Observations on the morphology and histopathology of *Quinisulcius acti* on corn

Nicola Vovlas

Istituto di Nematologia Agraria, C.N.R., 70126 Bari, Italy.

Summary

The original description of *Quinisulcius acti* (Hooper, 1959) Siddiqi, 1971 is amplified and supplemented with observations by light microscope and scanning electron microscope (SEM). The main characters added to those already reported for this species are the irregular areolations on the lateral field of the anterior part of the body ; the slightly fourlobed shape of the head ; the well-developed hemizonid and the inner incisure of the lateral field on the tail which does not end at the phasmid level, but is present for all the lenghth of the lateral field in the posterior portion. *Q. acti* has semi-endoparasitic habits on the feeder roots of corn and causes lesions and cavities in epidermal, subepidermal and cortical tissue.

Résumé

Observations sur la morphologie et l'histopathologie de Quinisulcius acti *sur maïs*

La description originale de *Quinisulcius acti* (Hooper, 1959) Siddiqi, 1971 est étendue et complétée grâce à des observations au microscope optique et au microscope électronique à balayage (SEM). Parmi les nouvelles caractéristiques de cette espèce, les principales sont constituées par les aréolations irrégulières du champ latéral observées à la partie antérieure du corps, la forme légèrement quadrilobée de la tête, l'hémizonide bien développé et l'incisure interne du champ latéral qui ne se termine pas au niveau de la phasmide mais est présente dans toute la partie postérieure du champ latéral. *Q. acti* est un endoparasite des racines nourricières du maïs et provoque des lésions et des cavités dans les tissus épidermique, subépidermique et cortical.

The genus *Quinisulcius* was established by Siddiqi (1971) and on that occasion, *Tylenchorhynchus acti* Hooper, 1959, and other species with five lines in the lateral field were included in this genus. Populations of *Q. acti* are reported from Chiavari, Genoa, Italy, around roots of *Phoenix dactylifera*, and from rhizosphere of *Bambusa* sp., in Mexico (Loof, 1959 ; Knobloch & Laughlin, 1973).

During 1981 a nematode survey of corn (*Zea mays* L.) was made in sandy soil fields along the Adriatic coast of Italy. High population densities (1,850-2,600 nematodes/kg of soil) of *Q. acti* were found in the fields close to the entrance of the Po river to the Adriatic Sea. No observations with scanning electron microscope (SEM) have been made on members of the genus *Quinisulcius*, and there is also lack of biological information on *Q. acti*. This paper describes characters of this species as seen by light and scanning electron microscope (SEM) and gives information on the pathological effects of the nematode feeding activity on corn roots.

Materials and methods

Specimens were obtained from soil around roots of corn growing in Lido di Volano, Ferrara, and from glasshouse cultures on corn hybrid Dekalb-XL-41 at Bari. Females were collected from soil by Cobb sieving and decanting method, killed and fixed in hot aqueous solution of 4% formaldehyde plus 1% propionic acid, dehydrated slowly in an ethanol saturated chamber and mounted in dehydrated glycerin (see Southey, 1970 for general techniques).

Several specimens were killed and fixed in TAF, transferred to 1% osmium tetroxide (OsO_4) solution for 12 hours and then infiltrated with Spurr's resin and coated with gold by the method of De Grisse

(1973). Ethanol was used for dehydration instead of acetone.

Clay pots, containing 500 g of steam pasteurized loam soil and one corn seedling, were inoculated with 500 specimens/pot of *Q. acti*.

For histological observations small segments (4-5 mm long) of corn hybrid Dekalb-XL-41 roots collected two and four weeks after inoculation were washed free of soil fixed in chrome-acetic-formalin solution for 48 hours, dehydrated in tertiary butyl alcohol, stained in Safranin and fast-green and mounted in dammar xilene (Johansen, 1940).

Results

Measurements and morphology

Measurements of *Quinisulcius acti* (Hooper, 1959) Siddiqi, 1971, from corn fields collected in Volano (Ferrara), Northern Italian Adriatic coast, are as follows :

Females (n = 25). L = 690 (641-730) µm ; a = 33 (31-35) ; b = 4.9 (4.1-5.3) ; c = 15 (13-16) ; stylet = 16 (15-17) µm ; V% = 56 (54-57) ; MB = 51 (57-60) ; c′ = 3.0 (2.8-3.2) ; m = 46 (43-50) ; O = 17 (18-19) ; phasmids = 32 (31-34) µm from terminus ; tail annules = 46 (42-51).

