

SEASONAL CHANGES IN THE NUMBERS AND STAGES
OF *DITYLENCHUS DIPSACI* (KÜHN) FILIPJEV,
IN SOIL AND HOST PLANTS IN PORTUGAL

by

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The stem and bulb nematode *Ditylenchus dipsaci* (Kühn) Filipjev is widely distributed in Portugal where it attacks several crops. Most work on this species has been concerned with the relationships between the nematode and its environment or on the influence of temperature, moisture and soil type on its distribution in soil (Seinhorst, 1956; Lewis and Mai, 1960; Wallace, 1961 and 1962; Sayre and Mountain, 1962; Webster, 1964; Miyagawa and Lear, 1970). Tseng *et al.* (1968) and Yeates (1972) studied seasonal fluctuation in an alfalfa field and a Danish beech forest, and Caubel (1973) fluctuations in crops of clover and onion plants.

The objective of our work was to study population changes in crops grown under Portuguese conditions.

Materials and Methods

In May 1972 in a field (714 m²) at S. Fipo, Condeixa, field beans (*Vicia faba* L.) were found infested with the stem nematode. In June the crop was harvested and the haulms left on the soil surface, the field was ploughed in July and remained uncultivated until October when oat plants (*Avena sativa* L.) were sown. After harvest in April 1973, the field was ploughed again and sown with maize (*Zea mays* L.) and beans (*Phaseolus vulgaris* L.) which were harvested in September. The field was unploughed until late October 1973 until when it was

covered with a growth of weeds. Except for August and October 1972 and April 1973 soil samples from the surface to 15 cm deep were collected at random every month from May 1972 to October 1973. Two sets of samples were taken in May 1973. The soil from each set of samples was thoroughly mixed, nematodes were extracted at room temperature by the tray method (Whitehead and Hemming, 1965) from two 300 ml sub-samples. Samples of plants were also collected, the tops were chopped into small pieces and the nematodes emerging from two 50g sub-samples were extracted on a mistifier for 48 h. The different stages of *D. dipsaci* from soil and plants were identified by examining the genital primordium (Yuksel, 1960).

Soil temperatures from 15 cm deep were recorded at 3 p.m. and the rainfall was obtained from the Instituto Geofisico, Universidade de Coimbra.

Results

Throughout the period studied the numbers of *D. dipsaci* in the soil fluctuated greatly with the crop grown (Fig. 1). Fig. 2 shows that there were dry periods notably during June, July and August 1972 and during June and August 1973. Figures 3 and 4 show the proportion of individuals in the different stages of development in soil and in oat stems respectively.

The greatest numbers were found in soil during June 1972, when dead field bean haulms were left on the soil surface. During July after the field was ploughed and left uncultivated, the soil was very dry and the numbers in soil decreased markedly. The increase in September coincided with an increase in rainfall. After oats were sown in October, the nematodes invaded them and reproduced, but when maize and beans (*P. vulgaris*) were sown the soil population decreased greatly and no nematodes were extracted from the plants.

In the susceptible oat plants all stages occurred every month from November 1972 to March 1973. In the soil, second stage juveniles, the first post-egg stage, occurred in every month except July and September 1972 and May 1973. Third stage juveniles were not found in July and September 1972 or in October 1973. Fourth stage juveniles were most abundant when conditions were unfavourable, i. e. in July and September 1972. Males and young females were found together in July 1972 and July 1973, and males only in Novem-

