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SHORT REPORT

HISTOLOGY OF THE FEMALE SEX PHEROMONE GLAND OF THE SAPODILLA FRUIT BORER (LEPIDOPTERA: PYRALIDAE)

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ABSTRACT

The sex pheromone gland of the calling female sapodilla fruit borer(SFB), has been studied histologically. The scent gland is located dorsally and ventrally in the intersegmental membrane between the eighth and ninth segments. The gland is histologically similar in adult female from 1-7 days old. The gland of every moth was composed of a single layer of columnar epithelial cells with round or oval basal nuclei. No vacuoles are seen in the cytoplasm. The external surface of the pheromone gland is covered by minute cuticular spines.

INTRODUCTION

The sapodilla fruit borer (SFB) is a major pest of unripe sapodilla fruit[1]. It is an undescribed phycitine moth and its previous names have been cited by Witethom and Gordh[2]. The relevant biology and development of both male and female SFB had been studied[1]. It was reported that the development periods of female SFB from egg to adult was 30.1 days, and the longevity was 7.2 days. This pest is unlikely to be controlled by insecticides because the larvae feed inside the fruit. The sex pheromone, once identified and synthesized, could be appropriate for controlling or monitoring population density[3]. According to Witethom[4] the SFB female exhibits calling behavior prior to mating during which the sex pheromone is presumably released. It is suggested that the sex pheromone should be extracted from 2 to 5-day old virgin females because they are most likely to call. The exact location and structure of the pheromone-producing gland of the female SFB remain unknown.

The morphology and histology of the female sex pheromone glands of Lepidoptera have been reported[5,6,7,8,9]. Typically, the glands are located in the intersegmental fold between the eighth and ninth abdominal segments and are of various shapes. The glandular cells are usually cuboidal or columnar cells, modified from epidermal cells[6,10]. We report here on the location and histology of the sex pheromone gland of the one- to seven-day old female SFB, in which the calling and mating behavior was observed.

MATERIALS AND METHODS

The SFB larvae were reared as described in Witethom and Silawatchananai[1]. For histological studies, the calling SFB females were divided into 7 groups according to their ages, one- to seven-day old. The abdominal tips of five calling females of each group were snipped and fixed in Bouin's fluid for 24 hrs and dehydrated through graded ethanol. The specimens were then cleared in xylene for 1 hr and embedded in paraffin wax (m.p. 56°C). The specimen blocks were sectioned by either sagittal and/or transverse planes at intervals of 6 to 8 micrometres. The sections were stained with Harris' haematoxylin and eosin[11]. The stained sections were examined under a light microscope.

RESULTS

The stained section of the abdominal segments shows that the mature oocytes are found in the ovaries of all SFB females, one- to seven-day old. Each mature oocyte is located on the proximal portion of an ovariole and its germinal vesicle is dorsally ecentric. The ovariole is of polytrophic type, in which trophocytes are included in each follicle[12] (Fig.1). The presence of mature oocytes in one-day old females indicated that the SFB females are reproductively mature upon emergence.

According to the longitudinal section of the abdominal tips, the sex pheromone gland is located on the dorsal and ventral intersegmental membrane between the eighth and ninth segments (Fig.2). The gland encircles ventrally as ventrolateral sac and forms as a ring-shaped structure (Figs.3&4).

The histology of sex pheromone gland of the SFB females is not remarkably different among ages. The glandular cells are composed of a monolayer of columnar epithelial cells with circular or oval basal nuclei. No vacuoles are observed in the cytoplasm. There is brush border at the apical edge of each glandular cell. The gland is covered by the cuticle. The overlying endocuticle is relatively thick and loosely laminated. The thin epicuticle possesses numerous minute spines (Fig.5).

DISCUSSION

In the SFB, the sex pheromone gland of the female is of the typical lepidopterous type. The gland is located in the intersegmental membrane between the eighth and ninth segments. It encircles ventral position as ventrolateral sac. Thus, the location of sex pheromone gland of SFB is similar to those reported for other arctiid moth, *D. hearseyana*[7] and the phycitine moth, *V. edmandsae*[5].

