cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Pratylenchus penetrans (Cobb, 1917) Filipjev & Schuurmans Stekhoven, 1941

Cobb's lesion nematode

Current Pest Rating: C

Proposed Pest Rating: C

Kingdom: Metazoa, Phylum: Nematoda
Class: Chromadorea, Order: Rhabditida
Family: Pratylenchidae

Comment Period: 07/28/2023 through 09/11/2023

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Pratylenchus penetrans* is described herein and a permanent pest rating is proposed.

History & Status:

Background:

Members of the genus *Pratylenchus* (Filipjev 1936) are commonly known as root-lesion nematodes. They are polyphagous, migratory root endoparasites. Developing and reproducing in the soil or roots, they cause root lesion disease on many plant taxa in temperate and tropical regions around the world. Their life cycle is often sexually reproducing; however, parthenogenicity is common in the genus and many species are not known to have males. Adults and juveniles of all stages are infective, moving in and out of roots. They feed on parenchyma cells, largely but not exclusively in the root cortex. They enter the roots behind the zone of elongation, but may feed ectoparasitically as well, on the outside at the root tip. The genus *Pratylenchus*, in the family Pratylenchidae (Nematoda, Tylenchina), has approximately 100 species recognized today (Castillo and Vovlas, 2007).

The genus name is derived from a contraction of the words pratum (Latin= meadow), tylos (Greek= knob) and enchos (Greek=spear). They insert their stylets into the root cortical cells and withdraw the

contents by pulsating their metacorpus. Traditionally, species have been distinguished primarily by the morphology of the stylets. Morphological identification of *Pratylenchus* species is difficult, requiring considerable subjective evaluation of characters and overlapping morphometrics. Molecular techniques are increasingly important for diagnostics (Subbotin et al., 2008).

Root-lesion nematodes are recognized worldwide as major constraints on important economic crops, including banana, cereals, and coffee. *Pratylenchus penetrans* often is found in a mixed infection with other species of nematodes, and very high yield losses are reported when nematodes interact synergistically with certain soilborne plant pathogens (Jones and Fosu-Nyarko, 2014; Bucki et al., 2020).

Pratylenchus spp. were first discovered in California in 1927, but their significance as plant pathogens was not recognized until investigations conducted from 1930 to 1943 revealed damages caused by root lesion nematodes to walnut, fig, and cherry trees. At that time, confusion over species identities, distribution, and host ranges made it difficult for state and county regulatory agencies to restrict the spread of root lesion nematodes until the group was revised by Sher and Allen in 1953. By 1959, *P. brachyurus, P. penetrans, P. vulnus, P. scribneri*, and *P. hexincisus* were recognized as root lesion nematodes of economic importance in California. In the early 1960s, a nematode survey of pear orchards was conducted in response to the occurrence of pear decline in California. Of the several different *Pratylenchus* species found in pear orchards, only *P. vulnus and P. penetrans* were recovered from pear roots (Chitambar et al., 2018).

Like other *Pratylenchus* species, *P. penetrans* has six life stages: egg, four juvenile stages and adult. Reproduction is mainly with males and females but possible through parthenogenesis. First-stage juveniles develop within the egg, followed by a first molt to the second stage juvenile that hatches from the egg. Each stage develops into the next via a molt of its cuticle (outer body covering). All juvenile and adult stages are worm shaped (vermiform). All post-hatch stages are motile and can infect plants. Generally, root lesion nematodes have a life cycle of 45-65 days. *Pratylenchus* spp. survive the winter in infected roots or soil as eggs, juveniles, or adults. During spring, when plant growth is active, eggs hatch, nematodes are attracted to the plant roots and begin to feed and continue their life cycle within roots or in rhizosphere soil. Within the root, the nematode feeds on cortical tissue causing necrosis of cortical cells, cell breakdown, and formation of cavities. Necrosis is apparent as lesions that expand as the nematodes move lengthwise within the infected roots. Some nematodes may leave the root, enter soil, and re-enter the root at a different site causing a new infection (Chitambar et al., 2018).

Hosts: Pratylenchus penetrans has an extremely large host range, including over 350 host plants from highly diverse families, including woody plants, vegetables, and ornamentals (Goodey, 1965; Nemaplex, 2023). Hosts recorded in CDFA Pest and Damage Records include alfalfa, stone fruit, pome fruit, grape, cane berries, bedding plants, indoor foliage plants, olive, lilies, garlic, fig, lilac, mint, potato, rose, strawberry, tomato and walnut.