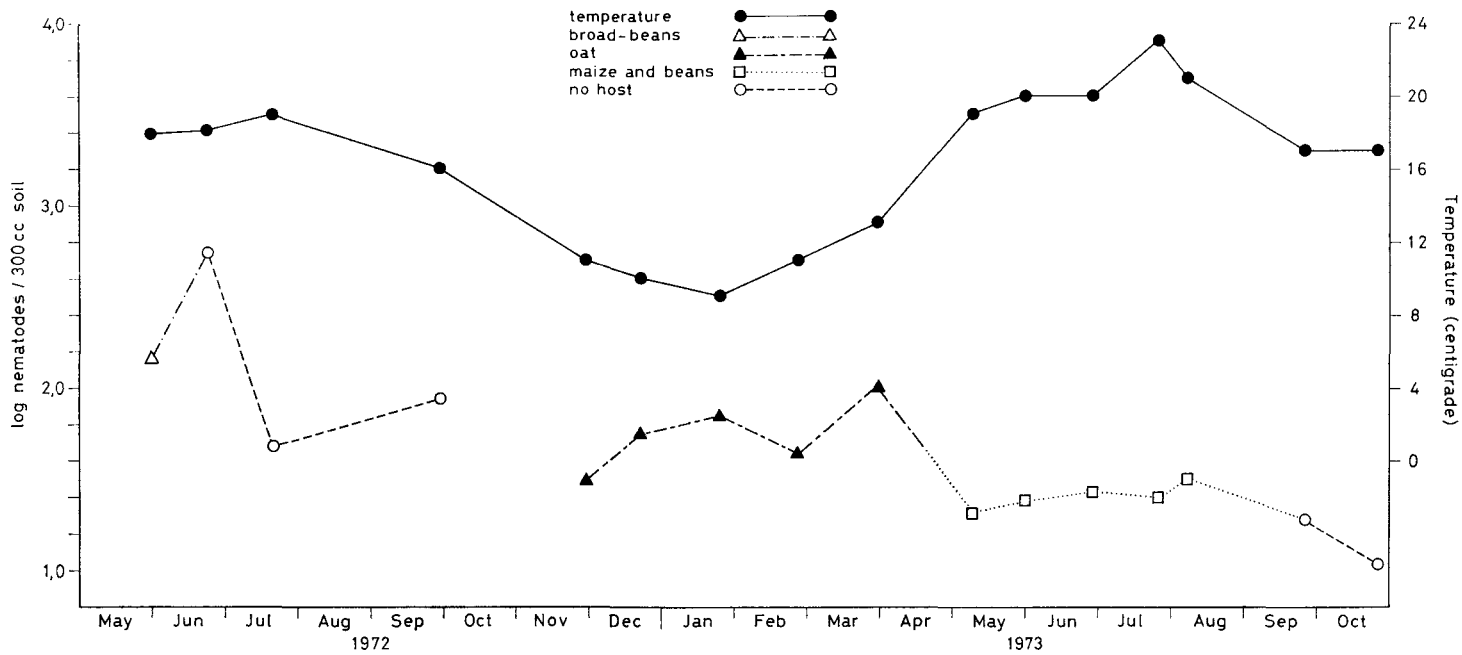


Fig. 1 - Seasonal fluctuations of *Ditylenchus dipsaci*.

ber 1972 and September 1973. Gravid females were never found in the soil. Table I shows the percentage of the different stages of *D. dipsaci* in the soil, the second and third stage juveniles being most abundant.

