

A NOTE ON *LONGIDORUS* AND *XIPHINEMA*  
SPECIES FROM THE SUDAN

by  
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*Longidorus* and *Xiphinema* have assumed increasing importance in recent years in many parts of the world. Many species have been shown to be vectors of viruses causing diseases of economic importance in many crops in the USA and Europe, and there is increasing evidence of the importance of many species causing direct damage by their feeding. Most species in both genera have long life cycles and individuals are able to exist for long periods in the soil, even without host plants. This ecological trait, together with their wide host range and extensive climatic adaptations, explains their cosmopolitan occurrence.

In the Sudan, at least three species of each genus are known to occur, having been recovered from around the roots of various field and orchard crop plants (Yassin *et al.*, 1970). Some aspect of the distribution, biology and pathogenicity of the species are described here.

*Methods*

Soil samples were collected by conventional methods from around the roots of crop plants showing unthrifty growth at various localities throughout the Sudan. Nematodes were extracted from 200 g samples by the methods described by Yassin (1967), using 10 and 150 mesh/in sieves and tissue paper (Kleenex, Kimberley-Clark) filters. Root samples collected during the survey were examined for symptoms of nematode attack and these were correlated with any above-ground symptoms of disease.

## Results

### *Longidorus.*

Stunting of plants and poorly developed root systems, often with characteristic stubbiness and swelling, were almost invariably associated with the presence of the three species of *Longidorus* on the ten crop plants sampled in the survey (Table I).

*L. africanus* Merny was found in association with cotton, grapefruit, grapevine and sugar cane on heavy clay or river silt at several localities. The largest populations (up to 50/200 g soil) were found on grapefruit with swollen and stubby roots. In western Sudan populations of *Longidorus* (possibly *L. africanus*) sometimes exceeded 100/200 g on crops such as Jew's mallow, lucerne and spearmint growing in fine sand. The plants were unhealthy in appearance with yellow foliage, and the roots were swollen and stubby.

The highest counts of *L. siddiqii* (Siddiqi) Aboul-Eid (30-50/200 g) were found in association with Jew's mallow, which were stunted, with yellow leaves and poorly developed root systems. *L. laevicapitatus* Williams was found on grapevine showing decline symptoms, but nematode populations were never more than 10/200 g.

### *Xiphinema.*

Three *Xiphinema* species were found on seven different crops or ornamental plants and were associated with characteristic root stunting; stubbiness and sometimes discoloration (Table I). *X. basiri* Siddiqi occurred in relatively high population densities of up to 50 nematodes/200 g soil in river silt and heavy clay soils in association with rose, grapefruit, mango and « Nim » trees; all of which showed decline symptoms and stubby roots.

*X. simillimum* Loof et Yassin was found on Golden mohur, rose and orange in heavy clay and river silt soils but populations never exceeded 10/200 g. It was, however, found in higher number (20-50) on cotton. A species close to *X. elongatum* Schuurmans Stekhoven et Teunissen was found in association with rose growing in river silt, with populations of about 10/ 200 g.

Table I - Longidorus and Xiphinema species associated with the rizosphere of various plant species at different localities throughout the Sudan.

Nematode species	Plants species	Locality	Soil type	
<i>Longidorus africanus</i> Merry	<i>Citrus paradisi</i> Macf. *** (grapefruit)	GRS	Heavy clay	
	<i>Gossypium barbadense</i> L. ** (cotton var Domain's Sakel and XLI)	»	» »	
	<i>Saccharum officinarum</i> L.* (Sugar cane var NCO 310)	Geneid	» »	
	<i>Vitis vinifera</i> L. **	Wad Medani	River silt	
<i>L. siddiqii</i> (Siddiqi) Aboul-Eid	<i>Corchorus olitorius</i> L. *** (Jew's mallow)	Shambat	» »	
	<i>Lablab vulgaris</i> Savi * (Dolichos bean)	Maringan	Heavy clay	
<i>L. laevicapitatus</i> Williams	<i>C. paradisi</i> *	GRS	» »	
<i>Longidorus</i> n. sp.	<i>C. olitorius</i> ***	Shambat	River silt	
	<i>Mentha spicata</i> L. *** (Spearment)	»	» »	
Unidentified (possibly <i>L. africanus</i> and others)	<i>C. paradisi</i> **	El Obeid	Fine sand	
	<i>C. olitorius</i> *	Bara	» »	
	<i>G. barbadense</i> * (XLI)	Gezira	Heavy clay	
	<i>Lycopersicon esculentum</i> * Mill (Tomato)	Port Sudan (K. Arbaat)	Silty sand	
	<i>Medicago sativa</i> L. **** (Lucerne)	Bara	Fine sand	
	<i>M. spicata</i> *	»	» »	
	<i>Musa sapientum</i> L. * (Banana)	Wad Medani	River silt	
	<i>Psidium guajava</i> L. * (Guava)	» »	» »	
	<i>S. officinarum</i> *	Sennar	Heavy clay	
	<i>Xiphinema basiri</i> Siddiqi	<i>Azadiracta indica</i> *** A. Juss (« Nim »)	Wad Medani	» »
		<i>Citrus sinensis</i> Osbeck (Sweet orange)	GRS	» »
		<i>Mangifera indica</i> L. *** (Mango)	Wad Medani	
<i>Rosa</i> sp. (Garden rose)		GRS	River silt	
<i>X. simillimum</i> Loof et Yassin	<i>C. sinensis</i> *	»	Heavy clay	
	<i>G. barbadense</i> **	»	» »	
	<i>Poinciana regia</i> Bojer * (Golden mohur)	»	» »	
<i>X. elongatum</i> Schuurmans Stekhoven et Teunissen	<i>Rosa</i> sp.	»	River silt	
	<i>Gardenia</i> sp. *	»	Heavy clay	
Unidentified (possibly <i>X. basiri</i> and others)	<i>C. paradisi</i> *	»	» »	
	<i>Gardenia</i> sp. *	»	» »	
	<i>Rosa</i> sp. **	»	River silt	
	<i>S. officinarum</i> « Zonia »	Geneid Wad Medani	Heavy clay » »	

