PLANT AND SOIL NEMATODES

ECONOMICALLY IMPORTANT CYST NEMATODES (*HETERODERA* AND *GLOBODERA*) IN AUSTRALIA

Cyst nematodes are one of the most important groups of plant-parasitic nematodes worldwide, as they cause yield losses on many crops, including major crops such as cereals, rice, potato, and soybean. Some cyst nematodes cause problems in Australia and require attention, but fortunately, biosecurity measures have kept the country free of many damaging species and pathotypes.

Life history

Cyst nematodes are found in two genera (*Heterodera* and *Globodera***)** but both have a similar life history.

- Juveniles hatch from eggs, move towards a root, and establish a feeding site within the root
- The juvenile loses its worm-like shape and becomes sedentary
- The head of the developing female remains in the root, but the body gradually becomes spherical or lemon-shaped and partly extends from the root
- Eggs are laid within the body and eventually fill the body cavity
- The external covering of the body hardens to become a thick-walled cyst, a protective structure that helps the eggs survive adverse conditions and periods when a host plant is absent

Fig. 1. Golden-coloured cysts of potato cyst nematode (*Globodera rostochiensis*) on the roots of potato.

Key cyst nematodes in Australia

The most important cyst nematode in Australia is cereal cyst nematode (*Heterodera avenae*). It is widely distributed in southern and western cereal-growing areas, and prior to about 1990 was a serious pest, causing millions of dollars in crop losses every year. The introduction of cyst nematode-resistant cereal varieties has changed that situation, and since those varieties are now used routinely, the nematode is generally kept under control (see Fact sheet PSN 030).

Potato is another crop threatened by cyst nematodes. In many overseas countries, two different potato cyst nematodes are widely distributed and cause serious problems wherever the crop is grown.

- Pallid potato cyst nematode (*Globodera pallida*)
- Golden potato cyst nematode (*Globodera rostochiensis*)

Fortunately, Australia does not have the pallid species, but the golden form is a major threat to the potato industry. It was detected in Perth in 1986 and some regions of Victoria in the 1990s, and although quarantine restrictions have prevented it from spreading, continuing vigilance will be required to ensure that cysts or infested soil are not moved to other potato-producing areas (see Fact sheet PSN 053).

Several other species of cyst nematode also occur in Australia. The most important are *Heterodera trifolii*, a serious pest of clovers, and *H. schachtii*, which is most commonly found on beets and brassicas.

Symptoms

Aboveground symptoms produced by cyst nematodes are much the same as those typically seen on crops damaged by other plant-parasitic nematodes: stunting, plant growth retardation, premature wilting, foliar chlorosis, patchiness, and premature death. Yield losses can be very high, with losses of 10-80% occurring in some crops.

Management of cyst nematodes

The best way to prevent a plant-parasitic nematode causing crop losses is to prevent its introduction and spread. Fortunately, this tactic has been successfully employed against cyst nematodes in Australia, as biosecurity programs have prevented the introduction of most *Heterodera* and *Globodera* species. One of the best examples is soybean cyst nematode (*Heterodera glycines*), which is found in most other soybean-growing areas of the world and is by far the most damaging soybean pest in some countries. Golden potato cyst nematode (*Globodera rostochiensis*) is another success story because, as mentioned previously, biosecurity measures implemented over the last 30 years have prevented it being spread to the main potato production areas.

Once cyst nematode is established in an area, crop rotation is a viable control option in many situations, as the majority of *Heterodera* and *Globodera* species have a relatively narrow host range. For example, only three cultivated plants (potato, aubergine, and tomato) will host *G. rostochiensis*, while *H. avenae* will only multiply on wheat, barley, and oat. Even cyst nematodes with a broader host range such as *H. schachtii* have relatively few cultivated hosts.

The most economical way of preventing damage from cyst nematodes is to incorporate resistance into commercial cultivars, as has been done in cereals for *H. avenae* and potatoes for *G. rostochiensis* and *G. pallida*. However, breeding programs of this nature are not always effective because some populations are heterogeneous and it is difficult to produce cultivars that are resistant to all pathotypes. Australia has only one pathotype of cereal cyst nematode and this is the reason its resistance breeding program was successful. However, as pointed out by Yuan et al. (2010), the innate variability of the nematode is an impediment to developing resistant cultivars in countries such as China, where many different pathotypes occur.

Literature cited

Yuan H, Sun J, Yang W, Xing X, Wang Z, Riley I, Li H (2010) New pathotypes of *Heterodera avenae* (cereal cyst nematode) from winter wheat in Zhengzhou, Hunan, China. *Australasian Plant Pathology* 39, 107-111.

Further reading

The paper by Vanstone et al. (2008) reviews 40 years of research on cereal cyst nematode in Australia. It explains how well-adapted cereal cultivars with resistance to the nematode were developed and deployed to significantly reduce yield losses.

Vanstone VA, Hollaway GJ, Stirling GR (2008) Managing nematode pests in the southern and western regions of the Australian cereal industry: continuing progress in a challenging environment. *Australasian Plant Pathology* 37, 220-234.

The following papers provide details of the introduction and spread of *G. rostochiensis* in Victoria, and explain how the two potato cyst nematodes can be identified.

Blacket MJ, Agarwal A, Wainer J, Triska MD, Renton M, Edwards J (2019) Molecular assessment of the introduction and spread of potato cyst nematode, *Globodera rostochiensis*, in Victoria. *Phytopathology*, 109, 659-669.

Wainer J, Dinh Q (2021) Taxonomy, morphological and molecular identification of the potato cyst nematodes, *Globodera pallida* and *G. rostochiensis*. *Plants* 10, 184. https://doi.org/10.3390/plants10010184

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