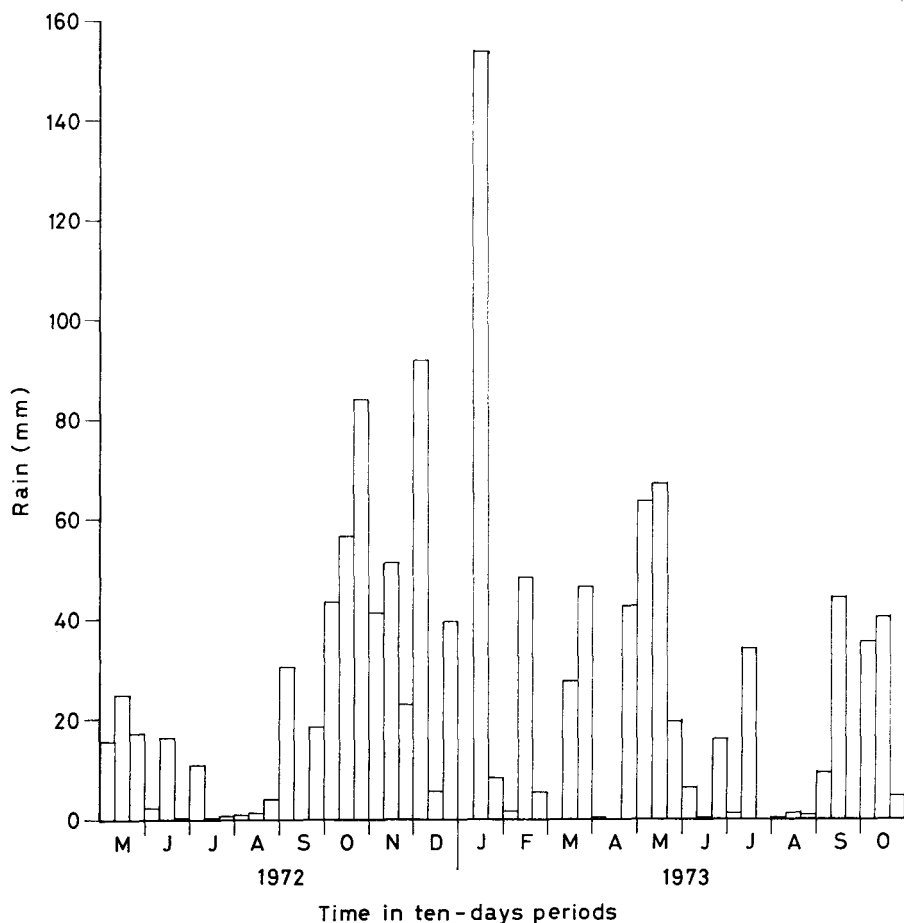


Fig. 2 - Rainfall during the sampling period.

Discussion

The numbers of *D. dipsaci* fluctuated greatly with seasonal changes in the presence and absence of a host plant. The first population peak, which was when dead broad beans haulms were left on the

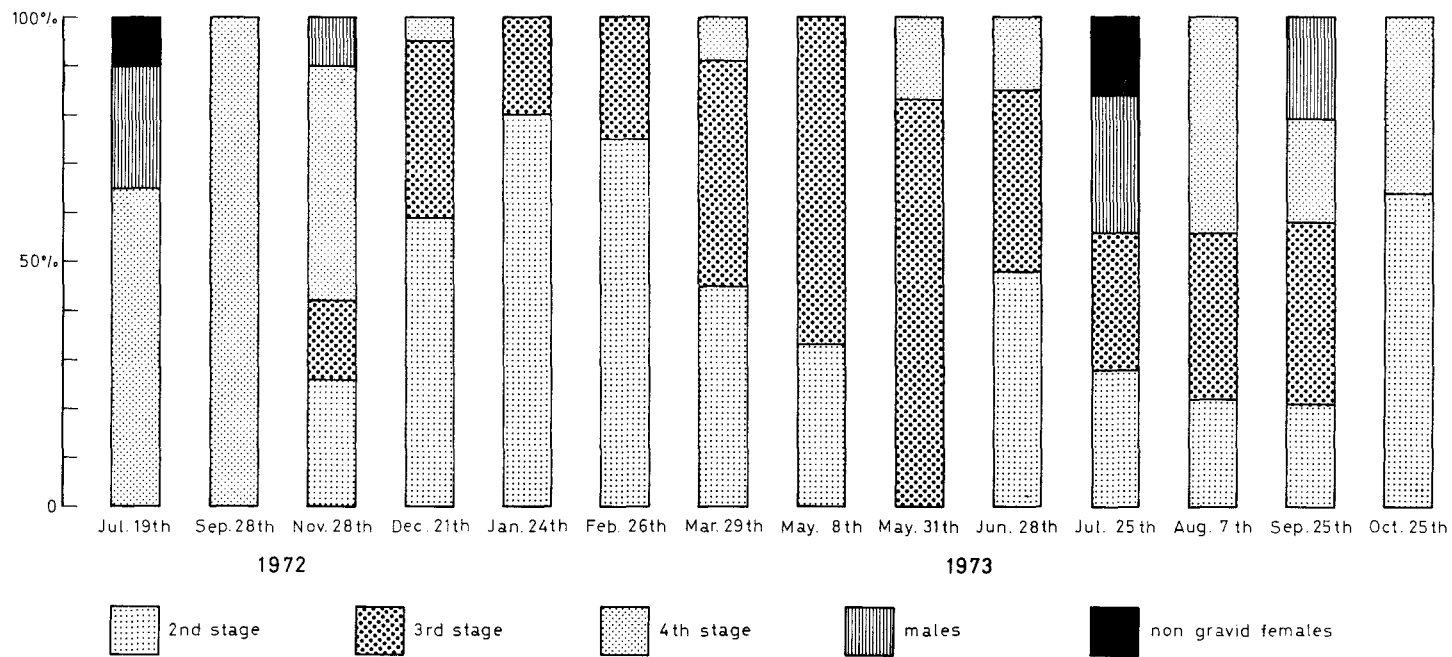


Fig. 3 - Stages of development of *Ditylenchus dipsaci* in the soil.

soil was undoubtedly the results of the migration from the haulms into the soil as when narcissus foliage dies (Hesling, 1966, 1967). Another peak occurred in March 1973 while susceptible oats were growing in the field in which a new generation was produced. Numbers tended to decrease from April 1973 onwards while maize and beans were growing in which no nematodes were ever found. The soil infestation was probably maintained at a lower level on the weeds occurring in these crops (Pereira and Santos, 1974,) as emphasized by Seinhorst (1957).

