TESTES DEGENERATION IN THE RED IMPORTED FIRE ANT, *SOLENOPSIS INVICTA*

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ABSTRACT

The reproductive system of the male red imported fire ant, *Solenopsis invicta* Buren, begins developing in the early larval stage. Testes are recognizable as four small white lobes. The system grows and develops until eclosion of the adult. The system begins degenerating with adulthood and continues until, after eleven days, all that remain of the testes are four small amber-colored bodies surrounded by the testicular capsule. Motile sperm are first observed during the late pupal stage.

Key Words: Reproductive system, myrmicine ant, sperm production

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Although the male reproductive system of some species of ants has been studied to some degree, only limited information is available concerning a very important species, the red imported fire ant, *Solenopsis invicta* Buren. Hung (1974) reported finding sterile males among imported fire ants; Tice (1967) reported that males taken from a nuptial flight have reduced testes; whereas, males taken directly from the mounds show very large testes. The purpose of the present study was to observe and diagram the development of the testes of the red imported fire ant from the first stages of their development in the larva until the male is ready for mating.

MATERIALS AND METHODS

The males utilized in this study were collected with brood by the technique reported by Markin (1968) from colonies in Gulfport, MS, that were known to have all males sex brood. In the laboratory, the brood and workers were transferred to clear plastic Wilson cells. Thus, newly eclosed males could be segregated with a few workers so males of a known age would be available. Subsequently, larvae, pupae and adults at various intervals after eclosion were dissected under 0.9% saline solution.

TERMINOLOGY

The names applied here to the various parts of the reproductive system in the male ants are taken mainly from Janet (1902). However, everyone involved in myrmecological studies is aware of the classic illustration of the gaster of *Myrmica rubra* (L.) in Wheeler's monograph (1910). We have also utilized this terminology as it was reworked by Hung and Vinson (1974).

OBSERVATIONS

Larva. Testes are visible in the early larval stage. Each testis is white, four-lobed and lies against the dorsal body wall; each is surrounded by the testicular capsule. At this stage of development, no accessory glands, vasa deferentia, or spermatozoa can be seen. Plate 1, Fig. A, shows a diagram of a testis at this time. The largest lobe is 0.21mm along the long axis.

By the time the larvae are ready for pupation, the size of the testes has increased about five-fold, but the accessory glands and vasa deferentia have not developed, and no spermatozoa were seen.

Pupa. In the early pupal stage, the testes become larger and occupy much of the dorsal space in the first two gastral segments. The accessory gland and the vas deferens are visible for the first time, both being small and clear.

The testicular lobes narrow at one end to form short ducts, the vas efferens. The vas efferens join into a single duct, the vas deferens. The curved vas deferens straightens and continues in a posterior direction until it opens into the median ventral wall of the accessory gland (Plate 3, Fig. J). The glands are slightly constricted in the midregion, and the anterior ends are tapered and directed laterally. They unite posteriorly to form the common median ejaculatory duct (Plate 1, Fig. E).

By midway through the pupal stage (Plate 1, Fig. C), which is recognized by the red eye color, the testes have lengthened to about 1.2mm. This is an increase of about six-fold from the larval testes. The first motile sperm are now seen in the vas deferens.

Adult. On the day of ecolsion, the testes begin to shrink away from the testicular capsule (Plate 1, Fig. D), and the vasa deferentia enlarges. The first sperm bundle is present one day after eclosion. The accessory glands also begin to enlarge.

Between the third and fourth day after eclosion, the testes continue to shrink until they are only 0.57mm long. The vasa deferentia are now about three times their original width, and the accessory glands also have doubled in length and width. The vasa deferentia are about half full of sperm; the testes are now half the size they were at the late pupal stage, and the accessory glands are very large (Plate 1, Fig. F).

At five days after eclosion, the testes have grown even smaller, and the vasa deferentia are filled with three sperm packets (Plate 1, Fig. G). The accessory glands have reached their maximum size and extend from the posterior region of the first gastral segment into the third segment.

By the eighth day (Plate 1, Fig. H), the testes are one-sixth the size they were in the pupal stage. The vasa deferentia appear filled with a whitish, ropy material, the spermatozoa.

