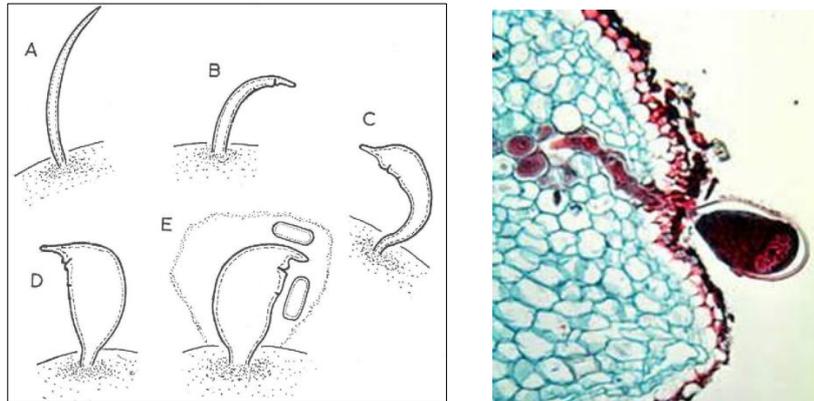


CITRUS NEMATODE (*TYLENCHULUS SEMIPENETRANS*), THE CAUSE OF SLOW DECLINE OF CITRUS

Citrus nematode occurs in all states of Australia but its occurrence to some extent depends on when citrus was first grown in a particular area. In regions where citrus was widely planted prior to about 1960 (e.g. along the River Murray in NSW, Victoria and SA, and in the Gayndah-Mundubbera region of Queensland), the nematode is widespread because citrus nurseries were infested with the nematode. Regions where citrus was introduced after nematode-free planting material became available are generally free of the nematode (e.g. locations near Bundaberg and Emerald in Queensland). Although citrus is the main host of citrus nematode, it will also be found on grapevines and olives, if they are planted in an infested area.

Life cycle

Males and juveniles of citrus nematodes are present in soil, but juveniles are the infective stage. As shown in the figure below, they partly penetrate the cortical tissue when they establish a feeding site, but their posterior end remains outside the root and becomes obese. When the female matures, her eggs are laid into a gelatinous matrix.



Stages in the life cycle of citrus nematode (left) and a mature female in a root (right)

Symptoms

Citrus trees affected by citrus nematode tend to lack vigour, grow slowly, and may show symptoms such as leaf chlorosis and leaf curling. The term 'slow decline' is sometimes used because when trees are planted in newly infested sites, there is a gradual decline in tree health that occurs over several years. As there are many possible causes of such symptoms, diagnostic samples must be collected to confirm the presence of citrus nematode. In some cases, root appearance can be a useful guide because infected roots usually have a 'dirty' appearance, as soil particles tend to adhere to the gelatinous material on the root surface.



Roots infested with citrus nematode often have soil particles adhering to the roots

Damage thresholds

Guidelines provided by some organisations on the number of citrus nematodes required to cause significant damage are no more than estimates for several reasons. First, the number of nematodes retrieved from a soil sample depends on the extraction method used. Second, the nematode population density in an orchard will vary with the time of the year. Third, yield loss caused by citrus nematode is affected by the presence of other soilborne pathogens, the rootstock, and many environmental and management factors. Nevertheless, if nematode analyses indicate that an orchard has more than 3,000 citrus nematodes/200 g soil, it is likely that the nematode is causing some damage.

Integrated nematode management practices

A range of pre-plant and post-plant measures can be used to reduce losses from citrus nematode.

- Infested nursery material is the main way of introducing citrus nematode into areas that have never previously grown citrus and so it is important to purchase planting material from nurseries certified to be free of the nematode.
- In situations where a citrus orchard is being replanted, soil fumigants have often been applied to control citrus nematode. However, methyl bromide and ethylene dibromide (EDB) have been removed from the market in the last 20 years, and the same is likely to happen to metham sodium and 1,3-dichloropropene (1,3-D) in the next few years. Practices such as cover cropping and the application of organic amendments will improve the biological health of the soil and provide some control in replant situations, but additional measures will generally be needed.
- When citrus is planted in areas where citrus nematode is known to be present, resistant rootstocks such as *Poncirus trifoliata* and Swingle citrumelo should be used. However, rootstocks vary in their adaptability to different soil types and their tolerance to soilborne diseases. They also affect yield, fruit size, and fruit quality. Thus, if the above rootstocks are unsuitable for some reason, Troyer, Carrizo and C35 citrange may be an option, as they are tolerant to citrus nematode.
- Non-volatile organophosphate and carbamate nematicides were used in the past to reduce citrus nematode populations in established orchards. However, these chemicals are no longer available, and it remains to be seen whether the newer nematicides that have replaced them will be registered for use on citrus, and whether they will be effective.
- One practice that must always be a component of an integrated management program for citrus nematode is to optimise agronomic and cultural practices. Thus, it is important to ensure that nutrient inputs are balanced, trees are irrigated regularly, and weeds are kept under control. Also, mulching is a practice that should be introduced, as it is likely to improve soil health and reduce stress on trees by reducing soil temperatures in summer, maintaining soil moisture levels, and reducing weed competition.

Further reading

The following book chapter provides an overview of the research program on citrus nematode that has been undertaken over the last 60 years in countries where citrus is grown.

Shokoohi E, Duncan LW (2018) Nematode parasites of citrus. In Sikora et al. (eds.) Plant parasitic nematodes in subtropical and tropical agriculture. CABI, Chapter 12, 446-476.