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THE LIFE CYCLE OF THE MEDITERRANEAN CEREAL CYST NEMATODE *HETERODERA LATIPONS* IN CYPRUS

by
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Summary. Field studies on the life cycle of the Mediterranean cereal cyst nematode, *Heterodera latipons*, on barley (cv. Athenais), revealed that the nematode completes only one generation per growing season. Juveniles started to invade young roots thirteen days after sowing, at a soil temperature of 14.5 °C, reaching peak populations (345 per 150 g soil) at plant emergence while disappearing completely ten weeks later. Young cysts, and cysts containing coiled embryos were firstly seen on the roots 54 and 98 days from juvenile root invasion while the accumulated heat units, above 7 °C, for the above developmental stages, reached 215 and 386 day degrees C°, respectively.

In Cyprus, the total area under cereals is about 63,500 ha (Anon, 1994) with 95% being sown annually to barley. The Mediterranean cereal cyst nematode, *Heterodera latipons*, is damaging to cereal crops on the island and this is exacerbated by a monoculture system of barley production and low rainfall. The nematode has been reported to attack cereals in other nearby countries (Franklin, 1969; Cohn and Ausher, 1973; Rumpenhorst *et al.*, 1996; Sikora, 1998) but there is little information on its biology under field conditions. A study was therefore undertaken in Cyprus on the life cycle of *H. latipons* Franklin.

Materials and methods

The study was carried out in a field west of Nicosia on barley (*Hordeum vulgare L.)* cv. Athenais, grown continuously for more than 23 years in the same field. The soil was classified as clay loam (30% clay, 35% silt and 35% sand) and during the experiment soil moisture ranged from 9 to 15% by weight. Maximum-minimum soil temperatures were recorded every day or every other day at 07.30 and 14.00 hrs. Soil samples to determine the juvenile population in the soil were taken on 8, 21 and 31 October, 1997, prior to sowing on 12 November, and then at 10-15 day intervals until the end of the experiment. On each occasion five samples of 500 g, made up of four sub-samples, were taken at random at 10-12 cm depth. Nematodes were extracted from 150 g soil using a modified sieving and Baermann funnel technique (Philis, 1995).

The first root samples, consisting of five randomly selected seedlings, were taken on 26 November, 1997, coinciding with plant emergence. Further samples were taken at approximately 4-6 day intervals until April, 1998. Nematode developmental stages within the roots were determined by staining the roots (Bridge *et al.*, 1982) and viewing with a microscope.

Results

The first entry of juveniles into the roots coincided with plant emergence on 26 November, 1997, thirteen days after sowing. Populations of juveniles in the soil were at a maximum and soil temperature reached 14.5 °C (Fig. 1). Mass invasion of roots continued until mid December, 1997 and juvenile populations in soil were drastically decreased by two months after plant emergence (Fig. 1). No juveniles were found in the soil from 74 days after plant emergence although soil moisture, at sampling depth during that time, was at satisfactory levels, accumulating to 56 mm of rain from 90 to 140 days from sowing (Fig. 2).

Female differentiation within roots was initiated on 8 December, 1997, when soil temperatures were approximately 13 °C or 12 days from juvenile invasion (Fig. 1) while developing females ruptured the root cortex on 17 December, 1997 or 21 days after juvenile root invasion (Fig. 1). White, newly formed, cysts on the roots were first observed on 20 January, 1998, or 68 days from sowing (Fig. 1). Most of them were small (570x415 μ) and in most cases were not visible to the naked eye. At this time the mean soil temperature at 10 cm depth was 10.5 °C, with a minimum of 7 °C at 21 days before the white cyst stage. Egg laying began on 4 February, 83 days from sowing (Fig. 1) and embryonated eggs within cysts were initially found on 4 March, 111 days after sowing. The soil temperature at this stage of development was 14 °C. Light-brown cysts were seen on the roots on 19 March with half of the eggs containing coiled embryos. Under the conditions of this trial and assuming that a basal temperature of 7 °C is required for development of *H. latipons* then the accumulated heat, above 7 °C, from juvenile invasion to the "cortex ruptured", "appearance of cysts", "formation of eggs" and "embryonated eggs" developmental stages reached 130, 215, 277, and 386 day degrees °C or 21, 54, 70 and 98 days, respectively (Fig. 3).

