IMPACT OF CLOVER CYST NEMATODE (*HETERODERA TRIFOLII*) INFECTION ON SOIL MICROBIAL ACTIVITY IN THE RHIZOSPHERE OF WHITE CLOVER (*TRIFOLIUM REPENS*) — A PULSE-LABELLING EXPERIMENT

BY

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White clover grown in pots of low or high fertility soil was inoculated with *Heterodera trifolii*, pulse-labelled with ^14C and after 14 days the distribution of ^14C was investigated. In the presence of many *H. trifolii*, soil fertility did not affect the root/shoot distribution of ^14C. With few *H. trifolii* in high-fertility soil, there was significantly less ^14C translocation to the roots. The ^14C content per pot of the microbial biomass carbon was significantly greater in those pots with many *H. trifolii* at both soil fertility levels. Not only was there a significant increase in the size of the microbial biomass in pots with many nematodes but also the micro-organisms had a greater ^14C concentration. This may indicate increased nutrient cycling in pots with plants infected by *H. trifolii*.

*Keywords*: nematode infection, nutrient cycling, phosphorus, soil microbial biomass.

Plant yield reduction following invasion of roots by plant-feeding nematodes has been studied extensively (Wallace, 1973; Evans *et al.*, 1993), and it has been established that nematodes excrete considerable amounts of nitrogen and other plant nutrients (Wright & Newall, 1976). There may also be significantly increased 'leakage' of nutrients from damaged plant root cells (Russell, 1977). Such plant and nematode products are a potential source of energy and nutrients for soil organisms which occur at high densities in the rhizosphere (Curl & Truelove, 1986; Lee & Pankhurst, 1992). The rhizosphere organisms are part of the 'soil microbial biomass', which is crucial in regulating both the decomposition of organic matter and the availability to plants of nutrients such as C, N, P, K and S (Jenkinson & Ladd, 1981). There is a flow of photoassimilated carbon (C) from plants to root-feeding nematodes and subsequently to the rhizosphere microorganisms. If infection by root-feeding nematodes results in greater fluxes of C and available nutrients in the rhizosphere, this may in turn lead to greater soil microbial biomass activity, with potential effects on the rate of soil
organic matter turnover and on nutrient dynamics. However, the flow of C from plant to nematodes and the impact this has on soil microbial biomass has not been quantified.

We hypothesise that increased leakage of C and other nutrients from roots of plants infected by plant-feeding nematodes will result in a greater amount of microbial C and nutrients than is derived from non-infected plants, and that these elements will be more rapidly cycled in soils of lower fertility. In order to test this hypothesis we conducted an experiment combining a sedentary nematode (*Heterodera trifolii* Goffart), each individual of which causes less tissue damage and thus potentially less secondary infection than a migratory nematode (e.g., *Pratylenchus*), a plant with roots likely to have high nitrogen content (*Trifolium repens* L., a legume), and a mineral soil with differing fertility (phosphorus) levels.

**MATERIALS AND METHODS**

Soil described as having either a low phosphate or a high phosphate fertility status was taken from 0-10 cm depth of a grazed pasture trial at Ballantrae AgResearch Hill Country Research Station, North Island, New Zealand as described by Saggar et al. (1997); the difference in fertility was reflected in a threefold difference in pasture herbage production. The soil was predominately Mangaweka silt loam, a Typic Dystrochrept; its chemical characteristics at the start of our trial are given in Table I.

A glasshouse experiment was conducted on sieved, moist soil defaunated by freezing at −20°C for 48 h. Aliquots of 388 g low phosphate soil (34% moisture) and 406 g high phosphate soil (33% moisture) were transferred to the experimental vessels ('pots'), which were plastic pipe of internal diameter 67 mm, height 120 mm and with a base of 1 mm mesh stainless steel. The pots were kept in a glasshouse (12/12 h day/night; 18-25°C), and three rooted clonal cuttings of *T. repens* (breeder's seedline cc 505) were planted in each on 25 January 1996. Pots were watered as required with tap water. Cysts of the *Palmerston*

**TABLE I**

*Characteristics of the low and high fertility Ballantrae soils used in the experiment (Saggar et al., 1997)*

<table>
<thead>
<tr>
<th>Fertility status</th>
<th>pH$_w$ (1:2.5)</th>
<th>Total C (%)</th>
<th>Total N (%)</th>
<th>Total P (%)</th>
<th>CEC (cmol c kg$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>5.24</td>
<td>4.99</td>
<td>0.40</td>
<td>0.064</td>
<td>22.3</td>
</tr>
<tr>
<td>High</td>
<td>5.00</td>
<td>5.01</td>
<td>0.45</td>
<td>0.082</td>
<td>21.2</td>
</tr>
</tbody>
</table>