

Distribution of *Xiphinema americanum* and Related Species in North America¹

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Abstract: All species of the *Xiphinema americanum*-group and their synonyms are listed. The North American species reported are listed by state or province. Among these species, *X. rivesi* has the most widely reported distribution. Six species (*X. diffusum*, *X. floridae*, *X. laevistriatum*, *X. luci*, *X. sheri*, and *X. tarjanense*) have been reported from only Florida. The reports of *X. pachtaicum*, *X. sheri*, and *X. luci* did not include morphometrics and need to be confirmed; *X. brevicolle* from California was identified before Lamberti and Bleve-Zacheo described 15 new species in 1979 and similarly needs to be confirmed. Because of the proliferation of species in this group, reports of *X. americanum* (sensu stricto) before 1979 are questionable. Extraction techniques for longidorids are discussed.

Key words: distribution, extraction, nematode, North America, *Xiphinema americanum*.

In a symposium at the Second International Nematology Conference in 1990, I presented information on the distribution of the North American Longidoridae (*Longidorus*, *Paralongidorus*, and *Xiphinema*) (20). Later, I and D. J. F. Brown summarized the taxonomy and distribution of the nepovirus-vectoring Longidoridae of North America (21). The *Xiphinema americanum*-group species were included in both reports (20,21).

In 1990, Loof and Luc published a polytomous key to the species of *Xiphinema* Cobb, 1913 that they considered to be valid, including species synonyms (15). In their key, the 32 species of the *X. americanum*-group were not differentiated from each other because they had similar character codes. These codes refer to a variety of morphological characteristics. In 1991 Lamberti and Carone (10) recognized 38 species of the *X. americanum* group and published a dichotomous key, along with tail shape drawings. No head shapes or morphometrics were included with this key which, I believe, limits its utility. The current worldwide list (Table 1) of the *X. americanum*-group species and their synonyms includes those reported by Loof

and Luc (15), plus the three new species described by Lamberti et al. (11). Loof and Luc (15) considered five other species to be very close to the *X. americanum* group but did not include them for various reasons (Table 2).

The 20 species of the *X. americanum* group reported from North America (Table 3) and their distribution was compiled by Robbins and Brown (21). *Xiphinema americanum* Cobb, 1913 (sensu stricto) is probably more widespread than indicated in Table 3, which includes only the locations reported in redescrptions or from personal identifications (12,21,23). Because of the proliferation of species in the *X. americanum* group since 1979, identifications of *X. americanum* before this time are questionable.

Distribution of the members of the *X. americanum* group varies greatly. *Xiphinema rivesi* Dalmasso, 1969 has the widest reported North American distribution (4,9,19,21,25,27). It has been reported from the Atlantic coast to the Rocky Mountains. *Xiphinema brevicolle* Lordello & da Costa, 1961, first described from South America, is reported in California, Nevada, and Utah (13,21,24). In 1991, Lamberti et al. (11) redescrbed *X. brevicolle* and differentiated it from *X. diffusum* Lamberti & Bleve-Zacheo, 1979. The California population was reported in 1973 and needs to be confirmed. I recently examined fixed California *X. brevicolle* specimens, found four juvenile stages to occur, and presented this finding and the supporting

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TABLE 1. A list of valid species and synonyms of the *Xiphinema americanum* group (10,15).

