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THE SUGARBEET CYST NEMATODE IN ITALY: DISTRIBUTION, YIELD LOSSES AND CONTROL (1)

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Sugarbeet (*Beta vulgaris* L. var. *saccharifera* Alefeld) is one of the major crops in Italy, covering about 250,000 ha. Three quarters of the total acreage is cultivated in the central and northern regions of the country. The Emilia Romagna region alone grows half of the Italian sugarbeets. In southern Italy, only in the Province of Foggia (Puglia), this crop plays an important role in several farms. Unfortunately many pests and diseases have been shown to cause severe yield losses to sugarbeet all over the country. Among them the sugarbeet cyst nematode, *Heterodera schachtii*, is reported as a pathogen in many regions.

Geographic distribution and economic importance

Distribution of *H. schachtii* is clearly related to cropping systems. The more intensively the sugarbeet is cultivated the higher are its population densities in the fields. The nematode has been reported from Veneto, Emilia Romagna, Abruzzi, Piemonte and Toscana, and is believed to infest 20% of the crops (Tacconi and Olimpieri, 1983). In a microplot experiment (Greco *et al.*, 1982 b) the tolerance limit of sugarbeet to the nematode was estimated at 1.8 eggs/g of soil and

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75% of the yield was lost at population densities of 32 eggs/g of soil. The minimum yield, at very large population densities, was 5% of that obtained in noninfested microplots.

In the Conca del Fucino (Abruzzi), an area of 15,000 ha, nearly all fields are infested with the nematode and in many of them sugarbeet is badly damaged, the yield losses averaging 25%. In Veneto region, according to a survey done in 1983, 52% of the sugarbeet fields, mainly in the province of Rovigo, were found infested. However, population densities of the nematode never exceeded 16 eggs/g soil and an average yield loss of 2% was estimated. In Emilia Romagna, the beet cyst nematode is considered a major parasite in the provinces of Bologna, Ferrara and Ravenna, where sugarbeet is more intensively cultivated. *H. schachtii* also occurs in Puglia, but it is only spread in a limited coastal area around the Lesina lake (Foggia), where population densities as large as 60 eggs/g of soil have been detected at sowing. In this area sugarbeet is also rotated with cauliflower, a very good host of *H. schachtii*, on which, too, very high yield losses have been noticed. Its effect on the yield is not known in Piemonte and Toscana, although the nematode occurs. In other regions, where sugarbeet is cultivated in limited areas, the beet cyst nematode has not been reported to our knowledge.

Biology

Investigations carried out by Greco *et al.* (1982 a) and Tacconi (1982) demonstrated that three generations of *H. schachtii* may occur in Italy in a growing season, the first one being completed by the end of June, the second by early August and the third by the beginning of October, each one taking about 294 day degrees above the basal temperature of 10° C. Soil temperatures and soil moisture content play important roles in the life cycle of the nematode. More second stage juveniles were observed in soils and sugarbeet roots after rainfalls. Microplot studies (Greco *et al.*, 1982 b) indicated that a maximum reproduction rate of 300 may occur. Although hatching of eggs occurs from cysts collected throughout the year, it is faster in spring when most of the juveniles emerge in four weeks.

Some populations of this nematode do not have a preferred feeding site and can invade both storage roots and lateral rootlets. Severe tap root infestations (Greco and Vovlas, 1979) were observed several

times in different areas, especially in those fields in which sugarbeet had been sown in November. The infested roots were covered with females and cysts, and showed normal syncytia formation and large necrotic areas.

Heterodera schachtii has a very wide host range, including *Chenopodiaceae* and *Cruciferae* species; many of them are weeds of the Italian flora. Among these weeds *Capsella bursa-pastoris* L. Medic. (Shepherd-purse) and *Raphanus raphanistrum* L. (wild radish) have been proved to support good reproduction of the nematode, leading to large populations densities in the soil even in the absence of sugarbeet (Greco and Brandonisio, 1982).

Spreading and survival

Farming machinery and grazing cattle may have played important roles in spreading the beet cyst nematode in the same area. Trucks are generally used for transportation of storage roots to sugar factories which can be in sugarbeet growing areas that are still uninfested. Most of the adhering soil detaches from the beet roots during the transportation and is unloaded in other fields spreading the parasite.

Once the nematode population reaches high densities, several years would be required for its decline to non-damaging levels. Usually a 50% decline per year of the population may be expected under fallow or non host crops. However, spontaneous hatching, fungal parasites (Tribe, 1979), soil moisture content and soil temperature may greatly affect the survival of the nematode in the soil.

Control

Because of severe yield losses caused by *H. schachtii* to sugarbeet, several trials have been done for controlling the nematode (Greco *et al.*, 1978, 1981; Tacconi and Saretto, 1976; Tacconi and Grasselli, 1978). Good control was achieved with the fumigants D-D and Di-Trapex (330 l/ha), Telone II (220 l/ha), and EDB (150 l/ha), which gave yield increases up to 236% in heavily infested fields (56 eggs/g soil). Unfortunately, if the soil has to be treated in March-April, high soil moisture and low temperature may greatly reduce

the diffusion of the fumigants through the soil profile and therefore their effectiveness on nematode control. Treatments done with optimal soil conditions indicated that 74% of the eggs within the cyst can be killed by using 100 l/ha of D-D (Greco *et al.*, 1982) and that rates higher than 400 l/ha did not improve control of the nematode. Ten per cent of the eggs remained viable even at the highest rate (550 l/ha), probably because the fumigant concentration did not reach lethal levels within the toppest layers of the soil. Non volatile nematicides have been shown promise in controlling *H. schachtii* and satisfactory results have been obtained with Aldicarb and Fenamiphos. Rates of 5-10 kg a.i./ha of these chemicals gave remarkable yield increases (up to 243% compared to the controls), mainly when the total rate was splitted in two doses, the first applied 1-2 days before sowing and the other one month after plant emergence. However, when the population density of the nematode is below 15 eggs/g of soil, which is generally the case, the thriftiness of these treatments is questionable. Therefore, attempts have been made to reduce soil population of the nematode by the use of trapping plants and crop rotations. In the Conca del Fucino, planting *Hesperis matronalis* doubled the decline of the nematode population in comparison with fallowed plots. However, this biennial plant has a slow growth during the first year and its value as fodder crop is limited. In two and four years term rotations, planting resistant varieties of *Raphanus sativa* ssp. *oleifera* after wheat, as a crash green manure crop, seemed to favour the decline of the nematode (Tacconi and Olimpieri, 1983). Even if this practice will prove satisfactory, as it appears from other countries (Heijbroek, 1982), intercalary crops are difficult to grow in many Italian regions because of lack of suitable soil moisture for seed germination during summer.

The most useful and economic way of combating the sugabeet cyst nematode, suggested so far in Italy, is the use of a proper rotation. This requires information on the soil population of the nematode. In the Fucino area and in Emilia Romagna, where *H. schachtii* is an important pest of the sugarbeet, farmers may ask the advisory services to sample their fields and be advised on the most suitable rotation. Advisers are persuading farmers to adopt long rotations (4-5 years) and to plant different crops on their farms. Corn, sunflower, alfalfa and some vegetables are among the most convenient crops introduced recently. They induced considerable population decreases of the nematode in the infested areas.

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