

HISTOLOGICAL AND SCANNING ELECTRON MICROSCOPIC STUDIES ON THE SENSORY ORGANS OF THE TERRESTRIAL FLATWORM *BIPALIUM KEWENSE*

Abdel-Haleem, A. A.¹, Beltagi, S. M.² and Ali, A, S.²

^{1&2}Department of Biology and Geology, Faculty of Education - Ain Shams University, Cairo, Egypt

¹Department of Biology, Faculty of Science & Arts, Rafha, Northern Borders University, Saudi Arabia.

Abstract: The present work showed the fine structure and histology of the flatworm *Bipalium kewense* (Moseley, 1878) on the sensory organs (included sensory papillae, sensory pits and small eyes or eyespots). Both sensory papillae and sensory pits are situated at the peripheral edge of the shovel-head of the worm. On the other hand, numerous fine eyes (eyespots) are located within the margin of the dorsal headplate and along the body margin. Each eye is composed of pigment cells surrounding half moon-like lens and retinal cells. The present study suggested that the sensory papillae and sensory pits are chemoreceptors to test the food, humidity and salinity of the surrounding environment.

Key Words: Land turbellarian, Terricola, *Bipalium sp.*, sensory organs, SEM, histology.

I. INTRODUCTION

The shovel-headed garden flatworm, *Bipalium kewense* (Bipalliidae, Terricola, Turbellaria, Platyhelminthes) was first described from a greenhouse at Kew Botanical Gardens near London, England, in 1878 (Moseley, 1878)[6]. Then, Esser (1981) [3] believed that the land planarian *B. kewense* is native to Indo-China and has been found commonly in American greenhouses since 1901.

In 2001, *B. kewense* had been firstly collected from the botanical garden of the faculty of Education, Ain Shams University, Cairo, Egypt [1].

B. kewense worms are not harmful to humans although they had been considered pseudoparasites to vertebrates and human. They are carnivorous and predators on earthworms, small insects, insect larvae, annelids, young snails and slugs [8, 9].

They detect their prey using chemical receptors found in a sensory organ-pit on the underside of the head. The head-waving allows the worm to hone in on the chemical cues emitted from its prey. Struggling prey are held close to the substrate and entangled in slimy secretion. They have a great economic importance but taxonomical, ecological, biochemical and ultrastructural studies are insufficient and covered only too limited parts of the taxa [2].

Thereby, the present work deals with ultrastructural, using SEM, and histological studies on the sensory organs, including sensory papillae and eyes, to reveal their fine structure and function.

II. MATERIALS AND METHODS

a- Histological Method:

Fresh specimens of *B. kewense* had been fixed in alcoholic Bouin's fixative, dehydrated in ethyl alcohol, cleared in xylene and finally embedded in paraffin wax. Serial sections (6-8 μ) had been prepared, stained with haematoxylin and eosin, dehydrated in ethyl alcohol, cleared in cedar wood oil and mounted in Canada balsam. Finally, photomicrographs were taken using a microscope attached with an automatic camera.

b- Scanning electron microscopy (SEM):

B. kwense worms were fixed in 4% glutaraldehyde in 0.1 M sodium cacodylate buffer (pH 7.3) for at least 48 hours and then washed for at least 1.5 hours with three changes of the same buffer, as recommended by Reynolds [7]. Then, post-fixation was carried out in 1% osmium tetroxide in the same buffer for at least 2 hours. The fixed specimens were washed in the same buffer for more 30 minutes. Dehydration of the specimens was carried out through a graded series of ethanol. Afterwards, the specimens were completely dried through the Critical Point Dryer with liquid CO₂, mounted on copper stubs with double-sides adhesive tape and coated with gold using Sputter Coater S. 150A Edwards-England. Finally, the specimens were examined under JXA-840A Electron Probe Microanalyzer-JEOL-JAPAN.

III. RESULTS AND DISCUSSION

Sense organs are neuro-sensory cells send one or more hair-like processes to the surface of the worm. In the present study, sense organs had morphologically revealed as sensory pits and sensory papillae, as detecting in figures (1-3) whereas figures (4-6) showed their histological features.

In details, sensory papillae are situated at the peripheral edge of the shovel-head (figs. 1-3), whereas each sensory pit is flask-shaped, usually originated from a depressed ciliated epidermis, i.e. lined by a ciliated submerged epithelium through which a nerve penetrates to its blind end and is encircled by fine eosinophilic gland cells. Each pit interconnected with others to open in the lateral as well as median ventral neuro-sensory pit (Figs.4-6).

