

MORPHOLOGY AND HISTOLOGY OF THE FEMALE
SEX PHEROMONE GLAND IN THE ARMYWORM
MOTH, SPODOPTERA EXEMPTA (WALKER)

by

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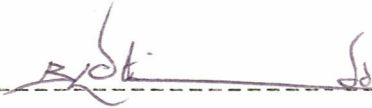
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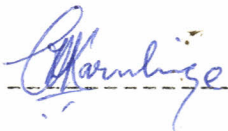
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This thesis has been submitted for examination with my approval as University Supervisor.

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SUMMARY

The work forming this thesis is a description of the structure of the sex pheromone gland in females of the African armyworm moth, Spodoptera exempta (Walker).

A general introductory account about the classification of pheromones and their production by females among insects forms the subject matter of Chapter I. This is followed by outlines of Objectives (Chapter II) and Materials and Methods (Chapter III).

The results are presented in Chapter IV. They include those of electroantennogram bioassay and external morphology studies, showing that the sex pheromone gland in S. exempta, as in other moths, is located in the intersegmental membrane between abdominal segments eight and nine. The gland is a ventral, bilobed, eversible sac. A fully everted sac has a surface of smooth texture, and its diameter is from 1.0 to 1.3 mm in recently emerged females.

Histologically, the surface of the gland is thrown into extensive folds. The inside of the cuticle is lined by a single layer of atrophied, epidermal cells. This layer of cells follows the outline of the folds though there is no comparable folding as that of the cuticle, and is continuous laterally with the

non-glandular cells comprising the remainder of the intersegmental membrane. The gland cells are, however, deeper than those of the non-glandular intersegmental membrane, but the overlying cuticle in both cases is similar in structure.

Histological evaluation of the sex pheromone gland development revealed the following structural characteristics:

1) variation in the thickness of the cuticle is as great within individuals as it is between individuals or among different moth ages.

2) In pharate individuals 3 to 4 days preemergence, the gland cells are short columnar and have linear distances measuring 5.2 μm wide and 11.6 μm high. Gland cells are tall columnar after emergence, and within 107 hours, the height is about doubled to 22.8 μm and the width is little changed as it increases to 6.2 μm .

3) The pupal cells are characterized by distinct intercellular spaces and a basophilic cytoplasm which is without vacuoles. The mature cells have rather indistinct intercellular spaces and an acidophilic cytoplasm that is vacuolated in texture.

Further results are those of the gland fine structure. The obvious characteristics in the topography of the glandular intersegmental membrane include a large degree of folding in the surface and the cuticular projections surmounted on the crests of folds. In sections, the cuticle has three layers: the outer electron lucent cuticulin, an electron dense epicuticle, and a laminated endocuticle. The latter layer contains conspicuous, electron dense areas which are of the same staining intensity as the epicuticular filaments observed within cuticular projections.

The cytoplasm is ultrastructurally characterized by numerous droplets and vesicles of diameter ranging from 0.6 to 4 μm . In cells where these organelles are found, the lengths of the nuclei are arranged vertically. There are also numerous mitochondria throughout the cytoplasm. Other organelles present in the basal cytoplasm are the rough endoplasmic reticulum, having distinct parallel stacks and whorls, a few microbodies that are of a fine granular appearance, and dense structures morphologically described as autophagic bodies. The endoplasmic reticulum is closely associated with droplets as well as vesicles.

The basement membrane in sex pheromone gland cells is 600 to 800 nm in thickness and shows

extensive infolding. Similar infolding in the lateral plasma membranes appear to be a multiple array of fenestrae originating from the intercellular space. The apical side of the plasma membrane is developed into microvillae, which appear in cells where a few or no droplets are observed.

The results are discussed in Chapter VI. They do indicate that the ventral sac in S. exempta is the sex pheromone producing tissue. The production of pheromone seems to involve uptake and or biosynthesis of lipid material, which is morphologically suggested to be occurring in the basal cytoplasm. The basal and lateral infoldings serve to increase the surface area for the movement of material. Apically, the pheromone substance would be transported across the microvillae, the lamellate endocuticle, and finally the epicuticular filaments to the outside of the cuticle. Furthermore, the presence of cuticular projections would suggest a controlled release of the pheromone into the environment, as the sac is rhythmically protruded and reverted.