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THE DIGESTIVE SYSTEM OF
PHLOEOMYZUS PASSERINII
(SIGNORET) (HOMOPTERA:
APHIDOIDEA)

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THE DIGESTIVE SYSTEM OF *PHLOEOMYZUS PASSERINII* (SIGNORET) (HOMOPTERA: APHIDOIDEA)

INTRODUCTION

The aphid *Phloeomyzus passerinii* (SIGNORET) belongs to BÖRNER's family Thelaxidae (BÖRNER, 1952). The morphology of the digestive system of this aphid was illustrated by BÖRNER (1938) and consists of a foregut, a dilated stomach, a very long coiled intestine, and a hindgut.

In the present study the anatomy of the digestive system of *P. passerinii* is investigated in more detail.

MATERIALS AND METHODS

Individuals of *Phloeomyzus passerinii* were collected from *Populus* sp. and fixed in DUBOSQ BRASIL's fluid. From this material, kindly supplied by Professor DR C. VIDANO (Turin, Italy), nine viviparous larvae were selected and embedded in paraplast and sectioned at 8 μ . The sections were stained in EHRlich's haematoxylin-eosin.

RESULTS

The alimentary tract starts as the food canal in the firmly interlocked maxillary stylets. The food canal passes into the pharyngeal duct which leads into the pharyngeal valve, pharyngeal pump, foregut, oesophageal valve, stomach, intestine, hindgut, and rectum that terminates at the anal opening (Fig. 1). The total length of the gut is about four times that of the body.

The foregut (oesophagus) runs posteriad from the tentorium, between the two salivary glands and dorsal to the nervous system. It consists of a thin tube made up of a single layer of squamous epithelial cells which secrete the chitinous intima.

The foregut opens into the stomach by way of a valve of chitinous material which projects half-way into the lumen of the first part of the stomach. The intima is secreted by the ectodermal columnar cells situated at the distal end of the foregut. These cells have basophilic cytoplasm with small elongated nuclei (Fig. 2A). A similar oesophageal valve is found in the bugs *Chrysocoris stollii* WOLFF. (RASTOGI, 1965) and *Piezosternum calidum* FAB. (GOODCHILD, 1966) which belong to the family Pentatomidae (Heteroptera).

The midgut is the longest part of the alimentary tract consisting of the stomach and intestine. The stomach starts in the metathorax and runs directly posteriad to the fourth or fifth abdominal segment where the transition to the intestine

