

## Notes brèves

### DAUERLARVE : IS THERE ONE IN *BURSAPHELENCHUS XYLOPHILUS*?

Cyril H. S. THONG and John M. WEBSTER

Department of Biological Sciences, Simon Fraser University, Burnaby, Canada, V5A 1S6.

The term "dauerlarve" was introduced by Fuchs (1915) to describe a larval (juvenile) stage in nematodes that (a) was structurally different from other juvenile stages of the species, (b) showed arrested development (anabiosis), (c) was resistant to unfavorable environmental conditions, and (d) had to transfer to another habitat for continuation of its development. The term is derived from the German "dauer", which means "resting, lasting or permanent". Fuchs initiated this term to describe specialised juvenile stages of *Diplogaster* spp. and *Rhabditolaimus* spp. which were found in a commensalistic or phoretic relationship with beetles.

Since Fuch's description of "dauerlarve", this term has taken on wider implications in nematology. Although ensheathment was not an attribute in the original description, ensheathed juveniles of several nematode species, which are resistant to adverse environmental conditions, have been called "dauerlarven" (Bird, 1971; Lee, 1977; Poinar, 1983), although Cassada and Russell (1975) suggest that the "sheath" is unnecessary for the maintenance of the dauerlarval state in *Caenorhabditis elegans*. Other authors have described "altered" cuticles in dauerlarven of free-living (Riddle, Golden & Albert, 1987) and of animal parasitic (Bird, 1971) nematodes. Poinar (1983) has suggested that the second stage juvenile (J2) of *Anguina* spp., the J3 of several aphelenchoiids, and the J4 of *Ditylenchus dipsaci* and *Pratylenchus* spp., may be designated "dauerlarve" by virtue of their resistance to adverse environmental conditions.

The pinewood nematode, *Bursaphelenchus xylophilus*, undergoes a life cycle that contains two morphologically different third and two morphologically different fourth stage juveniles (Mamiya, 1984). During periods of abundant food availability and low parasite burden in pine hosts, the nematode goes through several propagative cycles within the tree. All juvenile stages in these cycles are referred to as propagative juveniles. As the nematode population within the tree becomes increasingly stressed due to overcrowding and/or when winter approaches, normal, propagative J2 develop into J3 and subsequently J4 that look and behave differently from their propagative J3 and J4 counterparts. These have been called dispersal J3 and dispersal J4 to distinguish them from the normal propagative forms. The dispersal J4 is the stage that is vectored by beetles to pine tree hosts.

Mamiya (1984) has referred to the dispersal J4 of the pinewood nematode as a "dauerlarve". This stage can survive 6 months in the beetle vector or 12 months in the laboratory in an arrested state of development (Poinar, 1983). The outermost osmiophilic layer of the cuticle of the dispersal J4 is twice as thick as that of the normal propagative J4 (Bird, 1980). There is some doubt as to the degree of resistance to moisture stress demonstrated by the dispersal J4, despite its thick cuticle. Dry conditions in the pupal chamber of the vector beetle markedly reduced the number of J4 carried by beetles at emergence (Mamiya, 1984). However, the dispersal J3 appears to be another "resting" stage in the life cycle of *B. xylophilus* in that it is adapted to survive unfavorable environmental conditions, e.g. desiccation, low temperature as well as lack of food (Mamiya, 1984). This dispersal J3 has the thickest cuticle of all stages in both the propagative and dispersal forms in its life cycle (Kondo & Ishibashi, 1978).

When no vectors are present or when infected trees are in an advanced state of pine wilt disease, dispersal J3 make up an increasing proportion of the nematode population (Mamiya *et al.*, 1973). Nearly all juveniles observed in such trees in winter and in the following spring are dispersal J3. Therefore, the dispersal J3 also possesses some "dauerlarve" characteristics because, by virtue of its anatomy and physiology, it is the resting and resistant stage in the life cycle. In addition, quiescent dispersal J3 in wilted pines develop further when experimentally transferred to healthy pine trees (Ishibashi & Kondo, 1977). They molt to the propagative J4 stage and continue the propagative life cycle. Thus, they undergo "arrested development until transfer to a new habitat", a feature attributed to "dauerlarven" by Fuchs (1915). However, the dispersal J3 is not the stage normally vectored to a new pine host. Neither the dispersal J3 nor the dispersal J4 is ensheathed, which conforms to Fuchs' original attributes for "dauerlarve" designation.

The dispersal J3 of *B. xylophilus* molts to the dispersal J4 in the decaying wood of the pupal chamber of its insect vector and the dispersal J4 is adapted to being carried to a new habitat (Mamiya, 1984). Thus, if phoretic/vector transmission is considered a key attribute of dauerlarven, the dispersal J4 is indeed one. However, in all previously described life cycles of phoretic nematodes, the dauerlarve is both the dispersal

stage and the stage most resistant to adverse environmental conditions. In *B. xylophilus*, these two functions of dispersal and resistance are performed by two different juvenile stages.

No nematode species has ever had two different juvenile stages designated "dauerlarve" in its life cycle. Since neither the dispersal J3 nor the dispersal J4 qualifies by itself for "dauerlarve" designation, we propose that henceforth, this term not be used to describe the dispersal J4 of *B. xylophilus*. In the interest of consistency, both these juvenile stages should be instead referred to as dispersal juvenile stages to distinguish them from the propagative juvenile stages in the life cycle.

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## DECLINE RATE OF *PARATYLENCHUS BUKOWINENSIS* UNDER NON-HOST CROPS

Michał W. BRZESKI

Instytut Warzywnictwa, 96-100 Skierniewice, Poland.

*Paratylenchus bukowinensis* Micoletzky, 1922 is an economic pest of parsley and celeriac in many regions of Poland (Brzeski & Radzikowska, 1980; Brzeski, 1986a). This nematode parasitises umbelliferous and cruciferous plants (Brzeski, 1986b). The tolerance limit is low and population increase is relatively rapid due to a high fecundity of females and the long vegetative period of the main host plants (Brzeski, Zepp & D'Errico, 1976). For these reasons, a high degree of nematode control is required, if a susceptible crop is to be grown on an infested field. This cannot be easily achieved using nematicides, and it was considered important to learn about the population decline rate of *P. bukowinensis* under non-host crops as onion, tomato and wheat.

The experiment was conducted in microplots made of concrete well rings in which *P. bukowinensis* was in-

troduced about fifteen years ago. The soil contained also *Heterodera schachtii* Schmidt, a few *Merlinius brevidens* (Allen) and some trichodorids but no other *Paratylenchus* species was ever found. These plots were used for various experiments and, in 1985, cabbage (host plant for *P. bukowinensis*) was grown on all the plots. Non-host plants, onion and tomato, were cropped for next two years. There were 60 plots 0.63 m<sup>2</sup> each, and each plot was sampled in October 1985, 1986 and 1987 by taking thirteen soil cores of 2.5 cm in diameter to a 25 cm depth. Soil from each plot was mixed separately and nematodes were extracted from 100 cm<sup>3</sup> of soil by decanting and sieving through 40 µm sieves, and then washed onto 9 cm in diameter extraction sieves each with a filter. Extraction lasted for two days. The nematodes were then killed, the suspension made up to 10 cm<sup>3</sup> of