

Nematodes were readily identified when cut obliquely or along their longitudinal axis so that some of their internal organs could be recognised (Fig. 1A). Other nematodes cut in cross section often had their internal organs missing but could still be identified due to the general appearance of the cuticle and its circular form with a diameter corresponding to that of nematodes. In certain situations the width of the nematode annules could be measured and anastomoses observed in the lateral line (Fig. 1D).

This technique could be used to identify the ecological niche occupied by nematodes in different soil types and may help explain why different nematodes species appear to vary in their susceptibility to certain nematicides (Boag, 1979).

## REFERENCES

- BARKER, K.R. & NUSBAUM, C.T. (1971). Diagnostic and advisory programmes. In : Zuckerman, B.M., Mai, W.F. & Rohde, R.A. (Eds). *Plant Parasitic Nematodes* Vol. 1, London & New York, Academic Press : 281-300.
- BOAG, B. (1979). Nematodes associated with carrots in Scotland. *Ann. appl. Biol.*, 93 : 199-204.
- CENT, J. & BREWER, R. (1971). Preparation of thin sections of soil materials using synthetic resins. *C.S.I.R.O., Australia, Div. Soils, Techn. Paper No. 7.*
- FITZPATRICK, A.E. (1970). A technique for the preparation of large thin sections of soils and unconsolidated materials. In : Osmond, D.A. & Bullock, P. (Eds) : *Micromorphological techniques and applications*. Agr. Res. Council, Soil Survey, Harpenden (U.K.) Techn Monogr. No. 2 : 3-31.
- HEATH, J., BROWN, D.J.F. & BOAG, B. (1977). *Provisional Atlas of Nematodes of the British Isles*. Biological Records Centre, Abbots Ripton, England, 76 p.
- JONES, D. & GRIFFITHS, E. (1964). The use of thin soil sections for the study of soil micro-organisms. *Pl. Soil*, 20 : 232-240.
- JONES, F.G.W., LARBEY, D.W. & PARROTT, D.M. (1969). The influence of soil structure and moisture on nematodes, especially *Xiphinema*, *Longidorus*, *Trichodorus* and *Heterodera* spp. *Soil Biol. Biochem.*, 1 : 153-165.
- JONGERIOUS, A. & HEINTZBERGER, G. (1975). Methods in soil micro-morphology. A technique for the preparation of large thin sections. *Soil Survey Papers No. 10*, Netherlands Soil Survey Institute, Wageningen.
- PITCHER, R.S. (1967). The host-parasite relations and ecology of *Trichodorus viruliferus* on apple roots, as observed from an underground laboratory. *Nematologica*, 13 : 547-557.
- ROBERTSON, L. & NORMINGTON, J.H. (1976). Attachment for lapping consolidated materials with particular reference to the preparation of soil thin sections. *Lab. Prac.*, 25 : 470-471.

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A FURTHER OBSERVATION ON SPERM STRUCTURE IN A *HETERODERA* SP.

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Spermatogenesis and the ultrastructure of sperm in some cyst nematodes has been described by Shepherd, Clark and Kempton (1973). These authors noted differences in the condensation of the nucleus during spermatogenesis between members of the then subgenera *Heterodera* (*Heterodera*) and *H.* (*Globodera*). More recently Behrens (1975) and

Mulvey and Stone (1976) proposed that these subgenera (*Globodera* and *Heterodera*) be raised to generic rank and in support cited the differences in sperm development described by Shepherd, Clark and Kempton (1973), and other ultrastructural studies. During their studies of spermatogenesis in cyst nematodes Shepherd *et al.* (unreported) searched

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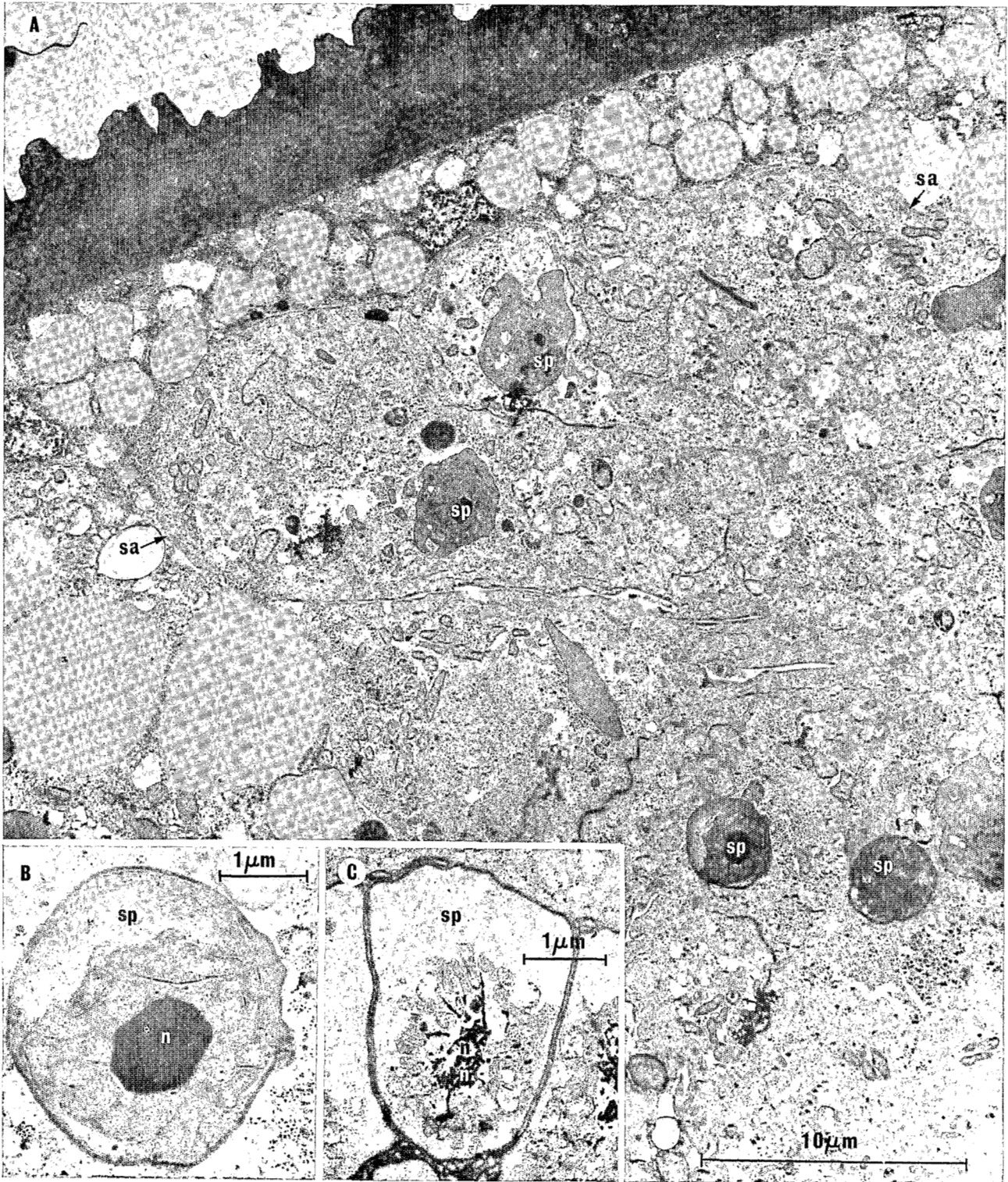


