CHAPTER EIGHT

NEMATODES

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Plant-parasitic nematodes are microscopic, nonsegmented roundworms that feed on plants and may cause yield or stand loss (Figure 8.1). Over 10 different types of plant-parasitic nematodes have been found in California alfalfa fields, but only two types—stem nematode (also called stem and bulb nematode) and root-knot nematode—have been associated with serious alfalfa crop damage in northeastern California. A third type, root-lesion nematode, is common in the region and has been shown to injure alfalfa in other areas. However, serious problems with root-lesion nematode in alfalfa in northeastern California have been rare.

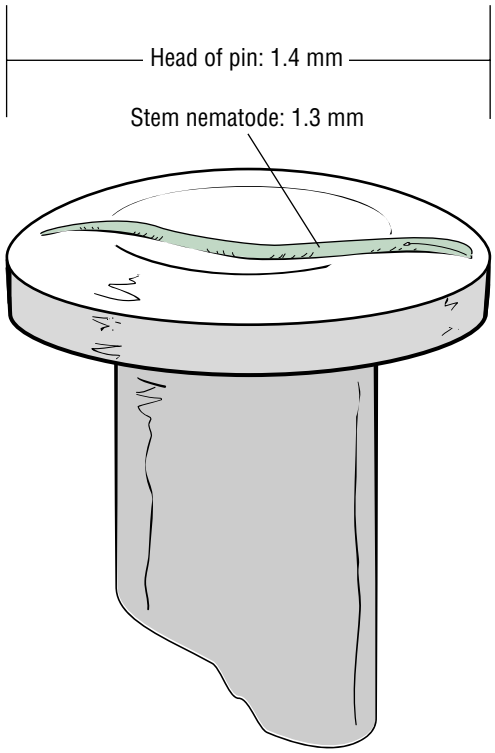

Figure 8.1. Plant-parasitic nematodes are too small to identify with the naked eye. Note the size of a stem nematode in relation to the head of a pin.

STEM NEMATODE

Significant alfalfa yield losses may occur in fields infested with stem nematode (*Ditylenchus dipsaci*). This nematode infests alfalfa stems and crowns. Affected stems are stunted and often turn yellow. Young infested shoots appear swollen, with shortened internodes, which gives the stems a dwarfed appearance (color photo 8.1). The thickened stems are usually spongy and brittle and are especially prone to frost damage—they may succumb to only moderate frosts. The stem nematode also attacks buds and leaves and may destroy young seedlings if present in large numbers.

Normally, symptoms of stem-nematode damage appear in patches of the field, reflecting the patchy distribution of the nematode (color photo 8.3). The nematode moves in free water, so infestation and damage are most severe during moist, cool, cloudy periods, when water films persist for extended times. Accordingly, stem nematode is most often a problem in cool inland valleys under sprinkler irrigation or in foggy coastal areas. In the Intermountain Region, stem nematode may present a problem only in the first or possibly the second cuttings, because hot, dry summer weather reduces nematode activity. Crop damage and yield loss from this nematode can be severe nonetheless.

Nematode infestation begins in one or more stems and, if weather conditions remain favorable, spreads throughout the crown. The nematode persists in the alfalfa crown throughout the year. When alfalfa is not

being grown, the nematode survives in plant debris or on the soil surface. Stem and bulb nematodes are spread from field to field in infested plant debris that may be carried by harvest or tillage equipment, wind, irrigation water, or animals.

ROOT-KNOT NEMATODE

Root-knot nematode infests and feeds on plant roots. It gets its name from the small galls that form on plant roots in response to nematode infestation. These galls can generally be found in the branches of lateral roots and distinguished from the nodules of nitrogen-fixing bacteria by gently rubbing the roots with your fingers (color photo 8.4). Nitrogen-fixing nodules are easily dislodged by rubbing; nematode root galls are not. In addition to root galls, root-knot nematodes often cause an increase in the branching of lateral alfalfa roots.