Eleven days after ecolsion, all that remains of the testes are four small, amber-colored bodies attached to the tip of the vasa deferentia and covered by a thick covering, the remnants of the capsule (Plate 1, Fig. I; Plate 3, Figs. K and L.)

DISCUSSION

The anatomy of the male reproductive system of the red imported fire ant

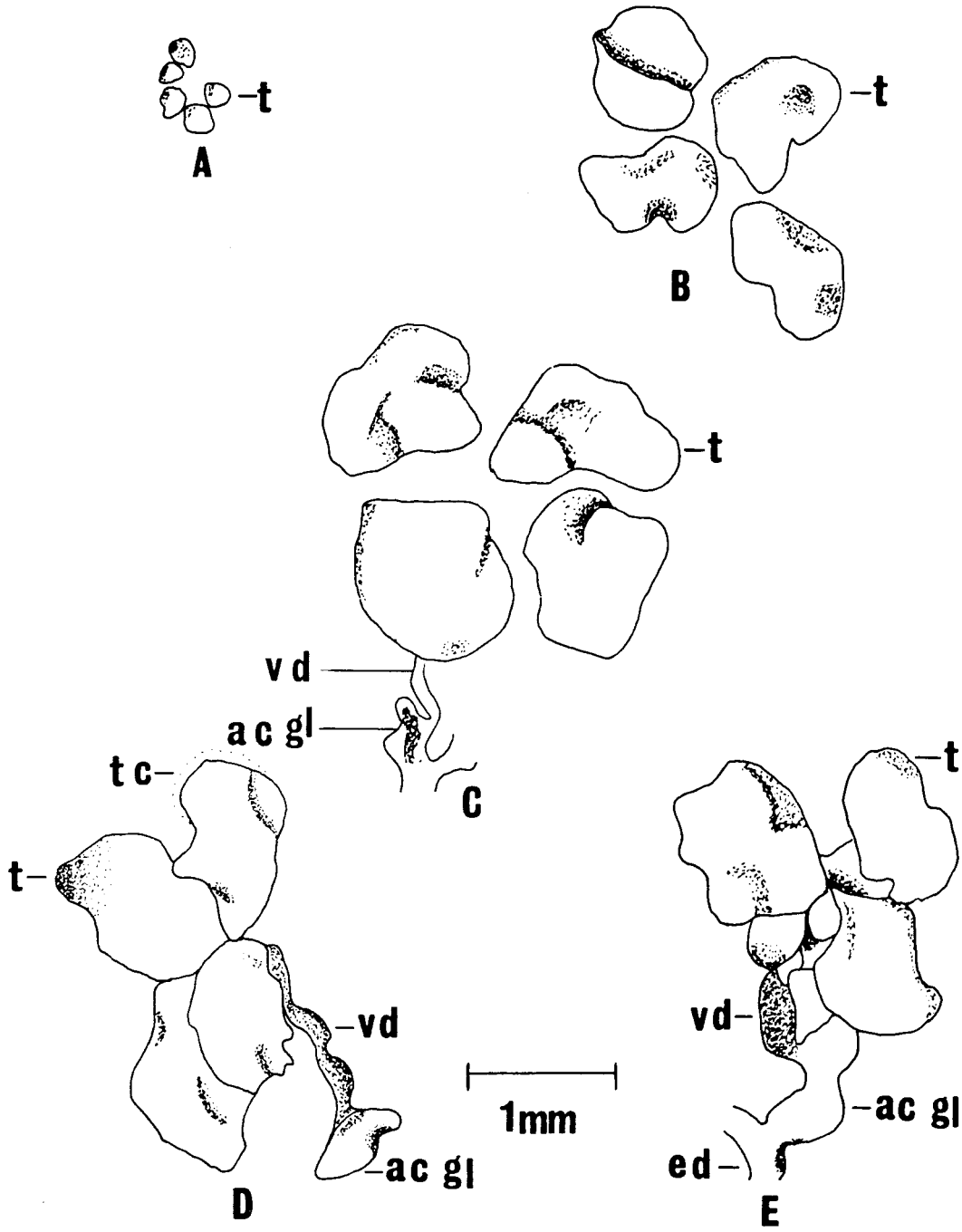

Plate 1. – (A) Diagram of early larval testes. (B) Pharate larval testes. (C) Reproductive system of red-eyed pupal stage. (D) Newly eclosed adult male. (E) One day after eclosion.

is similar to that of *Camponotus pennsylvanicus* DeGeer (Forbes, 1954). The male system consists of the testes, vasa efferentia, vasa deferentia, accessory glands, ejaculatory duct and the external genitalia.

