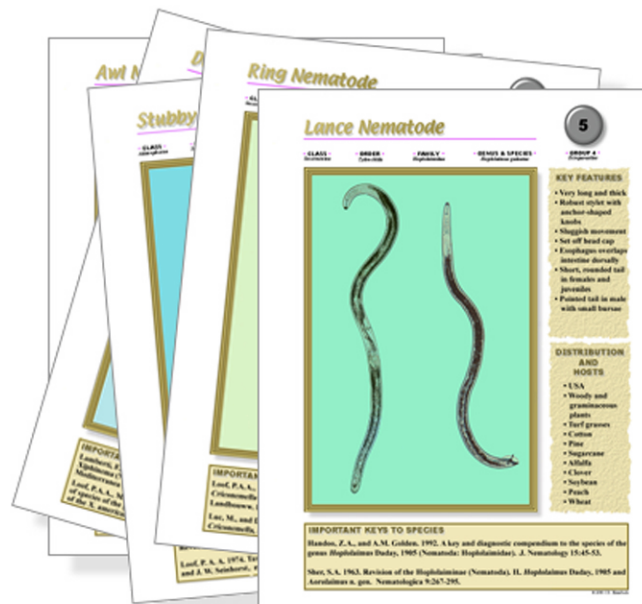

Identification Guides for the Most Common Genera of Plant-Parasitic Nematodes



Jonathan D. Eisenback
Department of Plant Pathology, Physiology & Weed Science
Virginia Polytechnic Institute & State University
Blacksburg, Virginia 24061

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Dedicated to

Mrs. Nina Hopkins

*for her many years of faithful service
to the Department of Plant Pathology,
Physiology and Weed Science.*

Preface

These identification guides are the result of my efforts to teach students how to identify the most common genera of plant-parasitic nematodes. My students have found them to be very useful in learning how to identify nematodes with a dissecting microscope. I have been encouraged by their acceptance of these guides and would like to make them available for others.

JDE

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Comparison of the Most Common Genera of Plant-Parasitic Nematodes

by J. D. Eisenback and E. C. McGawley

Genus	Length	Width	Stylet	Sclerotization
<i>Awl nematodes</i>	<i>Long</i>	<i>Medium</i>	<i>Very long</i>	<i>Medium</i>
<i>Cyst nematodes</i>				
<i>Males</i>	<i>Long</i>	<i>Medium</i>	<i>Short</i>	<i>Medium</i>
<i>Juveniles</i>	<i>Short</i>	<i>Medium</i>	<i>Short</i>	<i>Medium</i>
<i>Dagger nematodes</i>	<i>Long</i>	<i>Thin</i>	<i>Very long</i>	<i>Medium</i>
<i>Foliar nematodes</i>	<i>Medium</i>	<i>Medium</i>	<i>Very short</i>	<i>Light</i>
<i>Lance nematodes</i>	<i>Long</i>	<i>Medium</i>	<i>Medium</i>	<i>Heavy</i>
<i>Lesion nematodes</i>	<i>Short</i>	<i>Medium</i>	<i>Short</i>	<i>Medium</i>
<i>Needle nematode</i>	<i>Very long</i>	<i>Thin</i>	<i>Very long</i>	<i>Light</i>
<i>Pin nematodes</i>	<i>Very short</i>	<i>Medium</i>	<i>Short</i>	<i>Medium</i>
<i>Reniform nematodes</i>				
<i>Males</i>	<i>Short</i>	<i>Medium</i>	<i>Short</i>	<i>Light</i>
<i>Juveniles</i>	<i>Short</i>	<i>Medium</i>	<i>Short</i>	<i>Light</i>
<i>Immature females</i>	<i>Short</i>	<i>Medium</i>	<i>Short</i>	<i>Light</i>
<i>Ring nematodes</i>	<i>Short</i>	<i>Stout</i>	<i>Long</i>	<i>Heavy</i>
<i>Root-knot nematodes</i>				
<i>Males</i>	<i>Long</i>	<i>Medium</i>	<i>Short</i>	<i>Light</i>
<i>Juveniles</i>	<i>Short</i>	<i>Medium</i>	<i>Very short</i>	<i>Light</i>
<i>Sheath nematodes</i>	<i>Medium</i>	<i>Medium</i>	<i>Long</i>	<i>Medium</i>
<i>Spiral nematodes</i>	<i>Medium</i>	<i>Medium</i>	<i>Short-Med.</i>	<i>Medium</i>
<i>Sting nematodes</i>	<i>Long</i>	<i>Thin</i>	<i>Very long</i>	<i>Medium</i>
<i>Stubby root nematodes</i>	<i>Medium</i>	<i>Medium</i>	<i>Medium</i>	<i>Medium</i>
<i>Stunt nematodes</i>	<i>Medium</i>	<i>Medium</i>	<i>Short</i>	<i>Medium</i>