Aboveground symptoms of root-knot nematode infestation are generally more difficult to identify than

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are underground symptoms. With modest infestation, symptoms may include noticeable yield loss or increased plant sensitivity to nutrient or water stress. A severe nematode infestation may cause stunting in patches of the field and result in yield loss.

Two species of root-knot nematode are of primary concern to alfalfa producers in the Intermountain Region: the northern root-knot nematode (*Meloidogyne hapla*) and the Columbia root-knot nematode (*Meloidogyne chitwoodi*). Two separate races of Columbia root-knot nematode are present in the region. Columbia root-knot nematode race 1 does not do well or reproduce in significant numbers on alfalfa. Columbia root-knot nematode race 2 attacks alfalfa roots and successfully reproduces on alfalfa host plants.

Often the most serious consequences of root-knot nematode infestations in alfalfa is the damage the nematodes cause in subsequent crops (Table 8.1). Following several years of alfalfa production, populations of root-knot nematodes may be large enough to seriously injure higher-value crops such as potatoes, onions, or sugarbeets.

ROOT-LESION NEMATODE

Female root-lesion nematodes (*Pratylenchus* spp.) lay their eggs in root tissue or in the soil. Both larval and adult forms enter plant roots and migrate through root tissue while feeding on cell contents. Root-lesion nematodes are commonly found throughout the Intermountain Region. The two species most likely to be found in the area are *P. penetrans* and *P. neglectus*. Of the two, *P. penetrans* is the more likely to injure alfalfa. Both species are capable of feeding on many crop plants and weeds, but the extent to which they damage crops, including alfalfa, is not clear. Reported problems caused by root-lesion nematode in alfalfa in the Intermountain Region are rare. However, research conducted in other regions of the United States has shown that high root-lesion nematode levels can cause yield losses in established alfalfa and stand losses in fields of spring-seeded alfalfa seedlings. Root-lesion nematodes have also been shown to predispose alfalfa to infection by fusarium root and crown rot organisms.

Alfalfa may support fairly high populations of these nematodes without apparent loss of yield. However, if populations become extreme and environmental conditions are right for nematode development, alfalfa plant growth may become visibly stunted. Such stunting is the only obvious symptom of root-lesion nematode infestation.

NEMATODE DETECTION AND IDENTIFICATION

Unfortunately, plant-parasitic nematodes in alfalfa usually go undetected until visible plant injury occurs. When nematode damage is suspected, a nematologist must examine the soil or infected plants to determine

Table 8.1. Host potential of various crops in regard to root-knot nematode.

NEMATODE SPECIES	CROP					
	ALFALFA	SMALL GRAINS	POTATOES	SUGARBEETS	ONIONS	PASTURE GRASSES
Northern root-knot *M. hapla*	Host	Nonhost	Host	Host	Nonhost	Nonhost
Columbia root-knot *M. chitwoodi* race 1	Nonhost	Host	Host	Host	Host	Possible host
Columbia root-knot *M. chitwoodi* race 2	Host	Host	Host	Host	Possible host	Possible host

When nematode damage is suspected, a nematologist must examine the soil or infected plants to determine the species involved.

the species involved. Many factors—such as nutrient stress, moisture stress, or severe weather—may cause symptoms similar to those caused by nematodes.

