A REVIEW OF PLANT PARASITIC NEMATODES IN NEW ZEALAND

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Summary

The history of the study of plant parasitic nematodes in New Zealand is outlined. Lists are given of the plant parasitic species recorded in New Zealand and their hosts, as well as a list of genera which contain plant parasitic species which have been found in New Zealand soils, but whose pest status is unknown. A brief indication is given of the types of research which are required for an evaluation of the status of nematodes as plant pathogens in New Zealand.

HISTORICAL INTRODUCTION

THE STUDY OF plant parasitic nematodes in New Zealand appears to have begun early this century. In 1899 Kirk published an advisory leaflet for farmers on wheat cockle eelworm (*Anguina tritici* (Steinbuch, 1779)), and in the Annual Reports of the Dept. of Agriculture for 1903 and 1907 he recorded what appears to have been a root knot eelworm (*Meloidogyne* sp.) attacking the tubers of potatoes. In the light of modern knowledge his account appears somewhat contradictory, and it may be that he had a mixed infection of both a *Meloidogyne* species, and a *Ditylenchus* species, possibly *D. destructor* Thorne, 1945.

The Annual Report of the Dept. of Agriculture for 1908 contains an account of the eelworms known in New Zealand up to that time. This was issued separately a year later under the names of Kirk and Cockayne. The confusion over the nematodes from potatoes persists, but stem eelworm (*Ditylenchus dipsaci* (Kuhn, 1857)) was recorded on oats and wheat. Other plants are mentioned, but it is not clear whether these are true records for New Zealand, or culled from overseas literature. Root knot nematodes are also recorded from cucumbers and tomatoes. The beet cyst eelworm (*Heterodera schachtii* Schmidt, 1871) is recorded as "at present only locally distributed in New Zealand, and it has been found up to the present only on mangolds". This record will be referred to again later.

There then followed a period of 25 years during which nothing appears to have been printed on eelworms in New Zealand, but in 1935 Reid and Cottier recorded *Aphelenchoides ritzemabosi* (Schwartz, 1911) on chrysanthemum. Two years later Muggeridge and Cottier recorded this same nematode (under the name *Aphelenchoides ribes* (Taylor, 1917) as it was then known) causing the death of buds on black currants.

Jacks (1944, 1945, 1948, 1963) and Stanton, 1956, have all conducted trials for the control of *Meloidogyne* sp., chiefly on tomatoes.

Atkinson *et al.* (1949) discuss *Meloidogyne* sp., which they stated to be present throughout the Dominion on tomatoes. Blair and Morrison (1949) in their account of wheat diseases and insect pests list *Anguina tritici* as occurring occasionally in Canterbury, but never serious; *Ditylenchus dipsaci* as occasionally a serious pest of wheat and oats, and *Meloidogyne* sp., was recorded from glass-house grown wheat.

The most comprehensive account of the plant parasitic nematodes of New Zealand is that of Cottier (1956). The only new species

recorded was *Aphelenchoides fragariae* (Ritzema Bos, 1891) (syn. *A. olesistus* (Ritzema Bos, 1892)) from begonias, and the ferns *Pteris*, *Asplenium*, and *Adiantum*. Besides this new record Cottier added a large number of new host plants to the New Zealand list.

Morrison (1957) recorded the lucerne biotype of *Ditylenchus dipsaci* in New Zealand for the first time, also recorded an *Anguina* species from *Agropyron scabrum* which J. B. Goodey considered to be similar to *Anguina agrostis*, but probably distinct from it. Healy (1958) recorded *Anguina agrostis* (Steinbuch, 1799) on *Agrostis tenuis* in Sheffield, Coalgate, Springfield and Darfield districts.

The early workers who recorded plant parasitic nematodes in New Zealand had not had any particular training in this field and all records from the 1920's onwards were based on identifications made overseas, either by the late Dr T. Goodey or Dr J. B. Goodey, or on the basis of the symptoms evoked in the plant.

In 1961 the writer returned to New Zealand from the United Kingdom where he had been studying plant parasitic and free-living nematodes. Since then a number of new records have been made not only increasing the number of plant parasitic species and genera known in New Zealand, but also extending the known host ranges of previously recorded species.

TYPES OF PLANT PARASITIC NEMATODES

It is often convenient to classify plant parasitic nematodes on the basis of the part of the plant attacked, and on the habits of the nematodes themselves. Such a classification would include five groups: (1) ovary parasites, (2) stem parasites, (3) foliar parasites, (4) sedentary (often endo-parasitic) root parasites, and (5) migratory (usually external) root parasites.

