

The duration and the amplitude of the various deflections and intervals were very irregular in both *S. vulgaris* and *A. caninum*. Throughout these observations, the worms moved their posterior end in saline chamber. The slower waves depicted in Figs. 3 and 4 were clearly related to their body movements as the apparatus was positioned in such a way that both the posterior end of the worm and the ink recordings could be observed side-by-side. No evidence was obtained to show that the fast waves were related to pharyngeal activity.

The advantage of this apparatus over that used in an earlier study<sup>1</sup> was its simplicity of design and ready accessibility of the components such as the contractive membrane. Using this apparatus it was possible to demonstrate that species of cyathostomid nematodes on one hand and *Strongylus* spp., and *A. caninum* on the other, display a different feeding behaviour *in vitro*, in that the former did not ingest sufficient blood, for the blood to pass from its anus.

The study of electrical impulses emanating from worms feeding on blood through a rubber membrane did not provide any satisfying results but it cast some doubt on the validity of the interpretations offered in an earlier study<sup>2</sup> where this technique was used in a study of the feeding of *A. caninum*. It was not possible to show that pharyngeal pulses were responsible for electrical impulses in the apparatus used and it was considered that the slow waves were due to the change in capacitance of the system as the nematode moved relative to the recording electrode and the faster waves were probably due to the action potential of muscles both in the body wall and the pharynx.

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## EFFECT OF ENDOSULFAN ON THE MID-GUT EPITHELIUM OF THE ADULT *ODONTOPUS VARICORNIS* (DIST.) (HEMIPTERA : PYRRHOCORIDAE)

### Introduction

HISTOPATHOLOGICAL studies have shown that destructions like shedding of cytoplasm and chromatin clumping in the cells of the alimentary canal of insects are caused by organophosphorus and organochlorus insecticides<sup>1-3</sup>. The present work reports the effect of the insecticide, endosulfan on the mid-gut epithelium and its secretory activity in the adult *Odontopus varicornis*.

### Materials and Methods

Specimens of *O. varicornis*, collected from the vicinity of Annamalainagar, were reared as described earlier<sup>4</sup>. The insecticide, endosulfan (Technical grade obtained from M/s. Bharat Pulverising Mills Pvt. Ltd., Bombay), was dissolved and diluted with acetone for the treatment. Median lethal doses were experimentally ascertained in terms of micrograms of insecticide per gram weight of the insect, as suggested by Nayar *et al.*<sup>5</sup> and the value of LD<sub>50</sub> was found to be 0.002143 µg/g.

Adult male insects of the same age group were kept inside the refrigerator for a few minutes to slow down their activities. Each insect was, then, injected with 0.075 ml of LD<sub>50</sub> doses of endosulfan, into the intersegmental thoracic region with a micrometer syringe fitted with a 26 gauge needle. These insects have become moribund in about 3 to 4 hours after injection and their alimentary canals were vivisected in insect saline solution. The different mid-gut regions of the alimentary canal of endosulfan treated insects, acetone treated insects and non-treated insects were, then, fixed in Bouin's fluid. The permanent slides were made following the paraffin embedding procedure. Serial sections of 6 to 8 µ thickness were deparaffinised and stained in Heidenhain's hematoxylin, using eosin as counterstain.

