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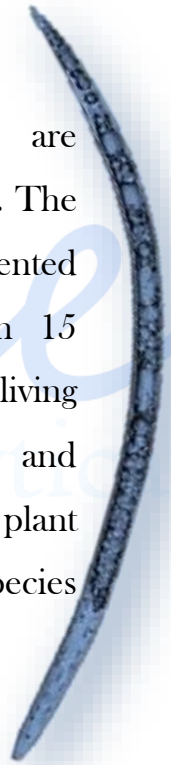
Root-knot nematode species in northwestern States of USA "Washington, Oregon and Idaho"



Root-knot nematode species are important part of nematode fauna. The nematodes in general are non-segmented round worms, comprising more than 15 thousand species. Most of them are free-living organisms, others are animal, insect, and fewer like rot-knot nematodes are plant parasitic species. Some of the latter species are economically very important.

Economic Impact of plant parasitic nematodes in general

Plant parasitic nematodes cause estimated losses to world agriculture of more than $100 billion per year. In the United States alone, nematode damage in major crops is estimated to reduce crop yields by more than $5 billion annually. Plant-parasitic nematodes are the largest unmet pest problem facing agriculture today.

Approximately 28% of US crop acreage planted with field crops, vegetables, potatoes, fruits and nut crops are infested with nematodes at economically damaging levels. The levels of infestations are even higher in the southern hemisphere, and among certain specialty crops. In the United States, annual yield losses in soybean due to nematodes have been estimated at more than $1 billion. Because the nematode can be present in fields without causing obvious aboveground symptoms, yield losses caused by nematodes are often underestimated. On cotton, National Cotton Council of America

estimates that losses due to nematode infestation is 4.7% valued at approximately $550 million. On alfalfa, it is estimated that nematodes can cause 6-13 percent yield losses, for which there is no economically feasible remedy. It is estimated that 40% of US strawberry acreage is infested with nematodes and 70% of the acreage receives chemical nematicide treatment. Likewise, 900,000 acres of peanuts in the US are infested by the root-knot nematode, causing $81 million in losses annually.

Root-knot Nematodes of NW of USA

Root-knot nematodes, are the most thoroughly studied, and consists of numerous species. However, due to colder winter temperature in tri-states root-knot nematode species are limited to Columbia root-knot nematode (*Meloidogyne chitwoodi* Golden *et al* 1980), northern root-knot nematode (*M. hapla* Chitwood 1949), and barley root-knot nematode (*M. nassi* Franklin 1965). The warmer temperature species like southern root-knot nematode (*M. incognita*), or Javanese root-knot nematode (*M. javanica*) have not been reported from tri-states.

Image-1: *Meloidogyne chitwoodi* larval tail

1. Columbia root-knot nematode, *M. chitwoodi,* (Images-1) was originally reported on potato from eastern part of Washington (Quincy) by Golden, O'Bannon, Santo & Finley in 1980. It has been suggested that this nematode was originally introduced to US from Netherlands. Presently, it is reported from Washington, Idaho, Oregon, northern California, Colorado, Nevada, New Mexico, Texas, Utah and Mexico. Eisenback *et al* (1986) reported the presence of this nematode in eastern USA. In the state of Washington Columbia root-knot nematode is widely spread–and it is thought that irrigation water has

dispersed *M. chitwoodi* to 60% of potato fields in the state.

2. Northern root-knot nematode, *M. hapla* [Chitwood 1949], (Image-2) is a more common species than Columbia root-knot nematode, and except for cereal crops it infects more than 250 plant species.

Image-2: *Meloidogyne hapla* larval tail

Both species infect potato plants and cause blemishes on tubers, and render them unmarketable. While the damage threshold of Columbia root-knot nematode on potato is one nematode per half a pint of soil at planting, that of *M. hapla* is 50.

Furthermore, *M. chitwoodi* becomes active at 5C soil temperature, whereas *M. hapla* is active at 10 C. Thus, *M. chitwoodi* can produce up to 5 generations per growing season on potato, while M. hapla produces only two. Furthermore, *M. chitwoodi* continues to remain active in potato tubers during the cold storage such that during storage. Thus *M. chitwoodi* is far more important pathogen of potato than *M. hapla.* While internal symptoms of potato tubers infected by the species are similar, the external symptoms caused by *M. chitwoodi* consist of bumps whereas *M. hapla* infected tubers are smooth on the surface (images-5 and 6)

M. hapla is an important pathogen of alfalfa crop, whereas most populations of *M. chitwoodi* do not parasitize alfalfa. The *M. chitwoodi* population that invades alfalfa roots is called alfalfa race.