Typically the epidermal cell of the scent glands of most Lepidoptera are columnar epithelial cells. However, in *Heliothis zea* and *Heliothis virescens* (Noctuidae), the cuboidal epithelial cells are also found in sex pheromone-producing cells[10]. The glandular cells of SFB are distinctly columnar and each cell contains a circular or oval basal nucleus. The observation of two types of nuclei in the same gland may due to the different stages in the secretory cycle of the cells or may occur as a result of different sectioning planes[5]. In addition, the position of the nucleus is varied from species to species. In *Choristoneura fumifera*, the large

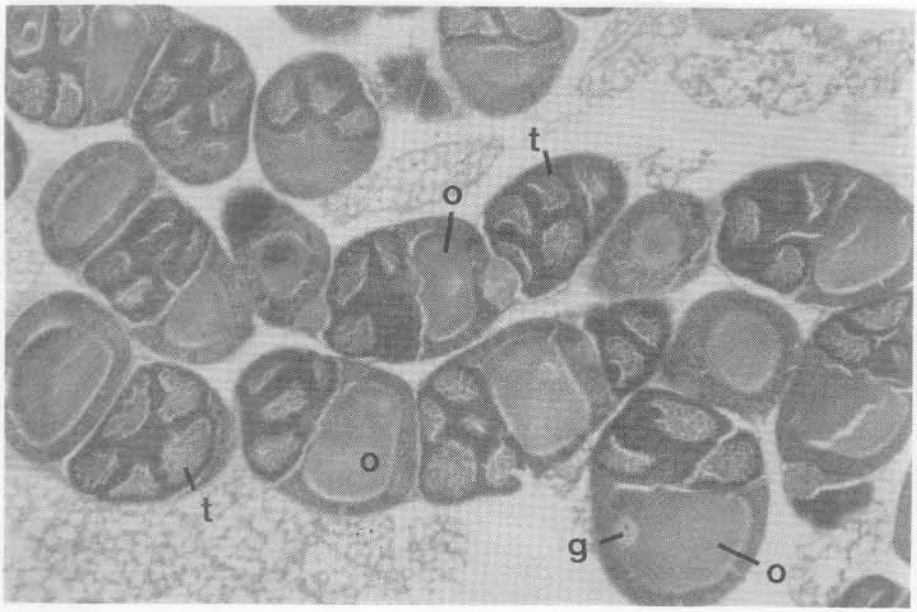

Fig. 1. The polytrophic ovarioles in the ovary of the SFB. g, germinal vesicle; o, oocyte; t, trophocyte. (100x).

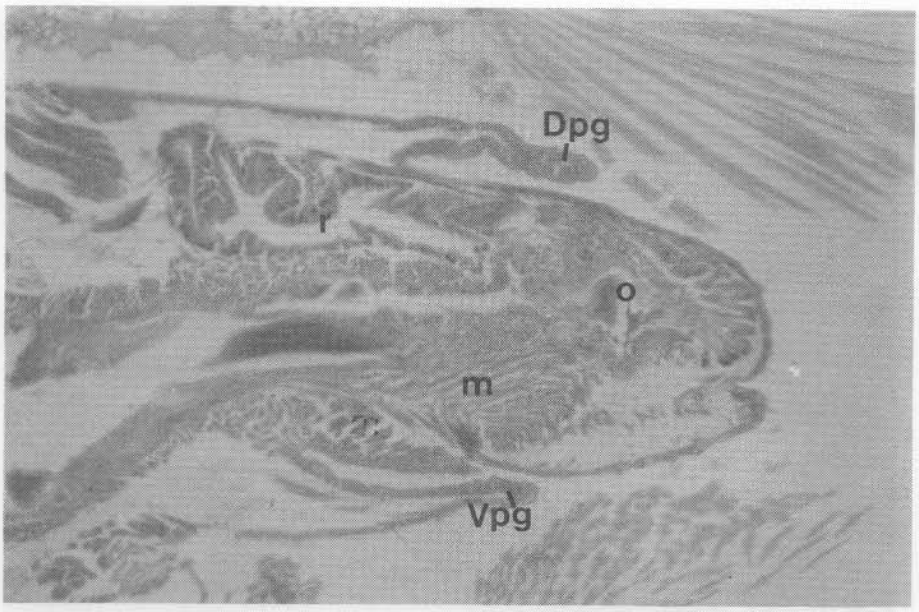

Fig. 2. Longitudinal section of the abdominal tip of the 3-day old female SFB showing the pheromone glands on dorsal and ventral sides. Dpg, dorsal pheromone gland; m, muscle; r, rectum; o, oviduct; Vpg, ventral pheromone gland. (100x).