We used the following criteria in describing the various attributes of the nematode genera listed in the preceding chart:

Body length

 Short (<600 μm)
 Medium (>600 μm < 1500 μm)
 Long (> 1500 μm)

Body width

(Based on the ratio α , body length/body width)

 Thin ($\alpha > 50$)
 Medium ($\alpha = 20-50$)
 Stout ($\alpha < 20$)

Stylet length

 Very long (>100 μm)
 Long (<80 μm <100)
 Medium (>30 μm <80)
 Short (>15 μm <30)
 Very short (<15 μm)

Stylet sclerotization
(Subjective observation)

 Heavy
 Medium
 Light

Root-Knot Nematode

1

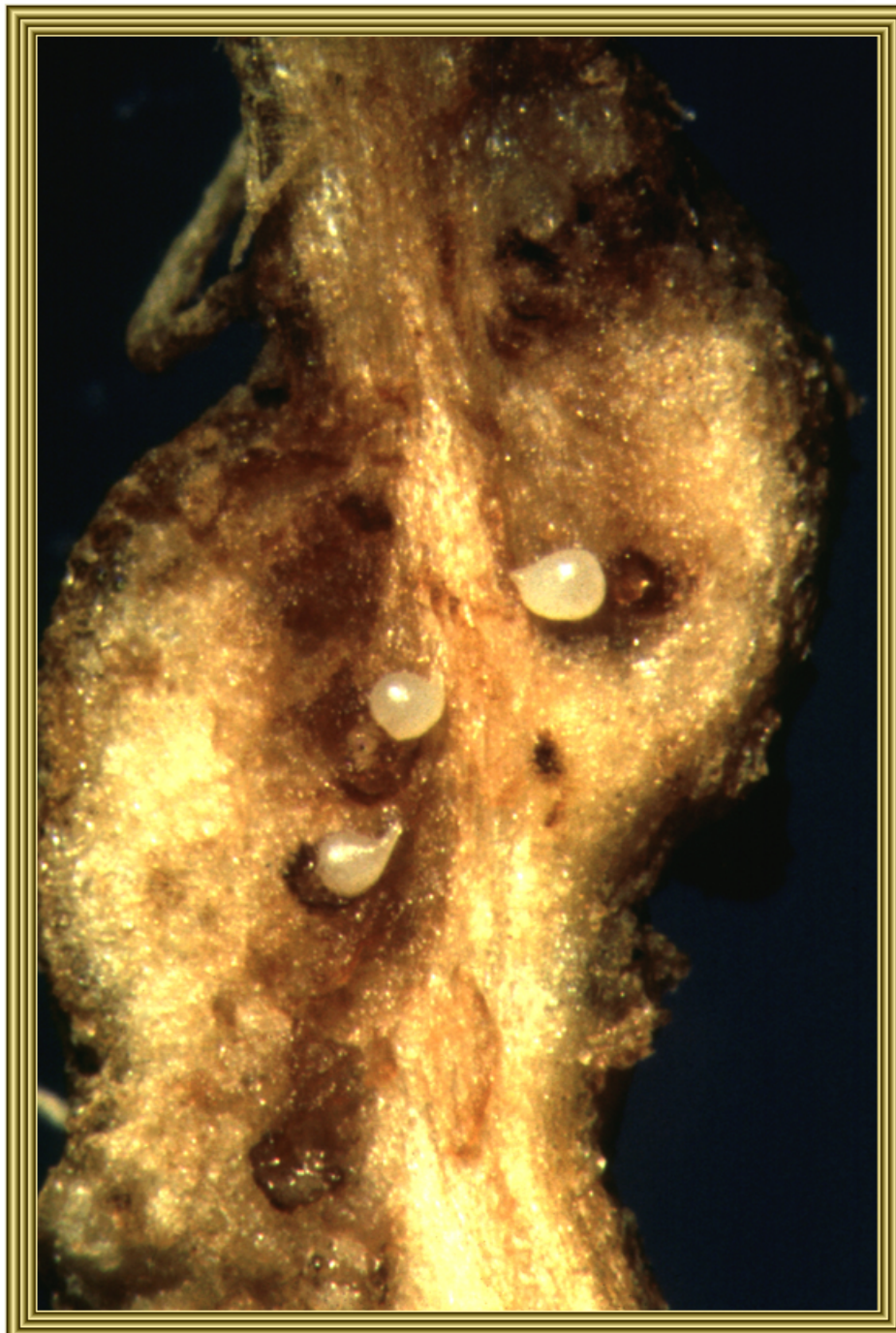
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Meloidogynidae

• GENUS & SPECIES •
Meloidogyne spp.

