REVIEW ARTICLE – REVISIÓN

POTATO CYST NEMATODES: PLANT HOST STATUS AND THEIR REGULATORY IMPACT

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ABSTRACT

Sullivan, M. J., R. N. Inserra, J. Franco, I. Moreno-Leheudé, and N. Greco. 2007. Potato cyst nematodes: Plant host status and their regulatory impact. Nematropica 37:193-201.

The known host range of potato cyst nematodes (PCN) (*Globodera pallida* and *G. rostochiensis*) includes mainly *Solanum* species and a few species of *Datura, Hyoscyamus, Lycopersicon, Physalis, Physoclaina, Salpiglossis,* and *Saracha,* all in the Solanaceae family. The unreported results of a host study conducted in Chile using a local population of *Globodera rostochiensis* pathotype Ro1 indicate that *Datura ferox, Nicotiana acuminata, Solanum ligustrinum* and *S. pinnatum* allowed nematode infection and reproduction. Oca (*Oxalis tuberosa*) was not infected by potato cyst nematodes in field and greenhouse studies conducted in Bolivia and Peru. These findings conflict with those of a previous report of *Globodera* populations infecting oca. An updated list of potential PCN hosts based on the literature and on the current study is included in this paper.

Key words: Datura ferox, Globodera pallida, G. rostochiensis, international crop and plant trade, *Nicotiana acuminata,* oca, *Oxalis tuberosa,* quarantine pests, *Solanum ligustrinum, S. pinnatum, Thecavermiculatus andinus,* weeds.

RESUMEN

Sullivan, M. J., R. N. Inserra, J. Franco, I. Moreno-Leheudé, and N. Greco. 2007. Nematodos quiste de la papa: sus hospedantes e impacto regulatorio. Nematropica 37:193-201.

El rango de hospedantes conocidos para los nematodos quiste de la papa (*Globodera pallida* y *G. rostochiensis*) incluye principalmente especies del género *Solanum* y algunas especies de *Datura, Hyoscyamus, Lycopersicon, Physalis, Physoclaina, Salpiglossis,* y *Saracha,* todas en la familia Solanaceae. Los resultados de un estudio inédito realizado en Chile con una población local de *Globodera rostochiensis* patotipo Ro1 indican que *Datura ferox, Nicotiana acuminata, Solanum ligustrinum* y *S. pinnatum* son susceptibles al nematodo. No se observó infección en oca (*Oxalis tuberosa*) en estudios de campo e invernadero realizados en Bolivia y Perú. Estos hallazgos contradicen lo encontrado en un registro previo de poblaciones de *Globodera* que infectan oca. En esta revisión se incluye una lista potencial de hospedantes de nematodos quiste de la papa, basada en la literatura y en los resultados del presente estudio.

Palabras clave: Datura ferox, Globodera pallida, G. rostochiensis, comercio internacional, *Nicotiana acuminata,* oca, *Oxalis tuberosa,* plagas cuarentenarias, *Solanum ligustrinum, S. pinnatum, Thecavermiculatus andinus,* malezas.

The potato cyst nematodes include two species, the golden nematode *Globodera rostochiensis* (Wollenweber) Skarbilovich, and the pale potato cyst nematode *G. pallida*

Stone. These damaging nematodes co-evolved with potatoes in the Andean region of South America. They are the most common nematode parasites of potato in Latin America and other potato growing areas in the world. Both species were accidentally introduced from South America into Europe where they were studied and described long before they were reported in their areas of origin. Both species parasitize potato roots and tubers and, at the end of their life cycle, persist in the soil and plant residues as a tanned and hardened sac containing embryonated eggs. This persistent stage, called a cyst, is derived from the female body and allows eggs to survive adverse environmental conditions for many years. In the absence of hosts, many eggs in the cysts gradually die. The annual egg mortality rate ranges from less than 50% in temperate regions to more than 75% in warmer geographical areas. Potato cyst nematodes are temperate species and attain high population densities in cool climates on long-cycle potato crops. They do not infect and reproduce at temperatures above 28°C (83°F). Therefore, in warm climates often they do not complete their life cycle, and their population densities on short-cycle potato crops remain low. Because of their serious adverse effect on tuber yield and quality, these nematodes have been the subject of many studies (Brodie, 1984; Brodie *et al.*, 1993; Marks and Brodie, 1998). Their ability to produce cysts that are transported passively for long distances with contaminated or infected plant root residues, tubers, and soil debris, has made the potato cyst nematodes the most highly regulated nematode pests.