Hyman [4] found in the flatworms *Stenostomum* and *Bothrosostoma* that the chemoreceptors are mostly limited to the head region and comprise ciliated pits and their variants, which are depressed epidermal areas devoid of rhabdoids.

Taxonomically, Winsor studied the internal anatomy and histology of the terrestrial flatworms in family Bipaliidae and claimed that such sensory pits provided an important taxonomic characters.

Eyes:

The present work detected that the *B. kewense* possesses numerous fine eyes or eyespots distributed on the margin of the dorsal lunate head as well as on the lateral margin right and left in row to the posterior end of the body. Each eye is dark brown in colour, simple pigment-cup typed, composed of a pigment cup which consists of numerous small pigment cells surrounding half moon-like lens and several retinal cells (Fig.6).

Hyman had early displayed eye-structure of land planarians and found that each eye had the structure of a pigment-cup ocellus consisted of one or more pigment cells and one to many photosensitive neuro-sensory cells (retinal cells) projecting from the cup through its opening [4]. In addition, he found that the eye has half moon-like lens and the eye-chamber is slightly oval with bipolar retinal nerve cells having rounded ends, expanded into the cup and the proximal sensory fibre joins with the central nervous system.

In this respect, Winsor [10] revealed that many eyes of *B.kewense* are distributed within the margin of the dorsal headplate as well as on the lateral margin right and left in row to the posterior end of the body. He detected that the eyes are dark brown in colour, pigment cup-shaped and located dorso-posteriorly to the brain mass. Also, Jones and Gerard [5] found that eye arrangement is employed as an important taxonomic character in the land planarians.

The present results reinforced the studies of Winsor [10] and it could be suggested that the sensory papillae and sensory pits may be olfactory or chemoreceptors to test food, humidity and salinity of the surrounding environment, which is in line with observations that chemo-receptors are well developed among turbellarians.

