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Short Communications

The gross morphology of the stinging and non-stinging states of the ant *Tetramorium caespitum* L. (Hymenoptera, Formicidae, Myrmicinae)

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Summary. The change in sting morphology of *Tetramorium caespitum* is described in detail. The sting-tip may protrude/retract from the sting-ending during its stinging/non-stinging process respectively. A possible trail laying function of the stings terminal membranous sheath is proposed.

Key words. Sting; *Tetramorium caespitum*; ant; trail laying.

Tetramorium caespitum is the only endemic species of the genus *Tetramorium* in Britain. It is a small and aggressive ant, the workers being individually tough and persistent. The main method of fighting involves three stages, the attachment of the workers mandibles to the appendages of the enemy; the ventral arching of the gaster and the insertion of the sting into the joints¹. Once sting penetration is achieved the venom, predominantly proteinacious in nature², is injected. Detailed investigations of the sting structure and mechanism of several formicine genera have been reported^{3,4}. We present here a study of the changes occurring in the sting during the act of stinging based upon scanning electron and light microscopic studies.

Materials and methods. Workers of *T. caespitum* were obtained from heathland surrounding Furzebrook Research Station, Wareham, Dorset. To obtain the stinging position workers were irritated by aggressive handling whilst the non-stinging position was achieved by anesthetizing live specimens with CO₂. In both cases the gaster was removed and examined. For light microscopical studies the gasters were fixed for 24 h in alcoholic Bouin's fixative, dehydrated in a graded series of ethanol solutions, and mounted on slides in Damar. Stains were not employed on the specimens. Using this procedure the Dufour's gland was not observed in the whole mount preparation (fig. 1). Scanning electron microscopy studies were performed on stings

individually mounted on specimen stubs and coated with gold. Samples were observed using a Cambridge stereoscan electron microscope (Model S600). In some cases the sting lancets were removed from the stings, in their stinging position, to ensure that the sting-tip (ST) was the distal end of the protruding sting lancet. Observations were chiefly made on the distal sting-ending.

Results and discussion. As is typical of formicine ants the gaster of *T. caespitum* is elongate, 1.20–1.35 mm long and 0.56–0.59 mm in diameter (fig. 1). The venom gland (VG) which is approximately spherical with a diameter of 0.28 mm, extends 0.32 mm anteriorly from the sting bulb via the main duct. The Dufour's gland is smaller than the venom gland being 0.16 mm long and 0.04 mm in diameter. This bulbous gland lies anterior to the sting bulb and ventral to the main duct. The sting (S), hidden by the 7th abdominal segment, may extend from its fully retracted position up to 0.3 mm from the posterior tip of the gaster, at its thickest its diameter is 30 µm. The sting curves slightly downwards at its anterior end and sclerotization is extensive. The poison canal (PC) from the sting bulb to the sting-ending decreases in diameter and at its termination it is 1.5 µm. A triangular membranous sheath (TS) is attached to the distal sting-ending (fig. 2), this extends dorsally to 70 µm perpendicular to the sting. The sting-ending viewed dorsoposteriorly is super-

