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INFESTATION OF *HETERODERA SCHACHTII* ON SUGARBEET STORAGE ROOTS

by

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Studies on the parasitism of the sugarbeet cyst nematode, *Heterodera schachtii* Schmidt, indicate that this parasite attacks the feeder roots of the sugarbeet (*Beta vulgaris* L. var. *saccharifera* Alefeld). Franklin (1951) observed that sometimes a few females may also occur on the tap roots and Steele (1971) found larvae of the nematode inside sugarbeet seedling tap roots, but not in large or fully grown tap roots. He used slices of storage roots as a substratum to culture *H. schachtii* and noticed that the nematode did not develop on tissues close to periderm (Steele, 1972). Therefore he assumed that the periderm might act as a barrier to the nematode and that infestations observed in large tap roots could have been facilitated by the parasitic action of fungi and bacteria which overcome the periderm defence. Other attacks of the sugarbeet cyst nematode on storage roots were observed in Northern Italy (Tacconi, 1977, personal communciation) and in the Fucino area in November 1976. Heavy infestations were again noticed in October 1977 on mature tap roots harvested in the same area. Several large storage roots were completely covered by a layer of white females and cysts, while in others the infestation was confined to a restricted area (Fig. 1). When the roots were pulled from the soil few nematodes remained attached which might explain why the infestation of the storage roots is often overlooked.

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Because of the heavy infestation detected on the storage roots further investigations have been conducted on the damage caused by this nematode on the host tissues.

MATERIALS AND METHODS

Portions, 10 x 15 mm wide, of the outer parts of an infested storage roots were fixed for 48 hrs in FAA (formalin-acetic acid-chromic acid), then dehydrated in an ascending series of tertiary butyl alcohol solutions and embedded in paraffin. Longitudinal and transverse sections, 15 μm thick, were mounted on microscope slides, stained with safranin and fast green, according to the Johansen's method and observed with the aid of a compound microscope.

Additionally, attempts were made to isolate eventual parasite fungi from the same roots. The behaviour of the nematode was also studied in a greenhouse experiment. Cysts of *H. schachtii* collected from storage roots growing in an infested field were added to steam sterilized soil in 18 cm diameter clay pots. Sugarbeet seeds were sown in the inoculated soil and the pots maintained in a greenhouse at 20-24°C. The plants were harvested two months after inoculation to localize the sites of nematode infestation in the root system.

Fig. 1 - Large sugarbeet storage root showing one area covered by cysts and females of *Heterodera schachtii.*

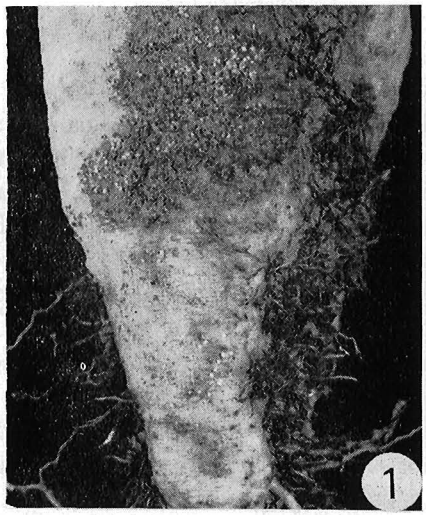
Fig. 2 - Cross section of storage root in which the outer layer (Exp), xylem (x), periderm (Ep) and one female (Hs) of *H. schachtii* are evident.

Fig. 3 - Longitudinal section of a storage root with 3 syncytia (s): two of them are necrotic.

Fig. 4 - Cross section of a syncytium (s) showing interruption of the cell walls and many nuclei spread in the granular cytoplasm.

Fig. 5 - Cross section of the tap root with larva (N) and syncytium in early stage close to the head of the nematode.

