Grassland Management Practices and the Diversity of Soil Nematode Communities

R. Cook
Institute of Grassland and Environmental Research, UK

P. J. Murray
Institute of Grassland and Environmental Research, UK

K. A. Mizen
Institute of Grassland and Environmental Research, UK

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R. Cook[1], P.J. Murray[2] and K.A. Mizen[1]
[1]Institute of Grassland and Environmental Research, Aberystwyth Research Centre, Aberystwyth, Ceredigion, SY23 3EB, UK, [2]Institute of Grassland and Environmental Research, North Wyke Research Station, Okehampton, Devon, EX20 2SB, UK, Email: phil.murray@bbsrc.ac.uk

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Introduction Nematodes are numerically abundant in northern temperate grassland soils where, through their feeding on plants, soil microbes and each other as well as being a food resource, they contribute to soil functioning and affect plant soil interrelationships. Permanent plant cover and the consequent abundance of root tissue supply a year-round food supply. There are only limited data on the effects of root-feeding by nematodes on the growth and development of pasture plants but under some circumstances above-ground biomass may be reduced. Herbivory by specific nematode parasites may not only directly affect the host plant but also promote soil microbial activity and nutrient fluxes. Nematodes in other feeding groups interact directly with the microbial communities influencing soil processes, including decomposition and mineralisation.

Materials and methods At the upland field site of the Natural Environment Research Council's Soil Biodiversity programme, plots of an established *Festuca - Agrostis* pasture and of a newly sown monoculture of *Lolium perenne* were treated for 3 years with nitrogen (as NH_4NO_3 at 240 kg/ha per year in two doses) and lime (as $CaCO_3$ at 6 t/ha per year at the beginning of the growing season) (N+L), or with pesticide (chlorpyrifos, 1.5 kg a.i./ha after each herbage cut, starting in late June 1999). The herbage was cut and removed monthly from June to September from 1999 to 2001. These treatments were designed to produce contrasting degrees of diversity in communities of soil animals and microbes as part of a study of the relationships between grassland management practice and the diversity and functions of soil biological communities. This paper describes the responses of nematode communities described by trophic composition and by ecological indices based on life history and reproductive potential ranked as five groups (c-p1, colonisers to c-p5, persisters) from soil samples taken in October each year. Details of responses and differences (at $P<0.05$) are based upon the analyses of transformed data, means are for non-transformed data.

Results and discussion N+L treated plots had fewer nematodes (2×10^7 per m^2) than either untreated controls or pesticide treated plots (both 3×10^7) and there were fewer nematodes in reseeded than in main plots (1 and 4×10^7, respectively). Main plot treatments had similar numbers of nematodes in all feeding groups in 1999 but thereafter N+L plots had fewer plant-hyphal and fungal feeders but more bacterial feeders and predators. Pesticide had no effect. The reduced abundance in response to reseeding was shown in 1999 and 2000 by groups feeding on plant roots, in all years by plant-hyphal feeders, in 1999 by fungal feeders and in 1999 and 2000 by omnivores. Communities in original untreated swards were predominantly plant and plant-hyphal feeders (together more than 60%) and similar proportions (*ca* 25% each) of fungal and bacterial feeders. The changes in abundance were reflected in changed community structures. Abundances of c-p groups 1 and 2 were affected by the main treatments: the N+L plots had more c-p1 nematodes than either untreated or pesticide treated plots in 2001, but fewer c-p 2 in 2000 and 2001. Abundances of c-p 3 and 4 were not affected. Reseeding had marked effects on all four groups: c-p 1 being more abundant in 1999 and the other groups less abundant than in original swards in at least some years. The community composition in terms of c-p groups was affected by these changes in abundance. Nematodes in the c-p 2 group were predominant in the original untreated swards (>50%), followed by c-p 3 (*ca* 33%) and similar smaller proportions (*ca*15%) of c-p 1 and 4.

Conclusions The trauma of cultivation, reseeding and a less diverse plant community was expected to reduce nematode numbers. The observed changes in nematode abundance and community structure in response to N+L can be correlated with a wide range of biotic and abiotic co-variates. The major impacts appear to be that N+L plots had increased plant inputs, promoting bacterial at the expense of fungal food channels, and that increased evapotranspiration of larger plants reduced soil moisture restricting nematode activity and multiplication. In addition, soil chemical changes may have directly affected some nematode taxa. The observations demonstrate how complex influences and feedbacks between nematode and plant communities are mediated by variations in biotic and abiotic factors such as are affected by grassland management practices and global climate change.

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