\* = < 10  
 \*\* = 10 - 30  
 \*\*\* = > 30 - 50  
 \*\*\*\* = > 100

} Nematodes/200 g soil

### *Vertical distribution.*

Investigations on vertical distribution of *X. basiri* were made at sites on the GRS where rose or grapefruit trees showed decline symptoms and stubby roots. Three soil samples were taken at 5, 30, 80, 90 and 100 cm depth at a distance of about 50 cm from the base of the plant. Under rose the largest numbers of *X. basiri* were found at 5 cm depth (Table II), and thereafter the numbers declined sharply. There was some evidence of an increase at 100 cm depth but this was not significantly different from any other depth other than 5 cm. On grapefruit only low numbers of *X. basiri* were found, with the highest at the 80 cm depth; possibly sampling was not undertaken in the root zone, as samples in the survey indicated that grapefruit was a good host for the nematode.

Table II - *X. basiri* populations at different depths of soil under garden rose and grapefruit trees at the GRS: mean number, and range, of nematodes/200 g soil.

	Depth in cm				
	5	30	80	90	100
Garden rose	191 (157 - 225)	37 (33 - 40)	33 (32 - 34)	31 (20 - 41)	61 (41 - 81)
Grapefruit	1 (0 - 2)	0	10 (8 - 12)	2 (1 - 3)	4 (3 - 4)

### *Pathogenicity and multiplication.*

Experiments were undertaken in a glasshouse with a mean daily temperature of 25° C in winter and 38° C in summer during the course of experiments lasting from 24 to 84 weeks. *X. basiri* was tested on citrus (local variety of bitter lemon), mango and « Nim » trees and *L. africanus* on cotton (« Domain's sakel ») only. Except for mango, seedling plants were established, each grown in a 5x10 cm polythene bag containing about 200 g of a sterilized 1:1 sand : river silt. Mango seedlings were found to establish best in 8 cm diameter pots containing about 400 g soil. Adult females of each species, extracted

Table III - *Parasitism by L. africanus and X. basiri: Numbers of nematodes recovered from pots of various plant species inoculated with various lots of nematodes, and the degree of root symptoms as in the given scale.*

Nematode species	Plant species	N. of Nematodes inoculated	Nematodes recovered	Intervals in weeks after inoculation	Degree of root (1) symptoms	
<i>X. basiri</i>	Mango	250	28	12	+	
			202	24	++	
			400	84	+++	
		500	126	12	++	
			258	24	+++	
			1250	84	++++	
	Bitter lemon	250	142	12	+	
			155	24	++	
			190	84	+++	
		500	128	12	++	
			240	24	+++	
			440	84	++++	
« Nim » (2)	250	32	12	++		
		40	24	+++		
		58	12	+++		
	500	165	24	++++		
		<i>L. africanus</i>	50	17	12	+
				61	18	+
81	32			++		
Cotton	200		81	12	++	
			281	18	+++	
			339	32	+++	

(1) + = Mild : Few root swellings, no conspicuous root stunting.  
 ++ = Moderate: Root swellings and stubbiness resulting in about 1/3rd reduction of root size.

+++ = Severe : As (++) , with about 1/2 reduction of root size.

++++ = V. Severe: As (+++), with 1/2 reduction of root size.

(2) No data taken after 24 wks. as plants died due to severe mealy bug attack.

from naturally infested soils, were introduced into the containers once the seedlings had become established in lots of 50 to 500 (see Table III). Examination was made at one to two weekly intervals for root symptoms, using two or three plants of each species on each occasion. Nematodes were extracted from random samples at longer intervals (Table III) to obtain estimates of rates of population increase.

