 1982. The nesting biology of *Diadasia afflicta* Cress. (Hymenoptera: Antophoridae). Journal of Kansas of Entomological Society 55:499–518.

Neff, J. L., and B. B. Simpson. 1992. Partial bivoltinism in a ground-nesting bee: the biology of *Diadasia rincornis* in Texas (Hymenoptera, Anthophoridae). Journal of the Kansas Entomological Society 65:377–392.

Ordway, E. 1987. Aspects of the nesting behavior and nest structure of *Diadasia opuntiae* Cockerell (Hymenoptera, Anthophoridae). Journal of the Kansas Entomological Society 57:216–230.

Roig-Alsina, A. 2007. A review of the *albidohirta* group of *Ptilotrix* (Hymenoptera: Apidae: Emphorini). Revista de la Sociedad Entomológica Argentina 66:113–119.

Roig-Alsina, A. 2008. Apidae. pp. 391–405. *In* Claps, L., G. Debandi and S. Roig-Juñent (eds.), *Biodiversidad de artrópodos argentinos* volumen 2. Editorial Sociedad Entomologica Argentina, Mendoza, Argentina.

Sipes, S. D., and P. G. Wolf. 2001. Phylogenetic relationships between *Diadasia*, a group of specialists bees. Molecular Phylogenetics and Evolution 19:144–156.

Sipes, S. D., and V. T. Teperino. 2005. Pollen-host specificity and evolutionary patterns of host switching in a clade of specialist bees (Apoidea: *Diadasia*). Biological Journal of Linnean Society 86:487–505.

Snyder, T. P., E. M. Barrows, and M. R. Chabot. 1976. Nests of *Diadasia afflicta* Cresson (Hymenoptera: Anthophoridae). Journal of the Kansas Entomological Society 49:200–203.