The potential for nematode problems in Australia’s developing soybean industry

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Abstract

Root-knot nematode (Meloidogyne spp.), soybean cyst nematode (Heterodera glycines) and reniform nematode (Rotylenchulus reniformis) have the potential to become serious pests of soybean in Australia. This paper outlines the risks associated with introducing soybean cyst nematode into the country and discusses the distribution and potential significance of the other two pests.

Introduction

Australia’s soybean industry is relatively small by international standards, as only 70,000 tonnes of soybeans are produced from about 30,000 hectares of land, mainly in Queensland and NSW. Nevertheless, there is considerable potential for expansion, particularly in coastal regions where soybean is proving an excellent crop for rotation with sugarcane (Garside and Bell 2001; Bell et al. 2003).

Since nematodes are important pests of soybeans and other oilseed crops and grain legumes in other parts of the world (Sikora and Greco 1990; Riggs and Niblack 1993), the Australian soybean industry needs to be aware of the nematode problems that could be encountered as it expands. This paper discusses the situation with regard to root-knot nematode (Meloidogyne spp.), soybean cyst nematode (Heterodera glycines) and reniform nematode (Rotylenchulus reniformis), the three most important nematode pests of soybean worldwide.

Root-knot nematode

At least six species of Meloidogyne have been reported to damage soybeans (Riggs and Niblack 1993), but M. incognita, M. javanica and M. arenaria are the most common species worldwide. Experience in the USA suggests that M. javanica and M. arenaria are the most important species in warmer climatic regions. All species produce galls on roots that vary in size from small beads about 1 mm in diameter to large swellings more than 10 mm in diameter that may completely envelop the major roots. Above-ground symptoms include chlorosis, slight to severe stunting, wilting during drought stress and yield suppression. Losses of 90% due to M. incognita have been reported in Florida (Kinloch 1974).

M. incognita, M. javanica and M. hapla occur on soybean in Australia (McLeod et al. 1994), but root-knot nematode has never been considered a significant pest, probably because the industry has been confined to relatively heavy-textured soils that are unlikely to suit the nematode (e.g. the clay, clay loam and alluvial soils of northern and north eastern NSW and south eastern Queensland). However, a few instances of severe root-knot nematode damage have been encountered in coastal regions where soybeans are increasingly being grown in rotation with sugarcane. Stunted plants with severely galled root systems have been observed following sugarcane at Bundaberg and Mackay, and since root-knot nematode occurs in about two-thirds of sugarcane fields in south and central Queensland (Blair and Stirling 1999 a, b), other instances of
root-knot nematode damage are likely to occur as soybeans are grown more widely. Root-knot nematode does best in coarse-textured soils, but the nematode can also cause damage in well-structured clay loam soils of volcanic origin.

The possibility that soybean yields could be reduced by root-knot nematode when the crop is grown after sugarcane, or that soybean could host enough nematodes to damage the following sugarcane crop, prompted a study of soybeans and other legumes at a site near Mackay that was infested with *M. javanica* and *M. incognita* (Stirling et al. 2006a, b). When soybeans were planted into the high nematode population densities that can occur soon after sugarcane is harvested, severe galling was observed on three cultivars (Leichhardt, Melrose and YY) and most of the plants died before reaching maturity. Galling was less severe when planting was delayed for eight weeks and the above soybean cultivars produced low to moderate grain yields. This result shows that the initial nematode population density is an important factor influencing the severity of damage by caused root-knot nematode. Crop losses can be reduced by delaying planting until nematode populations have declined to acceptable levels.

