

# Histopathogenesis of Galls Induced by *Subanguina radicola* on *Poa annua* Roots

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## ABSTRACT

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The histopathology of galls induced on *Poa annua* was examined on serial sections prepared from roots infested by an English population of *Subanguina radicola*. Mature galls (0.4–5 mm wide), characterized by a hyperplastic cortex, contained five to 10 more cell layers than healthy cortical parenchyma. Their cavities were filled with nematodes surrounded by cells with multinucleolate nuclei and necrotic walls. The alterations observed were similar to those induced by *Anguina* spp. and *Nothanguina* spp. on the epigeal organs of their hosts.

Galls induced by *Subanguina radicola* (Grf.) Param. are common on roots of several grasses and cereals in infested fields of northern Europe and Canada.

Among economically important graminaceous plants, barley and rye are naturally infested and damaged by this nematode. Wheat and oats also have been found to

be susceptible in experimental conditions (1,4,7,9).

Goodey (2) described the morphology of *S. radicola* and showed that nematodes extracted from roots of *Elymus arenarius* L. could produce galls on barley and *Poa annua* roots. Goodey (3) also described with detailed drawings the structure of galls caused by this nematode on *E. arenarius*.

## MATERIALS AND METHODS

Morphological and histological observations of root galls of *Poa annua* L. (a common weed in wheat fields) infested by an English population of *S. radicola* are illustrated in this paper. Roots were fixed in formalin-acetic acid-alcohol solution,

dehydrated in a tertiary butyl alcohol series and embedded in paraffin. Galled roots were sectioned at 15–18  $\mu$ m transversely or longitudinally with a rotary microtome, and stained with Safranin and fast-green for microscopic examination (5).