A testis consists of four lobes, which is within the range reported (3-6) for myrmicine ants (Forbes, 1954; Tice, 1967). The testes first appear in the early larval stage and reach full maturity just before the pupal skin is cast off.

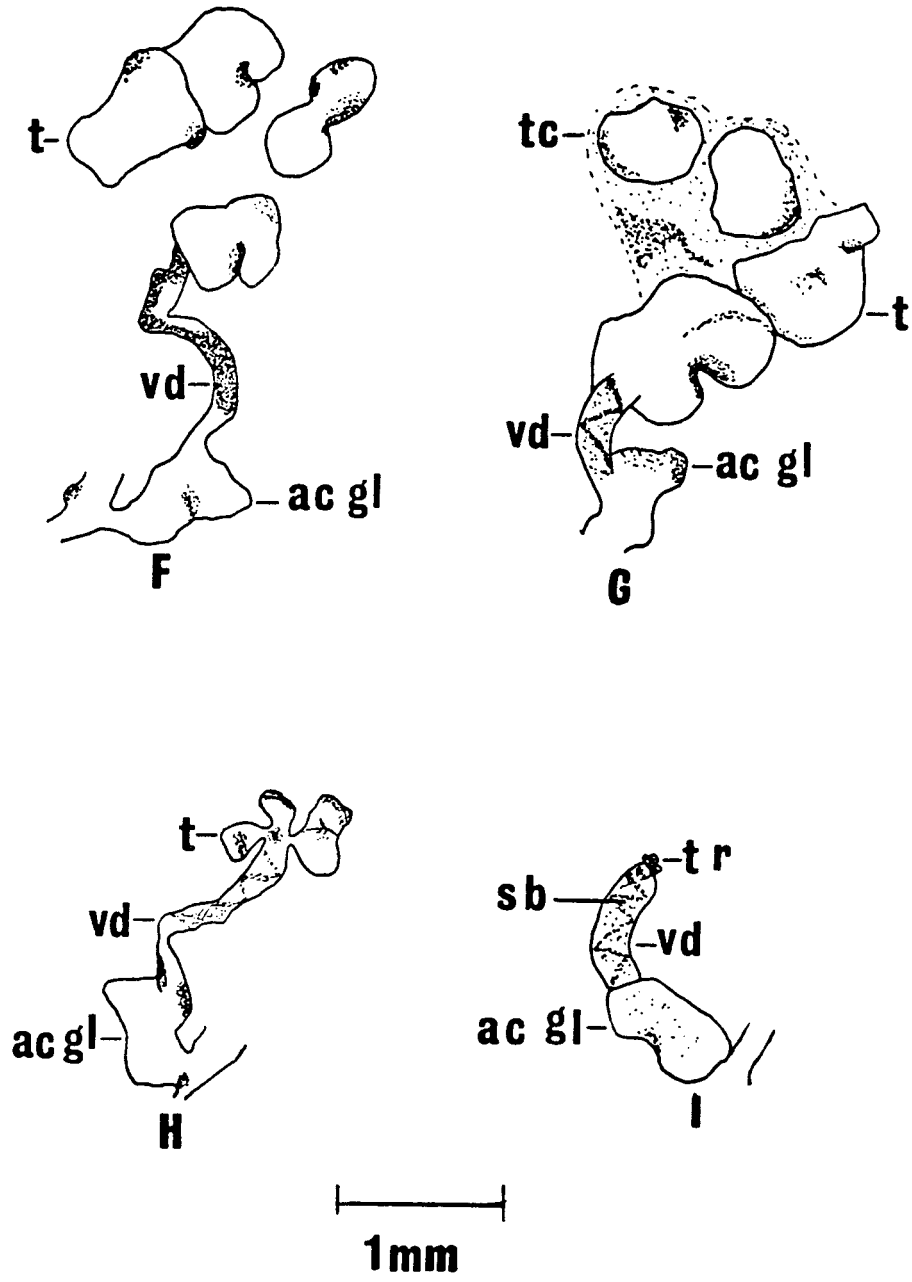

Plate 2. (F) Four days after eclosion. (G) Five days after eclosion (H) Eight days after eclosion. (I) Eleven days after eclosion; male ready for flight.