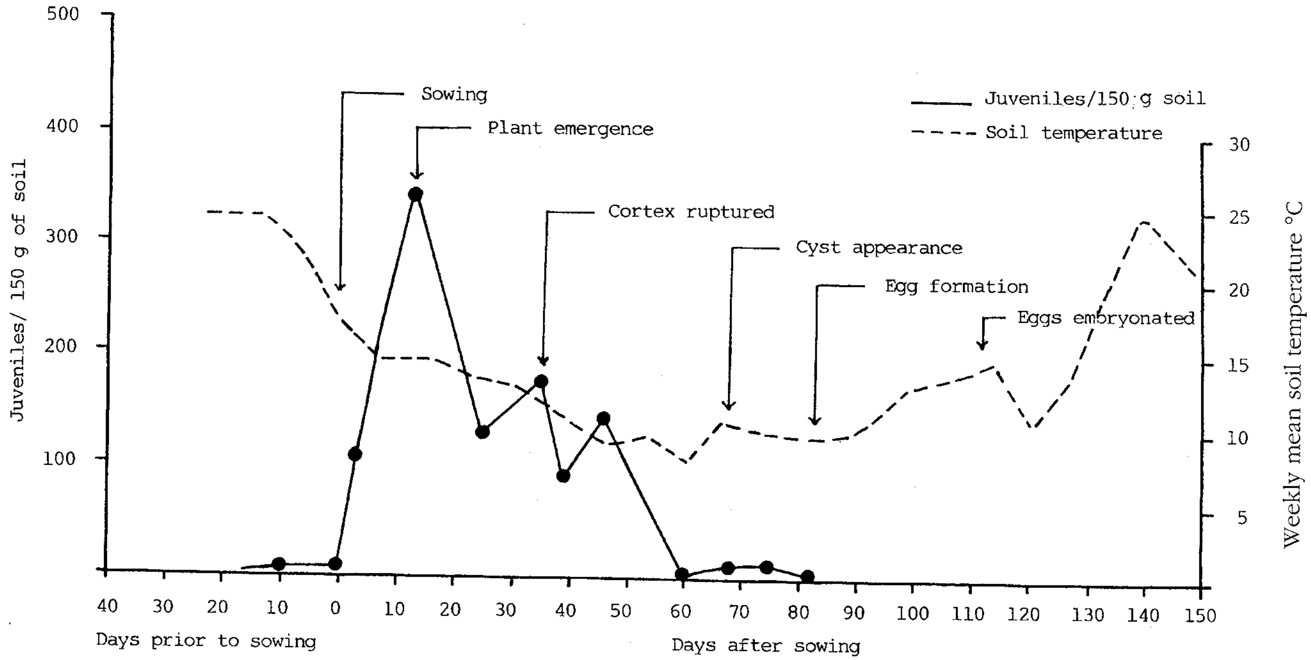

Fig. 1 - Juveniles in soil and occurrence of different developmental stages of *Heterodera latipons* on barley (cv. Athenais) during plant growth.

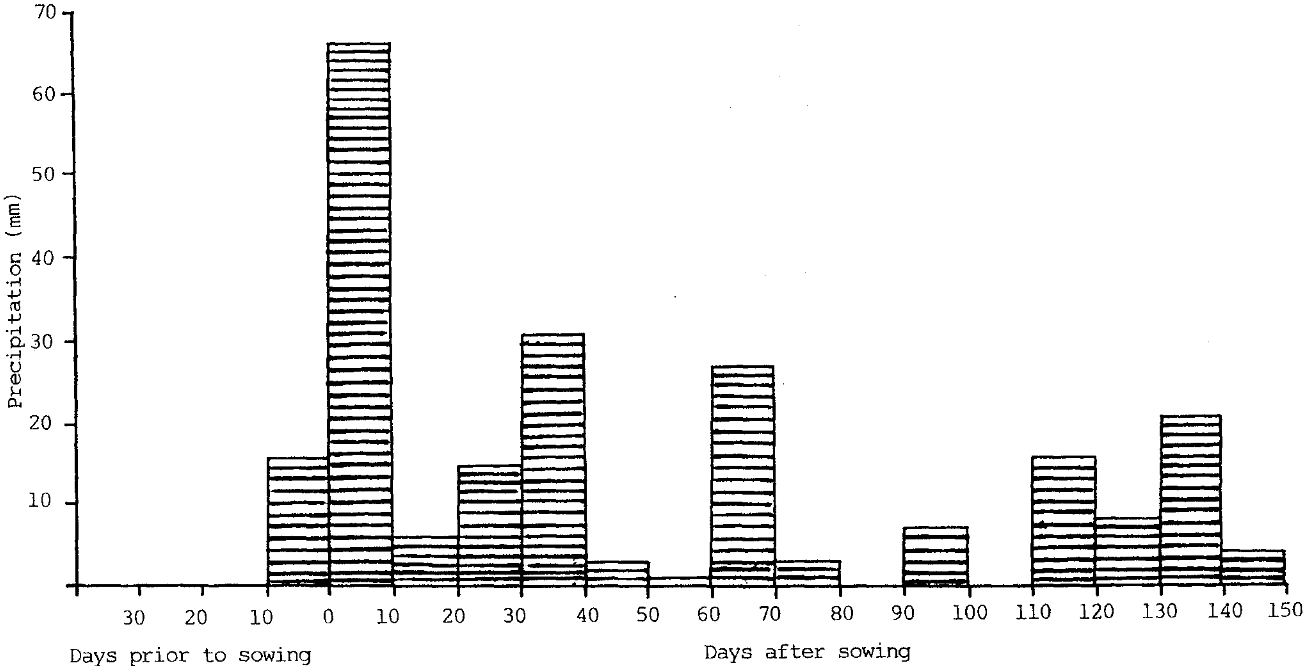

Fig. 2 - Rainfall, prior and after sowing, at experimental site.