• GROUP 1 •
Sedentary Endoparasites



KEY FEATURES

- Pear shaped, pearly white
- Eggs deposited externally in a gelatinous matrix
- Six large rectal gland cells secrete a gelatinous matrix through the anal pore
- Two long convoluted ovaries
- Unique fingerprint-like perineal pattern

DISTRIBUTION AND HOSTS

- Worldwide in distribution
- Numerous hosts from almost every plant family

IMPORTANT KEYS TO SPECIES

Eisenback, J.D. and H. Hirschmann. 1991. Root-knot nematodes: *Meloidogyne* species and races. Pp. 191-274, in, Manual of Agricultural Nematology. W.R. Nickle, ed. Marcel Dekker: N.Y.

Eisenback, J.D., H. Hirschmann, J.N. Sasser, and A.C. Triantaphyllou. 1981. A Guide to the Four Most Common Species of Root-Knot Nematodes (*Meloidogyne* spp.) with a Pictorial Key. North Carolina State University Graphics: Raleigh, N.C.

Root-Knot Nematode

2

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Meloidogynidae

• GENUS & SPECIES •
Meloidogyne spp.

• GROUP 1 •
Sedentary Endoparasites



KEY FEATURES

- Very long and thin
- Head cap indistinct, weakly sclerotized
- Strong stylet with well-developed knobs
- Esophagus overlaps intestine ventrally
- One testis
- Short, rounded tail
- Bursa absent
- Spicules open a short distance from the tail tip
- Sluggish movement

DISTRIBUTION AND HOSTS

- Worldwide in distribution
- Numerous hosts from almost every plant family

IMPORTANT KEYS TO SPECIES

Eisenback, J.D. and H. Hirschmann. 1991. Root-knot nematodes: *Meloidogyne* species and races. Pp. 191-274, *in*, Manual of Agricultural Nematology. W.R. Nickle, ed. Marcel Dekker: N.Y.

Eisenback, J.D., H. Hirschmann, J.N. Sasser, and A.C. Triantaphyllou. 1981. A Guide to the Four Most Common Species of Root-Knot Nematodes (*Meloidogyne* spp.) with a Pictorial Key. North Carolina State University Graphics: Raleigh, N.C.