<i>X. americanum</i> Cobb, 1913 (type species) = <i>Tylencholaimus americanus</i> (Cobb, 1913) Micoletzky, 1922
<i>X. brevicolle</i> Lordello & da Costa, 1961 Syn. <i>X. americanum</i> apud Carvalho (1955, 1962) Syn. <i>X. saopauloense</i> Khan & Ahmad, 1975
<i>X. bricolense</i> Ebsary, Vrain & Graham, 1989
<i>X. californicum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. citricolum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. diffusum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. floridae</i> Lamberti & Bleve-Zacheo, 1979
<i>X. fortuitum</i> Roca, Lamberti & Agostinelli, 1988
<i>X. georgianum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. inaequale</i> Khan & Ahmad, 1977 Syn. <i>X. neoamericanum</i> Khan & Ahmad, 1975 Homonym of <i>X. neoamericanum</i> Saxena, Chhabbra & Joshi, 1971
<i>X. incertum</i> Lamberti, Choleva & Agostinelli, 1983
<i>X. incognitum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. intermedium</i> Lamberti & Bleve-Zacheo, 1979
<i>X. kosaigudense</i> Quraishi & Das, 1984
<i>X. laevistriatum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. lambertii</i> Bajaj & Jairajpuri, 1977
<i>X. luci</i> Lamberti & Bleve-Zacheo, 1979
<i>X. occiduum</i> Ebsary, Potter & Allen, 1984
<i>X. opisthohysterum</i> Siddiqi, 1961
<i>X. oxycaudatum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. pachtaicum</i> (Tulaganov, 1938) Kirjanova, 1951 = <i>Longidorus pachtaicum</i> Tulaganov, 1938 Syn. <i>X. mediterraneum</i> Martelli & Lamberti, 1967 Syn. <i>X. neoelongatum</i> Bajaj & Jairajpuri, 1977†
<i>X. pachydermum</i> Sturhan, 1983‡
<i>X. pacificum</i> Ebsary, Vrain & Graham, 1989
<i>X. paramonovi</i> Romanenko, 1981 Syn. <i>X. paramericanum</i> Romanenko, 1973
<i>X. parvum</i> Lamberti, Ciancio, Agostinelli & Coiro, 1991
<i>X. peruvianum</i> Lamberti & Bleve-Zacheo, 1979
<i>X. pseudoguirani</i> Lamberti, Ciancio, Agostinelli & Coiro, 1991 Syn. <i>X. guirani</i> apud Lamberti & Bleve-Zacheo, 1979
<i>X. rivési</i> Dalmasso, 1969
<i>X. sheri</i> Lamberti & Bleve-Zacheo, 1979
<i>X. silvaticum</i> Luc & Williams, 1978
<i>X. simile</i> Lamberti, Choleva & Agostinelli, 1983
<i>X. tarjanense</i> Lamberti & Bleve-Zacheo, 1979
<i>X. taylori</i> Lamberti, Ciancio, Agostinelli & Coiro, 1991
<i>X. tenuicutis</i> Lamberti & Bleve-Zacheo, 1979
<i>X. thornei</i> Lamberti & Golden, 1986
<i>X. utahense</i> Lamberti & Bleve-Zacheo, 1979

Species inquirenda

† *Xiphinema neoamericanum* apud Saxena, Chhabbra & Joshi, 1973, a valid species according to Lamberti & Carone (10) is regarded as a species inquirenda (15,16).

‡ Included in the *X. americanum* group by Lamberti & Carone (10).

data at the 21st International Nematology Symposium of the European Society of Nematologists in April 1992. The presence of four juvenile stages suggests that *X. brevicolle* may be an imported species, as most of the North American species studied have three juvenile stages. The report from Nevada and Utah was made before the redescription of Lamberti et al. (11) but was not mentioned therein.

Xiphinema bricolense Ebsary, Vrain & Graham, 1989 has been found in sites near the Pacific coast of British Columbia and California (2,5,21). *Xiphinema californicum* Lamberti & Bleve-Zacheo, 1979 has been reported from the widely separated states of Arkansas, California, New York, Pennsylvania, and Guanguato (Mexico) (6, 8,9,13,26). Originally described from three females and one male from Florida, *X. citricolum* Lamberti & Bleve-Zacheo, 1979 has also been reported from Arkansas (2,9). *Xiphinema pachtaicum* (Tulaganov, 1938) Kirjanova, 1951 was reported from California and Oregon and is thought to have been introduced with planting material, probably grapevines from Europe (14,22). Because morphologic data was not presented, this species identification needs to be confirmed.

Six *X. americanum*-group species described by Lamberti and Bleve-Zacheo in 1979 (*X. diffusum*, *X. floridae*, *X. laevistriatum*, *X. luci*, *X. sheri*, and *X. tarjanense*) have been reported from Florida only (9,17,18, 21). For *X. luci* and *X. sheri*, described from Senegal and Thailand respectively, no morphometric data were given; thus, the species identifications need to be confirmed (17,18,21). The only North American population of *X. diffusum* (from Key West, Florida) appears to be close to *X. parvum* Lamberti, Ciancio, Agostinelli, & Coiro, 1991, which is from Jamaica. A seventh species, *Xiphinema neoelongatus* Saxena, Chhabbra, & Joshi, 1973, was reported by Norton et al. from Florida (19). Because this report was a personal communication without any morphometrics, the status of this species needs confirmation. This species is considered valid by Lamberti & Ca-

TABLE 2. A list of *Xiphinema* species very close to the *X. americanum*-group and the differences separating them from it (15).