Many studies have elucidated the mechanisms that influence the establishment of *G. pallida* and *G. rostochiensis* after their accidental introduction into new potato growing areas (Evans and Brodie, 1980; Brodie *et al.*, 1993). Important research has been conducted in New Zealand and Australia where potato cyst nematodes were introduced in the 1970s (Marshall, 1998). However, there is little information on the ability of these nematodes to become established on hosts other than potato after their introduction. This lack of information is partially due to the lack of extensive host range studies involving potato cyst nematodes, and to a limited knowledge of the damaging effect of these pests on hosts other than potato. The known host range of potato cyst nematodes includes mainly *Solanum* species and a few species of *Datura*, *Hyoscyamus*, *Lycopersicon*, *Physalis*, *Physoclaina*, *Salpiglossis*, and *Saracha,* all in the Solanaceae family (CAB International, 2005a, b; Center for Integrated Pest Management, 2007; Society of Nematologists, 2001a, b; Sullivan, 2006). Tomato (*Lycopersicon esculentum*) and eggplant (*Solanum melongena*) are agronomic crops other than potatoes attacked by both species of potato cyst nematodes (Brodie, 1984). However, these crops are usually grown in the warm season and, therefore, will not likely favor the reproduction of these nematodes.

Oxalis tuberosa Molina (oca), a native Andean tuber crop, is also considered to be a host of the potato cyst nematodes (CAB International, 2005a, b; Society of Nematologists, 2001a, b; Sullivan, 2006). Oca is a tuber crop of economic importance in the Andean region of South America, where it is grown at high elevations. In recent years, oca production has been initiated in other areas of the world. In New Zealand, oca is produced for export to Taiwan, a market that regulates the potato cyst nematodes. Trade regulations involving potato cyst nematodes have adversely affected the trade of oca from New Zealand to Taiwan. Oca was reported as a host for *Globodera* by Jatala *et al.* (1979) after detecting globose white females on the roots of this edible plant in the southern highlands of Peru. However, the host status of oca to potato cyst nematodes was not clearly confirmed or refuted by the authors in subsequent published reports. It is noteworthy to mention that these authors also described the new cystoid nematode species *Thecavermiculatus andinus* from oca plants collected in Peru near Lake Titicaca (Golden *et al.*, 1983), and noted the morphological similarity between female *T. andinus* and females of potato cyst nematodes. They emphasized the difficulty of distinguishing the two species at low magnification and in mixed populations.

Although the study by Golden *et al.* (1983) casts some doubts on the single report of *Globodera* on oca (Jatala *et al.*, 1979), regulatory agencies have included oca on the host lists of the potato cyst nematodes. These host lists have important economic significance, because they are the basis for many regulatory decisions concerning quarantine pests. The accuracy of these lists is essential to avoid unjustified regulatory actions that have potential to cause serious impact on the international trade of crops and plants.