Root-Knot Nematode

3

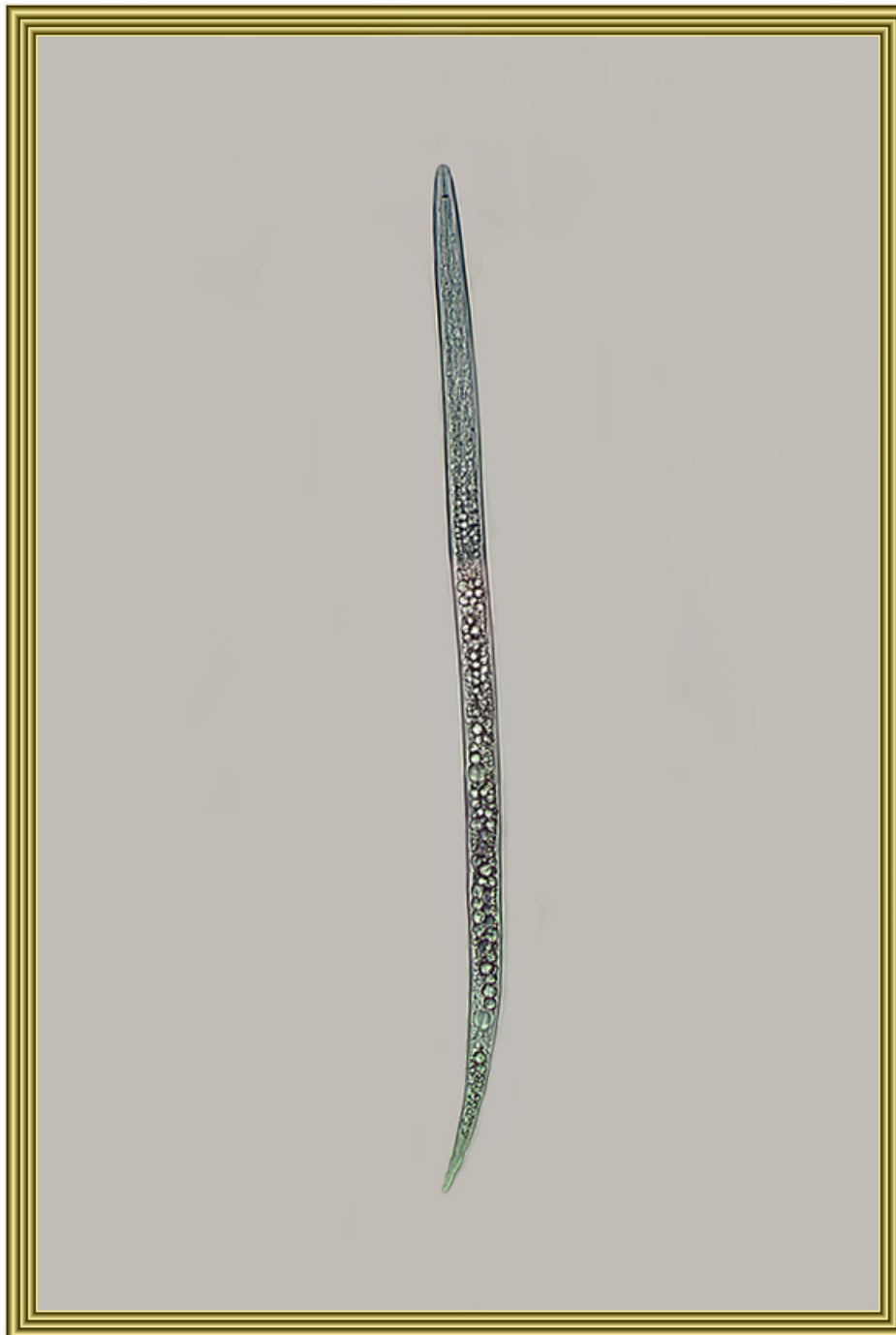
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Meloidogynidae

• GENUS & SPECIES •
Meloidogyne spp.

• GROUP 1 •
Sedentary Endoparasites



KEY FEATURES

- Body short and thin
- Cephalic framework lightly sclerotized
- Stylet short and weak with indistinct knobs
- Esophagus overlaps intestine ventrally
- Narrow, pointed tail with clear terminus
- Sluggish movement

DISTRIBUTION AND HOSTS

- Worldwide in distribution
- Numerous hosts from almost every plant family

IMPORTANT KEYS TO SPECIES

Eisenback, J.D. and H. Hirschmann. 1991. Root-knot nematodes: *Meloidogyne* species and races. Pp. 191-274, *in*, Manual of Agricultural Nematology. W.R. Nickle, ed. Marcel Dekker: N.Y.

Eisenback, J.D., H. Hirschmann, J.N. Sasser, and A.C. Triantaphyllou. 1981. A Guide to the Four Most Common Species of Root-Knot Nematodes (*Meloidogyne* spp.) with a Pictorial Key. North Carolina State University Graphics: Raleigh, N.C.

Round Cyst Nematode

4

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Heteroderidae

• GENUS & SPECIES •
Globodera spp.

• GROUP 1 •
Sedentary Endoparasites



KEY FEATURES

- Mature female pearly white, globose
- Cuticle of dead female turns from light to dark brown
- Several hundred unhatched eggs with second-stage juveniles protected within the cyst
- Two long, convoluted ovaries
- Unique terminal area cuticular pattern

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- Numerous hosts, particularly solanaceous plants
- Potato
- Tobacco
- Tomato
- Pepper
- Eggplant

IMPORTANT KEYS TO SPECIES

Wouts, W.M. 1984. *Globodera zelandica* n.sp. (Nematoda: Heteroderidae) from New Zealand, with a key to the species of *Globodera*. *New Zealand Journal of Zoology* 50: 129-135.

Lemon Cyst Nematode

5

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Heteroderidae

• GENUS & SPECIES •
Heterodera spp.

• GROUP •
Sedentary Endoparasites



KEY FEATURES

- Mature female pearly white, lemon shaped
- Cuticle of dead female turns from light to dark brown
- Several hundred unhatched eggs with second-stage juveniles protected within the cyst
- Two long, convoluted ovaries
- Unique vulval cone pattern

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- Numerous hosts
- Soybean
- Sugarbeet
- Cabbage
- Fig
- Carrot
- Hops
- Clover
- Bean

IMPORTANT KEYS TO SPECIES

Golden, A.M. 1986. Morphology and identification of cyst nematodes. Pp. 23-45, in, Cyst Nematodes. F. Lamberti and C.E. Taylor, eds. Plenum Press: N.Y.