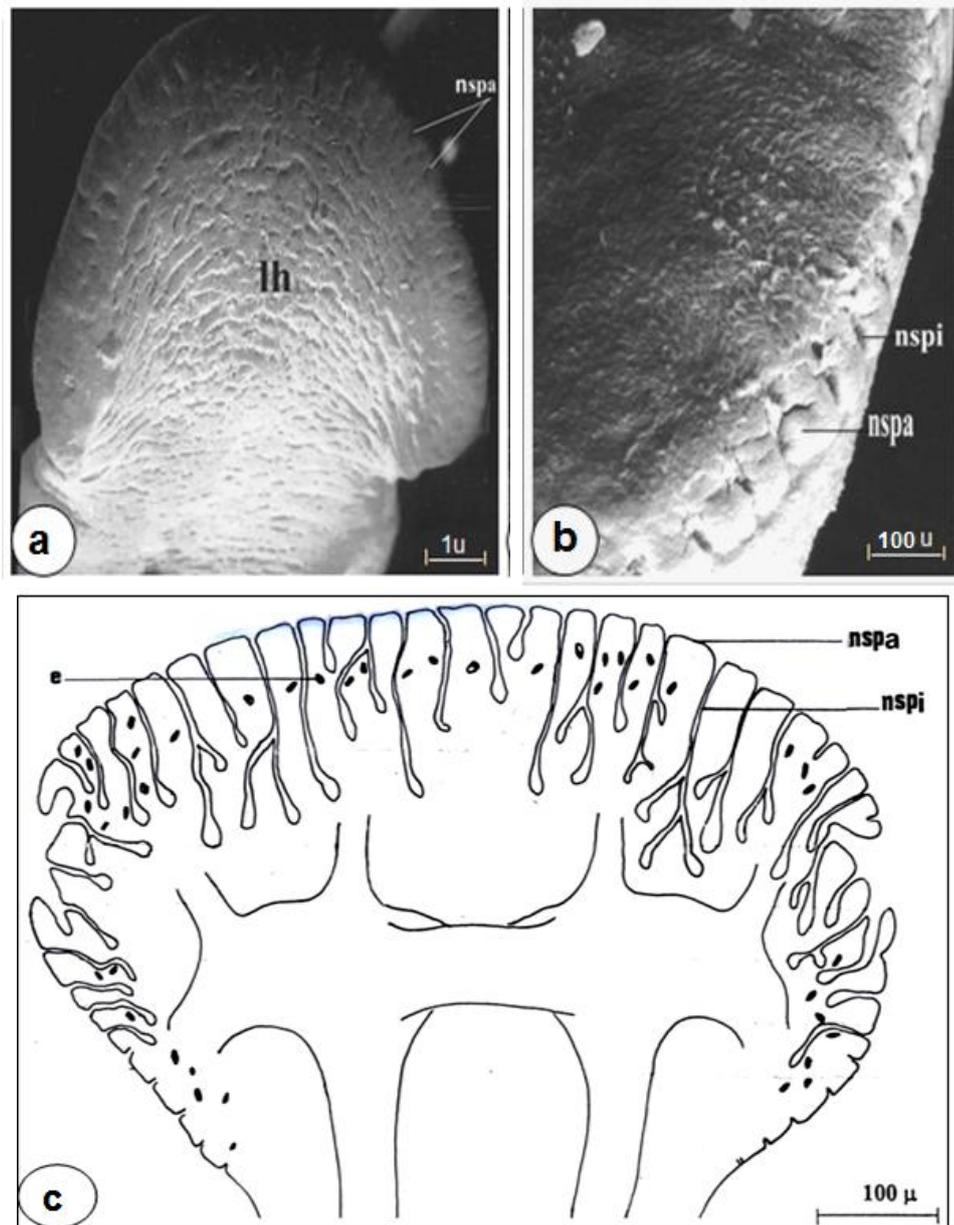


Fig.(1): Scanning electron micrograph (SEM) showing ultrastructure of dorsal view of the head region of *Bipalium kewense* (a) lh=expanded lunate head, nspa= sensory papilla (scale = 1 μ), (b) nspi = sensory pits (scale = 100 μ) and (c) diagrammatic representation of dorsal view of head region, e = eyespot (scale = 100 μ).

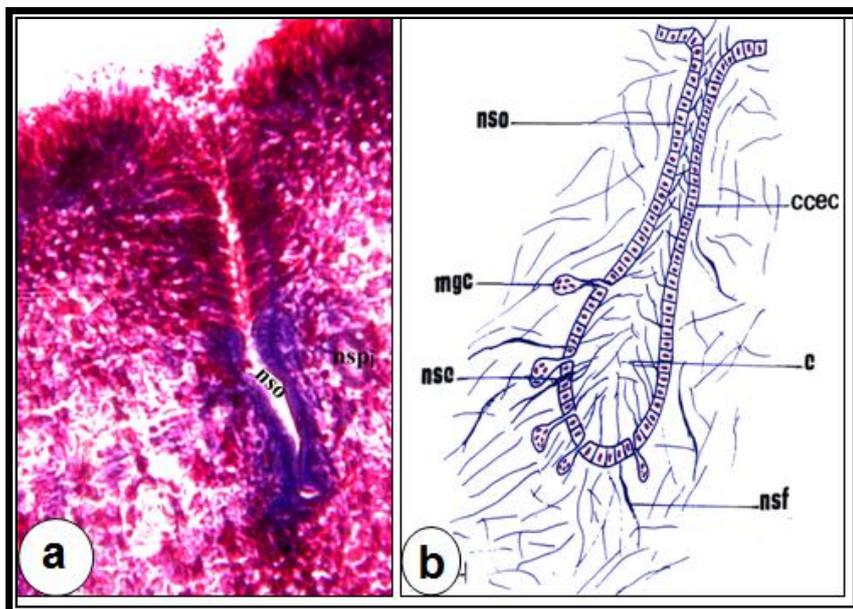


Fig.(2): Part of peripheral part of head region of *B. kewense* showing an enlarged L.S. of neuro-sensory organ (a) Photomicrograph, **nso** = sensory organ and **nspi** = neuro-sensory pit (b) diagrammatic representation, **mgc** = mucous gland cells, **ccec** = ciliated columnar epithelial cells, **nsf** = neuro-sensory fibres, **mgc** = mucous gland cells, **c** = cilia (H&E., X=320).