Temperature and moisture also influenced the nematode population. The dry periods of July and August 1972 coincided with a population decrease, 65% of the nematodes then being 4th stage larvae, which is better able to survive adverse conditions (Miyagawa and Lear, 1970; Perry and Ellenby, 1972). The peak population in September 1972 coincided with a period of rain after a dry spell. This supports Wallace's (1962) findings that the numbers of *D. dipsaci* in the soil surface increase greatly after rain but not those of Caubel (1973) who found no correlation between numbers and rainfall.

The identification of the stages of *D. dipsaci* in soil allowed us to conclude (Fig. 3 and Table I) that second and third-stage juveniles were absent in July and September 1972, not only because of the dry conditions but also because of the short duration of these stages (Yuksel, 1960). Fourth stage larvae, although usually less

Table I - Percentage of the different stages of *Ditylenchus dipsaci* in soil; average from July 1972 to October 1973.

Stage	% of numbers
2 nd stage larvae	36
3 rd stage larvae	31
4 th stage larvae	26
non-gravid females	2
gravid females	0
males	6

abundant than the other juvenile stages were present after dry periods and were the only stage present in September 1972. They are the stages that establish infestations on susceptible crops and presumably this is why they were absent or few during most months, when oats were growing in the field. Young females occurred infrequently in the soil (only in July 1972 and 1973) possibly because they are endoparasitic and are forced to move into the soil only when the host plants is dying. Gravid females were never extracted from the soil, which supports Yuksel's observations (1960) that they die after egg laying and occur only in host plants. Males were more abundant than females which suggests that they survive better in the soil. However, Yeates (1972) found many young females and a few gravid females in the soil of a Danish beech forest, but he extracted nematodes from soil and litter whereas our extractions were from soil previously passed through a 4 mm mesh sieve to remove plant material. Possibly the females found in the soil from the beech forest came from plant debris.

Fig. 4 shows that there were adult nematodes in oat plants during winter. Perret (1971) reported that in France few adults remained in oat plants by the end of November. The difference may be that in Portugal, autumn and winter 1972, mean air temperatures never fell below 9° C whereas the lower temperatures in France keep the nematodes quiescent until February when temperatures rise again.

Our observations confirm oats are attacked following infested broad beans as found by Hooper (1971), so only oat cultivar resistant to *D. dipsaci* should be grown in rotations that include broad beans.

The changes in population structure when oats grew in the field are shown in Fig. 5. From 21st December until 24th January the number of second stage larvae in the soil increased following reproduction in the oat plants and subsequent migration of the larvae into the soil. The number of the fourth-stage larvae in the soil decreased from November to February largely because they invaded the plants, following which there was an increase of adults in oats until 24th January. By the 29th March there was a further increase of the fourth-stage larvae in the soil when oat plants were senescent and ready for harvesting. As nematodes did not invade the senescent plants they remained in the soil.