The recent detection of *G. pallida* in Idaho (U.S.A.) in April 2006 and *G. rostochiensis* in Quebec province (Canada) in August 2006 (Sun and Miller, 2007) has intensified the interest of international regulatory agencies in acquiring accurate information about hosts other than potato that can support populations of these two pests. An intensive delimiting survey for *G. pallida* was initiated in Idaho after the initial find in tare soil sampled by Idaho State Department of Agriculture (USDA, 2006). After intensive field soil sampling, the infestation has been defined and a regulated area established. This area is strictly controlled and at this time no movement of soil, nursery stock, transplants, or manure from the regulated area is permitted. A survey of *G. pallida* and *G. rostochiensis* in potato growing regions at the national level has been proposed and efforts are underway to implement the survey for 2007. An eradication plan for *G. pallida* in Idaho is being developed. Failure to ensure that weed hosts are controlled is likely to impede successful eradication. Weeds that are good hosts for PCN interfere with nematode control efforts by providing alternative sites for feeding and reproduction when potatoes are not present. Therefore, the objectives of this review were to obtain, revise and make available information on hosts of the potato cyst nematodes not currently reported in the literature, and to help to clarify "oca" host status for these pests, with the aim to preparing an updated list of potato cyst nematode hosts based on previous lists by CAB International (2005a, b), Center for Integrated Pest Management (2007), Society of Nematologists (2001a, b), Sullivan (2006), and the current study.

Host Studies Conducted in Chile

Information on additional hosts of the potato cyst nematodes was obtained from the results of a host test conducted in pots in a non-heated glasshouse in La Serena (IV Region), Chile, from June 1988 to January 1989. The pots contained about 4 dm^3 of sandy soil (specific gravity 1.25) infested with about 745 cysts (161 eggs/cyst). This initial density value was equivalent to about 20 eggs/g of soil of the pathotype Ro1 of the golden nematode. This pathotype was collected from La Serena and reared on potato *cv* Ultimus. The plants (Table 1), tested in two replicates, were mainly weeds that are commonly found in potato growing areas of Chile. Seeds of these weeds were sown in the pots on June 1 and germinated from 4 to 15 August, 1988. Observa-

Table 1. Developmental stages and final soil densities (Pf) of the golden nematode pathotype Ro1 from Chile, detected in the roots and rhizosphere of selected weeds grown in soil infested with an initial density (Pi) of 20 eggs/g soil.

Plant species[x]	Life stages	Nematode life cycle[y]	Pf (eggs/g soil)[z]
Datura ferox L.	White females and cysts	Complete	3.8
D. stramonium	J2	Incomplete (nematode penetration into the roots, but no development)	0.3
Cestrum parqui L'Her	None	Prevented (no nematode penetration into the roots)	1.4
Ipomoea batatas (L.) Lam.	None	Prevented (no nematode penetration into the roots)	—
Nicandra physalodes Gaertn.	J2	Incomplete (nematode penetration into the roots, but no development)	1.8
Nicotiana acuminata Hook.	White females and cysts	Complete	1.8
N. glauca Graham	None	Prevented (no nematode penetration into the roots)	1.4
Physalis viscosa L.	None	Prevented (no nematode penetration into the roots)	4.1
Solanum elaeagnifolium Cav.	White females	Complete	0.7
S. ligustrinum Lodd.	White females and cysts	Complete	21.8
S. muricatum Ait.	None	Prevented (no nematode penetration into the roots)	—
S. nigrum	J4	Incomplete (no females, cysts and eggs)	3.5
S. pinnatum Bert. ex Dun.	White females	Complete	6.9
S. radicans	None	Prevented (no nematode penetration into the roots)	3.4

[x]Plants which allowed the production of white females and/or cysts with eggs in their roots were considered hosts for potato cyst nematodes.
[y]Soil final nematode densities were assessed by counting the nematode eggs after crushing the cysts extracted from the soil (see text). A large portion of the final cyst population may have included cysts that remained from original cyst population (Pi).
[z]Values are mean of two replicates.

tions were made on 24 October and 12 December, in 1988, and in early January 1989 based on the development of the plant species. At each observation date, the root balls of mature plants were carefully removed from the pots and the roots examined for presence of white females and cysts on their surface. The developmental life stages of the nematode inside the root tissues were determined after processing an average of 10 g of roots per replicate using the maceration and centrifugation method described by Coolen (1979), and observing the nematode in water suspension using a dissecting stereo-microscope. Also, dried soil samples (250 g/pot) were processed with the Fenwick can to extract and count cysts. Cyst egg content was determined by crushing the cysts according to Seinhorst and den Ouden (1966).

