cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Nacobbus aberrans (Thorne, 1935) Thorne & Allen, 1944 (sensu lato)

False root-knot nematode

Pest Rating: A

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

Comment Period: 11/01/2024 through 12/16/2024

Initiating Event:

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

History & Status:

Background: The false root-knot nematode *Nacobbus aberrans* sensu lato is native to the American continent. It has been reported in tropical and subtropical regions and is an important pathogen of field and vegetable crops. Because of differences in host range and genetic variability among populations, *N. aberrans* should be regarded as a species complex (sensu lato) with species being difficult to discriminate using only morphological characters (Lax et al., 2021). All populations of this species complex are plant pathogens, but the validity of species, subspecies, and races is not fully resolved (Baldwin and Cap, 1990; Reid et al., 2003; Vovlas et al., 2007).

The occurrence of this nematode has likely been underestimated due to confusion with widely occurring but diverse nematode taxa. The sedentary saccate females and the resulting root galls caused by *N. aberrans* can be mistaken for those associated with other saccate nematodes. This genus can also easily be confused with other gall-forming species like *Meloidogyne*; this is the origin of the common name “false-root knot nematode” (Veremis et al., 1997). *Nacobbus aberrans* is listed as one of the “top 10” of plant-parasitic nematodes based on scientific and economic importance and is used as a biological model for understanding plant pathogenesis at a molecular level (Jones et al., 2013).

Naccobus is a unique genus having both migratory and sedentary endoparasitic stages (Eves-van den Akker et al., 2015). The life cycle is made up of eggs, four juvenile phases, and adults (male and female). Juveniles in the first stage grow inside eggs laid in a gelatinous matrix that extends into the soil from the root surface. Second, third, and fourth-stage juveniles, as well as young females and males, migrate through the soil and can invade, depart from, and re-invade host plant roots. They create holes in the root cortex when they are feeding, and necrotic lesions form at these sites. Mature females undergo sedentary behavior and create unique feeding locations known as syncytia through cell division, partial wall disintegration, and protoplast fusion. Galls are produced around these feeding sites from the proliferation of vascular and cortical tissue (Inserra et al., 1983). *Nacobbus aberrans* can survive unfavorable environmental conditions, such as extremely low soil humidity and low temperatures, by entering a quiescent dormant stage (Anthoine et al., 2006).

"Sensu lato" is used to mean "in the broad sense" to describe a species complex and in this case includes *N. batatiformis* from North America and *N. serendipiticus, N. bolivianus, N. celatus,* and *N. aberrans* (sensu stricto) from South America (Sher, 1970; Baldwin and Cap, 1990; Lax et al., 2021). In the United States, *N. aberrans* is an economic pest of sugarbeet in Nebraska and Wyoming. United States populations of *N. aberrans* are in the sugarbeet race. They infect beets and can also infect many other plant species in diverse families. However, they are unable to infect potatoes (Manzinilla-Lopez et al., 2002). There is a potato race of *N. aberrans* which is found in Mexico and the Andes Mountains of South America. These can infect potatoes and many other cultivated plants including sugarbeet, beet, carrot, and turnip. A third race that infects beans occurs in Mexico. The bean race does not infect either potato or sugarbeet (Manzinilla-Lopez et al., 2002; Inserra et al., 2004). Tomato, however, appears to be a good host for all three races (Anthoine and Mugniery, 2006). The broad host range of the potato pathotype of the false root-knot nematode could facilitate the establishment of this pest on potatoes and alternative hosts if it was introduced into the United States (Inserra et al., 2004).

Hosts: Naccobus aberrans sensu lato has a broad host range among crops and noncultivated plants representing at least 18 botanical families. *Amaranthus hybridus* (hybrid amaranth), *A. hypochondriacus* (prince's feather), *A. quitensis* (South American amaranth), *A. retroflexus* (American pigweed), *Amaranthus* sp.*, A. spinosus* (spiny pigweed), *Anoda cristata* (anoda-weed), *Atriplex confertifolia* (spiny saltbrush), *Baccharis salicifolia* (seep-willow), *Bassia scoparia* (burningbush), *Beta vulgaris* (garden beet), *Brassica juncea* (brown mustard), *B. napus* (canola), *B. nigra* (black mustard), *B. oleracea* (broccoli), *B. rapa* (field mustard), *Capsella bursa-pastoris* (shepherd's purse), *Capsicum annuum* (pepper), *Capsicum baccatum* var. *pendulum* (Peruvian pepper), *C. frutescens* (red chili), *C. pubescens* (rocoto chile), *Cestrum roseum* (rosy cestrum), *Chenopodiastrum murale* (Australian spinach), *Chenopodium album* (lamb's quarters), *Chenopodium berlandieri* var. *berlandieri* (pitseed goosefoot), *C. quinoa* (quinoa), *Coryphantha vivipara* (cactus), *Cucumis sativus* (cucumber), *Cucurbita maxima* (pumpkin), *Cucurbita pepo* (squash), *Datura ferox* (large thorn-apple), *Datura stramonium* (common thorn-apple), *Daucus carota* (carrot), *Dysphania ambrosioides* (wormseed)*, Escobaria vivipara* (pincushion cactus), *Gaillardia pulchella* (blanket flower), *Ipomoea batatas* (sweet potato), *Kochia scoparia* (summer cypress), *Lactuca sativa* (lettuce), *Lupinus mutabilis* (pearl lupine), *Malva parviflora* (ring-leaf mallow), *Matthiola* sp., *Nicotiana tabacum* (tobacco), *Opuntia fragilis* (prickly pear), *O. macrorhiza* (cactus), *Origanum vulgare* (wild marjoram), *Oxalis tuberosa* (New Zealand yam),