Cyst Nematode

6

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Heteroderidae

• GENUS & SPECIES •
Heterodera and *Globodera* spp.

• GROUP •
Sedentary Endoparasites



KEY FEATURES

- Very long and thin
- Head region rounded and framework sclerotized
- Strong stylet with well-developed knobs
- Esophagus overlaps intestine ventrally
- Tail short and rounded
- Spicules open very near tail tip
- Movement is sluggish

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- Numerous hosts
- Sugarbeet
- Soybean
- Cabbage
- Carrot
- Fig
- Potato
- Tobacco
- Pepper
- Tomato

IMPORTANT KEYS TO SPECIES

Golden, A.M. 1986. Morphology and identification of cyst nematodes. Pp. 23-45, in, *Cyst Nematodes*. F. Lamberti and C.E. Taylor, eds. Plenum Press: N.Y.

Wouts, W.M. 1984. *Globodera zelandica* n.sp. (Nematoda: Heteroderidae) from New Zealand, with a key to the species of *Globodera*. *New Zealand Journal of Zoology* 50: 129-135.

Cyst Nematode

7

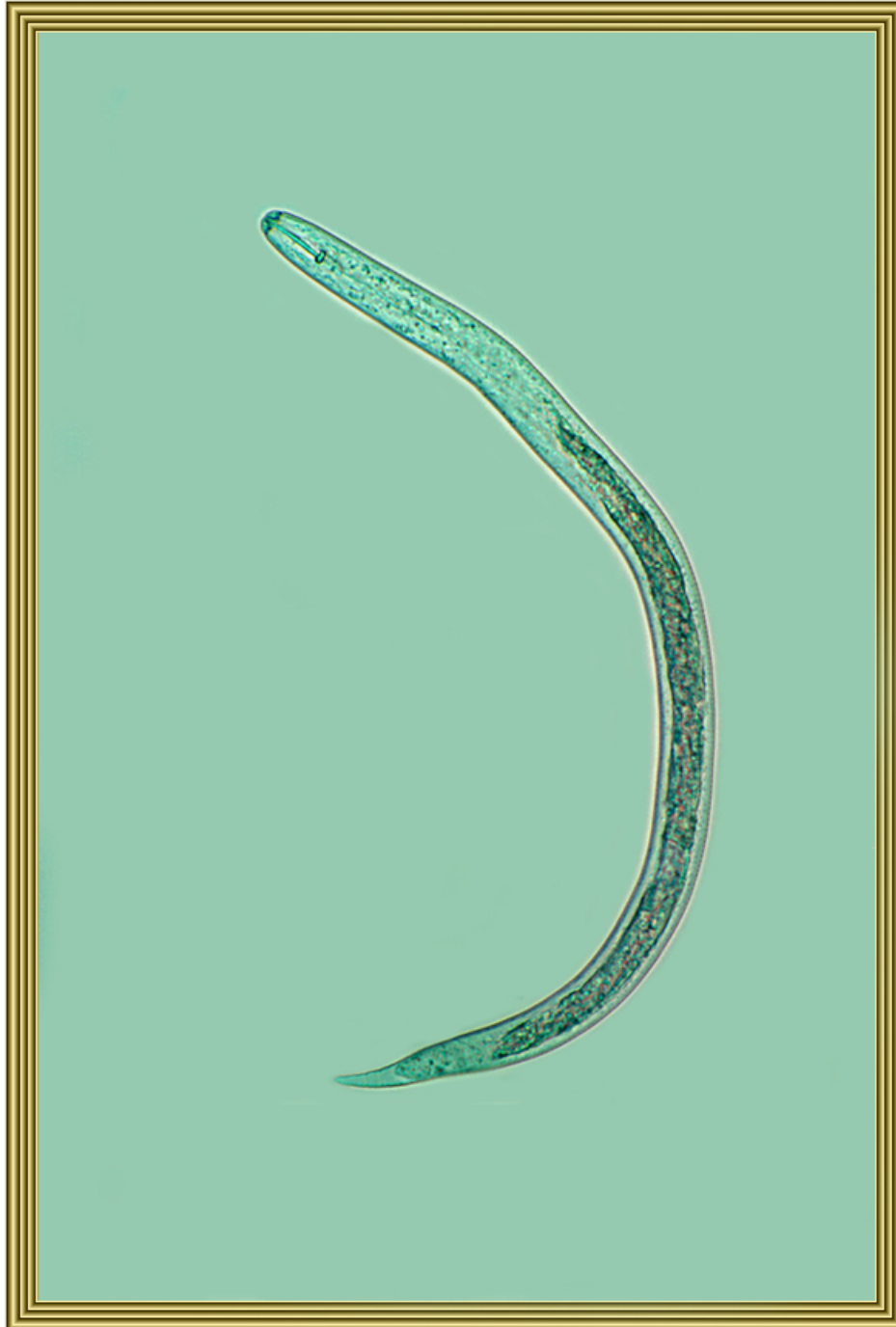
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Heteroderidae