The soybean cultivar Stuart showed relatively little galling and performed much better than the other cultivars in the above trial, suggesting that it was relatively resistant and tolerant to the two *Meloidogyne* species present at the site. Further studies in the glasshouse showed that *M. javanica* and *M. incognita* did not increase significantly on a range of soybean lines from the CSIRO tropical soybean breeding program (Stirling et al. 2006b). Since resistance is the most feasible method of nematode control in a field crop such as soybean, these findings are encouraging because they suggest that there is some resistance to root-knot nematode in the soybean material currently in Australia. Interestingly, soybean cv. Leichhardt was badly damaged by a population of *M. incognita* from Mackay but not by a population from Bundaberg in a glasshouse study (Stirling et al. 2006b), indicating that soybean cultivars may respond differently to different populations of the same nematode species. This phenomenon has been observed previously in the USA (Davis et al. 1998) and demonstrates that any future attempts to improve the level of root-knot nematode resistance in soybean cultivars must start with a good understanding of the variability of the nematode in all soybean growing regions.

**Soybean cyst nematode**

*Heterodera glycines*, a major pest of soybean throughout the world, has not been recorded in Australia. It is probably a native of Asia, as it has been known for many years in China, Japan, Korea and parts of the former Soviet Union. The nematode was introduced into North America in 1954 and has now spread to the main soybean growing regions in the USA, Canada, Colombia, Brazil, Argentina and Chile.

As with most root-parasitic nematodes, the above-ground symptoms of soybean cyst nematode are non-specific and the only universal symptom is a reduction in seed yield. When severe infestations occur, yields may be reduced to almost nothing. In the USA, yield losses from soybean cyst nematode are greater than for any other soybean disease, with losses in 2003, 2004 and 2005 amounting to about 2.8 million tonnes per year (Wrather and Koenning 2006).

The situation in North America is a salutary lesson to the Australian soybean industry on the importance of keeping Australia free of soybean cyst nematode. After its introduction in the 1950’s, it took less than 40 years for the nematode to spread to every major soybean producing state of the USA and also into Canada. The widespread distribution of the nematode has meant that major breeding programs have had to be established to minimise losses through resistant
cultivars, and some of the issues involved in introducing nematode resistance into commercial soybean cultivars are discussed by Davis et al. (1998).

*H. glycines* is recognised as an important quarantine pest in the biosecurity plan of the Australian grains industry, but it is important that growers, consultants and other people associated with the soybean industry are aware of the risks of introducing soybean cyst nematode into Australia. The nematode’s survival mechanisms favour its dissemination, with soil in seed lots, farm machinery and plant products or on the shoes of travellers being the most likely source of entry into Australia. Growers and others visiting infested soybean-growing areas overseas should therefore be particularly vigilant and take steps to ensure that traces of soil are not brought into the country.

Soybean cyst nematode is not easy to detect because normal-looking fields may experience yield losses without any obvious above-ground symptoms (Wang et al. 2003). If the nematode is eventually introduced into Australia, it is most likely to be detected in situations where soybean crops are grown frequently. Relatively infrequent cropping of soybeans (such as its use as a break crop following 4-6 years of sugarcane) will limit the capacity of soybean cyst nematode to increase to readily detectable levels. One way of checking for the nematode is to look for white cysts on roots at or shortly after flowering. Plants must be dug out rather than pulled and the fine roots inspected for white or yellow, pin-head sized cysts. Another alternative is to collect soil in a systematic pattern from a field (at least 50 sampling points per hectare) and forward the sample to a nematology laboratory for analysis.

**Reniform nematode**

There have been few detailed studies of *Rotylenchulus reniformis* on soybean, but it is known to cause stunting and reduce yield (Riggs and Niblack 1993). The nematode has a wide host range (which includes most plants except grasses) and is widely distributed throughout tropical regions of the world. In Australia, it is common in coastal areas north of Bowen in Queensland. It should not be confused with another species of reniform nematode (*Rotylenchulus parvus*), which is common on sugarcane and other grasses and occurs throughout the Queensland sugarcane industry.

*R. reniformis* is often found on leguminous crops such as lablab and soybean when they are grown as green manure crops on sugarcane farms in north Queensland, but nematode populations are generally low to moderate (<2,000 nematodes/200 mL soil). If soybeans continue to be grown intermittently as a break crop between sugarcane cycles, this situation should continue and the nematode is unlikely to become a significant pest.

**References**


