POTENTIAL SPREAD OF PESTS IN NEW ZEALAND THROUGH COMMERCIAL TRANSPORT OF NURSERY PLANTS

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ABSTRACT

This study assessed the potential for plant pests to be transported within New Zealand in association with shipments of plants among commercial nurseries in North and South Islands. Searches of soil and litter sampled from three deliveries of nursery plants to Christchurch indicated there is enormous potential to vector plant pests on this pathway. A diversity of nematodes, seeds and arthropods was recovered, including *Trichodorid* and *Xiphinema* nematodes, which can vector some plant viruses and currently have limited distributions in New Zealand. This small survey showed that transport of nursery plants must be an important pathway for the dispersal of a wide range of organisms within New Zealand. Not only is there a direct threat to the nursery plant industry from the activity of some pest species but also there is the obvious potential to spread pathogens and arthropod pests into the wider environment.

Keywords: biosecurity, pest dispersal, human-assisted pest movement, nematode pests, insect spread.

INTRODUCTION

About 40 unwanted, new organisms were detected in New Zealand in 2003 and this number has been steadily increasing each year since 1990 (Wilson et al. 2004). The accidental arrival and establishment of new pests into New Zealand can have significant financial and social costs both in terms of eradication (e.g. painted apple moth, *Teia anartoides* Walker, Lepidoptera: Lymantriidae) and phytosanitary controls placed on New Zealand exports, as is the case with the newly discovered plant disease *Phytophthora kernoviae* Brasier, Beales, and Kirk (AQIS 2006). There are also ecological costs associated with the establishment of new organisms, such as with didymo (*Didymosphenia geminata* (Lyngbye) M. Schmidt).

For these reasons, MAF Biosecurity aims to prevent foreign, unwanted organisms from becoming established in New Zealand. Attempts to eradicate newly discovered, unwanted organisms are undertaken where the potential risk from the organism is high, a successful outcome is plausible and the intended actions are acceptable to stakeholders (Stephenson et al. 2003; Wilson et al. 2004). Containing the spread of the targeted pest throughout the campaign is fundamental to eradication success (Stephenson et al. 2003). In cases where eradication is not possible, 'slow to spread' measures may be implemented to delay distribution of the pest to unfested regions (e.g. varroa bee mite). Although it is generally difficult to limit pests' natural dispersal (e.g. aerial dispersal), it is possible to influence the extent to which humans unintentionally assist them to spread.

Nematodes in particular have very limited dispersal abilities so their spread is largely via human or animal movement (Boag 1985; Jikumar & Togashi 2003). For plant parasitic nematodes, dispersal is restricted largely to movement of soil, although some

genera (e.g. *Heterodera*, *Paratylenchus* and *Ditylenchus*) have life stages able to survive in dry soil. Transportation of plants therefore has obvious potential to assist pests to spread. The survey described here assessed movements of insects, nematodes and seeds in association with the commercial carriage of nursery plants within New Zealand.

METHODS AND MATERIALS

On three separate occasions, 25 June 2004, 01 September 2004 and 8 April 2005, truck and trailer units delivering plants to South Island nurseries were sampled for invertebrates and weeds. The consignments included flowering shrubs and bagged or bare-rooted trees originating from nurseries in several North Island locations, including Hamilton, Te Awamutu, New Plymouth and Palmerston North. Samples were taken from material being delivered to Christchurch nurseries, but the trucks were also delivering plants to a wide range of other South Island locations. Litter was sampled from the top of plant containers along with litter, potting mix and soil taken from the decks of the truck and trailer unit. Sampling was carried out by hand or by using a blower-vac with a net fitted to the inlet to catch the debris. No potting mix was sampled from within the plant containers.

Arthropods

On all three sampling occasions, arthropods were extracted from litter and soil using the Berlesse-Tullgren funnel technique, which relies on heat from a light bulb to drive living organisms from the litter into a collecting vial containing 70% ethanol. Arthropods were categorised into order, family and life stage (e.g. larva, adult).

Nematodes

From the June 2004 sample, over 30 kg of soil, litter and potting mix was collected. Therefore, ca 13 kg of soil was sent to Ruakura, where 11 subsamples of 75 g were taken and nematodes extracted over 72 h, using the tray method described by Bell & Watson (2001). Briefly, soil was placed on a layer of tissue paper overlaying fine and coarse meshes contained within a plastic photographic tray. The soil was saturated by adding 500 ml of tap water into the tray, and trays were maintained at room temperature for the duration of the extraction. Nematodes were observed at 20–80× magnification and plant feeding species were identified to genus.

