PLANT AND SOIL NEMATODES

CEREAL CYST NEMATODE (*HETERODERA AVENAE*), A SERIOUS PEST OF CEREALS IN AUSTRALIA'S SOUTHERN AND WESTERN WHEATBELT

Cereal cyst nematode (CCN) was introduced to Australia in the 19th century and became a serious pest in southern and western cereal-growing areas, causing millions of dollars in crop losses every year. This fact sheet provides an overview of a 40-year research program that was so effective that the nematode is now a relatively minor production constraint.

Distribution of CCN and crop losses

CCN was not considered an important pathogen of wheat, barley, and oats until the 1960s when huge yield increases were obtained when fumigants and nematicides were applied in field trials. Surveys then showed that *Heterodera avenae* was widespread in Victoria and South Australia and was a major factor limiting production. By 1980, the nematode was present in about two million hectares of land and yield losses were estimated to be approximately $72 million/annum.

Biology, ecology, and pathogenicity

The eggs of CCN are surrounded by a thick-walled cyst that protects them from desiccation and so they have the capacity to survive the hot, dry conditions that occur during the Australian summer. Summer dormancy is also an important survival mechanism because when temperatures are high and the soil is moist following a summer rainfall event, eggs do not hatch. Most hatching occurs in autumn and early winter when the soil is moist and temperatures are much lower. As this corresponds to the period when cereal crops are planted, the juveniles invade roots and begin feeding near the root tip, causing knotting and a reduction in root growth. The juveniles then grow to maturity and eventually become lemon-shaped females that are visible on the root surface. The female is then fertilised and a tough, dark brown leathery cyst is formed that contains her eggs.

Root 'knotting' caused by CCN (left) and white females on roots (right)

Patches of stunted, chlorotic plants will occur in paddocks infested with CCN, and the roots of those plants will be markedly reduced in size. However, effects on yield will vary, as they depend on many factors, including the initial nematode population, time of sowing, the type of cereal, rainfall, and the presence of weeds.

Symptoms caused by CCN: patches of yellow, stunted plants

Management of CCN

Practices such as reducing tillage, improving soil fertility, minimising the effect of competitive weeds, and sowing before large numbers of juveniles are released into the soil, will help reduce losses from CCN. However, the most effective practices are discussed below.

Crop rotation. During the period when populations of CCN were very high on many farms, crop rotation was the main method of control. Legume pastures were commonly used as they not only reduced nematode populations but also provided fodder for livestock and nitrogen for the following cereal crop. However, by the 1980s a range of legume crops (e.g. field peas, chickpea, lentil and faba bean) and oilseed crops (e.g. canola) were increasingly being included in the rotation because, in addition to reducing CCN populations, they gave farmers the opportunity to continually crop their paddocks. Two consecutive seasons of a non-host crop was recommended because only 50-85% of the eggs hatch in a single season. Also, breaks had to be grass- free because weeds such as ryegrass and wild oats are susceptible to CCN.

Tolerant cultivars. The ability of a plant to cope with the damage caused by plant-parasitic nematodes is a useful trait. However, cereal cultivars with the capacity to tolerate damage caused by CCN were never widely used in Australia because in the long term, they increase the nematode population to the point where tolerance is no longer effective. This changed when resistance became available, because wheat breeders began to produce cultivars that were both resistant and tolerant to CCN, and also had high yield potential in the absence of the nematode.

Resistant cultivars. The ultimate breakthrough in CCN management occurred in the early 1980s, when the first cereal cultivars resistant to the Australian pathotype of CCN were released. Initially, some of these cultivars had low yield potential but in the next 20 years, numerous high yielding, well-adapted, CCN-resistant wheat cultivars were released. They are now the predominant cultivars in southern areas of Australia, and their use has reduced CCN populations to non-damaging levels.

Further reading

The fact that CCN is now a minor constraint to cereal production in Australia is testimony to the efforts of many nematologists, plant breeders and agronomists over a 40-year period. Details of the research programs that were undertaken and the results obtained can be found in the following paper.

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.

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