The golden nematode pathotype Ro1 from Chile was able to complete its life cycle on plants not reported as hosts in the literature such as *D. ferox, N. acuminata, S. ligustrinum* and *S. pinnatum* (Table 1). In this test, *D. ferox* was a more suitable host than the closely related species *D. stramonium.* A species of the genus *Nicotiana, N. acuminata* was able to support the complete life cycle of this pest; this is noteworthy because this genus was not previously reported as a host of the golden nematode. *Nicotiana acuminata* is a weed native to Chile and Argentina and is present in North America, including the western states of the United States. Golden nematode infection of *S. ligustrinum* and *S. pinnatum* extends the number of *Solanum* species known to be hosts of this potato cyst nematode. The known hosts, *S. elaegnifolium* and *S. nigrum,* were infected by the nematode; however, only 4th-stage juveniles and no white females were found on *S. nigrum. Solanum radicans,* another reported host, was not infected by the Chilean population of the nematode. Variation in the susceptibility of *Solanum* species to the nematode is influenced by the host preference of the populations of the potato cyst nematodes. Although several of the tested plant species were hosts for *G. rostochiensis* pathotype Ro1, none except *S. ligustrinum* supported an increase in the final nematode population density in the soil (0.3-6.9 eggs/g soil *vs* 21.8 eggs/g soil for *S. ligustrinum*). However, the small number of replicates in the study prevents a meaningful statistical comparison of the final nematode densities on the various plant species, or a valid host rating. The low number of replicates may also have prevented the detection of nematode development in the roots of some potential plant hosts. Many plants, which were non-hosts for the golden nematode pathotype Ro1 from La Serena (Table 1), were hosts for other potato cyst nematode populations in other studies reported in literature (Table 2).

Field and Greenhouse Observations Conducted in Bolivia and Peru

Observations were conducted in Peru to confirm the host status of oca for potato cyst nematodes. Oca plants from production areas in Peru and Bolivia infested with the golden and pale cyst nematodes were collected and their roots examined for the presence of potato cyst nematodes. In addition, in 1982-1984 oca plants in pots in a greenhouse were exposed to *G. pallida* eggs (10 g/soil) for three months. At the end of the experiment, the roots of oca plants were examined for nematode infection. Preliminary results of this test were reported by Golden *et al.* (1983).

The results of this study indicated that oca is not a host of the potato cyst nematodes. Oca plants collected from fields infested with potato cyst nematodes showed no evidence of infection by either of the two pests. The only white females observed on the oca roots were of *T. andinus* from areas where this species was present. The oca plants exposed for three months to the pale potato cyst nematode were not infected by the nematode, confirming the field observations. Potato plants used as controls were infected by the *G. pallida* population tested. Thus, although *T. andinus* infects both oca and potato, there is no compelling evidence that potato cyst nematodes infect oca. Although potato cyst nematodes and *T. andinus* are native species in the Andean regions of South America where potato and oca are also native plants, these nematodes maintain distinct host preferences regarding oca. Indeed, the non-host status of oca for potato cyst nematodes has been exploited effectively to manage *G. rostochiensis* and *G. pallida* in infested potato

Table 2. Modified taxonomical combinations (International Plant Names Index, 2005) for potential plant hosts of *Globodera pallida* and *G. rostochiensis* compiled from data published in Crop Protection Compendium, Global Module (c) (CAB International, 2005a, b), Center for Integrated Pest Management (2007), Sullivan (2006) and the current study.