Phaseolus vulgaris (bean), *Physalis* sp., *Pisum sativum* (garden pea), *Plantago lanceolata* (buckhorn), *Portulaca oleracea* (portulaca weed), *Raphanus sativus* (daikon radish), *Salsola kali* (prickly saltwort), *Senecio vulgaris* (common fireweed), *Sisymbrium irio* (London rocket), *Solanum acaule, S. andigenum, S. chmielewskii, S. hirsutum*, *S. infundibuliforme, S. lycopersicum* (tomato), *S. megistacrolobum, S. melongena* (eggplant), *S. nigrum* (black nightshade), *S. peruvianum* (Peruvian nightshade), *S. pimpinellifolium* (currant tomato), *Solanum* sp., *S. sparsipilum, S. tuberosum* (potato), *Spergula arvensis* (corn spurrey), *Spinacia oleracea* (spinach), *Stellaria media* (chickweed), *Taraxacum officinale* (common dandelion), *Tragopogon porrifolius* (salsify), *Tribulus terrestris* (puncture vine), *Trifolium* sp. (clover), *Tropaeolum tuberosum* (mashwa), and *Ullucus tuberosus* (ullucus) (Nemaplex, 2010; EPPO, 2024).

Symptoms: Damage from *Nacobbus aberrans* can be seen in the host root system as galling. The galls are similar to those caused by *Meloidogyne* spp. but often occur along the root as discrete and rounded swellings, like beads on a string. In highly infested fields, symptoms are areas or patches with poor plant growth, stunting, chlorosis, and signs of wilting, even in soils with adequate moisture. Infected plants have a lower chance of resisting unfavorable conditions, especially drought (Cabrera Hidalgo et al., 2014). Damages can be even greater when other soil-borne pathogens present (Rodríguez et al., 2007; Ortuño et al., 2013).

Transmission: Nacobbus aberrans has a limited ability to spread through undisturbed soil, and its movement is limited to short distances. Movement over longer distances, within fields or regions, happens with the movement of infested soils or crop debris, including soil adhering to agricultural machinery and the movement of irrigation water. Tubers for planting are the main pathway of spread with potatoes.

Damage Potential: Yield losses have been reported on sugar beet in the range of 10–20%. In Mexico, yield losses of 55% and 36% for tomatoes and beans, respectively, have been reported. The yield losses reported on staple and industrial crops average 65% for potatoes in the Andean regions of Latin America (Manzanilla-Lopez et al., 2002).

Worldwide Distribution: Americas: *Argentina, Bolivia, Chile, Ecuador, Mexico, Peru, United States of America* (Arkansas, Colorado, Kansas, Montana, Nebraska, South Dakota, Utah, and Wyoming) (EPPO, 2024).

Official Control*: Nacobbus aberrans* is on the EPPO's A1 list for Bahrain, Brazil, Eurasian Economic Union, European Plant Protection Organization, Georgia, Jordan, Paraguay, Russia, Serbia, Switzerland, Türkiye, Ukraine United Kingdom, Uruguay, and Uzbekistan. It's on the A2 list for Argentina and is a quarantine pest in China, the European Union, Israel, Moldova, Morocco, Norway, and Tunisia (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Antarctica, Albania, Argentina, Brazil, China, Colombia, Costa Rica, El Salvador, Eurasian Customs Union, European Union, Georgia, Guatemala, Holy See (Vatican City State), Honduras, Iceland, Indonesia, Israel, Japan, Jordan, Monaco, Morocco, Nicaragua, Norway, Oman, Paraguay, Qatar, Republic of North Macedonia, San Marino, Serbia, Taiwan,

Thailand, The Republic of Korea, The Republic of Türkiye, Timor-Leste, Tunisia, United Arab Emirates, Uruguay, and Viet Nam (USDA-PCIT 2024).

California Distribution: None

California Interceptions: None

The risk that *Nacobbus aberrans* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** *Nacobbus aberrans* is adapted to different climatic conditions and has been found in its suspected area of origin in the Andean highlands, as well as lower altitudes (Manzanilla-Lopez et al., 2002). There appears to be a wide range of adaptation to temperature and the temperature requirements vary among populations.

   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 be established in a larger but limited part of California.
   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** This nematode has a wide host range with plants in many families.

   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:** Natural spread is slow but the spread of infested soils with eggs, juveniles, and adults can be rapid.

   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:** This nematode causes large yield losses on sugarbeets, beans, and potatoes**.** It is an important quarantine pest in many countries. It can be spread with irrigation water.

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

Economic Impact: A, B, C, G

A. The pest could lower crop yield.
B. The pest could lower crop value (including increasing crop production costs).
C. The pest could trigger the loss of markets (including 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: Many common weeds are good hosts for this nematode so if introduced, it will likely persist in the environment. There would be no way to eradicate it from home/urban gardens or ornamental plantings.

Evaluate the environmental impact of the pest on California using the criteria below.

Environmental Impact: A, 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: 3
- 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 *Nacobbus aberrans:* High

Add up the total score and include it here. **14**
-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 'Not established'.

Score: 0

-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 the 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* ***= 14***

Uncertainty:

The validity of species, subspecies, and races is not fully resolved.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Nacobbus aberrans*** **is A.**

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Responsible Party:

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***Comment Period: 11/01/2024 through 12/16/2024**

***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.

Pest Rating: A