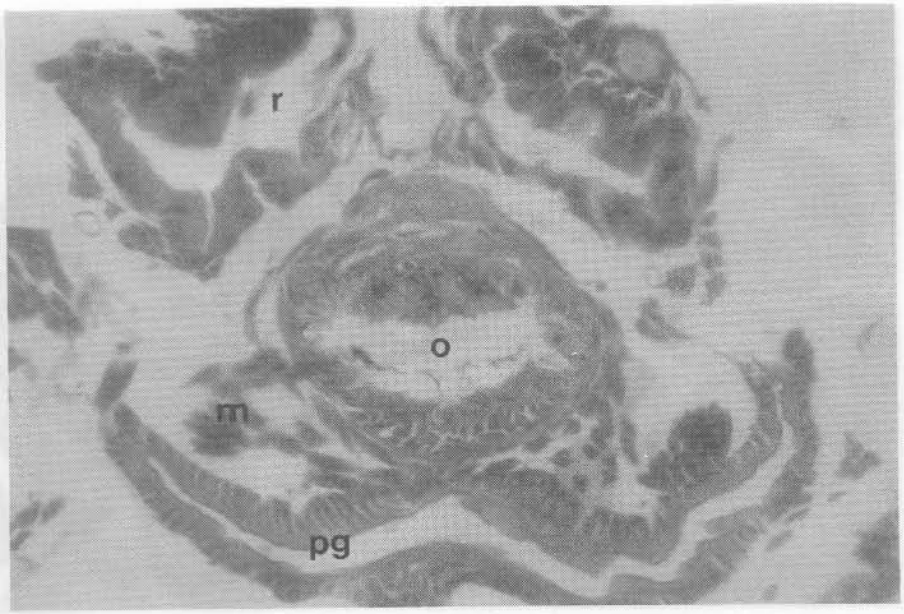

Fig. 3. Transverse section through ventral sex pheromone gland ot the 2-day old SFB female. m, muscle; pg, pheromone gland; r, rectum; o, oviduct. (200x).

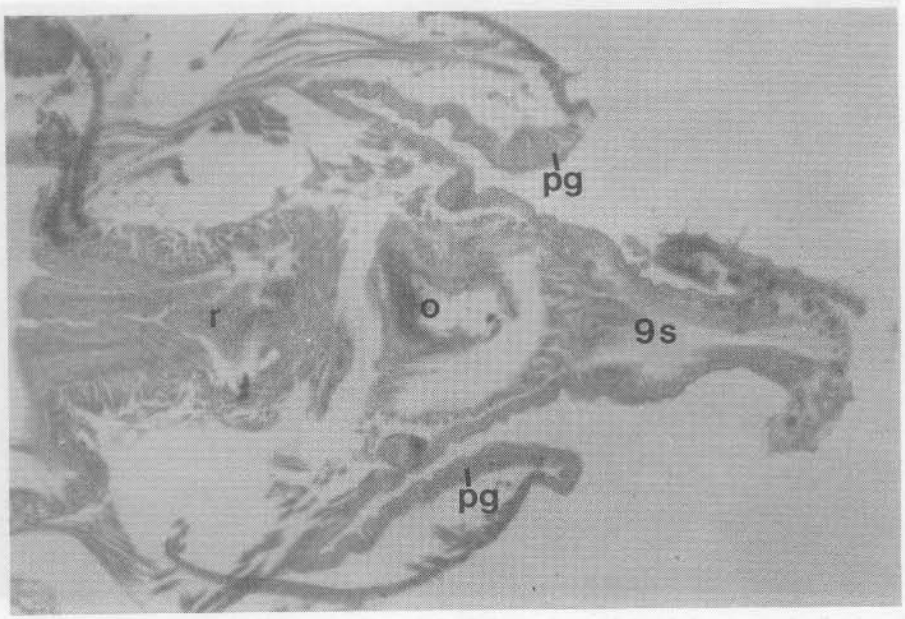

Fig. 4. Frontal section of the abdominal tip of the 3-day old SFB female showing sex pheromone gland on both lateral sides. pg, pheromone gland; r, rectum; 9s, the ninth segment; o, oviduct. (100x).