Discussion

The appearance of large numbers of juveniles in the soil at plant emergence resulted from mass egg hatching presumably induced by an increase in soil moisture after the occurrence of rain a few days prior to and after sowing (Figs. 1, 2). The possible role of root exudates on egg hatching cannot be clarified from this trial as many juveniles were found in the soil one week prior to plant emergence. The complete absence of juveniles in the soil after 84 days from sowing and thereafter cannot be explained by lack of soil moisture as this was near to soil tilth conditions (Fig. 2). These findings, as concerns the appearance of juvelines in the soil, agree with those of Meagher (1970) who, under Australian field conditions, observed that juveniles of *H. avenae*, a species very similar to *H. latipons*, reached peak populations in the soil at the end of June while juveniles had disappeared from the soil 90-95 days later. In this trial, disappearance of juveniles from soil around mid plant growth and onwards could be due either to the fact that all hatchable juveniles had escaped from cysts, a phenomenon reported also by others experimenting on *H. avenae* (Kerry and Jenkison 1976) or that eggs fell in a "facultative diapause", an ability of the eggs to cease hatching (Shepperd and Cox, 1967). Also, soil samples at 15, 26 and 29 days after egg embryonation did not yield any juveniles, indicating that the nematode completes only one generation per growing season. The relationship between the accumulated day degrees, above a basal temperature development of 7 °C and the time required by the nematode for development was very close (Fig. 3). The amount of day degrees, above 7 °C, required by *H. latipons*, for the autumn-spring cereal growing season, from juvenile invasion to egg embryonation reached 386 day degrees, this being 7% less than that required by the potato cyst nematode, *Globodera rostochiensis*, during the spring potato cropping season and for the same nematode developmental period, based on a 10 °C basal developmental threshold (Philis, 1980). This sug-

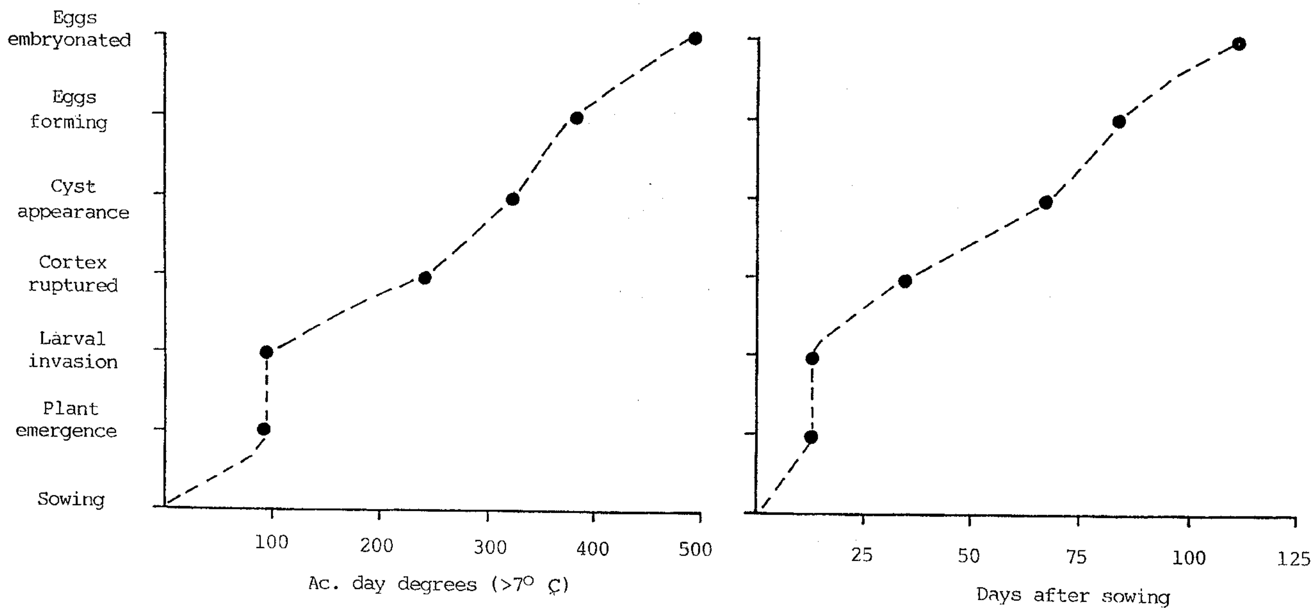

Fig. 3 - Relationship between accumulated day degrees °C and time after sowing of barley at different developmental stages of *H. latipons*.

gests that *H. latipons* requires less energy for development and reproduction than the potato cyst nematode. Under Cyprus field conditions, however, time of plant emergence for barley may vary, depending mainly on the time and amount of rain occuring prior and/or after sowing. Under normal weather conditions rainfall during November, the month of cereal sowing, reaches 30 to 40 mm while it is not unusual for the amount of rainfall during this month to be less than 15 mm, thus delaying seed germination and, consequently, nematode activity and development.

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