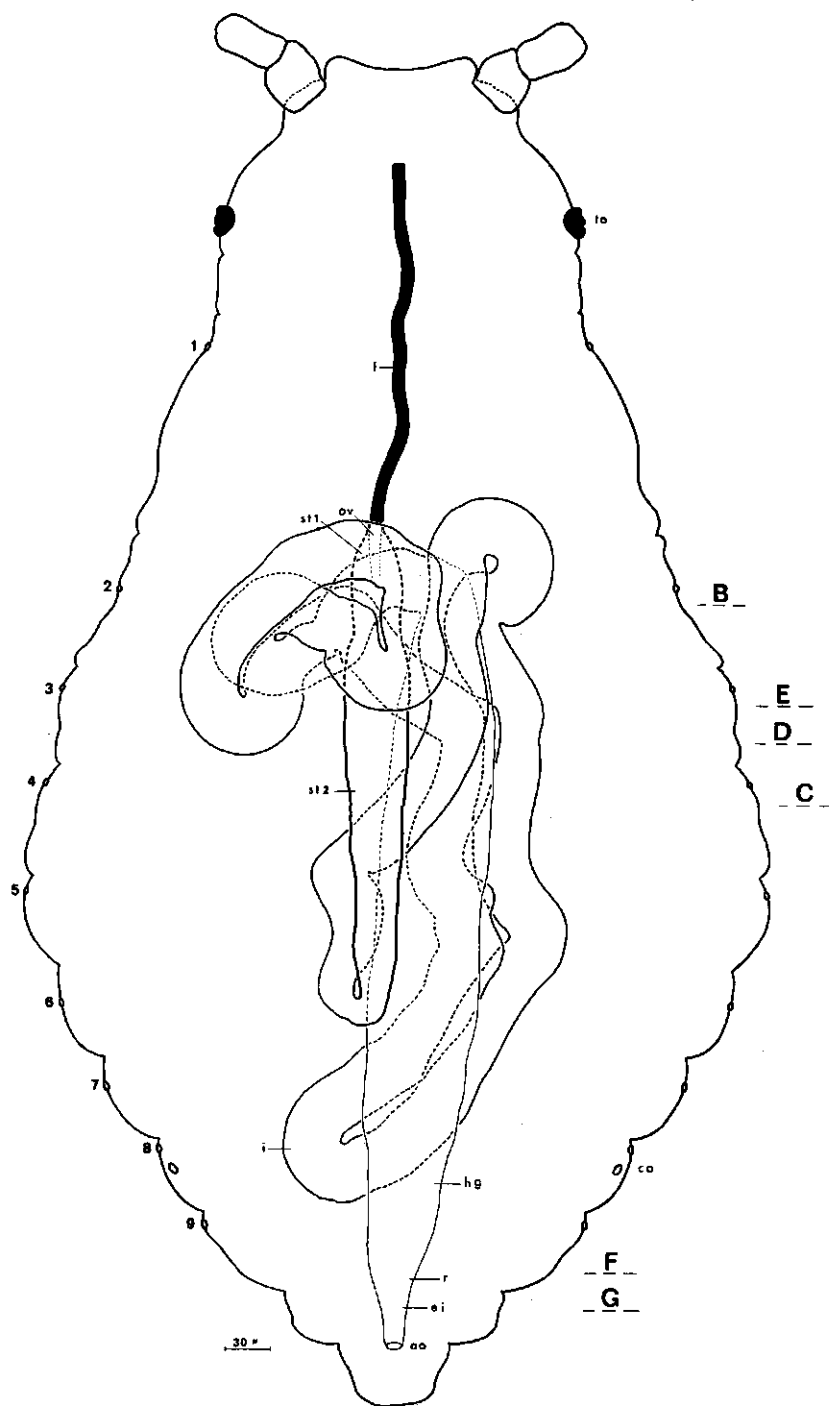


Fig. 1. Dorsal view of the digestive system of *Phloeomyzus passerinii* reconstructed from serial sections. The cornicles (pores, co) are situated on the sixth abdominal tergite. 1-2, meso and metathoracic spiracles; 3-9, abdominal spiracles. ao, anal opening; ei, epidermal invagination; f, foregut; hg, hindgut; i, intestine; ov, oesophageal valve; r, rectum; st1, first part of the stomach; st2, second part of the stomach; to, triommatidion. The letters B-G correspond with transverse sections given in Fig. 2.