Light microscope and SEM observations have shown that the body of this species is cylindrical, tapering at both ends (Figs. 2 B, E) assuming an open C-shaped when killed by gentle heat (Fig. 1 B). Head hemispherical in profile with eight distinct postlabial annules, clearly separated from the body by a distinct lip constriction (Fig. 2 A, B). The head region is divided into two halves by a dorsal and ventral hollow assuming a four-lobed shape ; each half is subdivided by shallower grooves that delimit the two lateral sectors, these being smaller than the subdorsal and subventral sectors (Fig. 2 A). Body annules fine, about 1.2 µm wide at mid body. The lateral fields have five incisures, 6-7 µm wide, and occupy 30% of body width (Figs. 1 D, 2 C, D). Anteriorly the lateral fields begin at 12th-15th body annule as two or three bands forming 3-4 incisures, and after another 5-10 annules show the 5th incisure. Irregular areolations of the lateral field are present only on the anterior part of the body ; the arealotions usually correspond with the body annulations (Fig. 2 B). No longitudinal striations are present on the body annules outside the lateral field, and in the lateral field the middle incisure does not end at the phasmid level (Fig. 2 C) as originally described for *Q. acti* by Hooper (1959), but continues until the lateral field ends near the tail terminus. Stylet slender, with well-developed knobs (3 µm wide) with anterior faces inclined posteriorly as illustrated (Fig. 1 A). Median oesophageal bulb ovoid ; nerve ring encircling oesophagus near middle of isthmus. Hemizonid distinct, 2-3 annules long, two annules anterior to opening of excretory pore. Basal oesophageal bulb saccate which extends in length for about a body width. Dorsal oesophageal gland opens 2.4 µm behind the stylet base. Excretory pore located 121 µm (119-128) from the anterior end. Tail conoid (44-48 µm), bluntly pointed with a characteristic enlarged tip (Fig. 1 C), bearing 46 (42-51) annules (Fig. 2 E). Phasmids conspicuous, opening at 32 µm (31-34) from terminus (Figs. 1 C, 2 E). The anal opening is located 44-48 µm from terminus and is visible by SEM as a small pore about an annule width in diameter (Fig. 2 F).

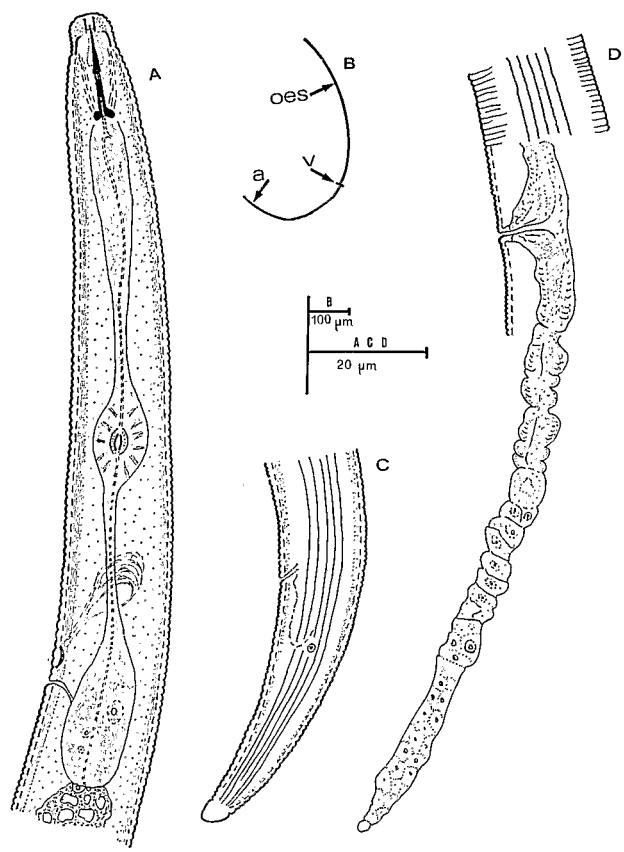

Fig. 1. *Quinisulcius acti*. A : Female oesophageal region. B : « Habitus » when killed by heat. C : Female tail. D : Female reproductive tract (oes = oesophageal-intestinal valve ; V = vulva ; a = anus).