Take soil, root, and plant-tissue samples to a diagnostic laboratory whenever alfalfa vigor seems limited without an apparent cause. To begin this sampling, visually divide the field into areas that represent differences in soil texture, drainage patterns, or cropping history. When soil is moist, take several samples from each area and include feeder roots if possible. Because nematodes feed on roots, they are more prevalent in the rooting zone of the current or previous crop than elsewhere. A series of samples from throughout the field is necessary because nematodes are usually not uniformly distributed. In an established field, collect samples from areas that show symptoms and from adjacent healthy areas. Sampling at the edge is usually better than sampling the middle of an unhealthy area—roots in the center of an infested area may be too decayed to support a nematode population. Mix samples from the same area together, and place 1 quart of the mixed soil and roots into a plastic bag. Seal the bag, place a label on the outside, keep the samples cool (do not freeze them), and, as soon as possible, take the bag to a diagnostic laboratory. Prolonged exposure of sealed plastic bags to direct sunlight may cause sufficient heating to kill nematodes. Be certain to inform the laboratory that alfalfa is the current or planned crop for the field so the technicians will use appropriate extraction techniques. Your local Farm Advisor can help you locate a diagnostic laboratory.

Careful soil sampling and examination by a qualified nematologist can detect nematode problems before planting. Because of the time and expense involved, most growers do not test for nematodes prior to alfalfa planting, though such tests are done before planting higher-value rotation crops (such as onions or potatoes). Take the presence of nematodes in soil samples or previous crops into account before establishing an alfalfa crop.

CONTROL

The primary tools available for nematode control in alfalfa are nematicides, resistant varieties, and crop rotation. Cost precludes the use of nematicides in alfalfa fields. However, nematicides may be economical for higher-value crops grown in rotation with alfalfa.

Crop Rotation

Neither root-knot nematode nor stem nematode can persist in the soil for long periods without a host crop.

Therefore, rotation with nonhost crops can be an effective means of reducing soil populations of these pests.

Many races of stem nematode can infest many plant species; however, the most likely alternative hosts for stem nematode in northeastern California are red clover, ladino clover, and sweet clover. Two years of crop rotation to nonhost crops—such as small grains, sugarbeets, or potatoes—should reduce soil populations below levels that cause economic loss in alfalfa. For a nonhost crop rotation to be effective, take care to control all volunteer alfalfa in the rotation crop.

Crop rotation can effectively control root-knot nematode also, but proper identification of the root-knot species is critical to the selection of the rotation crop. Different root-knot species and races prefer different hosts (Table 8.1). For example, rotation to a cereal crop is an effective way to lower soil populations of northern root-knot nematode, but cereal rotation will tend to maintain populations of Columbia root-knot nematode. Likewise, alfalfa is an excellent rotation crop for row crops infested with Columbia root-knot nematode race 1 but is unsuitable for controlling Columbia root-knot nematode race 2.

If no suitable nonhost crop can be identified, a year of noncrop, weed-free fallow can be effective in lowering soil populations of root-knot nematode. For maximum effectiveness, cultivate the fallow field during the fallow season. This disturbs nematodes and plant debris and helps control weeds and volunteer alfalfa that may be nematode hosts.

Crop rotation may affect root-lesion nematode population numbers, but it will probably not control the pest because of the number of crop and weed species that are suitable hosts for it.

Variety Resistance

If a field has a history of stem nematode infestation, plant it with alfalfa after crop rotation has lowered soil nematode populations. Use only varieties with demonstrated resistance to stem nematode. Many resistant varieties adapted to the Intermountain Region are available.

Although some varieties are resistant to root-knot nematode, the value of this resistance is not clear-cut. This is largely due to the time, effort, and difficulty of screening alfalfa cultivars against all the root-knot species and races known to infest alfalfa. Before purchasing a variety, discuss the potential effectiveness of cultivar resistance to specific root-knot nematode species with the seed dealer or with a University of California Farm Advisor.

Varieties with resistance to root-lesion nematode are not available, although breeding programs to increase cultivar resistance to nematodes are in progress.

ADDITIONAL READING

Ferris, H., P. B. Goodell, and M. V. McKenry. 1981. *General recommendations for nematode sampling.* Berkeley: University of California Division of Agricultural Sciences, Leaflet 21234.

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McKenry, M. V., and P. A. Roberts. 1985. *Phytonematology study guide.* Oakland: University of California Division of Agricultural Sciences, Publication 4045.