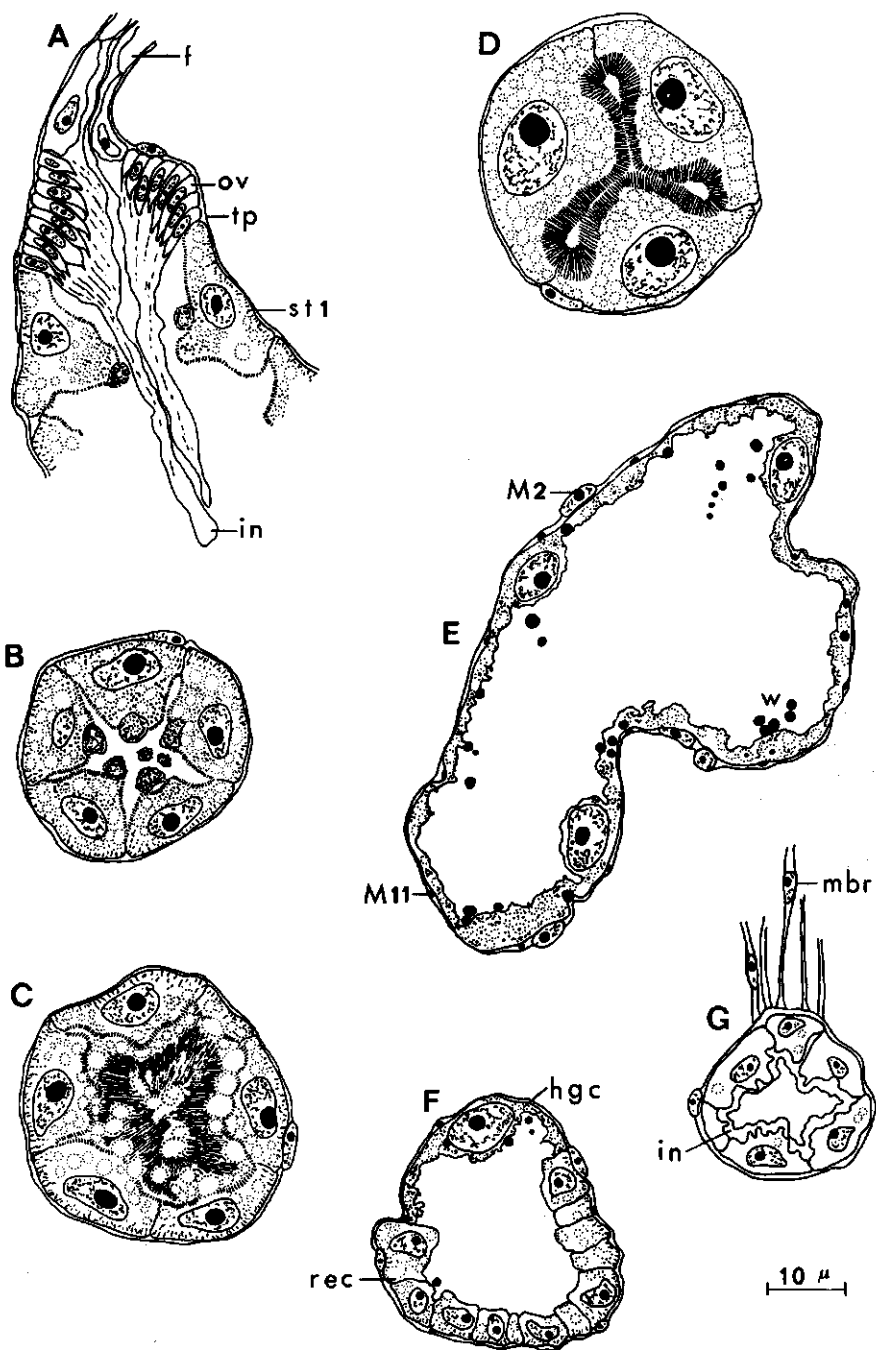


Fig. 2. Longitudinal section of the oesophageal valve (A) and transverse sections of the first (B) and second (C) parts of the stomach, intestine (D), hindgut (E), rectum (F), and epidermal invagination (G) of *Phloeomyzus passerinii*. hgc, hindgut cell; in, intima; M2, circular muscle fibres; M11, longitudinal muscle fibres; rec, rectal cell; tp, tunica propria; w, waxy droplet, other abbreviations as in Fig. 1. The position of the sections (B-G) are given in Fig. 1.

is marked by a sharp loop (Fig. 1). The stomach consists of two parts; the second part is about four times as long as the first part and has the same maximum diameter as the intestine.

The wall of the stomach is made up of a single layer of nine triangular cells (Fig. 2B) in transverse sections of the anterior end decreasing to five or six cells at the posterior end. The lining epithelium of the second part of the stomach consists of somewhat flattened cells in contrast to the triangular cells of the first part (Fig. 2C); where the stomach passes into the intestine there are only four cells. The stomach cells contain basophilic cytoplasm with many vacuoles, flattened nuclei at the base of the cells, infolded basal cell membranes, and apical striated borders.

The triangular stomach cells have in their apical region numerous small vacuoles and granules and clusters of granules, which are discharged as irregular-shaped bodies and dissolve in the lumen of the stomach. A similar type of secretion occurs in the stomach of *Adelges laricis* VALL., *Chaitophorus* (*Eichochaitophorus*) *versicolor* (KOCH) (= *Chaitophorus leucomelas* KOCH), and *Myzus ascalonicus* DONC. (KUNKEL, 1966). The flattened cells lining the second part of the stomach continuously secrete the contents of the vacuoles situated between the striae and on the luminal surface of the striated border. This material dissolves in the stomach lumen forming a trace of coagulated material as a result of the fixation. This secretion resembles that produced in the posterior region of the stomach of *Myzus persicae* (SULZ.), and the stomach of *Cryptomyzus ribis* (L.) and four *Eulachnus* species (PONSEN, 1981).