Symptoms: The symptoms of *P. penetrans* infection are often hard to distinguish from those of other plant pathogens. Low to moderate populations of lesion nematodes may cause no visible aboveground symptoms. On well-managed turf and in some woody ornamentals, the only symptoms are a lack of winter hardiness (Davis and MacGuidwin, 2005). Root lesion nematodes penetrate roots and cause

damage by feeding and producing wounds that allow other pathogens to enter (Lakshman et al., 2007). Infected plants with *Pratylenchus penetrans* have roots with black lesions and fewer feeder roots than non-infected plants, resulting in stunted root growth. Top growth may exhibit general symptoms of an impaired root system, including lack of vigor, dieback, chlorotic and small leaves, and reduction of yield. Infected roots exhibit retarded growth, and sometimes shoots do not emerge from their bulbs as a result (Chitambar et al., 2018).

The extent of lesion formation caused by *P. penetrans* can be accelerated during concomitant root invasion by other soilborne plant pathogens, and sometimes these interactions can develop into synergistic disease complexes. Lesion nematode damage to roots not only causes losses in yield but also can cause losses in marketable quality of infected plant products. The wounds inflicted on plant roots and other belowground plant parts by lesion nematodes can serve as infection courts for pathogenic soil microbes, primarily fungi. This appears to be particularly true in disease complexes that involve lesion nematodes and wilt fungi such as *Fusarium* and *Verticillium*. Areas of disease become more pronounced in adverse environmental conditions such as water and nutrient stress, or if the root system is damaged. The root lesions may predispose plant tissues to invasion of fungi and bacteria that can accelerate root decay (Davis and MacGuidwin, 2005).

Transmission: Pratylenchus spp. are transmitted in multiple ways. They are transmitted in all manners in which soil is moved from location to location. The spread of lesion nematodes within fields is usually accelerated by the cultural practices of the grower, such as moving soil with cultivation. Lesion nematodes can be introduced to non-infested sites by poorly sanitized farm equipment and contaminated planting stock, such as tubers and bulbs. Lesion nematodes spread readily in contaminated soil via equipment, wind, and with movement of animals. Lesion nematodes may also be spread in run-off water (Davis and MacGuidwin, 2005).

Damage Potential: In general, the damage from *P. penetrans* is proportional the population of the nematodes in the soil, and the sensitivity of the host to root damage. Additional to the direct damage from nematodes acting as a nutrient sink, physical damage from the wounding of roots, and subsequent invasion of other pathogens can be even more detrimental (Davis and MacGuidwin, 2005).

Worldwide Distribution: This nematode is very widespread - in Africa, the Americas, Asia, Europe, and Oceana (CABI, 2023; EPPO, 2023).

Official Control: *Pratylenchus penetrans* is on the EPPO's A1 list for Paraguay. It is on the A2 list for Jordan, and it is a quarantine pest in Mexico. It is a regulated non quarantine pest in Switzerland and the United Kingdom. It is on the USDA PCIT's harmful organisms list for Argentina, Brazil, Canada, Chile, Colombia, El Salvador, Guatemala, Honduras, Iceland, Jordan, Mexico, Nicaragua, Norway, Panama, Paraguay, Peru, Svalbard and Jan Mayen, and Taiwan (USDA PCIT, 2023).

California Distribution: Widespread, likely statewide where hosts are grown (CDFA PDR database, 2023).

California Interceptions: There have been occasional interceptions from outside of California, mainly on nursery stock or houseplants arriving from other states.

The risk *Pratylenchus penetrans* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:**

Pratylenchus penetrans is likely to be found wherever its hosts are grown.

Evaluate if the pest would have suitable hosts and climate to establish in California.

Score: **3**

- Low (1) Not likely to establish in California; or likely to establish in very limited areas.
- Medium (2) may be able to establish in a larger but limited part of California.
- **High (3) likely to establish a widespread distribution in California.**

2) **Known Pest Host Range:**

Pratylenchus penetrans has an extremely large host range with records from 350 species.

Evaluate the host range of the pest.

Score: 3

- Low (1) has a very limited host range.
- Medium (2) has a moderate host range.
- **High (3) has a wide host range.**

3) **Pest Reproductive Potential:**

Pratylenchus penetrans has a high reproductive rate but it disperses extremely slowly without human help.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- Low (1) does not have high reproductive or dispersal potential.
- **Medium (2) has either high reproductive or dispersal potential.**
- High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:**

There is direct damage from nematode feeding and an increase in other root diseases. *Pratylenchus penetrans* is a quarantine pest for some countries. Nematodes are spread with soil and water.