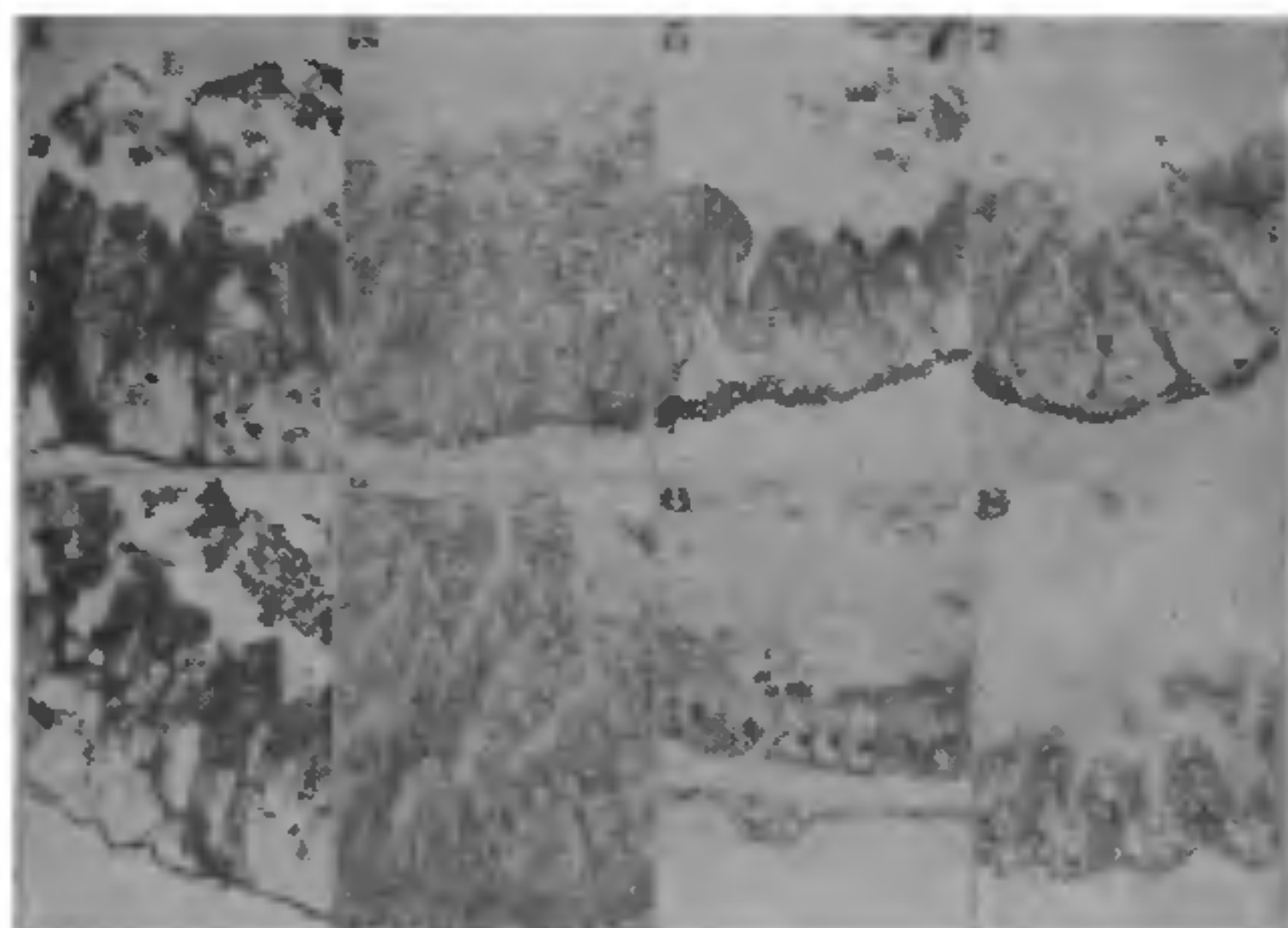
### Observations

The folded mid-gut epithelium with distinct cell boundaries of acetone treated and normal insects (Figs. 1, 3, 5 and 7) show, under endosulfan treated condition, signs of degeneration, shrinkage and indistinct cell boundaries in all mid-gut regions (Figs. 2, 6 and 8) excepting the second mid-gut which is characterized by hypertrophy of cells (Fig. 4). The epithelium of third mid-gut region appears to have been seriously affected by endosulfan as it stands separated from the muscular layers (Fig. 6).

Further, the cytoplasm of the mid-gut epithelial cells show sparse distribution of cytoplasmic granules (Figs. 2, 4, 6 and 8). The secretory product, which is usually present in the lumen of first, second and third



mid-gut regions (Figs. 1, 3 and 5), is found to be absent in endosulfan treated insects (Figs. 2, 4 and 6).



FIGS. 1-8. Fig. 1. C.S. of first mid-gut of normal insect showing the folded columnar epithelium (CE) and some secretory products (SP) in the lumen (L),  $\times$  ca 500. Fig. 2. C.S. of first mid-gut of treated insect showing cytoplasmic vacuoles, degeneration of cells (arrow) and the absence of secretory products,  $\times$  ca 500. Fig. 3. C.S. of second mid-gut of normal insect showing the uniform distribution of cytoplasmic granules,  $\times$  ca 500. Fig. 4. C.S. of second mid-gut of treated insect showing sparse distribution of cytoplasmic granules and hypertrophy of cells,  $\times$  ca 500. Fig. 5. C.S. of third mid-gut of normal insect showing the epithelium with distinct cell boundaries,  $\times$  ca 500. Fig. 6. C.S. of third mid-gut of treated insect. Note the epithelium with indistinct cell boundaries and its separation from muscular layers (ML),  $\times$  ca 500. Fig. 7. C.S. of fourth mid-gut of normal insect showing distinct nuclei,  $\times$  ca 500. Fig. 8. C.S. of fourth mid-gut of treated insect showing pycnotic nuclei,  $\times$  ca 500.

In addition to these changes, the nuclei of the cells of mid-gut epithelium have become pycnotic (Figs. 2, 6 and 8) and indicate signs of chromatin clumping.

#### Discussion

Histological effects of insecticides on the tissues of the alimentary canal have been studied for a number of insects such as *Prodenia eridania*<sup>1</sup>, House-fly<sup>6</sup>, *Poeciloceris pictus*<sup>7</sup>, *Spodoptera litura*<sup>2</sup>, and *Periplaneta americana*<sup>3</sup>. These studies have shown that different tissues of the alimentary canal, particularly the cells of the mid-gut epithelium have been affected by various insecticides. The present observations on *O. varicornis* have indicated that degeneration, vacuolization, separation of epithelium, nuclear distortion and pycnosis and chromatin clumping are some of the significant changes caused by the treatment of endosulfan.

Lakshman Lal *et al.*<sup>2</sup> and Datta *et al.*<sup>3</sup> have obtained similar results for the mid-gut epithelium of *S. litura* and *P. americana* respectively using organochlorus insecticides. Similarly, Chadbourne and Rainwater<sup>8</sup> have reported that calcium arsenate treatment has resulted in complete disorganization and disintegration of the mid-gut epithelial cells of the larva of *Heliothis armigera*.

It was reported earlier for this insect that the secretory products are absent in the lumen of mid-gut regions of endosulfan treated insects as against their presence observed in the lumen of first, second and third mid-gut regions of acetone treated and normal insects. Based on these observations it may be suggested that treatment with endosulfan has some influence over the production of secretory substances (enzymes). Sabesan and Ramalingam<sup>4</sup>, have recently reported for this insect that prolonged starvation has resulted in shortening of the epithelial cells and their reduced secretory activity. Thus, endosulfan seems to interfere with the mechanism of enzyme production rather than starvation although its other effects are almost similar to that of the latter.

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