Developmental Morphology of Larvae and Eggs of the Imported Fire Ant, *Solenopsis invicta*[1]

R. S. PETRALIA AND S. B. VINSON[2]

Department of Entomology, Texas A&M Univ., College Station 77843

ABSTRACT

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The egg of the imported fire ant, *Solenopsis invicta* Buren, becomes embryo-like before the larva emerges. Hatching is described. First instars are hairless. Second instars have only a few small, simple hairs. Third instars have moderately numerous short hairs, either simple, branched or bifid. Fourth instars have long, straight, simple hairs on the head and anteroventral body region; all other body hairs and some posterior head hairs are strongly bifid. The mandibles of only the 4th instar are sclerotized.

Both eggs and larvae stick together in clumps in the colony by means in eggs and 1st and 2nd instars of an adhesive coating, and in 3rd and 4th instars by hooked hairs which interlock on adjacent larvae.

A simple method for determining the developmental stage of live larvae of the imported fire ant is provided.

We know little about the developmental biology of ants despite their ecological, sociobiological, and economic importance. The general morphology of larvae of the genus *Solenopsis* was described by Wheeler and Wheeler (1955, 1960), who, however, did not determine the number of larval instars for any species of *Solenopsis*, and described only "mature" or "young" larvae of undetermined age. Either 3, 4, or 5 instars occur in species of other ant genera (reviewed by Delage-Darchen 1972). Delage-Darchen (1972) described 3 instars for *Crematogaster* (*Nematocrema*), distinguished by mandible size and, to a lesser extent, chaetotaxy. O'Neal and Markin (1975) described 4 larval instars in the imported fire ant, *Solenopsis invicta* Buren, differentiating them by the morphology of the mouthparts, and by Dyar's principle (1890). However, the 1st instars of *S. invicta* were found to have a larger number and variety of setae than the youngest larvae of *S. molesta* (Say) as described by Wheeler and Wheeler (1955). Thus, the morphological variation within the genus seemed usually large. We investigated the developmental morphology of *S. invicta* with the view of clarifying these discrepancies, and to discover a means to identify the developmental stage of fire ant larvae.

Materials and Methods

Mature colonies of *S. invicta* were maintained according to Petralia and Vinson (1978). Examination of individual larvae and eggs was made on moist tissue paper in small plastic petri dishes. The relationships between brood and adult worker ants were observed with 1–100 workers in a petri dish provisioned with moist filter paper and a small amount of peanut butter. Most studies, including the descriptions of minor worker larvae, were conducted with colonies producing only minor workers.

Most specimens for light microscopy were mounted alive in Hoyer's medium or Hoyer's modified with iodine and potassium iodide (Schuster and Pritchard 1963). Mature reproductive larvae (either unmounted or whole mounted as above) were fixed in Kahle's fixative (Vinson 1969) and stored in 80% ethanol. Other specimens were examined alive. For most scanning electron microscope (SEM) studies, larvae were mounted on stubs with either silver paint or "Tube-Coat"™ and examined alive. "Tube-Coat" allowed fire ant larvae to survive longer exposures to the electron beam than silver paint. Some SEM studies were conducted using larvae metal-coated alive or fixed in 2–3% glutaraldehyde or Kahle's fixative. Following fixation, specimens were dehydrated in an ethanol series and critical-point dried. Specimens were examined in a Jeol JSM-U3 or 35 SEM at 20–25 kV for metal coated specimens and 15 kV for live specimens.

The morphological terminology of Wheeler and Wheeler (1976) was followed in most cases. The term "microsetae" denotes protuberances in early instars, which are probably precursors of hairs found in equivalent positions in succeeding instars. Bifid hairs were measured from the base to the intersection of the branches, because measuring the length of the branches was too difficult.

Details of molting were studied to provide evidence for the number of instars. A larva was considered ready to molt when the hairs of the succeeding instar became visible under the transparent cuticle (Fig. 17, 24). Usually the hairs of the body's anteroventer and of the head became visible first. Newly molted larvae and larvae ready to molt were compared for each instar. We examined all hairs, microsetae, spinules, the antennae, mandibles, maxillary palps and galea, labial palps, labial spinules, and the opening of the sericteries. Newly formed larvae (Fig. 5), experimentally removed from the egg shell within 12–14 h after the egg took the shape of the fully formed embryo, were compared with 1st instars in which 1 or 2 hairs of the 2nd instar were visible in the lateral region of the head (i.e., 1st instar preparing to molt). Larvae which had just molted to the 2nd instar (Fig. 9) (< 3 h after molting) were compared with larvae ready to molt to the 3rd instar. Third instars similarly were studied (Fig. 14, 17) (new molted larvae examined

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