A similar finding was reported by Glöckner (1958) for *S. fugax* (Latreille). Once *S. invicta* reaches the adult stage, the testes undergo a process of degeneration that lasts for about 12 days. A like condition was described by Trakimas (1967) in *Myrmica rubra*. Also, Forbes and Do-Van-Quy (1965) indicated, following histological studies of the testicular follicles of *Neivamyrmex harrisii* (Haldeman), that the follicles were not functioning and might be undergoing disintegration.

Testicular degeneration also has been reported in honey bees, *Apis melli-*

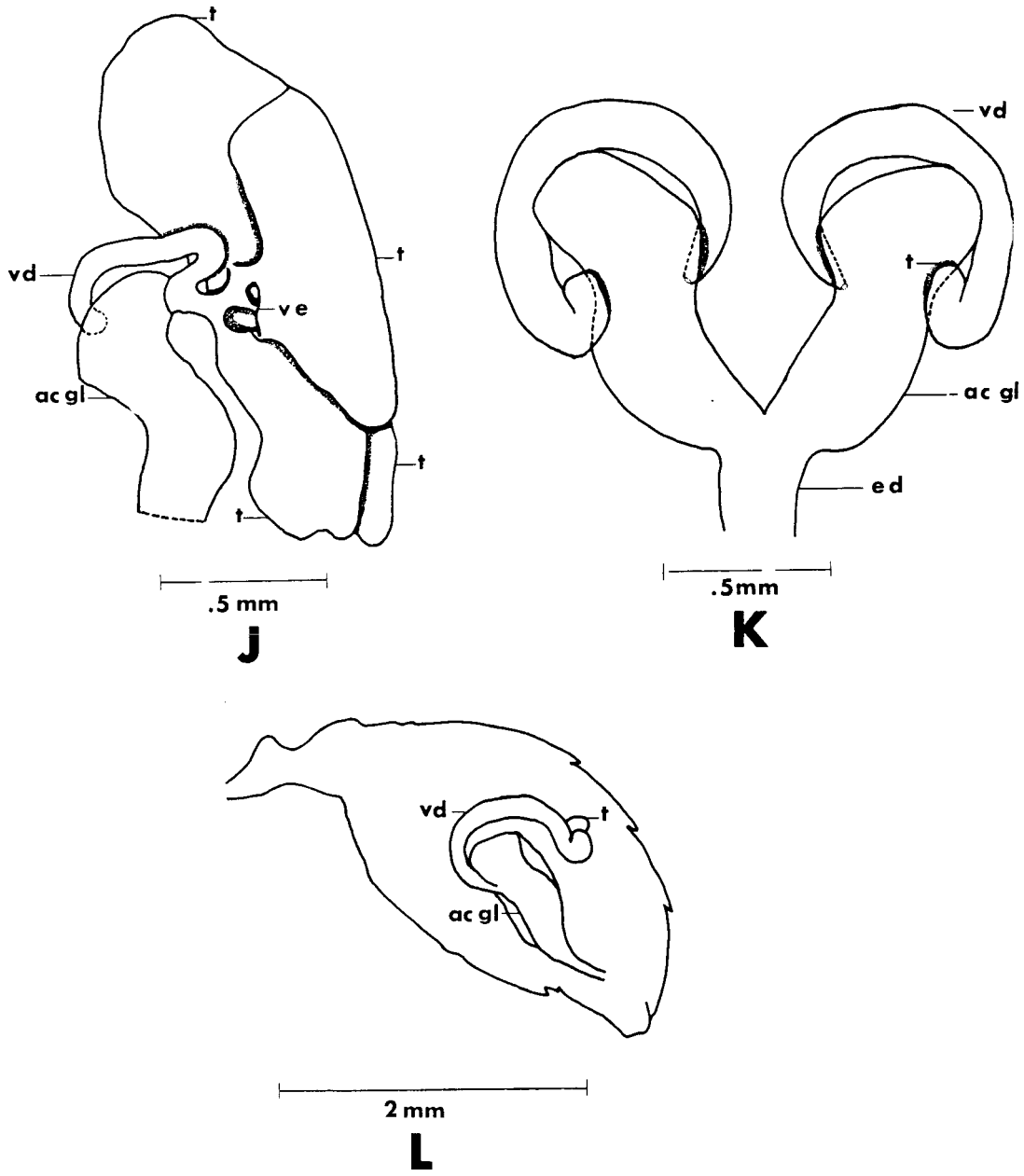

Plate 3. – (J) Diagram of reproductive system of newly eclosed male (after Tice). (K) Dorsal view of the reproductive system of the mature male (after Tice). (L) Diagram showing relationship of the reproductive system to the body in the mature male (after Tice).

fera L. According to Snodgrass (1956), the spermatozoa mature in the four days before the emergence of the drone from the comb cell. Then within a few days after emergence, the spermatozoa pass down the vasa deferentia and into the seminal vesicles. Also, the testes shrink and acquire a greenish yellow color. Twelve days after emergence, the drone is sexually mature, and the testes have shrunk to one-third their maximum length.

Evidence for hormonal control of spermatogenesis has been sought by some investigators. However, at present, our knowledge of control of sperma-

togenesis is limited, and there is no concrete evidence for or against direct hormonal involvement in any species (Engelmann, 1970).

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ABBREVIATIONS

Ac gl, accessory gland; Ed, ejaculatory duct; Sb, sperm bundle; T, testicular lobe; Tc, testicular capsule; Tr, testicular remnants; Vd, vas deferens; Ve, vas efferens.