• GENUS & SPECIES •
Heterodera and *Globodera* spp.

• GROUP •
Sedentary Endoparasites



KEY FEATURES

- Small and thin
- Head region rounded, heavily sclerotized
- Stylet strong with short, distinct knobs
- Esophagus overlaps intestine ventrally
- Tail tapers to a pointed tip
- Tail terminus hyaline
- Sluggish movement

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- Numerous hosts
- Sugarbeet
- Soybean
- Cabbage
- Carrot
- Fig
- Potato
- Tobacco
- Pepper
- Tomato

IMPORTANT KEYS TO SPECIES

Golden, A.M. 1986. Morphology and identification of cyst nematodes. Pp. 23-45, in, Cyst Nematodes. F. Lamberti and C.E. Taylor, eds. Plenum Press: N.Y.

Wouts, W.M. 1984. *Globodera zelandica* n.sp. (Nematoda: Heteroderidae) from New Zealand, with a key to the species of *Globodera*. New Zealand Journal of Zoology 50: 129-135.

Reniform Nematode

1

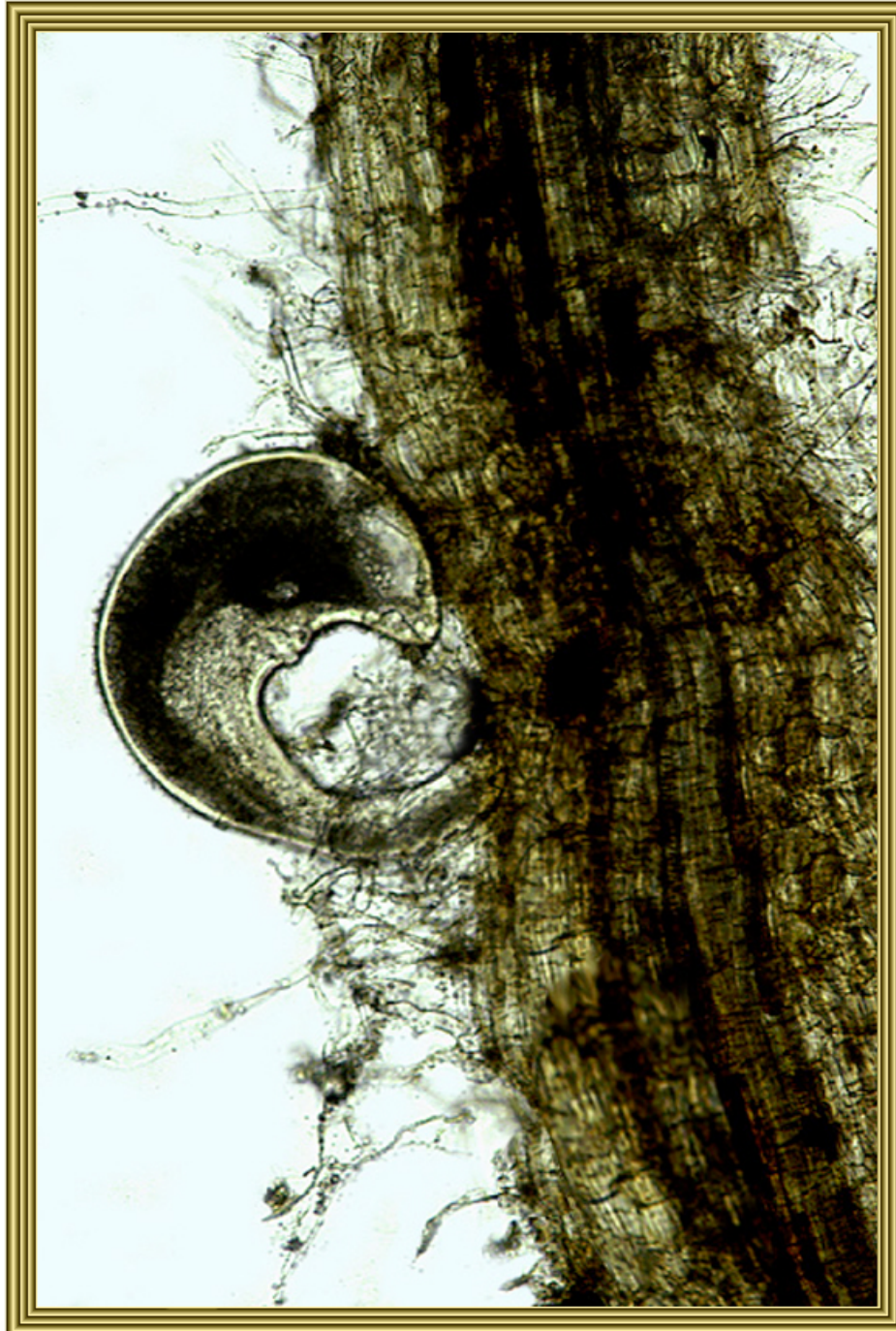
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Tylenchulidae