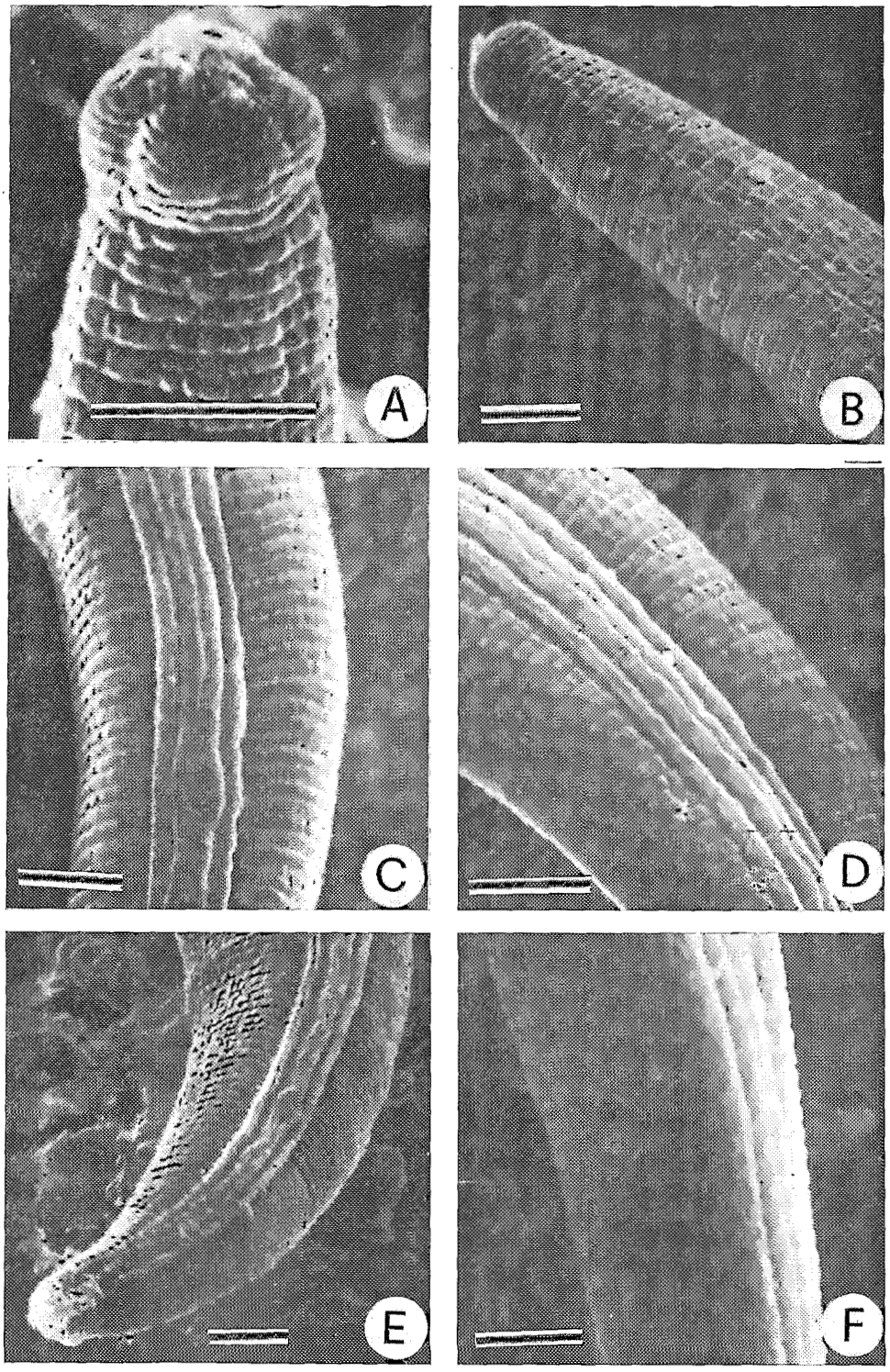

Fig. 2. *Quinisulcius acti*. SEM micrographs. A : Head region. B : Female body anterior region. C : Lateral view of the tail at the phasmid level. D : Annulation and lateral field of female body. E : Female tail. F : Ventral view of tail portion around anus (Scale bar = 5 µm).

PARASITIC HABITS

Q. acti has been observed in semi-endoparasitic feeding position on fifteen-day-old seedling roots of corn. The surface of infested roots showed numerous irregular brown necrotic lesions, due to the nematode feeding activity. Examination of nematode infected corn root cross sections showed that the anterior portion of the nematode penetrates through the epidermal cells and the outer layers of the cortex (Figs. 3 A-B). Usually brown lesions and cavities were observed in tissues near the nematode. Necrotic (as indicated by positive safranin stain) and collapsed epidermal and subepidermal cells with thickened walls were observed at the nematode feeding sites (Fig. 3 A, B). The nematode damage seemed to be limited to epidermal and cortical tissues without any evidence of vascular alterations.

Corn appears to be a suitable host of *Q. acti* and an average of 18,750 nematodes/kg soil were obtained by culturing the nematode for four months on corn hybrid seedlings inoculated with one nematode/g soil and maintained in glasshouse at 24-28° of temperature and 65-75% of humidity. The detrimental effect of this nematode on the growth and yield of corn are unknown. Further studies are needed on its pathogenicity, threshold limits, and influence of population densities.