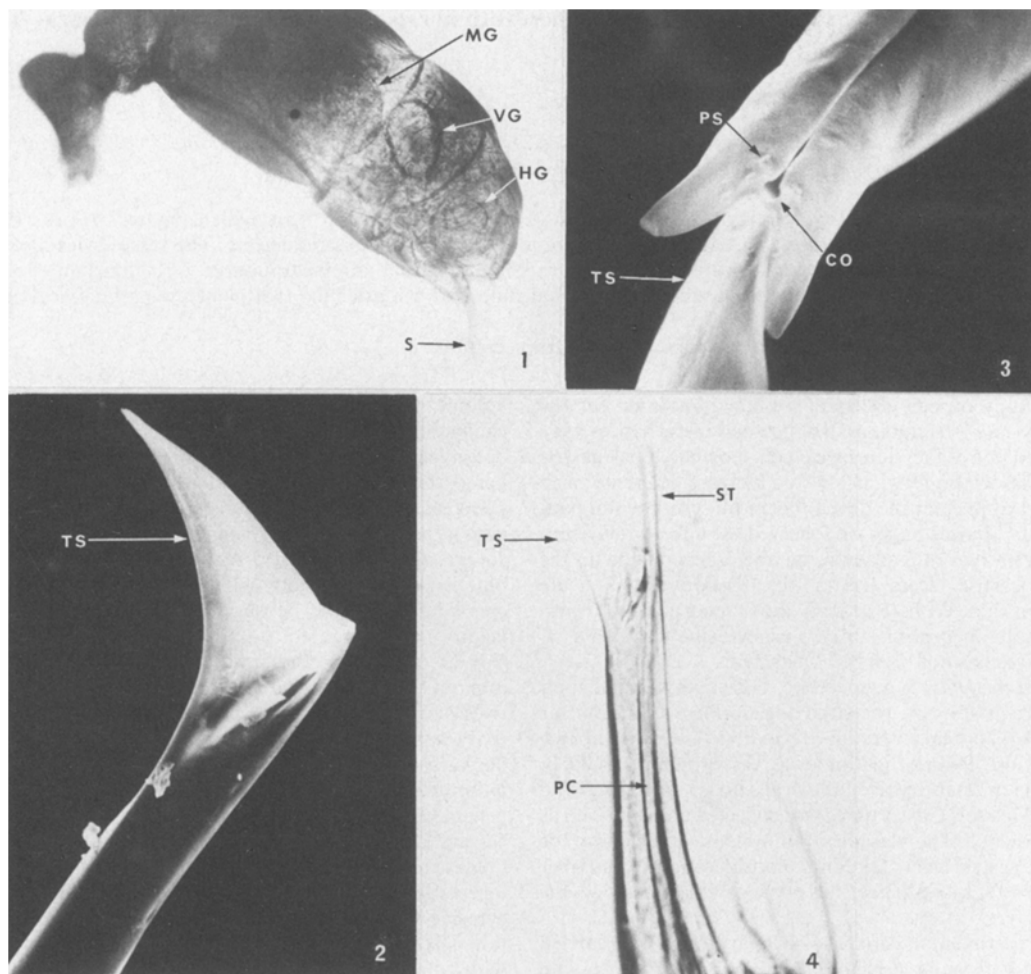


Figure 1. Light micrograph of the lateral view of *T. caespitum*'s gaster and sting in partially distended position using a plane polarized light filter. $\times 32$. Figures 2 and 3. Scanning electron micrographs of the sting of *T. caespitum* in its non-stinging state. 2 Lateral view of entire sting-ending. $\times 750$. 3 Posterodorsal view of sting-ending. $\times 1500$. Figure 4. Light micrograph of the sting of *T. caespitum* in its stinging position. $\times 255$. MG, mid gut; HG, hind gut; VG, venom gland; S, sting; TS, triangular sheath; PS, pore structures; CO, canal opening; ST, sting-tip; PC, poison canal.

ficially 'V' shaped (fig. 3) with the triangular sheath firmly attached to the groove formed at the apex and extending anteriorly 30–35 μm between the dorsal supporting arms (fig. 2).

The sting of the *T. caespitum* may assume either of two states, stinging and non-stinging. In its non-stinging state the sting may be retracted within the gaster or extended posteriorly. In either position the lancets are at rest, extending to the end of the sting and not beyond⁴. In this state the sting-tip, the distal end of the lancet, is hidden (figs 2 and 3). In its stinging state the sting is extended from the gaster with the sting-tip protruding from the canal opening (CO) up to 40 μm from the sting-ending. Tapering of the sting-tip is slight and at its proximal end it has a diameter of 5 μm . There are no barbs present on the sting-tip (fig. 4).

In both the stinging and non-stinging states the triangular sheath is extended. As this membrane lies posteriorly to the poison canal opening it may provide a means of laying a wider train. Chemical evidence for trail laying behavior comes from the identification of two volatile trail laying components derived from a pyrazine nucleus present in the venom gland⁵. A similar triangular sheath has also been observed in workers of the closely related *T. impurum* species (Morgan and von Sicard, unpublished). The role played by the membranous sheath is under further investigation.

Minute sensory pore structures (PS) line the dorsal arms of the sting base, three on each side (fig. 3). Similar sensory structures,

Sensilla campaniformia, have been reported on both the sting-ending and the distal tips of the lancets of *Paraponera clavata*⁶. It is possible that in *T. caespitum* workers these pore structures may serve as chemoreceptors during both the stinging and trail laying processes.

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