3. Barley root-knot nematode, *M. nassi* [Franklin 1965], (Image-3) a cereal crop pathogen considered of little importance in the northwest. However, *M. nassi* in high numbers may cause aboveground symptoms in small grains. The effective method to control this pest is crop rotation.

Image-3: *Meloidogyne nassi* larva

Specific identification of root-knot nematodes is based on perennial patterns of female nematodes. In the northwest, however *M. chitwoodi*, *M. hapla* and M. *nassi* are distinguished by their tail shape (Images-1 and 2).

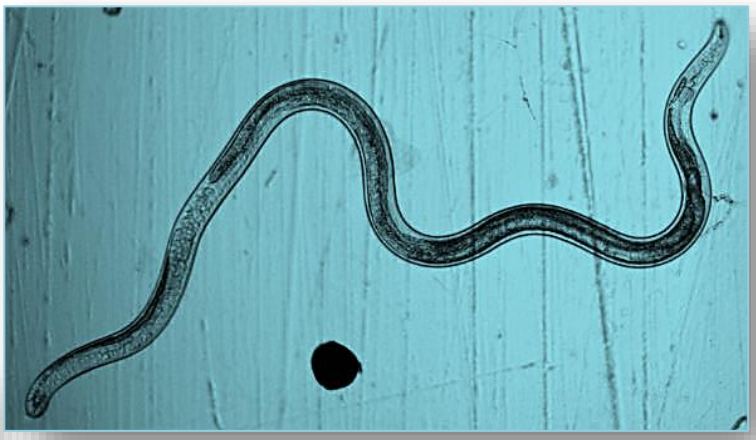


Image-4: Root-knot nematode Male

Measures to control root-knot nematodes on:

POTATOES

Originally, rotating potato with alfalfa was considered an effective method to control *M. chitwoodi*. Three to four years of alfalfa would reduce the nematode population such that one season of potato can be harvested safely, especially—early varieties. However, after the discovery of *M. chitwoodi* race that infect alfalfa, this procedure may be risky. That is why application of 15 gal/acre Telone II (injected 18 inches deep) and surface

application of 30 gallons of metham sodium (Vapam) is recommended for control both *M. chitwoodi* and *verticillium* wilt of potato. Rotating potato with cereal crops for at least one year and application of Vapam will control *M. hapla* and *verticillium* wilt on potato. Soil sampling prior to planting and after fumigation will help the farmers to determine whether their potato crop will avoid economic damage from these pathogens. In case of escape of root-knot nematodes (especially *M. chitwoodi*) after fumigation, application of Vydate on growing plants has rendered positive results in certain cases.

Image-5: Potato tuber infected with root-knot nematode *M. chitwoodi*

New chemicals with nematicidal activity, like Velum Prime, Movento etc. have been introduced to market.

Image-6: Potato tubers infected with *M. chitwoodi* (left) and *M. hapla* (right)

Alternative to chemical treatments, green manures have also been tried to control root-knot nematodes. Planting crops like Rapeseed, Sudangrass and incorporating them in the fall, have reduced the root-knot nematode population in the soil significantly. However, because of low tolerance to *M. chitwoodi,* reduction of >80% of population will not be sufficient to crop potato after the green manure usage.

At present, there are no commercially registered root-knot nematode resistant potato varieties available.

ALFALFA

Alfalfa is impacted by *M. hapla*. Infected alfalfa lose winter hardiness and plant stands are reduced. The common practice to control or at least reduce the impact of *M. hapla* on alfalfa is to rotate alfalfa with grassy crops like wheat, and barley. Resistant variety, Nevada Synthetic XX can also be tried.

GRAPES

On grape, *M. hapla* is considered a serious pathogen. It feeds on or within roots and quite frequently go undetected because their feeding does not result in the production of characteristic above ground symptoms. Vineyard sites should always be sampled for nematodes prior to establishment. This is critical because there are no longer any post-plant chemical control options for nematodes on grape, so control must be achieved before planting. Proper identification of the types of nematodes present in any location is imperative in order to design management plans especially if cultural tactics will be utilized.

ONIONS AND GARLICS

Other crops like garlic and onions are also impacted by Columbia and Northern root-knot nematodes (image-7).

Image-7: Onion roots infected with Root-knot nematodes

If the field is not known to be infested with root-knot nematode pests, make sure clean, uninfested cloves are used when planting garlic. Garlic cloves can be tested by AGNEMA laboratory if they are infested. Avoid infesting new fields by cleaning machinery and equipment with water, and preventing movement of infested soil. At present, there are no commercially registered root-knot nematode resistant onions/garlic cultivars available. Pre-plant fumigation can be effective in onion fields.

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