Radopholus citrophilus

Introduction

Radopholus citrophilus, the borrowing nematode of citrus, is considered to be the citrus race of *R. similis.* Hence, the morphology and biology are similar to *R. similis*. So far it is only found on citrus in the USA- Florida and Hawaii where it can cause a spreading decline of these crops. It has not been reported from the Caribbean where it could pose a serious threat to the citrus industry.

Identity

Authority : Cobb, (1893)
Classification
- Kingdom : Animalia
- Phylum : Nemata
- Class : Secernentea
- Order : Tylenchida
- Family : Pratylenchidae
- Genus : *Radopholus*
- Species : *citrophilus*
- Synonyms : *Tylenchulus granulosus* Cobb, 1893; *T. similis* Cobb, 1893; *T. acutocaudatus* Zimmerman, 1898; *T. biformis* Cobb, 1909; *T. similis* Micoletzky, 1922; *Anguillulina similis* Goodey, 1932; *Tylenchorhynchus similis* Filipjev, 1934; *Bitylenchus granulosus* Filipjev, 1934; *Rotylenchus similis* Filipjev, 1936; *T. granulosus* Filipjev, 1936; *Radopholus similis* Thorne, 1949.

Common name : Burrowing nematode (citrus race).
Role : Pest

Signs & Symptoms

On citrus *R. citrophilus,* a migratory endoparasite, enters citrus root tips from the root cap to the region where epidermal cells have started to suberize. If the apical meristem is destroyed, then terminal growth ceases. If terminal growth continues, lesions eventually will be located several centimetres from the root tip; the root would then appear to have been invaded at a site other than the tip. Lesions of various sizes occur and they may coalesce to form large cankers with calloused margins.

An infected tree may have approximately half as many functional feeder roots as a healthy tree. At depths between 25 and 75 cm, 25 to 30% of the feeder roots are destroyed; below 75 cm, 90% of feeder roots are destroyed.

Individual trees infected with the burrowing nematode have sparse foliage, dead twigs with branching ends, and dead limbs. Trees appear undernourished; the leaves are small. Blooming is profuse but few fruits are set, and these are usually small; it was found that

spreading decline caused yield reductions of 40 to 70% in oranges, and 50 to 80% in grapefruit. Affected trees wilt readily in drought conditions.
"Spreading decline" is seen as a group of trees, all showing the same degree of decline, in an area that increases in size every year (Fig. 1). This continuous spread in all directions (about 1.5 trees per year) is the most characteristic feature of the disease, hence its name. Aboveground symptoms usually appear one year after initial infection of roots. Parasitized, but healthy- looking trees occur one to three rows in advance of those visibly declining.
Spreading decline symptoms are noticed primarily in deep, well-drained sandy soils. In Florida, minimal rainfall from February to May puts additional stress on trees already weakened by the nematode. When summer rains fall, trees recover partially, but never recover normal growth.

On anthurium: Poor vegetative growth accompanied by decreased bloom production has been a common and persistent problem in anthurium production in Hawaii. Affected plants bear only a few, small, dull green leaves; older leaves turn yellow and the plant produces few blooms; these are smaller than normal. Most of the roots and basal stem become rotted, until few functional roots remain.

Morphology

Dimensions and morphological characters are identical to *Radopholus similis*, except for certain minor differences. In fact, current opinion is that *R. citrophilus* is merely a *Radopholus similis* pathotype.

Biology & Ecology

Radopholus citrophilus is a migratory endoparasite spending its adult veriform life in the roots, but capable of emerging in adverse conditions. At 24-32 C the life cycle took 20-25 days, and 18-20 days at 24-27 C. All larval stages and females are infective. Fertilization is usual but parthenogenesis does occur. Egg hatch occurs in three to seven days. Females produce about two eggs/day. Males do not penetrate intact roots and may not feed. The species survives less than six months in soil free of host roots. At least two *Radopholus citrophilus* biotypes were formerly recognized, similar morphologically but different in host range. The "banana race" could attack banana, but not citrus, while the "citrus race" was pathogenic to both citrus and banana. In 1984, the citrus and banana races were described as sibling species, and the citrus race elevated to *R. citrophilus* (Huettal and Yaegashi, 1988).

Dispersal/vectors

Radopholus citrophilus is a migratory endoparasite that enters the host plant via root tips and initiates the spread of the disease

Management

Cultural and Chemical Control

Of spreading decline of citrus: Initially, in Florida, local quarantine measures were established, and enforced, to limit the spread of the nematode and to prevent its establishment in unaffected groves. Up to now, all other citrus growing areas in the USA, and elsewhere, have stringent quarantine and other regulations to prevent the spread of *R. citrophilus* via affected plant materials or growing media. It has to be said that the measures to keep the nematode within Florida have been eminently successful, since spreading decline of citrus has never been reported to occur anywhere outside that state. Within Florida, the disease was managed for a long time by the "push and treat" method, and the use of barriers to prevent the spread of the nematode. When the use of EDB was discontinued, so was the push and treat method to control spreading decline. The major management strategies are the use of "nematode-free nursery stock" certification programmes, and the use of resistant or tolerant rootstocks. However, this latter strategy does not appear to have much of a future. More recent trials have shown some benefit of restricting the growth of citrus roots across root free buffer zones. Other strategies involve ways of encouraging optimum plant vigour through fertilization, irrigation and other relevant cultural practices.

Of anthurium decline: Raising the planting bed level by replenishing the growing medium (repacking the bed) resulted in development of young, vigorous, functional roots, and large, healthy leaves. This response, however, was always temporary, since three to four months later, plants declined again. Treating beds with phenamiphos ® resulted in the development of vigorous plants with large leaves; these produced up to 60% more blooms over untreated control plants. It seems that the best option would be to grow nematode free (micro-propagated) plants in nematode-free plots. In fact, this is now common practice.

Host Notes

Radopholus citrophilus, up to 1998, was present only in Florida, USA, causing a disease called "spreading decline" of citrus. A nematode identified as *R. citrophilus* was reported in 1998 to be the cause of anthurium decline in Hawaii.

Distribution

Florida and Hawaii (USA).

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WEB RESOURCES -

http://www.nematode.unl.edu/rcitrop.htm
http://www.cosave.org.py/lpcradopholussimilis.htm
http://www.www.ianr.unl.edu/ianr/plntpath/nematode/radods.htm
http://www.ucdnema.ucdavis.edu/imagemap/nemmap/ent156html/nemas/radopholussimilis
http://www.ucdema.ucdavis.edu/imagemap/nemmap/ENT156HTML/nemas/radopholussimilis

Fig. 1: Citrus on left showing symptoms of advanced "spreading decline" caused by *Radopholus citrophilus;* Plant on right growing in soil free of the nematode.