The possibility of transfer and establishment of nematodes from transported bare rooted trees to a Christchurch nursery was investigated further. Here, bare rooted trees received from the North Island are dug into rotted sawdust where they remain prior to delivery to clients in the Canterbury region. Therefore, in April 2005 the sawdust into which the trees were temporarily placed, soil in an adjacent waste area, soil under native shrubs and potting mix around *Betula pendula* Roth (European white birch) was sampled using a 25 mm corer to a depth of 100 mm. Six samples were taken from each location, transferred to plastic bags and sent to AgResearch, Ruakura, for extraction.

Seeds

From the June 2004 consignment, approximately 2.5 kg of soil was dried for 16 h at 60°C. The sample was coarse sieved to remove leaf litter and three lots of 500 g of soil was placed in plastic bags. The samples were forwarded to the National Seed Laboratory (AgriQuality Limited) where any seeds found in the soil were identified.

RESULTS AND DISCUSSION

Arthropod species

On all three sampling occasions, large numbers of a wide range of arthropods were recovered, with Collembola and Acari being the most abundant (Table 1). Arthropods were found in their nymphal, larval, pupal and adult stages. The diversity of arthropods shown in Table 1 is probably an underestimate of that associated with the consignments of nursery stock because plant foliage was not directly sampled. Many of the families represented in the samples contain species that are well known as pests (e.g. springtails, aphids, mites, scales, thrips and weevils). It seems possible that some very important pests which still have restricted distributions in New Zealand might frequently be

associated with nursery stock. For example, an adult *Listronotus bonariensis* (Coleoptera: Curculionidae) was recovered from the litter in one of the samples and it is conceivable that a highly mobile weevil, such as *Sitona lepidus* Gyllenhal (Coleoptera: Curculionidae), which has only recently been found in the South Island, could occur in clovers growing as weeds in nursery plant containers. Similarly, bees have been seen visiting flowering plants placed on the deck of the covered truck (G. Hayman, pers. comm.), which suggests there is a risk that the distribution of varroa bee mite (*Varroa jacobsoni* Oudemans) could be extended from the North Island to the South Island via this pathway.

TABLE 1: The order, family and life stage of arthropods extracted from litter and soil collected on three occasions from a trailer unit transporting plant material from North to South Island nurseries.

Order	Family	Stage
Acari (mites)	Orbatidae, Phytoseiidae, others	Adults
Araneae (spiders)	Salticidae, others	Adults
Collembola (springtails)	Isotomidae, Sminthuridae, Entomobryidae	Larvae, adults
Diplopoda	Millipedes	Adults
Coleoptera	Staphylinidae (rove beetles), Curculionidae (weevils), others	Larvae, adults
Diptera	Sciaridae (fungus gnats), Psychodidae (sand flies), Empididae, others	Larvae, pupae adults
Hemiptera (sucking bugs)	Aphididae (aphids), Coccidae (scales)	Larvae, adults
Hymenoptera	Braconidae, Ichneumonidae (parasitoid wasps), Formicidae (ants)	Adults
Lepidoptera	Moths	Larvae, adults
Psocoptera	barklice	Larvae, adults
Thysanoptera	Thripidae (thrips)	Larvae

Nematodes

Trichodorids (probably *Paratrichodorus*) and *Pratylenchus* were the most commonly observed nematodes (Table 2). In terms of damage potential, particularly to woody plants, the *Xiphinema* nematodes are the most problematic as they not only cause direct feeding damage to plant roots (including root swelling in some cases) but they are also vectors of plant viruses (e.g. Jones et al. 1995). There are currently six species of *Xiphinema* reported from New Zealand (D. Sturhan, pers. comm.), with three found in the South Island. Two occur only in the Nelson area (*X. krugi* and *X. radiculicola*), and another (*X. diversicaudatum*) is reported from south of Nelson (Sturhan et al. 1997).

TABLE 2: Plant parasitic nematode genera observed from soil removed from truck transport and an indication of their abundance and frequency of occurrence in the 11 subsamples.