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, C, G

A. The pest could lower crop yield.
B. The pest could lower crop value (includes increasing crop production costs).
C. The pest could trigger the loss of markets (includes quarantines).
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **3**
- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- High (3) causes 3 or more of these impacts.

5) Environmental Impact:

The impact of *Pratylenchus penetrans* on natural environments is most likely not significant as the species is already widespread without causing apparent detriment to ecological balances and processes, however, the infestations of this root lesion nematode could affect home/urban gardening.

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: E
A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 2
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Pratylenchus penetrans:* High

Add up the total score and include it here. **13**
-Low = 5-8 points
-Medium = 9-12 points
-High = 13-15 points

6) **Post Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication, or have been delimited with no further detections should not be included.

   Evaluation is 'High'.

   Score: -3

   -Not established (0) Pest never detected in California or known only from incursions.

   -Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).

   -Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.

   -High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of introduction score minus the post entry distribution and survey information score: (Score)

   Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 10***

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Pratylenchus penetrans*** **is C.**

References:

Agrios, G. N. 2005. Plant Pathology, 5th Edition. Elsevier Academic Press. 922 pg

Allen, M. and Maggenti, A., 1959. Plant nematology in California: State's: Crop losses led to first department for research in plant nematology to be established by experiment stations. California Agriculture, 13(9), pp.2-3.

Bucki, P., Qing, X., Castillo, P., Gamliel, A., Dobrinin, S., Alon, T. and Braun Miyara, S., 2020. The genus Pratylenchus (Nematoda: Pratylenchidae) in Israel: From taxonomy to control practices. Plants, 9(11), p.1475.

Castillo, P. and Vovlas, N., 2007. *Pratylenchus* (Nematoda: Pratylenchidae): diagnosis, biology, pathogenicity, and management (Vol. 6). Brill.

Chitambar, J. J., Westerdahl, B. B., and Subbotin, S. A. 2018. Plant Parasitic Nematodes in California Agriculture. In Subbotin, S., Chitambar J., (eds) Plant Parasitic Nematodes in Sustainable Agriculture of North America. Sustainability in Plant and Crop Protection. Springer, Cham.

EPPO Database. https://gd.eppo.int/taxon/ PRATPE Accessed 7/11/23

Davis, E.L. and A.E. MacGuidwin. 2000. Lesion nematode disease. The Plant Health Instructor. DOI: 10.1094/PHI-I-2000-1030-02. Updated 2005.

Farr, D.F., and Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved December 6, 2019, from https://nt.ars-grin.gov/fungaldatabases/

French, A. M. 1989. California plant disease host index. CA Division of Plant Industry. 2nd Ed. 394 pg

Goodey, J.B., Franklin, M.T. and Hooper, D.J., 1965. T. Goodey's' The nematode parasites of plants catalogued under their hosts'. T. Goodey's' The nematode parasites of plants catalogued under their hosts'., (3rd ed.(rev.)).

Jones M., Fosu-Nyarko J. Molecular biology of root lesion nematodes (*Pratylenchus* spp.) and their interaction with host plants. Ann. Appl. Biol. 2014; 164:163–181.

Lakshman, D., Vieira, P., Pandey, R., Slovin, J. and Kamo, K., 2017. Symptom development in response to combined infection of in vitro-grown *Lilium longiflorum* with *Pratylenchus penetrans* and soilborne fungi collected from diseased roots of field-grown lilies. Plant Disease, 101(6), pp.882-889.

Nemaplex UC Davis Nemabase. 2023. http://Nemaplex.ucdavis.edu. Accessed 7/11/23

Sher, S. A., and Allen, M. W. 1953. Revision of the genus *Pratylenchus* (Nematoda: Tylenchidae). University of California Publications in Zoology, 57, 441–447.

Subbotin, S.A., Ragsdale, E.J., Mullens, T., Roberts, P.A., Mundo-Ocampo, M., and Baldwin, J.G., 2008. A phylogenetic framework for root lesion nematodes of the genus Pratylenchus (Nematoda): Evidence from 18S and D2–D3 expansion segments of 28S ribosomal RNA genes and morphological characters. Molecular phylogenetics and evolution, 48(2), pp.491-505.

USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Pratylenchus penetrans*. Accessed 7/11/23.

Responsible Party:

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***Comment Period: 07/28/2023 through 09/11/2023**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: C