• GENUS & SPECIES •
Rotylenchulus reniformis

• GROUP 2 •
Sedentary Semi-Endoparasites



KEY FEATURES

- Anterior end irregularly shaped
- Posterior end kidney shaped
- Vulval lips prominent and protruding
- Two convoluted ovaries
- Small, pointed tail
- Eggs deposited into gelatinous matrix
- Not easily confused with other genera

DISTRIBUTION AND HOSTS

- Southeastern USA
- Hawaii
- West Africa
- Ghana
- India
- Cuba
- Soybean
- Cotton
- Banana
- Papaya
- Sugarcane

IMPORTANT KEYS TO SPECIES

Robinson, A.F., R.N. Inserra, E.P. Caswell-Chen, N. Vovlas, and A. Troccoli. 1997. *Rotylenchulus* species: identification, distribution, host ranges, and resistance. *Nematropica* 27:128-180.

Reniform Nematode

2

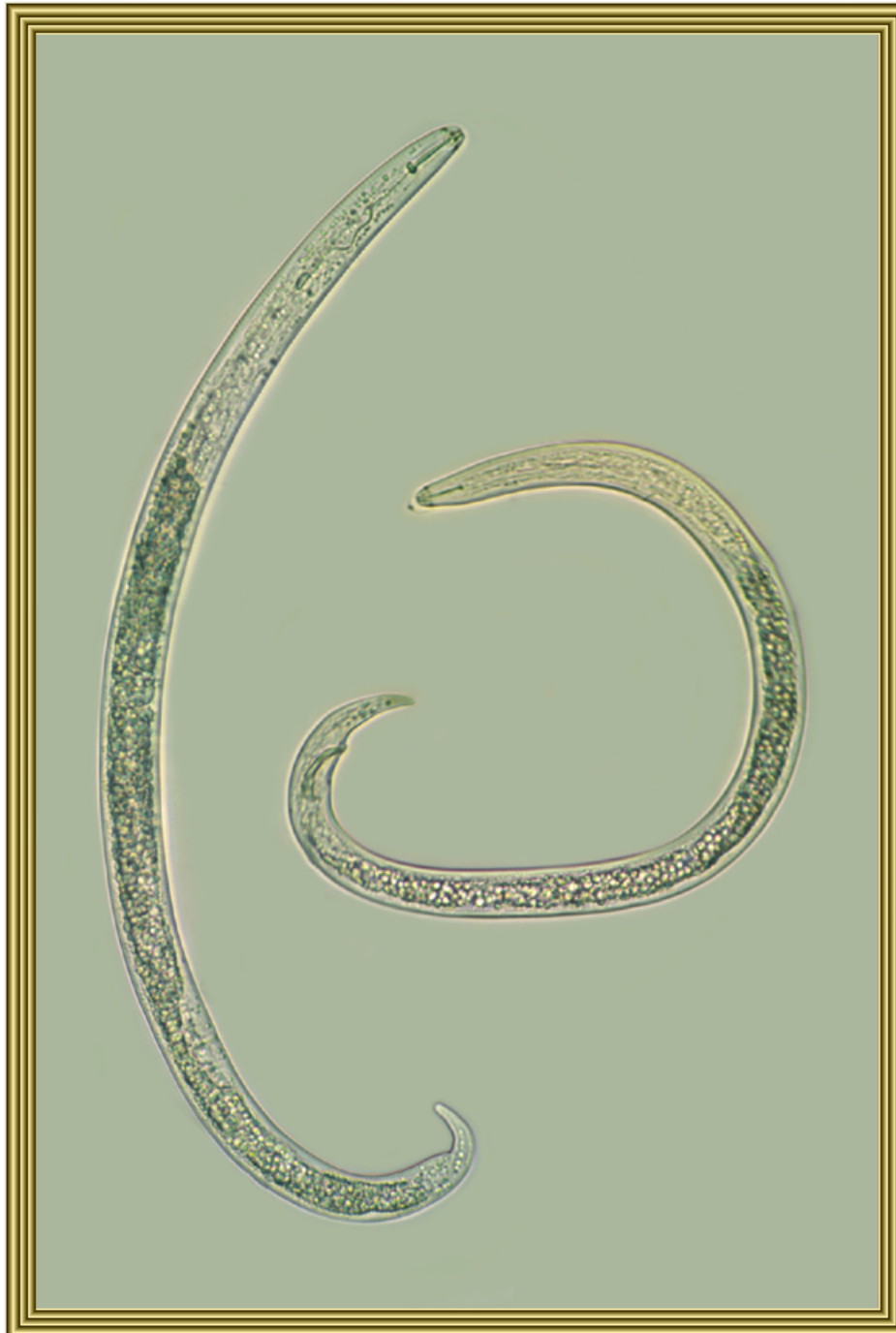
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Tylenchulidae

