Nematodes as a Possible Cause of Damage to *Opuntia ficus-indica* in the Province of Santiago del Estero, Argentina

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In the summer of 2000/2001 in Santiago del Estero, Argentina, we encountered problems with rotting and breaking of main stems of cactus, which was associated with nematodes. When the plant material was first processed, we found nematodes of the orders Aphelenchida, Dorylaimida, Monochida and Rhabditida. (It is important to point out that the nematodes may have been in the plant tissues and in the soil attached to the tissues). When a second extraction was performed only from deteriorated plant tissues, nematodes of Rhabditida were observed. As representative of the first order, the species *Aphelenchus avenae* Bastian, 1865 was detected. This species of cosmopolitan distribution is often found on decomposing tissues and can grow easily on nutrient agar where it feeds on the hyphae of various fungi (Goodey, 1963). It is considered a typically mycophagous species. We found representatives of at least two families of the second order: one of them is the family Longidoridae, which was represented by a phytophagous species. The other species (as well as the family to which it belongs) is in process of identification.

The third order corresponded to a predatory species. Species representing the fourth order were apparently bacteriophagous, one of which was dominant in quantity. Identification of the corresponding species will need a specific study. While much remains to be known about this problem, due to the severity of the damage and the novelty of the disease-causing organism, we felt it important to alert the cactus community to this potential problem as we continue to refine the details and control of the disease. The literature on nematodes infecting *Opuntia* is sparse. In a review of *Pests of Cactus Pear* for an FAO technical volume (Longo and Rapisarda, 1995), the only citation was a conference proceedings in Peru in 1988. Granata (1995) who reviewed biotic and abiotic diseases in the same volume did not mention nematodes. Borrego, Escalente, and Burgoz Vazquez (1986) reviewed various diseases and stated that: "also various nematodes cause problems in cactus plantations, among them is *Heterodera cacti*". In the review of "plagas y enfermedades" by Pimienta (1990), and also by Hernandez-Gutierrez (1992), no mention was made of nematodes. In Argentina the phytophagous nematode *Xiphidorus yepesara yepesara* Monteiro, 1976 was detected in soil around *Opuntia* roots (Luc and Doucet, 1990). In the unusually high-rainfall summer of 2000/2001 in Santiago del Estero, Argentina, 1.0-m to 1.5-m tall, 10cm diameter, 2-year-old seedlings in hybrid progeny trials and in 2-year-old cladode-propagated plants were frequently observed to break off at ground level or, occasionally, 30 cm above ground level. This breakage was visually associated with a discoloration of the stem from green to yellow and a softening and rotting of the tissue. When the break was below ground level it appeared that the main stem rotted off. Approximately 40 plants of the total of 500 plants were affected by similar symptoms, of which 7 died before the treatment was discovered. Due to similarity of this appearance to fungal and bacterial rots,

various fungicides and antibiotics (benomyl, thioallophanate, copper oxychloride, and oxytetracline) were applied without controlling the "rot". Samples first examined by the pathologist of our group (S. Weht) found small quantities of *Phytophthora cactorum* (Lebert and Conn) Schroter which survive saprophytically in the soil and whose zoospores are easily dispersed in water but did not find serious bacterial or fungal pathogens. However, he observed the presence of very significant quantities of nematodes. Subsequent analyses by the nematologist of our group (M. Doucet) using classic techniques of nematode extraction from plant tissues confirmed the presence of large quantities of nematodes (mainly bacteriophagous). Generally, these nematodes are not a primary invader of tissue and only become a problem after some other damage produces wound openings. The continual burrowing, ingestion and defecation of soft *Opuntia* tissue by the bacteriophagous nematodes would be an ideal substrate for growth of the bacteria. This kind of situation was observed in garlic where the high-water-content, soft tissue favors both the nematode *Cruznema tripartitum* (Linstow, 1906) Zullini, 1982 and the bacteria (Doucet, M. E. and E. L. de Ponce de León. 1994).

Following the possibility of damage by nematodes, the insecticide/nematocide Furadan (carbofuran) was applied to the rotted areas in a backpack sprayer at a concentration of 1.0 g/l with a coadjuvant. In 4 days the soft rotten area became dry and a marked demarcation zone with dead dried tissue on one side and green healthy tissue on the other side became apparent. The further development of the soft rot of the tissue was stopped by the carbofuran application.

We speculate that the *Phytophthora cactorum*, which can easily penetrate the cactus tissue via the lenticels and stomates, probably has created the route of entry for the infection by the nematodes. We assume that they could leave the soil where they usually live and they could move in a thin layer of water covering the plant caused by rain or dew. Thus the nematodes could penetrate the tissues through a wound caused by other pathogens.

Wounds caused by the burrowing insect cactoblasitis (*Cactoblastis cactorum*) prevalent in this area could also serve as an entry for nematodes. When new rots are observed in plantations it would be useful to examine the tissue with a microscope for the presence of nematodes because these organisms cannot be observed by the naked eye.