On each of the three kinds of plants tested with *X. basiri*, root-swelling and stubbiness became apparent at about 3-4 weeks after inoculation with the nematodes. Damage symptoms were more severe at 12 weeks with 500 nematodes than with 250 (Table III). The symptoms observed were similar to those reported by Cohn (1970). Apparently multiplication of *X. basiri* is relatively slow. Assuming an efficiency of extraction of 50% (Yassin, 1967) it is estimated that *X. basiri* would have multiplied 2-5 times during the 84 weeks of observation; this is based on an observed 28 weeks between the appearance of fourth stage larvae moulting to females and the presence of gravid females. The results obtained concur with those reported by other investigations for related species (Radewald and Raski, 1962; Flegg, 1968).

*L. africanus* added in lots of 50 or 200 to cotton plants produced stubby and stunted roots, and again the severity of symptoms was related to the numbers of nematodes in the inoculum (Table III). Multiplication was somewhat quicker than *X. basiri*. It is estimated that *L. africanus* would have multiplied 2-8 times over a period of 30 weeks under experimental conditions and assuming an efficiency of extraction of 50%.

#### S U M M A R Y

Three species of *Longidorus*, *L. africanus* Merny, *L. siddiqii* (Siddiqi) Aboul-Eid and *L. laevicapitatus* Williams, were found associated with soil around the roots of various field crops throughout the Sudan. Their geographical distribution ranged from light sandy to heavy clay soils of up to 55% clay content. The most important was *L. africanus* which produced stubby and swollen roots on cotton plants when tested in the glasshouse at the Gezira Research Station. There was a direct correlation between the degree of severity of symptoms and the number of nematodes in the inoculum. Among *Xiphinema* species, found mainly around the roots of trees and woody plants, were *X. basiri* Siddiqi, *X. simillimum* Loof et Yassin and possibly *X. elongatum* Schuurmans Stekhoven et Teunissen. Like *Longidorus*, species of *Xiphinema* were also of wide occurrence in light and heavy clay soils. The commonest was *X. basiri* which also often induced root stubbiness, but sometimes discolored roots, on bitter lemon, mango and « Nim » trees. Severer symptoms resulted with higher numbers of *X. basiri*.

## RIASSUNTO

*Nota sulle specie di Longidorus e Xiphinema in Sudan.*

Tre specie di *Longidorus*, *L. africanus* Merny, *L. siddiqii* (Siddiqi) Aboul-Eid e *L. laevicapitatus* Williams, sono state rinvenute nella rizosfera di diverse piante in Sudan. La loro distribuzione geografica è compresa in tipi di terreno che vanno dal leggero, sabbioso all'argilloso fino a terreni con un contenuto in argilla del 55%. La specie più importante è apparsa essere *L. africanus* che ha indotto su cotone, in prove in serra, presso la Stazione di Ricerche di Gezira, formazione di radici raccorciate e ingrossate all'apice. Vi è una correlazione positiva tra la severità dei sintomi e la consistenza dell'inoculo. Tra le specie di *Xiphinema*, riscontrate per la maggior parte nella rizosfera di alberi e piante legnose, sono stati osservati *X. basiri* Siddiqi, *X. simillimum* Loof et Yassin e forse *X. elongatum* Schuurmans Stekhoven et Teunissen. Anche le specie di *Xiphinema* sono state trovate sia in terreni sabbiosi che in terreni argillosi. La specie più comune è stata *X. basiri* che spesso ha indotto sulle radici di Limone amaro, Mango e « Nim » raccorciamenti accompagnati, alle volte, da imbrunimenti tanto più accentuati quanto più elevate erano le popolazioni del parassita.

## RÉSUMÉ

*Note sur les espèces de Longidorus et Xiphinema au Sudan.*

Trois espèces de *Longidorus*: *L. africanus* Merny, *L. siddiqii* (Siddiqi) Aboul-Eid et *L. laevicapitatus* Williams, ont été trouvées associées à plusieurs cultures au Sudan. Leur distribution géographique va des terrains légers sableux aux terrains lourds ayant une teneur en argile de 55%. La plus importante des espèces est *L. africanus* qui a provoqué sur coton, en conditions contrôlées (Station de Recherches de Gezira), la formation de racines courtes à extrémité renflée. Il y a une corrélation directe entre le degré des symptômes et le nombre des nématodes inoculés. Parmi les espèces de *Xiphinema*, pour la plupart associées aux racines d'arbres et de plantes ligneuses, on a trouvé *X. basiri* Siddiqi, *X. simillimum* Loof et Yassin et peut-être *X. elongatum* Schuurmans Stekhoven et Teunissen. Les espèces de *Xiphinema* ont également été trouvées en sols sableux et argileux. Le plus commun a été *X. basiri* qui, souvent, a induit sur citronamer, mangue et « Nim », des racines courtes et quelquefois brunes, dont l'intensité est fonction du nombre de nématodes.

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