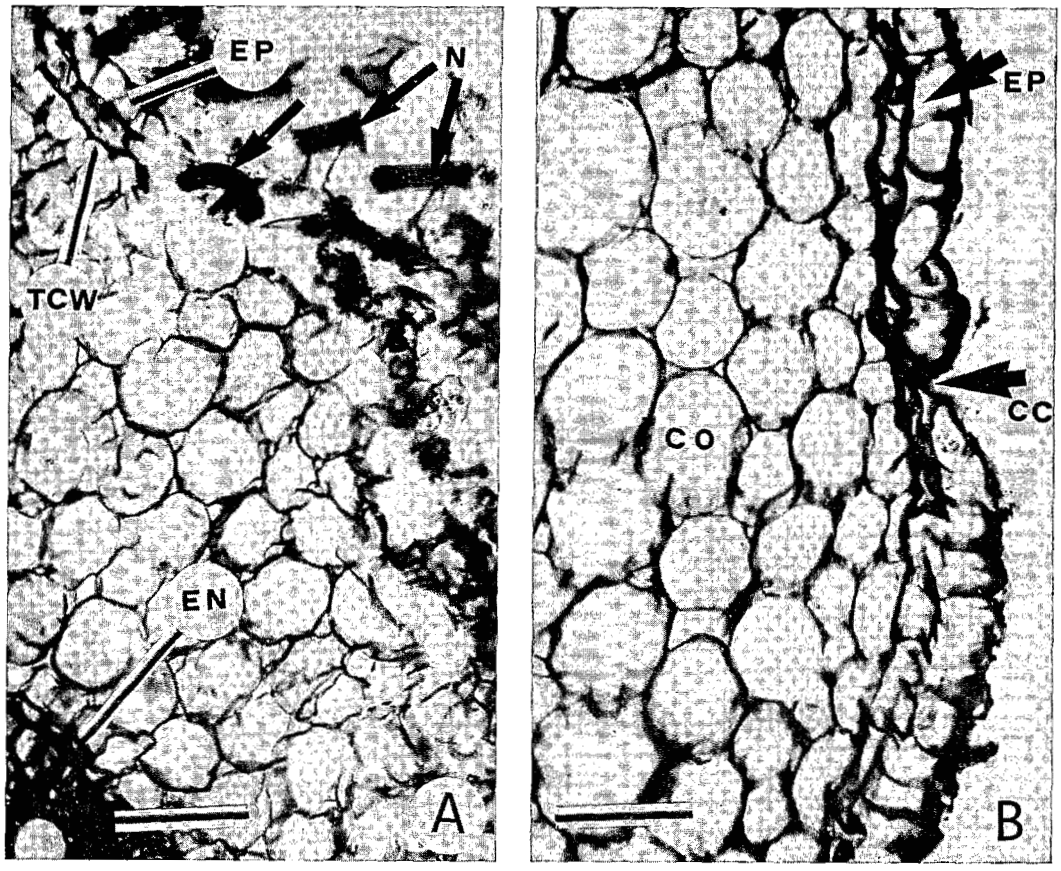

Fig. 3. Corn roots infected by *Quinisulcius acti*. A-B : Root cross sections showing cavities (CA), thickened cell wall (TCW), necrosis and collapse of epidermal and subepidermal cells (CC) due to the infection of *Q. acti* (N), (EP = epidermis ; EN = endodermis ; CO = cortex) (Scale bar = 100 μm).

References

De Grisse, A. (1973). A method for preparing nematodes and other soft tissues for SEM. *Meded. Fac. Landb. Wet. Rijksuniv. Gent*, 38 : 1685-1703.

Hooper, B.E. (1959). Three new species of the genus *Tylenchorhynchus* (Nematoda : Tylenchida). *Nematologica*, 4 : 23-30.

Loof, P.A.A. (1959). Miscellaneous notes on the genus *Tylenchorhynchus* (Tylenchinae : Nematoda). *Nematologica*, 4 : 294-306.

Johansen, D.A. (1940). *Plant microtechnique*. New York, McGraw-Hill, 523 p.

Accepté pour publication le 18 juin 1982.

Knobloch, N.A. & Laughlin, C.W. (1973). A collection of plant parasitic nematodes (Nematoda) from Mexico with descriptions of three new species. *Nematologica*, 19 : 205-217.

Siddiqi, M.R. (1961). Studies on *Tylenchorhynchus* spp. (Nematoda : Tylenchida) from India. *Z. Parasitkde*, 21 : 46-64.

Siddiqi, M.R. (1971). Structure of the oesophagus in the classification of the superfamily Tylenchoidea (Nematoda). *Indian J. Nematol.*, 1 : 25-43.

Tarjan, A.C. (1964). A compendium of the genus *Tylenchorhynchus* (Tylenchidae : Nematoda). *Proc. helminth. Soc. Wash.*, 31 : 270-280.