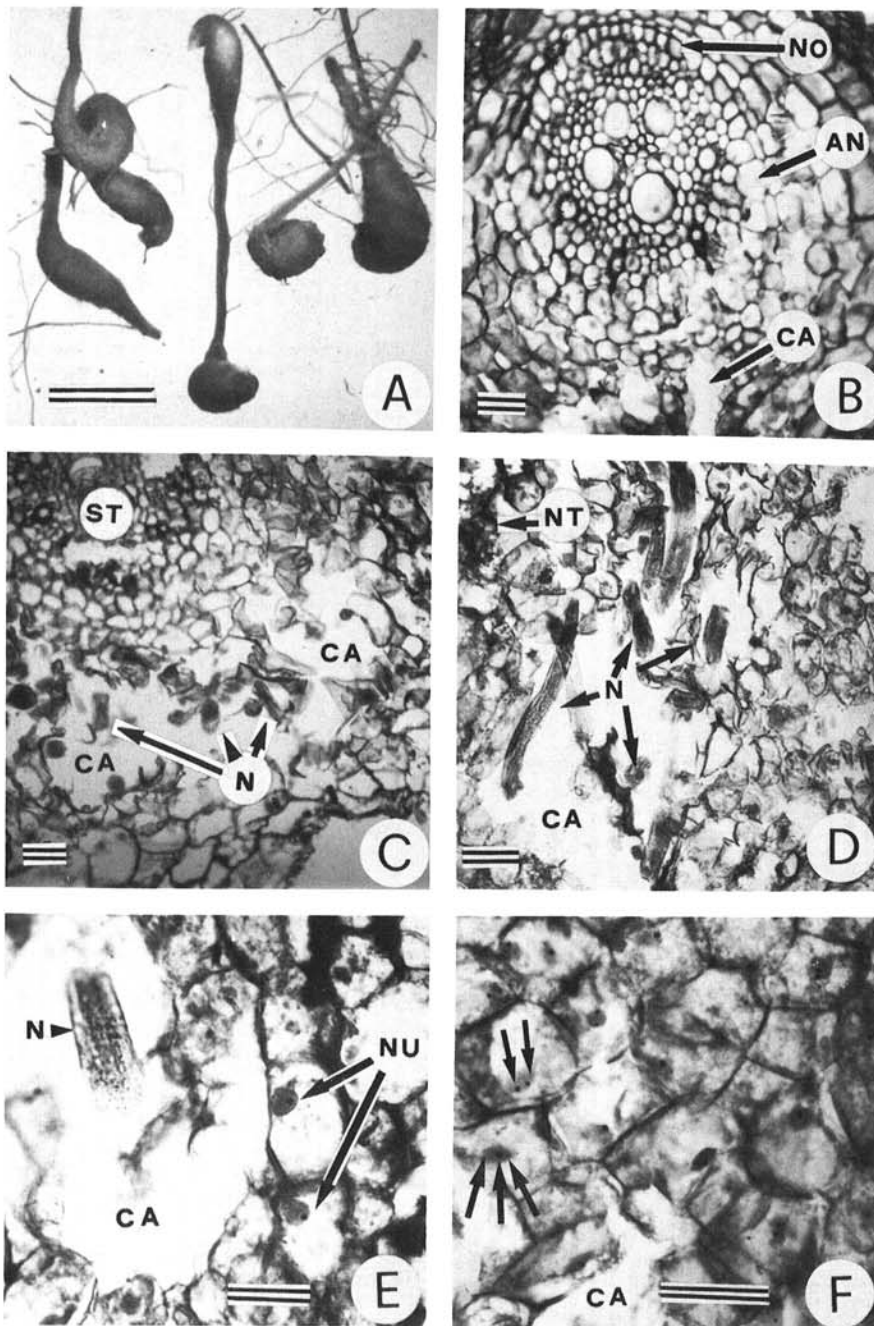
## RESULTS AND DISCUSSION

**Morphological and histological observations.** The galls formed on *P. annua* were spheroidal or elongate, from 0.4 to 5 mm wide. They could be found either on the root apex or on the axis, and sometimes they had numerous lateral roots (Fig. 1A). Swollen and twisted root tips occurred when hypertrophic tissues coalesced (Fig. 1A). Histological observations of nematode-infested roots showed a hyperplastic cortex that contained five to 10 more cell layers than healthy cortical parenchyma. Nematode feeding induced formation of large intercellular spaces and cavities surrounded by cells with necrotic walls in the cortex (Fig. 1B–D). All nematode stages were present in the hyperplastic parenchyma (Fig. 1C). Numerous cortical cells with granular cytoplasm and hypertrophic

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**Fig. 1.** Morphological and histological changes induced by *Subanguina radicolica* in *Poa annua* roots. (A) Roots deformed by the galls induced by the nematode. (B) Transverse section of gall showing hypertrophic pericycle cells (AN) and asymmetry of the central cylinder; NO = normal pericycle cells, CA = cavity. (C and D) Root, TS, and longitudinal section (LS) respectively, showing cavities (CA), nematodes (N), ST = stele, and necrotic tissues (NT) in the hyperplastic parenchyma. (E) TS of root showing cells with granular cytoplasm and hypertrophic nuclei (NU) at the periphery of a cavity (CA) containing part of a nematode (N). (F) TS of root showing cavities (CA) surrounded by granular cells with multinucleolate nucleus (nucleoli arrowed). Scale bars: (A) 6 mm; (B-F) 50  $\mu$ m.

nuclei and nucleoli were present at the peripheries of the cavities (Fig. 1E and F). Multinucleolate nuclei (with two or three nucleoli) were also common in the damaged area (Fig. 1F).

In addition to the large cavities that occurred in the cortex, collapsed and enlarged cells were present in the endodermis, pericycle and vascular parenchyma, causing asymmetry of the central cylinder (Fig. 1B). These structural changes inhibited root function and consequently decreased plant growth.

The histological changes seen in *P. annua* are similar to those reported for epigeal parts of plants infested by *Anguina* spp. and *Nothanguina* spp. (6,8), especially in the formation of hyperplastic cells with a multinucleolate nucleus. The endoparasitic habit supports the placing of this species in the genus *Subanguina* as proposed by Paramonov (7) rather than in the largely ectoparasitic genus *ditylenchus*, where it was left by Hooper and Southey (4).

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