Species and authority	Differences described
<i>X. elitum</i> Khan, Chawla & Saha, 1978	Peculiar tail shape, much longer tail length.
<i>X. elongatum</i> Schuurmans Stekhoven & Teunissen, 1938	Vulva position 30–44%, exceptionally 45–49%, tail much longer than <i>X. americanum</i> -group.
Syn. <i>X. campinense</i> Lordello, 1951	
Syn. <i>X. hydrabadense</i> Quraishi & Das, 1984	
Syn. <i>X. nagarjunense</i> Khan, 1982	
Syn. <i>X. pratense</i> Loos, 1949	
Syn. <i>X. usai</i> Edward & Sharma, 1982	
<i>X. louisii</i> Heyns, 1979	Longer body length, longer hyaline portion of tail.
<i>X. mampara</i> Heyns, 1979	Longer body length, longer hyaline portion of tail, males common.
<i>X. pachydermum</i> Sturhan, 1983†	Long uteri, many males.
<i>X. variable</i> Heyns, 1966	Body generally more slender, males common.

† Included in the *X. americanum* group by Lamberti and Carone (10).

rone (10) but species inquirenda by Loof & Luc (15) and Luc et al. (16). *Xiphinema georgianum* Lamberti & Bleve-Zacheo, 1979 has been found in Florida and Georgia, whereas *X. intermedium* Lamberti & Bleve-Zacheo, 1979 was reported in Florida and Mississippi (2,9,21).

Xiphinema occiduum Ebsary, Potter & Allen, 1984 has been reported only in the

Canadian provinces of Alberta, Manitoba, and Saskatchewan; and *X. pacificum* Ebsary, Vrain & Graham, 1989, only in British Columbia (4,5,21). Tennessee and Arkansas (9,21,26) are the only reported locations for *X. tenuicutis* Lamberti & Bleve-Zacheo, 1979; Colorado, North Dakota, and Idaho (2,13,21) have *X. thornei* Lamberti & Golden, 1986; and *X. utahense*

TABLE 3. A list of the *Xiphinema americanum*-group species reported from North America (21).

Species	Distribution in North America
<i>X. americanum</i>	Arkansas, California, Pennsylvania, Rhode Island, Virginia
<i>X. brevicolle</i> †	California, Nevada, Utah
<i>X. bricolense</i>	California, British Columbia
<i>X. californicum</i>	Arkansas, California, New York, Guanajuato
<i>X. citricolum</i>	Arkansas, Florida
<i>X. diffusum</i>	Florida
<i>X. floridae</i>	Florida
<i>X. georgianum</i>	Georgia, Florida
<i>X. intermedium</i>	Florida, Mississippi
<i>X. laevistriatum</i>	Florida
<i>X. luci</i> †	Florida
<i>X. neoamericanum</i> ‡	Florida
<i>X. occiduum</i>	Alberta, Manitoba, Saskatchewan
<i>X. pachtaicum</i> †	California, Washington
<i>X. pacificum</i>	British Columbia
<i>X. rivesi</i>	Arkansas, Kansas, Maryland, Nebraska, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, West Virginia
<i>X. sheri</i> †	Florida
<i>X. tarjanense</i>	Florida
<i>X. tenuicutis</i>	Arkansas, Tennessee
<i>X. thornei</i>	Colorado, Idaho, North Dakota
<i>X. utahense</i>	Utah, Oregon

† No morphometric data given, confirmation needed.

‡ Species Inquirenda by Loof and Luc (15) and Luc et al. (16), but considered a valid species by Lamberti and Carone (10).

Lamberti & Bleve-Zacheo, 1979 is found in Utah and Oregon (9,13,21).

Five *X. americanum*-group species (*X. citrocolum*, *X. laevistriatum*, *X. tarjanense*, *X. tenuicutis*, and *X. utahense*) were described from eight or fewer specimens (9). It was not stated whether these specimens were the entire *Xiphinema* population recovered or were selected from larger populations. Because of the ability of several species in the *X. americanum* group to transmit nepo-viruses, disease control strategists must correctly identify the virus-vector species. Therefore, the separation of closely related species with only a few specimens may not be helpful, especially because of the paucity of clearly distinguishing characters available to facilitate unequivocal species determinations.

The extraction procedures used in many North American nematology laboratories are often not the best for larger, sometimes inactive specimens such as *Longidorus*, *Paralongidorus*, and *Xiphinema* species. Baermann funnel and mist extraction techniques rely on the nematodes being active. Longidoridae of North America, when compared to those of Europe or Africa, move sluggishly and are often inactive and may fail to migrate downward as required for these methods to be effective. Because of their importance as vectors of potentially serious plant viruses, care should be taken to ensure that these nematodes are recovered. Soil screens of 10 mesh (2 mm) and thorough backwashing should be used to ensure that these very long nematodes are not discarded with the debris (1). To facilitate extraction of these nematodes, I normally use sugar flotation-centrifugation. I have found the 1.23 sp. gr. sucrose solution used by Dunn (3) for cyst nematodes to be efficient. This solution is prepared by addition of sufficient warm water to 615 g sucrose to bring the volume to one liter.

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