OVARY PARASITES

The ovary parasites known from New Zealand are all members of the genus *Anguina*: *A. tritici* of wheat, *A. agrostis* of browntop and Chewings fescue. The infective larvae of this genus are contained within a gall apparently formed from the tissues of the aborted ovary of the plant.

STEM PARASITES

For practical purposes the only stem parasite of any significance is *Ditylenchus dipsaci*, though *Aphelenchoides ritzemabosi* has been recovered from the stems of lucerne in large numbers on one occasion.

FOLIAR PARASITES

The foliar parasites are predominantly *Aphelenchoides ritzemabosi*, *A. fragariae*, and *Ditylenchus dipsaci*, although the *Anguina* spp. feed as external foliar parasites in the juvenile stages of the life history.

SEDENTARY ROOT PARASITES

This group includes the most commonly recognized root parasites, the root knot nematodes. These produce the striking and well known knots or galls on the roots of a tremendous variety of plants. Recently they have become important pests in areas broken out of pasture for market gardening. The first crop of root vegetables grown on some such areas has been virtually unmarketable because of this pest alone. Such attacks have been very unpredictable, and appear to be related to the moisture content of the soils when the plants are small. Knowledge of the biology of this group is inadequate for an understanding of its epidemiology at present.

The incidence of *Heterodera* species in New Zealand is at present under investigation by the Dept. of Agriculture. *H. trifolii* infestations appear to be widespread and of long standing (Grandison,

TABLE 1: PLANT PARASITIC NEMATODES AND THEIR HOSTS
IN NEW ZEALAND

(Those marked * are new records for New Zealand)

- Ditylenchus dipsaci* (Kuhn) — stem and bulb eelworm.
Hosts: *Narcissus* sp., *Hyacinthus orientalis* L., *Tulipa* cult. var.,
Gladiolus sp., *Solanum tuberosum* L., *Plantago lanceolata* L.,
Plantago major L., *Secale cereale* L., *Avena sativa* L., *Triticum*
vulgare Vill., *Allium cepa* L., *Phlox* sp., *Medicago sativa* L.,
Scilla sp.
- Anguina tritici* (Steinb.) — wheat cockle eelworm.
Hosts: *Secale cereale* L., *Triticum vulgare* L.
- Anguina agrostis* (Steinb.) — bent grass eelworm.
Hosts: *Agrostis tenuis* Sibth., *Festuca rubra* var. *fallax* Gaud.
(Chewings fescue)*.
- Anguina* sp. — near *agrostis*.
Host: *Agropyrum scabrum* Beauv.
- Tylenchulus semipenetrans* Cobb.*
Host: *Citrus* sp., sweet orange.
- Pratylenchus* spp.*
Hosts: *Nicotiana tabacum* L.*, *Allium cepa* L.*, *Anagallis arvensis*
L.*, *Plantago lanceolatum* L.*, *Aphelandra squarrosa* var. *Leopoldi*
van Houtte.*
- Tylenchorhynchus* sp.*
Host: *Aphelandra squarrosa* var. *Leopoldii* van Houtte.*
- Heterodera humuli* Filipjev.* — hop cyst eelworm.
Host: *Humulus lupulus* L.*
- Heterodera trifolii* (Goffart) — clover cyst eelworm.
Host: *Trifolium repens* L.
- Meloidogyne hapla* Chitwood.* — root knot nematode.
Hosts: *Daucus carota* L., *Pastinaca sativa* L., *Cirsium vulgare*
(Savi)*, *Solanum nigrum* L.*, *Chenopodium album* L.*, *Rumex*
obtusifolius L.*, *Phebalium billardieri*.*
- Meloidogyne incognita* (Kofoed & White)* — root knot nematode.
Hosts: *Nicotiana tabacum* L.*, *Solanum tuberosum* L., *Gerbera*
jamesoni Bolus*, *Lycopersicon esculentum* Mill., *Carica papaya*
L.*
- Meloidogyne* sp.*
Host: *Trifolium repens* L.
- Meloidogyne* spp. [Previously recorded as *Heterodera marioni*
(Cornu) and not at present referable with certainty to any
species of *Meloidogyne*.]
Hosts: *Cyclamen*, *Delphinium*, *Scabiosa*, *Allium cepa* L., *Fragaria*
sp., *Curcubita* (cucumber), *Beta vulgaris* (beetroot), *Lactuca*
sativa L.
- Aphelenchoides fragariae* (Ritzema Bos)
Hosts: *Begonia* sp., *Pteris* sp., *Adiantum* sp., *Asplenium* sp.
- Aphelenchoides ritzemabosi* (Schwartz) — chrysanthemum eelworm.
Hosts: Florist's *Chrysanthemum*, *Medicago sativa* L.*, *Bouvardia*
longiflora HBK*, *Peperomia magnifolia variegata**, *Gloxinia* sp.*,
Begonia sp.*, *Lilium hybrid**, *Ribes uva-crispa* L.*, *Ribes*
nigrum L.
- Dolichodorus* sp.*
Host: *Desmoschoenus spiralis* Hook.f.*
- Trichodorus cottiieri* Clark
Host: *Carpodetus serratus* Forst.
- Xiphinema* sp.*
Hosts *Fragaria* sp.* (strawberry) (record courtesy G. S. Grandison).