The intestine leaves the stomach as a narrow tube forming a sharp loop, after which it gradually broadens and runs anteriorly to the metathorax. In this segment it turns and runs posteriorly to the sixth abdominal segment where it turns anteriorly and forms the voluminous abdominal loop. Then it runs anteriorly to form a succession of loops in the metathorax and first abdominal segment. The intestine is about seven times as long as the stomach, and about five times as long as the hindgut. Transverse sections of the intestine reveal 3–4 triangular cells which are strongly vacuolated and have an ovoid-shaped nucleus. The luminal surfaces of these cells have well-developed striated borders which form a stellate-shaped closed or partly closed lumen (Fig. 2D).

The hindgut starts in the metathorax and runs directly caudad to open into the rectum. It is made up of a single layer of squamous epithelial cells with ellipsoid-shaped nuclei which protrude into the lumen (Fig. 2E). The luminal surfaces of the cells show minute projections and are covered with a delicate intima. The cells contain vacuoles surrounded by clusters of basophilic granules, with waxy droplets in the vacuoles. The waxy droplets originate from fat cells and are released by the hindgut cells into the lumen. A similar structured hindgut occurs in *M. persicae* (SULZ.), *C. ribis*, *Eulachnus* species (PONSEN, 1981), and *Diuraphis* (*Holcaphis*) *holci* (HRL).

The rectum starts in the posterior part of the seventh abdominal segment and is made up of a single layer of cuboidal cells (Fig. 2F). It passes into an epidermal invagination of which the cuticular lining is thicker than that of the

rectal epithelium (Fig. 2G). The anal opening is both laterally and dorsally connected by muscles to the ninth abdominal segment.

DISCUSSION

Morphologically the digestive system of *Phloeomyzus passerinii* described here agrees with BÖRNER's (1938) illustration. This aphid is included in BÖRNER's family Thelaxidae (BÖRNER, 1938, 1952; BÖRNER and HEINZE, 1957), but its digestive system is different from that of *Glyphina* and *Thelaxes* (PONSEN, 1982), which consists of a short foregut, a tubular stomach, a primitive intestine, and lacks a hindgut of ectodermal origin. In contrast the digestive system of *P. passerinii* is composed of a short foregut, a somewhat dilated stomach consisting of two histologically distinct parts, a very long intestine with a number of coils, and a hindgut of ectodermal origin. Moreover, in *Glyphina* and *Thelaxes* the oesophageal valve is an invagination of the foregut into the stomach whereas in *P. passerinii* it is a tube of chitinous material (Fig. 2A), and the transition from the stomach to the intestine is quite different from that in *Glyphina* and *Thelaxes* (see Fig. 3 in PONSEN, 1982). Thus *P. passerinii* does not belong in the same group as *Glyphina* and *Thelaxes*.

SUMMARY

The digestive system of the aphid, *Phloeomyzus passerinii* (SIGNORET) consists of a short foregut which opens into the stomach by way of a simple tubular valve of chitinous material that projects into the lumen of the stomach. The stomach consists of two parts; the first part is lined with triangular cells that secrete irregular-shaped bodies, whereas the second part is lined with flattened cells that secrete the contents of their vacuoles. The transition from the stomach to the intestine is marked by a sharp loop. The intestine is very long with a number of coils and passes into the hindgut of ectodermal origin. The hindgut opens into the rectum which terminates at the anal opening.

SAMENVATTING

Het spijsverteringskanaal van de bladluis, *Phloeomyzus passerinii* (SIGNORET), heeft een korte slokdarm die in de maag uitmondt via een klep bestaande uit een buis van chitineus materiaal. De maag bestaat uit twee enigszins verwijde delen; het eerste deel is met driehoekige cellen bekleed die onregelmatige lichaampjes afscheiden, terwijl de platte epitheel cellen van het tweede deel vacuolen secreteren. De overgang van de maag naar de darm is door een scherpe lis gemarkeerd. De darm is zeer lang met een aantal lissen en gaat in een einddarm van ectodermale oorsprong over, die via het rectum in de anale opening eindigt.

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