Datura ferox L.[z]	***S. lanciforme*** Rydb. (heartleaf nightshade)
S. jujuyense Hawkes	***S. lapazense*** Hawkes
D. stramonium L. (Devil's trumpet)	***S. lechnoviczii*** Hawkes
D. tatula L.	***S. leptostigma*** Juz. & Juz. (potato)
Hyoscyamus niger L. (black henbane)	***S. ligustrinum*** Lodd.
Lycopersicon esculentum Mill. (tomato)	***S. longipedicellatum*** Bitter
L. esculentum Mill. ***aureum***	***S. luteum*** Mill. (red-fruited nightshade)
L. glandulosum C. H. Müll. (Peruvian nightshade)	***S. macolae*** Bukasov
L. hirsutum Dunal (hairy tomato)	*S. macrocarpon* L. (African eggplant)
L. peruvianum (L.) Mill. (wild tomato)	***S. maglia*** Schtdl.
L. pimpinellifolium Mill. (currant tomato)	***S. malinchense*** Hawkes
L. pyriforme Dunal (garden tomato)	***S. mamilliferum*** Juz. & Bukasov (chuacha)
L. racemigerum Lange	*S. marginatum* L. f. (white-edged (margined) nightshade)
Nicotiana acuminata Hook.	***S. mauritianum*** Willd. ex Roth. (tree tobacco, earleaf nightshade)
Physalis longifolia Nutt. ***subglabrata***	***S. melongena*** L. (eggplant, aubergine)
Physalis philadelphica Lam. (Mexican groundcherry)	***S. miniatum*** Bemh. ex Willd. (red-fruited nightshade)
Physochlaina orientalis G. Don	***S. mochiquense*** Ochoa
Salpiglossis spp. (painted tongue)	*S. multidissectum* Hawkes
Saracha jaltomata Schlecht.	***S. muricatum*** Bert. ex Dunal (pepino melon)
Solanum acaule Bitter (wild Andean potato)	***S. neocardenasii*** Hawkes & Hiert.
S. aethiopicum Jacq. (Ethiopian night shade, African eggplant)	***S. nigrum*** L. (black nightshade)
S. ajanhuiri Juz. & Bukasov	*S. nitidibaccatum* Bitter (Argentinian nightshade)
S. ajuscoense Bukasov ex Rybin	*S. ochroleucum* Bast.
S. alandiae Cárdenas	***S. okadae*** Hawkes & Hjert.
S. alatum Moench (red fruited nightshade)	***S. oplocense*** Hawkes
S. americanum Mill. (American black nightshade)	***S. ottonis*** Hylander (divine nightshade)
S. anomalocalyx Hawkes	***S. pampasense*** Hawkes
S. antipoviczii Bukasov	***S. parodii*** Juz. & Bukasov
S. armatum R. Br. (forest nightshade)	***S. pennelli*** Correl
S. ascasabii Hawkes	***S. photeinocarpum*** Nakamura & Odashima (termini inuhoozuki)
S. asperum Vahi	***S. phureja*** Juz. & Bukasov (chaucha)
S. auriculatum Aiton	***S. pinnatisectum*** Dunal (tansyleaf nightshade)
S. aviculare G. Forst. (kangaroo apple)	***S. pinnatum*** Bert. ex Dun.
S. berthaultii Hawkes (wild potato)	***S. platense*** Dieckmann
S. blodgettii Chapm. (mullein nightshade)	***S. platypterum*** Hawkes

Table 2. (Continued) Modified taxonomical combinations (International Plant Names Index, 2005) for potential plant hosts of *Globodera pallida* and *G. rostochiensis* compiled from data published in Crop Protection Compendium, Global Module (c) (CAB International, 2005a, b), Center for Integrated Pest Management (2007), Sullivan (2006) and the current study.