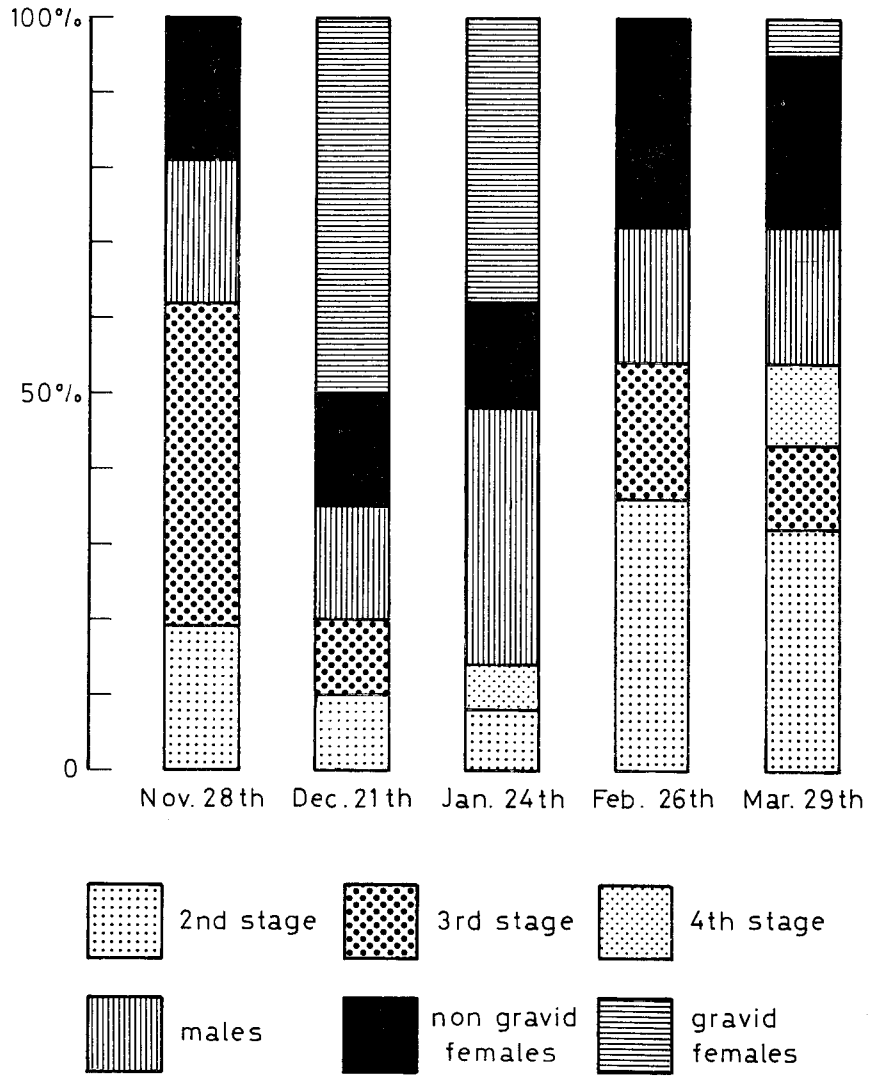


Fig. 4 - Stages of development of *Ditylenchus dipsaci* in oat stems.

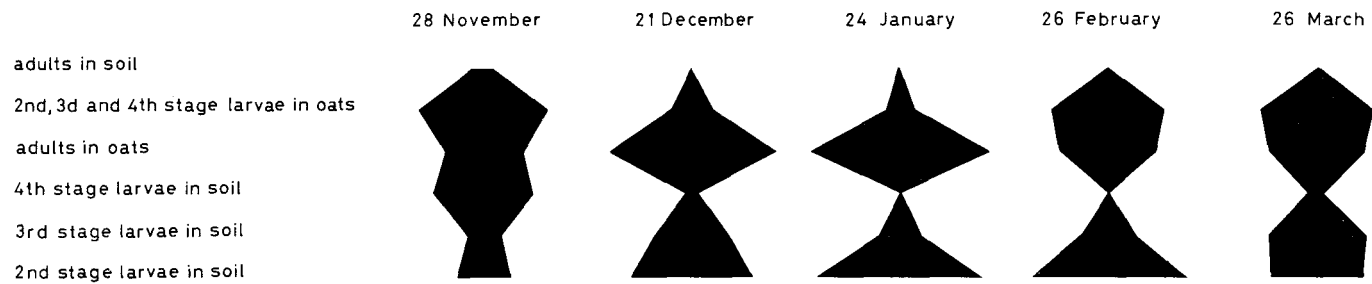


Fig. 5 - Changes in the population structure.

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S U M M A R Y

The numbers of *Ditylenchus dipsaci* (Kühn) Filipjev fluctuated greatly with seasonal changes in the presence and absence of a host plant. Temperature and moisture also influenced the nematode population. Changes in the number of all stages of *D. dipsaci* in oat plants and soil are discussed.

R I A S S U N T O

Variazioni stagionali del numero e degli stadi di Ditylenchus dipsaci (Kühn) Filipjev nel suolo e nei tessuti di piante in Portogallo.

Il numero di individui di *Ditylenchus dipsaci* (Kühn) Filipjev ha subito forti variazioni nelle diverse stagioni e con la presenza o l'assenza di una pianta ospite; la popolazione del nematode ha anche subito l'influenza della temperatura e dell'umidità. Vengono discusse, inoltre, le variazioni del numero di esemplari dei diversi stadi in tessuti di piante d'Avena e nel suolo.

R É S U M É

Fluctuations saisonnières dans le nombre et le stade de Ditylenchus dipsaci (Kühn) Filipjev, dans le sol et dans les plantes hôtes au Portugal.

Le nombre de *Ditylenchus dipsaci* (Kühn) Filipjev, a fortement varié avec les saisons et la présence ou l'absence d'un hôte; la population du nématode a également subi l'influence de la température et de l'humidité. Les variations des nombres d'individus de tous les stades de *D. dipsaci* dans l'avoine et dans le sol sont commentées.

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