

Nonsolanaceous Hosts of Globodera in the Andes

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The potato cyst nematodes *Globodera pallida* (Stone) and *G. rostochiensis* (Wollenweber) are important pests of potatoes in the Andes of South America. Concern was occasioned by the discovery of these nematodes in soil collected from potatoes in a Peruvian ship, "Amazonas," arriving at the port of Seattle, Washington, U.S.A., on April 3, 1951, and again in another Peruvian ship arriving in New York harbor in September 1951. Investigators traced potatoes on the "Amazonas" to the province of Ambo, Department of Huanuco (8). Later surveys revealed widespread distribution of potato cyst nematodes in the highlands of Peru (5, 8). The only round-cyst-forming nematode reported from the Andes (in addition to those attacking potatoes) is *Globodera leptonepia* (Cobb & Taylor), which was collected on April 26, 1952, from soil (in ship's storage) with potatoes taken aboard at Callao, Peru, and intercepted at the port of Oakland, California (1). This nematode has not been found again in Peru or elsewhere.

Before Stone's (7) description of *H. Pallida*, in 1973, the potato cyst nematodes

were regarded as a single species, *Heterodera rostochiensis*. Mulvey and Stone (6) placed the potato cyst nematodes and other nematodes with special cysts in a separate genus, *Globodera*. Stone used the cream or white immature female color in *G. pallida* to differentiate it from the golden color of female in *G. rostochiensis*. Evans et al. (3) reported that in Southern Peru *G. pallida* and *G. rostochiensis* occur together, but only *G. pallida* occurs north of Lake Titicaca in Peru, Ecuador, and Colombia. The host range of the potato cyst nematode is reported to be limited to Solanaceous plants (4).

Diaz and co-workers (2) suspected that *Oxalis tuberosa* ([Gray] Heller), *Ullucus tuberosus* (Caldas.), and *Chenopodium quinoa* (Wild.) were hosts of the potato cyst nematodes. Martin et al. (5) observed white female nematodes, which they called "white cysts," on the roots of *Oxalis tuberosa* and *Tropaeolum tuberosum* (Ruiz and Pav.) (two tuber-bearing food crops in the Andes) and on *Medicago* species in the province of Canta, Department of Lima, and the Department of Cajamarca (central and northern highlands of Peru). Franco (unpublished) tested those species in a greenhouse with a population of *G. pallida* from Tarma in the central highland and found that no cyst nematodes developed on

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their roots. Therefore, he concluded that an unrecognized mixture of segments of potato roots with roots of *Oxalis*, etc., might account for the observation by Martin et al. There are scattered unpublished reports of infection of nonsolanaceous crops by potato cyst nematodes in the southern highlands of Peru.

During several collection trips made in 1976, 1977, and 1978 in the southern highlands of Peru in the Department of Puno, near Lake Titicaca, we observed field infection of *Oxalis tuberosa*, *Tropaeolum tuberosum*, *Ullucus tuberosus*, and some Malvaceous weeds by a *Globodera* having white female color. In this same area *Chenopodium quinoa* was observed to be infected by a *Globodera* with yellow females. In a preliminary study using the cysts collected from *O. tuberosa* and *C. quinoa* roots, infection of these plants by the respective *Globodera* was confirmed. It is interesting that these nematodes also infected potatoes.

It is believed that the high plateau of the Lake Titicaca area is the center of origin of *Solanum tuberosum* subsp. *andigena* and probably that of *O. tuberosa*, *C. quinoa*, and *T. tuberosum*. Similarly, this area is considered to be the center of origin of the potato cyst nematodes. In this area both *G. pallida* and *G. rostochiensis* coexist, with a great diversity of races. Potatoes and their nematode pathogens have probably had a parallel evolution, which accounts for such diversity. The same parallel evolutionary process may have also been operative in *Oxalis*, *Chenopodium*, *Tropaeolum*, and *Globodera* spp. Through constant association of *Globodera* species with these plants and selection pressure, new races and perhaps species of *Globodera* were probably evolved. Morphologically, and on the basis of female color, the *Oxalis*-infecting nematode is closely related to *G. pallida*, while

those infecting *Chenopodium* resemble *G. rostochiensis*. Nevertheless, some morphological differences between these nematodes and the potato cyst nematodes warrant critical evaluation. Parallel host-range tests and electrophoretic examinations are needed to clarify the classification of these nematodes. Should any of these nematodes prove to be the same species as the potato cyst nematodes, they may belong to newly evolved and geographically restricted races. It is possible that potato cyst nematodes are not restricted to Solanaceous plants.

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