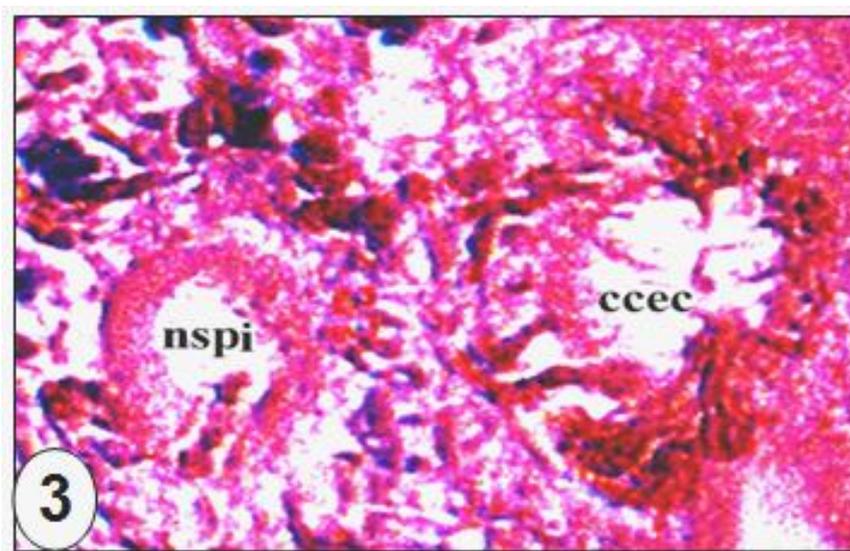


Fig.(3): Photomicrograph of a part of T.S. of the head region of *B. kewense* showing an enlarged tube of neuro-sensory pit (nspi) that lined by ciliated columnar epithelial cells (ccec) (H&E., X=880).

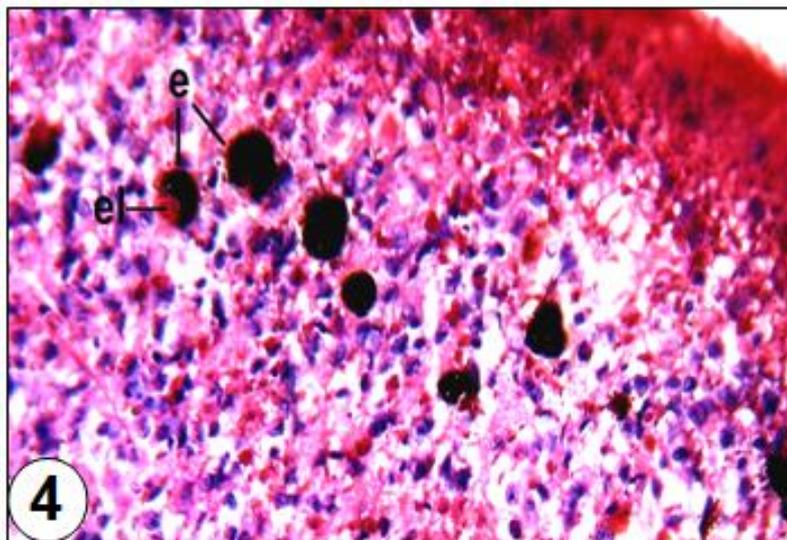


Fig.(4): Photomicrograph of a part of T.S. of the head region of *B. kewense* showing an enlarged eyespot (e) that is black in colour and eye lens (el) that is half moon-shaped (H&E., X=600).

IV. REFERENCES

- [1] Ali, A. S., Biological, histological, physiological and ultrastructural studies on terrestrial turbellarian *Bipalium kewense*, 1st record in Egypt. *Ph.D Thesis, Ain Shams University, Cairo, 2008.*
- [2] Cork, J., Shovel-headed Garden Worm. Australian Museum contact forms. Available online at <http://australianmuseum.net.au/Shovel-headed-Garden-Worm>, 2009.
- [3] Esser, R.P., Land planarians (Tricladida: Terricola), *Contribution no. 227, Bureau of Nematology, Fla. Dept. Agric. Consumer Services, Division of Plant Industry, Gainesville, Fl, 1981.*
- [4] Hyman, L.H., Native and introduced land planarians in the United States. *Science, 92, 1940, pp.105-106.*
- [5] Jones, H.D. and Gerard, B.M., A new genus and species of terrestrial planarian (Platyhelminthes; Tricladida; Terricola) from Scotland, and an emendation of the genus *Artioposthia*. *Journal of Natural History. 33 (3), 1999, pp. 387-394.*
- [6] Moseley, H.N., Notes on the structure of several forms of land planarians with a description of two new genera and several new species, and a list of all species at present known. *J. Microsc. Sci. 17, 1878, pp. 273-292.*
- [7] Reynolds, E.S., The use of lead citrate at high pH as an electron opaque stain in electron microscopy. *J. Cell Biol. 17, 1963, pp. 208-212.*
- [8] Winsor L., Pseudoparasitism of domestic and native animals by geoplanid land planarians. *Aust. Vet. J. 56, 1980, pp. 194-199.*
- [9] Winsor L., Vomiting of land planarians (Turbellaria: Tricladida : Terricola) ingested by cats. *Australian Veterinary Journal, V. 60, (9) 1983.*
- [10] Winsor, L., Land planarians (Turbellaria: Tricladida: Terricola). Introduced into Australia *Bipalium kewense* (Moseley, 1878). *Victorian Nat. V. 103 (3) 1985.*
- [11] Winsor, L., A revision of the cosmopolitan land planarian *Bipalium kewense* (Turbellaria: Tricladida: Terricola). *Zoological Journal of the Linnean Society 79, 1997, pp. 61-100.*