Fig. 1. A : Spermatozoa (sp) in the spermatheca (sa) of *H. goettingiana*, ( $\times 4500$ ). B : An enlargement of one of the spermatozoa (sp) showing the nuclear material (n) in the condensed state ( $\times 15000$ ). C : A spermatozoon (sp) of *Globodera rostochiensis* in the female reproductive tract showing the nuclear material (n) in the coarsely stranded state ( $\times 14000$ ).

Table 1  
Morphology of nucleus in members of the genus

STAGE OF SPERMATOGENESIS	<i>Globodera</i>	<i>Heterodera</i>
Spermatogonium	membrane-bound ovoid nucleus	membrane-bound ovoid nucleus
Spermatocyte	chromatin in shadowy patches	chromatin in shadowy patches
Spermatid	chromatin homogeneous, electron-dense, no nuclear membrane	chromatin homogeneous, electron-dense, no nuclear membrane
Mature spermatozoon in male	<i>beaded filamentous until near cloaca then homogeneous, electron-dense</i>	<i>homogeneous, electron-dense</i>
Mature spermatozoon in female	electron-dense on entry, changing to <i>coarsely stranded</i>	<i>homogeneous electron-dense</i>

for but were unable to find spermatozoa in the female reproductive tract of the members of the genus *Heterodera* examined.

Whilst studying the intracellular rickettsia-like micro-organisms in cyst nematodes (Walsh, 1979, 1981), spermatozoa were observed in the spermatheca of the pea cyst-nematode, *H. goettingiana*. This note describes these spermatozoa and reveals a further difference between the members of the genera *Globodera* and *Heterodera* studied.

Females of *H. goettingiana* were obtained and prepared for electron microscopy as described by Shepherd, Clark and Dart (1972).

Fig. 1A shows spermatozoa (sp) in the spermatheca (sa) of *H. goettingiana*; 1B is an enlargement of one of these spermatozoa showing the nuclear material (n) in a condensed state. This represents another difference between the members of the genera *Globodera* and *Heterodera* that have been studied because in *G. rostochiensis* the nuclear material (n) of the spermatozoa is "coarsely stranded" by the time it reaches the spermatheca (Fig. 1C). This coarsely stranded appearance and the beaded filamentous appearance (Tab. 1) of *Globodera* sperm nuclei have never been observed in *Heterodera* spermatozoa. Infection of spermatozoa by the rickettsia-like organisms does not seem to affect the structure of the nuclear material; the condensed state of the nucleus has been seen in infected (Fig. 1 A & B) and uninfected (Triantaphyllou & Hirschmann, 1962) *Heterodera* spermatozoa and the stranded state has also been seen in spermatozoa from an infected (Fig. 1C) and an uninfected (Fig. 7c in Shepherd, Clark & Kempton, 1973) population of

*Globodera rostochiensis*. The morphology of the sperm nucleus during the stages of spermatogenesis described by Shepherd (1981) are summarized in Table 1 for the members of the genera *Globodera* and *Heterodera* studied and differences are in italics.

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#### REFERENCES

- BEHRENS, E. (1975). *Globodera* Skarbilovich, 1959, eine selbständige Gattung in der Unterfamilie Heteroderinae Skarbilovich, 1947 (Nematoda : Heteroderidae). 1. Vortragsstagung zu Aktuellen Problemen der Phytonematologie am. 29-5-1975 in Rostock, 12-26.
- MULVEY, R.H. & STONE, A.R. (1976). Description of *Punctodera maladorensis* n. gen., n. sp. (Nematoda : Heteroderidae) from Saskatchewan with lists of species and generic diagnoses of *Globodera* (n. rank), *Heterodera* and *Sarisodera*. *Can. J. Zool.*, 54 : 772-785.
- SHEPHERD, A.M. (1981). Interpretation of sperm development in nematodes. *Nematologica*, 27 : 122-125.
- SHEPHERD, A.M., CLARK, S.A. & DART, P.J. (1972). Cuticle structure in the genus *Heterodera*. *Nematologica*, 18 : 1-17.