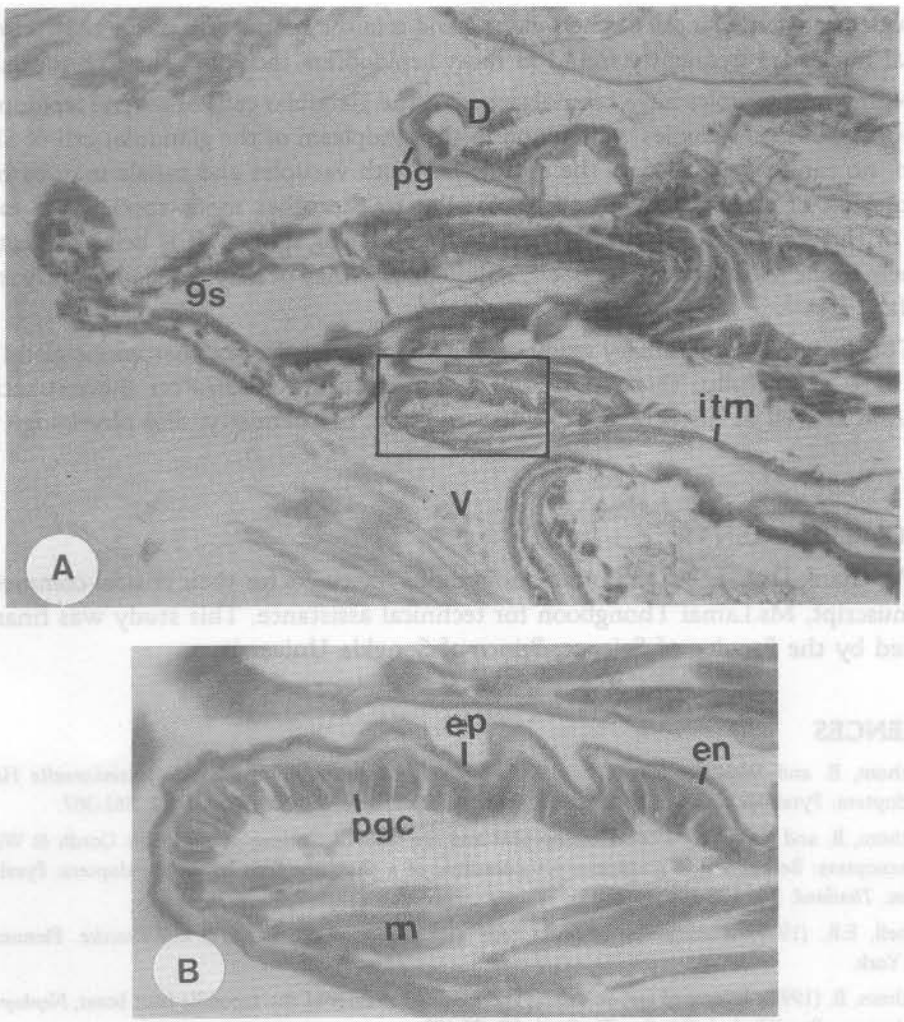

Fig. 5. **A**, Sagittal section of the abdominal tip of the 4-day old SFB female. (100x).

B, Higher magnification of the ventral side of sex pheromone gland. (400x). en, endocuticle; ep, epicuticle; D, dorsal; itm, intersegmental membrane; m, muscle; pg, pheromone gland; pgc, pheromone gland cell; 9s, the ninth segment; V, ventral.

ovoid nucleus of glandular cell of pheromone gland is in the central area of the cell[6]. However, the basal nuclei are frequently found in most Lepidoptera including the SFB moth.

Numerous vacuoles have been observed in the glandular cells of several lepidopterous females[7,10,13], but no vacuoles were found in the cytoplasm of the glandular cell of SFB. In addition, no canals were seen in the epicuticle. Both vacuoles and canals may be beyond the resolution of the light microscope. Similar to the other moth species, the external surface of the scent gland is covered by minute cuticular spines. It is believed that these spines help in the release of pheromone[14], although they may or may not significantly increase the surface area[15].

This paper is a preliminary study on the histology of the sex pheromone gland of the female SFB. Hopefully, this report will facilitate future studies on the extraction of pheromone as well as histochemistry, ultrastructure, biochemistry, and physiology of the gland.

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บทคัดย่อ

จากการศึกษาลักษณะโครงสร้างทางเนื้อเยื่อวิทยาของต่อมสร้างฟีโรโมนในผีเสื้อกลางคืนของหนอนเจาะผลละมุด (Lepidoptera: Pyralidae) ตัวเต็มวัยเพศเมียในขณะที่มีพฤติกรรมการเรียกหา อายุตั้งแต่ 1 ถึง 7 วัน พบว่าผีเสื้อกลางคืนทุกวัยที่ศึกษามีต่อมสร้างฟีโรโมนอยู่ทางด้านหลังและด้านท้องระหว่างปล้องที่ 8 และ 9 ลักษณะของต่อมประกอบด้วยเซลล์รูปทรงกระบอกเรียงต่อกันชั้นเดียว เซลล์มีนิวเคลียสรูปร่างแบบกลม หรือรีอยู่ค่อนไปทางฐานเซลล์ ไม่พบแวคิวโอลในไซโตพลาสซึม ที่ผิวบนของต่อมปกคลุมด้วยคิวติเคิลที่มีหนามแหลมขนาดเล็ก