S. boergeri Bukasov	***S. polyacanthos*** L'Her. ex Dun.
S. brevidens Phil. (wild potato-diploid)	***S. polyadenium*** Grenm. (potato)
S. brevimucronatum Hawkes	***S. prinophyllum*** Dunal (forest nightshade)
S. bukasovii Juz. ex Rybin	*S. quitoense* Lam. (Naranjillo)
S. bulbocastanum Dun. (ornamental nightshade)	*S. radicans* L. f. (cusmayllo)
S. calcense Hawkes	***S. raphanifolium*** Cárdenas & Hawkes (wild potato)
S. calcense × *S. cardenasii* Hawkes	***S. rostratum*** Dunal (buffalobur nightshade)
S. caldasii Humb. & Bonpl. ex Dun.	***S. rybinii*** Juz. & Bukasov (phureja)
S. canasense Hawkes	***S. salamanii*** Hawkes
S. capsicibaccatum Cárdenas	***S. saltense*** Hawkes
S. capsicoides Mart. (cockroach berry)	***S. sambucinum*** Rydb.
S. cardiophyllum (heartleaf horsenettle)	*S. sanctae-rosae* Hawkes
S. carolinense L. (Carolina horsenettle)	***S. sarrachoides*** Sendt. (hairy nightshade)
S. chacoense Bitter (Chaco potato)	***S. scabrum*** Mill.
S. chaucha Juz. & Bukasov	*S. schenkii* Bitter
S. chenopodioides Lam. (tall nightshade)	***S. schickii*** Juz. & Bukasov
S. chloropetalon Schltdl.	*S. schrankii* Steud.
S. citrullifolium A. Braun. (watermelon nightshade)	***S. semidemissum*** Juz. & Bukasov
S. coeruleiflorum Hawkes (chaucha)	***S. simplicifolium*** Bitter
S. commersonii Dunal ex Poir. (Commerson's nightshade)	*S. sinaicum* Boiss. (nightshade)
S. curtilobum Juz. & Bukasov (rucki)	***S. sisymbrifolium*** Lam. (sticky nightshade)
S. curtipes Bitter	***S. sodomaeum*** Drege ex Dun. (apple of Sodom)
S. demissum Lindl. (nightshade)	***S. soukupii*** Hawkes
S. demissum × *S. tuberosum* L.	*S. sparsipilum* Hawkes
S. dulcamara L. (bittersweet)	***S. spegazzinii*** Bitt.
S. elaeagnifolium Cav. (silverleaf nightshade)	***S. stenotomum*** Juz. & Bukasov (pitiquina)
S. ehrenbergii Rydb.	***S. stoloniferum*** Sclecht. & Bouche
S. famatinae Bitter	***S. suaveolens*** Kunth & Bouche
S. fraxinifolium Dunal	***S. subandigenum*** Hawkes (Andigena)
S. fructo-tecto Cav.	***S. sucrense*** Hawkes
S. garciae Juz. & Bukasov	***S. tarijense*** Hawkes
S. gibberulosum Juz. & Bukasov (chaucha)	***S. tenuifilamentum*** Juz. & Bukasov
S. giganteum Jacq. (African holly)	***S. tlaxcalense*** Hawkes
S. gigantophyllum Bitter (apharuma)	***S. tomentosum*** L.
S. gilo Raddi (scarlet or tomato eggplant)	***S. toralapanum*** Cárdenas & Hawkes
S. glaucophyllum Desf. (waxyleaf nightshade)	*S. triflorum* Nutt. (cutleaf nightshade)
S. goniocalyx Juz. & Bukasov (yellow potato)	***S. tuberosum*** L. ssp. ***andigena***
S. gourlayi Hawkes	***S. tuberosum*** L. ssp. ***tuberosum*** (Irish potato)

Table 2. (Continued) Modified taxonomical combinations (International Plant Names Index, 2005) for potential plant hosts of *Globodera pallida* and *G. rostochiensis* compiled from data published in Crop Protection Compendium, Global Module (c) (CAB International, 2005a, b), Center for Integrated Pest Management (2007), Sullivan (2006) and the current study.