Nematode family/genus	Likelihood of establishment	Damage potential	No. of subsamples where present	Abundance per subsample
Trichodoridae	Low	High	11	Common to abundant
<i>Pratylenchus</i>	High	Moderate	11	Rare to abundant
<i>Helicotylenchus</i>	High	Low	11	Rare
<i>Xiphinema</i>	Medium	High	7	Rare
<i>Paratylenchus</i>	High	Low	1	Rare

Trichodorid nematodes can also vector some plant viruses (e.g. Brown et al. 1989) and are probably somewhat more widespread than *Xiphinema*, although still with a limited South Island distribution in many cases. All three of the remaining plant parasitic genera have nationwide distributions.

Despite the presence of economically important nematodes in the soil taken from the deck of the truck, sampling at the nursery did not find Trichodorid or *Xiphinema* nematodes. The waste area contained *Pratylenchus*, *Paratylenchus* and *Heterodera* (cyst) nematodes with *Heterodera* also found in one of the sawdust samples. This suggests that while the nematodes occur in the soil around transported bare rooted trees and are dislodged during transport, either they are not present in the soil adhering to the roots, or they do not survive transfer into the sawdust at the nursery. The plant feeders found in the waste area are likely to be associated with weeds growing there.

Seeds

Seeds from 30 different plant species were found, with *Amaranthus*, *Cardamine* and *Poa* being the most common species (Table 3), but 43% of the species were represented by a single seed. While none represent significant new weed threats to the South Island, the results demonstrated the potential for inadvertent transfer of economically important weed species (e.g. kikuyu grass), to be unintentionally spread in New Zealand.

TABLE 3: Plant species and number of seeds recovered from 2.5 kg soil removed on 25 June 2004 from trailer unit transporting plant material from North to South Island nurseries.

Common name	Scientific name	Total seeds
Amaranth	<i>Amaranthus</i> sp.	103
Annual mouse-ear chickweed	<i>Cerastium glomeratum</i>	1
Bittercress	<i>Cardamine</i> sp.	22
Black nightshade	<i>Solanum nigrum</i>	6
Catsear	<i>Hypochaeris radicata</i>	1
Clovers	<i>Trifolium</i> (two spp.)	15
Fathen	<i>Chenopodium album</i>	2
Grass species	Nine species	38
Hairy birdsfoot trefoil	<i>Lotus suaveolens</i>	1
Hawksbeard	<i>Crepis capillaris</i>	1
Hedge mustard	<i>Sisymbrium officinale</i>	1
Hydrocotyle	<i>Hydrocotyle</i> sp.	1
Oxalis	<i>Oxalis</i> sp.	8
Plantain	<i>Plantago</i> (two spp.)	7
Purslane	<i>Portulaca oleracea</i>	1
Wireweed	<i>Polygonum aviculare</i>	2
Scarlet pimpernel	<i>Anagallis arvensis</i>	1
Twin cress	<i>Coronopus didymus</i>	11
Violet	<i>Viola</i> sp.	1
Vulpia hair grass	<i>Vulpia bromoides</i>	3

This research has shown that transportation of plants almost certainly provides a significant, unintentional, human-assisted means of spread of many pests within New Zealand. While none of the insects, acarids or weeds found in these samples appears to be unique to the South Island, the Trichodorid and *Xiphinema* nematodes are more restricted in their distribution and are known vectors of plant viruses. The geographical distribution of nurseries visited by the commercial road transport company involved in this study range from Whangarei to Invercargill, New Plymouth to Gisborne and West Coast to Christchurch. Moreover, the service runs on a weekly basis all year round

providing ample opportunity for pests to be spread rapidly throughout the country. The range and volume of plant material being transported around New Zealand, along with the diversity of often cryptic organisms associated with it, makes it difficult to envisage practical management solutions. Nevertheless, the nursery plant industry would directly benefit from reductions in the rate of spread of pathogens and arthropod pests in New Zealand. One approach to reducing the risk would perhaps be to encourage the adoption of an industry-wide plant hygiene standard.

However, the movement of potential pests is clearly not restricted to commercial nurseries and numerous other plant-based industries, as well as amateur gardeners, must also contribute to this issue. For these reasons, the development of effective strategies to reduce internal movements of pests in association with transportation of nursery plants represents a large and complex challenge, which will require commitment from plant protection scientists, the nursery industry, the public and probably also government agencies such as the Ministry of Agriculture and Forestry.

ACKNOWLEDGEMENTS

We thank Grant Hayman (Headford Propagators), Murray Mannall (Southern Woods Nursery) and several other nurseries for their assistance and support in this project. We are also grateful to the National Seed Laboratory (AgriQuality Limited) for the seed identifications. This research was funded by FRST contract C10X0317, 'Improved Biosecurity'.

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