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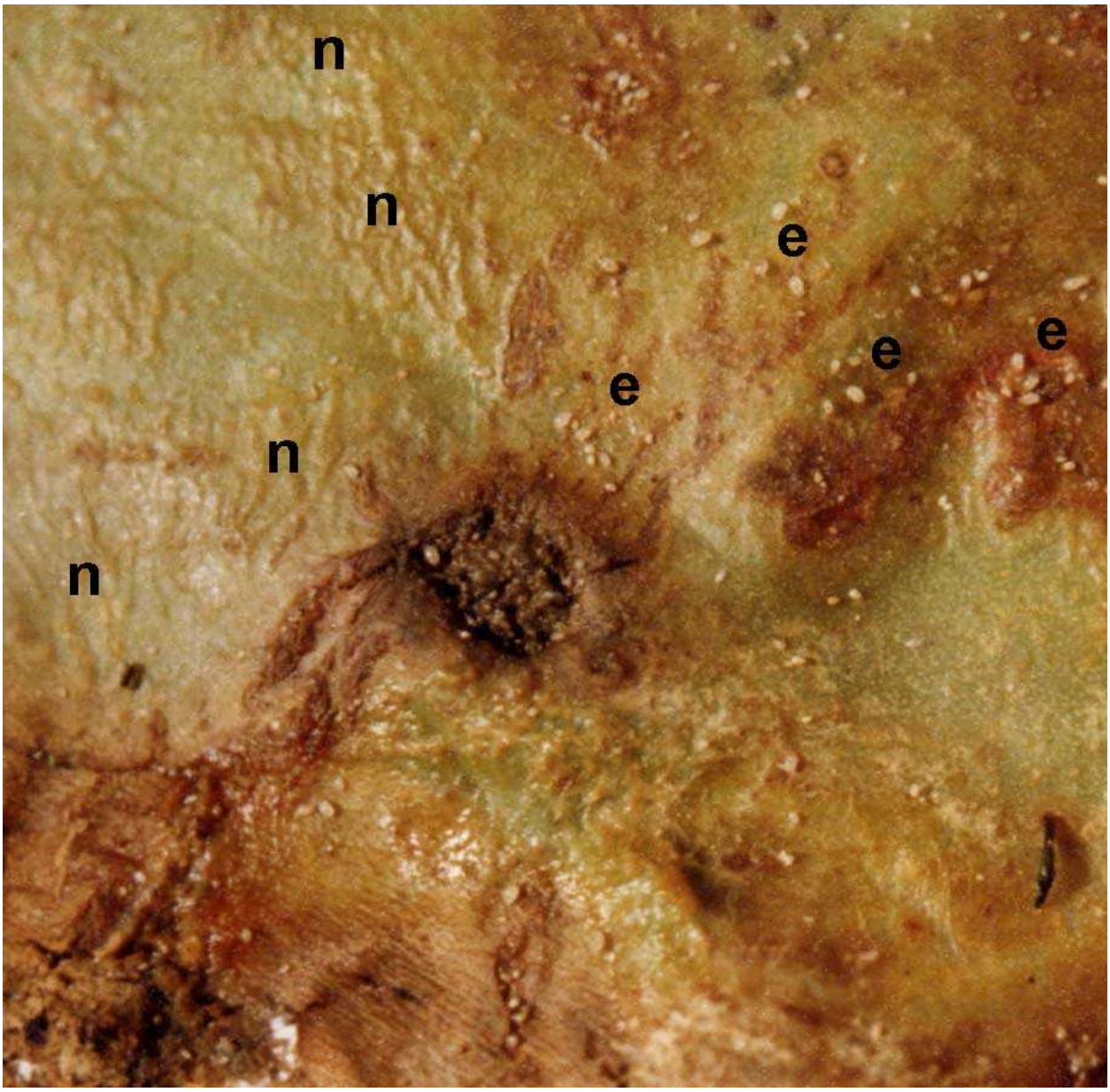

Figure 1.

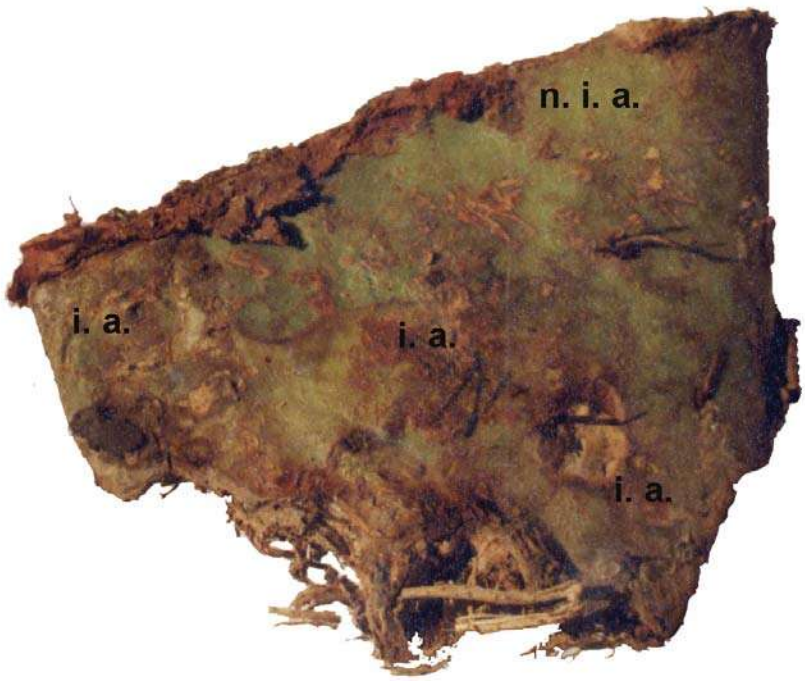

Figure 2.

Figure 3.