LITERATURE CITED

Engelmann, F. 1970. The Physiology of Insect Reproduction. Pergamon Press, New York. 307 pp.

Forbes, J. 1954. The anatomy and histology of the male reproductive system of *Camponotus pennsylvanicus* DeGeer (Formicidae: Hymenoptera). J. Morphol. 95:523-56.

Forbes, J. and Do-Van-Quy. 1965. The anatomy and histology of the male reproductive system of the legionary ant, *Neivamyremex harrisii* (Haldeman). J. New York Entomol. Soc. 73:95-111.

Glöckner, W. E. 1958. Histologische untersuchungen an der diebsameise *Solenopsis fugax*. Latr. waehrend der metamorphose. Studia Entomologia, Editora Vozes Limitada, Petropolis, Rio de Janeiro, Brasil, 1:529-44.

Hung, A. C. F, and S. B. Vinson. 1975. Notes on the male reproductive system in ants (Hymenoptera: Formicidae). J. New York Entomol. Soc. (In press.)

Hung, A. C. F., S. B. Vinson, and J. W. Summerlin. 1974. Male sterility in the red imported fire ant, *Solenopsis invicta* Buren. Ann. Entomol. Soc. Am. (In press.)

Janet, C. 1902. Anatomie du Gaster de la *Myrmica rubra*. Georges Carre' et C. Naud, Paris. p. 68.

Markin, G. 1968. Handling techniques for large quantities of ants. J. Econ. Entomol. 41:1744-75.

Snodgrass, R. E. 1956. Anatomy of the Honey Bee. Comstock Publishing Associates, Ithaca, NY. 334 pp.

Tice, J. E. 1967. The anatomy and histology of some of the systems of the male of the imported fire ant, *Solenopsis saevissima richteri* Forel (Hymenoptera: formicidae). Diss. Abstr. 122 pp.

Trakimas, W. 1967. An anatomical and histological study of the male myrmicine ant, *Myrmica rubra* L. (Hymenoptera: Formicidae). Diss. Abstr. 28B:4360.

Wheeler, W. M. 1910. Ants: Their Structure, Development and Behavior. Columbia Univ. Press, New York. 663 pp.

J. Georgia Entomol. Soc. 11(1) January, 1976, 83-88