1963), but *H. humuli* appears to be local and rare. The record of *H. schachtii* on mangolds is problematical. For a long time *H. schachtii* included *H. trifolii* from which it is not easily distinguished, apart from the occurrence of males in the former, but not the latter, and the host ranges of the two species. It is interesting to note, however, that Franklin (1951) recorded *H. trifolii* as attacking *Beta vulgaris*, so it may be that *H. schachtii* in the modern sense is not, and has never been, present in New Zealand.

Dr F. J. Newhook (pers. comm.) has found *Tylenchulus semipene-trans* Cobb, on sweet oranges in Auckland.

MIGRATORY ROOT PARASITES

Nematodes which never become obese, retain the power of locomotion, and usually feed as ectoparasites are included here. The majority of plant parasitic nematodes fall into this category. Generally such parasites produce no specific above-ground symptoms other than ill-thrift and poor growth. The root system is, however, often greatly reduced and may show necrotic lesions, and malformations. This group is insidious in its effect and is probably responsible for more loss of production than all the other groups.

PRESENT POSITION

In New Zealand at the present time there is enough knowledge of the potential plant parasites amongst the soil nematodes to be able to infer that there is probably a fairly considerable loss of production from this cause. Except in the few cases where it has been possible to identify species with those already known from other countries, there is no knowledge whatever of the pathogenicity of the nematodes concerned, nor of their biology. A vast number of species await the attentions of the taxonomist and the experimental worker.

Apart from the damage they may do as primary pathogens nematodes are now known to act as vectors for several of the "soil borne" plant virus diseases. So far only the genera *Trichodorus*, *Longidorus* and *Xiphinema* have been implicated as virus vectors, but all of

TABLE 2: GENERA OF PLANT PARASITIC NEMATODA
OCCURRING IN NEW ZEALAND

TYLENCHOIDEA	APHELENCHOIDEA
<i>Tylenchus</i>	<i>Aphelenchus</i>
<i>Tylenchorhynchus</i>	<i>Aphelenchoides</i>
<i>Psilenchus</i>	<i>Bursaphelenchus</i> *
<i>Ditylenchus</i>	
<i>Anguina</i>	ENOPLIDA
<i>Rotylenchus</i>	<i>Diphtherophora</i>
<i>Heliocotylenchus</i>	<i>Trichodorus</i>
<i>Pratylenchus</i>	<i>Longidorus</i>
<i>Neotylenchus</i>	<i>Xiphinema</i>
<i>Dolichodorus</i>	
<i>Heterodera</i>	
<i>Meloidogyne</i>	
<i>Criconema</i>	
<i>Criconemoides</i>	
<i>Hemicycliophora</i>	
<i>Paratylenchus</i>	
<i>Tylenchulus</i>	

* *Bursaphelenchus* is not a parasite of flowering plants, but is commonly found feeding on fungi which have invaded higher plants, and is easily mistaken for an *Aphelenchoides* sp.

these three genera have representatives in New Zealand. No case of transmission of a virus by a nematode is as yet recorded from New Zealand.

At the present time much needs to be done to describe and name the indigenous plant parasitic species and to evaluate their status as plant pathogens. Once this has been done the matter of host ranges, persistence in soil in the absence of host plants, and control either chemical, or by breeding resistant plants can be investigated.

The list of genera known to occur in New Zealand (Table 2) leaves no room for complacency in this matter.

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