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Root-Knot Nematodes

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Root-knot nematodes, *Meloidogyne* spp., are some of the most damaging plant pathogens. Several of the most common species of root-knot nematodes have been confirmed to reproduce and cause damage on sunflower, including *M. arenaria, M. hapla, M. incognita, M. javanica,* and *M. hispanica.*

Meloidogyne spp. occur worldwide but are especially common in temperate, subtropical, and tropical regions. Countries where *Meloidogyne* spp. have been confirmed to affect sunflower include the United States and the African nations of Egypt, Mozambique, South Africa, and Zambia. Root-knot nematodes tend to cause the most damage to plants grown in sandy soils. Among these species, *M. javanica* has been shown to reproduce to the highest population density on sunflower.

Symptoms

Root-knot nematodes are named for and especially known for the swollen root galls or "knots" that they cause on roots of susceptible plants (Figs. 154 and 155). The extent of root galling is dependent on the population density of nematodes, the *Meloidogyne* sp., and the plant species. Root galling may be overlooked and lead to misdiagnosis if workers focus on other aboveground symptoms. The galls damage the roots' ability to transport water and nutrients, which can lead to plant symptoms aboveground. Stunting, yellowing, and daytime wilting of plants are often the initial symptoms noted in affected plants. Symptomatic plants often have fewer, smaller leaves, blooms, and/or fruits. Overall, plants may be yellowed, unthrifty, and prone to exhibit the wilt symptoms of drought stress, but they usually recover somewhat overnight.

Disease Cycle and Epidemiology

Root-knot nematodes are sedentary, endoparasitic nematodes. They hatch from eggs as second-stage juveniles (J2), having undergone their first molt in the egg. Hatching is affected by both temperature and exudates from plant roots. J2 is the infective stage; the nematodes migrate through the soil to the roots and most often penetrate just behind the root cap before migrating intercellularly to the zone of cell differentiation in the root cortex. The nematode's head embeds in the vascular bundle, where it begins feeding and enlarging, and becomes largely immobile. In a susceptible plant, marked changes occur at the site of feeding, with the development of up to a dozen specialized cells called giant cells. Simultaneously, other cells around the nematode undergo hyperplasia and hypertrophy, eventually leading to development of swollen galls on the roots, which can inhibit root function and plant health. The nematode subsequently increases in size and undergoes two more molts to develop into the fourth stage (J4). During J4, the nematode's sex becomes evident, and it emerges from the fourth and final molt as a sexually dimorphic adult male or female.

Most *Meloidogyne* spp. that affect sunflower reproduce asexually by parthenogenesis (without fertilization by males). An enlarged adult female remains sedentary in the root during feeding and reproduction while its posterior end ruptures the root epidermis. A female deposits up to several hundred eggs in a protective gelatinous matrix on the root surface. Survival and hatching of the nematodes are largely determined by temperature. The length of the reproductive cycle varies according to field conditions, host plant, and nematode species and can take from 20 to more than 45 days to complete, allowing for multiple *Meloidogyne* spp. in a single growing season.

Management

Several nematicides have been effective in limiting damage to sunflower caused by nematodes, but applying these chemicals is not economically viable in all production situations. Following a crop rotation sequence that includes a nonhost crop is a common management strategy for most nematodes. However, *Meloidogyne* spp. are especially difficult to manage because of their wide host ranges, which can include plant species from many diverse families; this can limit the benefit of crop rotation for nematode management.

Where root-knot nematodes are problematic, it is important to know which species are present in the fields where sunflowers are to be grown; this allows optimization of the crop rotation sequence to include nonhost crops and thus minimize damage. Results of a few research studies have shown that some sunflower cultivars are more resistant to one or more *Meloidogyne* spp. Selecting more resistant cultivars (when available or known) can be an economical way to reduce damage caused by the nematodes.

Fig. 154. Root-knot nematodes (*Meloidogyne* spp.) can cause minor galling on the roots. (Courtesy T. J. Gulya)

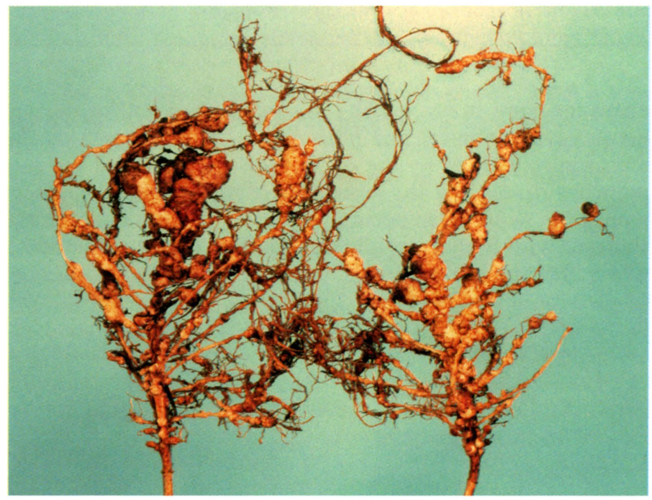

Fig. 155. Root-knot nematodes (*Meloidogyne* spp.) can cause severe galling on the roots. (Courtesy T. J. Gulya)

For additional information, see the Selected References earlier in the section "Diseases Caused by Nematodes."

(Prepared by T. A. Jackson-Ziems)