Fig. 6 - Syncytium with cell walls thickened and hypertrophic nuclei (NU 2) compared to the normal nuclei (NU 1) of the healthy cells.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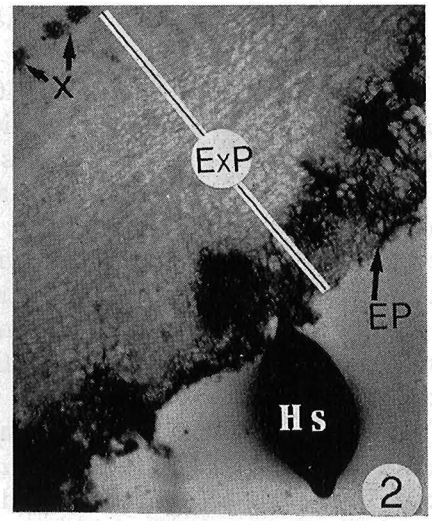
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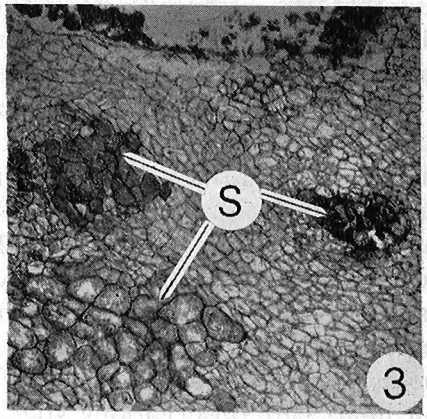
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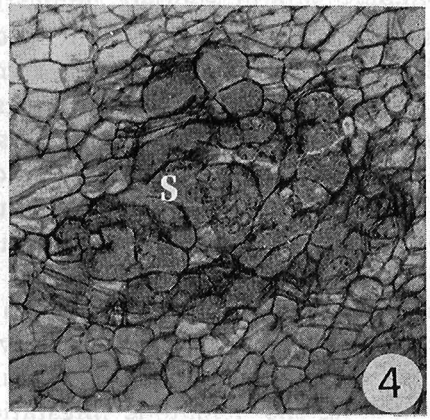
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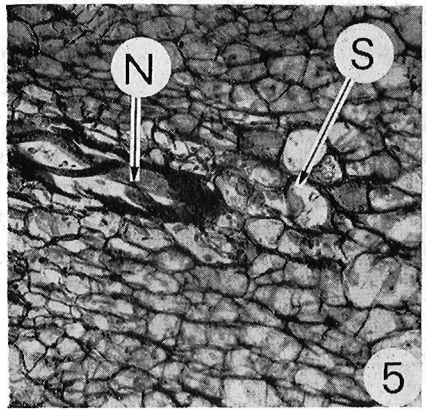
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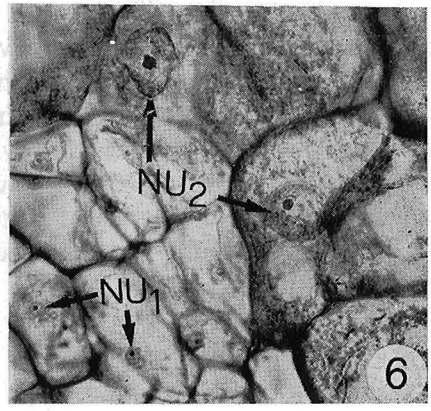
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RESULTS AND DISCUSSION

The nematode's feeding activity is confined to the outer part of the root (Fig. 2), namely the periderm and outer two layers of secondary xylem. These latter layers according to Esau (1960) are not well differentiated and do not stain well. The storage root tissues reacted in the usual way to the penetration of the nematode, i.e. they induced the formation of syncytia, characterized by thick cell walls, many large nuclei and granular cytoplasm (Figs. 3-4). In instances of heavy infestation the syncytia were found on the outermost part of the tap root and when they become necrotic cambial cell activity decreased.

In the greenhouse experiment, two months after inoculation, white females and cysts of *H. schachtii* were detected in the storage roots of the sugarbeet plants and also, in greater numbers, in the secondary lateral rootlets, indicating that the nematode population used did not have a preferred feeding site and can invade independently both storage roots and lateral rootlets of the infested plants.

In the field, the storage roots at harvest were of normal size, suggesting that the nematode infestation occurred late in the season, while the intensity of the infestation pointed to a high soil inoculum at sowing time. The soil temperature recorded at 20 cm was 15-19°C from May to September, with a maximum of 21°C in July and 9-12°C in October. Our investigations in other infested fields have shown that *H. schachtii* can reproduce on sugarbeet feeder roots throughout the entire growing season. Thus, we conclude that the increased temperatures during summer time (June-August) were not important for stimulating the nematode infestation later. Our observations suggest that lower population densities at planting would increase by one or two generations, giving rise to heavy infestations on the storage roots.

Histological examination of the tap root tissues invaded by the nematode shows that the host-parasite relationships are similar to those seen in the feeder roots. No evidence was obtained of the presence of pathogenic bacteria or fungi which may have facilitated the invasion of the nematode through the periderm barrier (Steele, 1972) and if they do occur it would seem that this is rarely rather than usually.

SUMMARY

A case of heavy infestation by the sugarbeet nematode, *Heterodera schachtii* Schmidt, on sugarbeet storage roots is reported. Histological examination of the infested root shows normal host-parasite relationships. No pathogenic fungi were associated with the infestation. We feel that the reported infestation on storage root is a characteristic behaviour of this population of the nematode.

RIASSUNTO

Infestazioni di Heterodera schachtii *su fittoni di Barbabietola da zucchero.*

Viene segnalato un caso di grave infestazione di *Heterodera schachtii* su fittoni di Barbabietola da zucchero. Le alterazioni istologiche indotte dal nematode e le interrelazioni esistenti tra ospite e parassita non sono state differenti da quelle descritte nel caso di attacchi delle radici laterali. Nei fittoni infestati non sono state notate infezioni di funghi parassiti. Viene esclusa, inoltre, l'influenza di particolari condizioni di temperatura sul comportamento di questa popolazione del nematode che preferisce insediarsi sul fittone delle piante infestate.

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