S. gracile Otto ex W. Baxt. (whitetip nightshade)	***S. tuberosum*** **L. 'Aquila'**
S. heterodoxum Andrieux ex Dun. (melonleaf nightshade)	***S. tuberosum*** L. '**Xenia N**'
S. heterophyllum Lam. (unarmed nightshade)	***S. utile*** Klotzsch
S. hirtum Vahl (huevo de gato)	***S. vallis-mexici*** Juz. ex Bukasov
S. hispidum Pers. (devil's fig)	*S. vernei* Bitter & Wittm. (purple potato)
S. indicum Roxb. (Indian nightshade)	***S. verrucosum*** Schlecht.
S. integrifolium Poir. (scarlet or tomato eggplant)	***S. villosum*** Mill. (red-fruited nightshade)
S. intrusum J. Soria (garden huckleberry)	*S. violaceimarmoratum* Bitter
S. jamesii Torr. (wild potato)	***S. wittmackii*** Bitter
S. juzepczukii Bukasov (ckaisalla)	***S. xanti*** Coville (chaparral nightshade)
S. kesselbrenneri Juz. & Bukasov (phureja)	***S. yabari*** Hawkes (pitiquina)
S. kurtzianum Bitter	*S. zuccagnianum* Dumm. (gilo)

[z]The original sources of the host studies concerning the plants in bold letters were verified. Plants in non bold letters were retrieved from CAB International (2005a,b), Center of Integrated Pest Management (2007) and Sullivan (2006). Unverifiable scientific names such as *Lycopersicon mexicanum* cited by CAB International (2005a,b) and Sullivan (2006), *Solanum durum* and *S. wittonense* cited by CAB International (2005a,b), Stelter (1987) and Sullivan (2006) were not listed.

fields in the Andean regions of Bolivia, where it is a common agronomic practice to include this tuber crop in long term rotations to suppress potato cyst nematode populations in the soil (Franco *et al.*, 1999). The cyst stage has favored the dissemination of the potato cyst nematodes with infected potato tubers in the major potato production areas of the world, whereas the lack of a resistant cyst has prevented the dissemination of *T. andinus*, which so far, has been reported only in the Andean regions of South America.

The results of the experiments mentioned above were used for the preparation of an updated list of hosts for potato cyst nematodes which is shown in Table 2. This list includes *Physalis longifolia subglabrata* confirmed by Lynn Carta (personal communication). Unverifiable scientific names reported on previous lists were omitted from the updated list and cited in a footnote. They include, *Lycopersicon mexicanum* cited by CAB International (2005a, b) and Sullivan (2006), *Solanum durum* and *S. wittonense* cited by CAB International (2005a, b), Stelter (1987) and Sullivan (2006).

The host-studies conducted in Chile are almost 20 years old. It is possible that the populations of *G. rostochiensis* from La Serena have changed their host preference due to the effect of new potato cultivars rotated in that area. Host preference change may have also occurred in the fields where host-studies were conducted in the past and reported in the literature. Taking into account the host preference variability of potato cyst nematodes, the plants listed in Table 2 should be considered as potential hosts for both *G. pallida* and *G. rostochiensis*. The host response of these plants may vary when exposed to different pathotypes of both *G. pallida* and *G. rostochiensis*.

In summary, the authors are of the opinion that potato cyst nematodes, introduced into new areas with potato tubers or other contaminated plants and soil debris, are much more likely to establish during long-cycle potato crops in the cool season than in a warm environment on short-cycle potato crops. However, crops other than potatoes, such as tomato and eggplant, are good hosts for these pests. Although these plants require temperatures higher than those required for potato for a good crop stand, they may still grow, though less vigorously, in cooler areas and provide the nematodes with a chance to establish. Even in the absence of a host crop, the possibility that potato cyst nematodes can become established at a low population density in the soil cannot be discounted because they may reproduce on any of several wild hosts present in and around fields or in another crop.

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