• GENUS & SPECIES •
Rotylenchulus reniformis

• GROUP 2 •
Sedentary Semi-Endoparasites



KEY FEATURES

Immature Female

- Small with rounded, striated head region
- Stylet moderately strong, rounded knobs
- Median bulb large, with prominent lumen lining
- Vulva posterior

Male

- Stylet small, weak
- Median bulb weak, lining indistinct
- Small bursa

DISTRIBUTION AND HOSTS

- Southeastern USA
- Hawaii
- West Africa
- Ghana
- India
- Cuba
- Soybean
- Cotton
- Banana
- Papaya
- Sugarcane

IMPORTANT KEYS TO SPECIES

Robinson, A.F., R.N. Inerra, E.P. Caswell-Chen, N. Vovlas, and A. Troccoli. 1997. *Rotylenchulus* species: identification, distribution, host ranges, and resistance. *Nematropica* 27:128-180.

Citrus Nematode

3

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Tylenchulidae

• GENUS & SPECIES •
Tylenchulus semipenetrans

• GROUP 2 •
Sedentary Semi-Endoparasites



KEY FEATURES

- Body behind neck irregularly swollen, distorted, and embedded in root tissue
- External portion of body swollen and pyriform
- Tail digitate
- Ovary conoid
- Excretory pore in front of vulva

DISTRIBUTION AND HOSTS

- Occurs almost wherever citrus is grown, including 23 countries
- 29 Citrus spp.
- 21 Citrus hybrids
- 11 other Rutaceae
- Grape
- Lilac
- Persimmon
- Olive
- Loquat
- Pear

IMPORTANT KEYS TO SPECIES

Inserra, R.N., N. Vovlas, J.H. O'Bannon, and R.P. Esser. 1988. *Tylenchulus graminis* n.sp. and *T. palustris* n.sp. (Tylenchulidae), from native flora in Florida, with notes on *T. semipenetrans* and *T. furcus*. *Journal of Nematology* 20:266-287.

Lesion Nematode

1

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Pratylenchidae

• GENUS & SPECIES •
Pratylenchus spp.

• GROUP 3 •
Migratory Endoparasites



KEY FEATURES

- Short, narrow body
- Broad, flattened anterior end
- Short, strong stylet with large knobs
- Metacarpus prominent
- Esophagus overlaps intestine ventrally
- Vulva near tail
- One ovary
- Tail of female tapers to a blunt tip
- Males maybe common

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- A pest of numerous plant species including fruit trees, woody ornamentals, vegetables, fruits, grasses, maize, and flowers

IMPORTANT KEYS TO SPECIES

Hando, Z.A. and A.M. Golden. 1989. A key and diagnostic compendium to the genus *Pratylenchus* Filipjev, 1936 (Nemata: Pratylenchidae). *Revue de Nématologie* 21:202-218.

Café Filho, A.C. and C.S. Huang. 1989. Description of *Pratylenchus pseudofallax* n.sp. with a key to the species of the genus *Pratylenchus* Filipjev, 1936 (Nematoda: Pratylenchidae). *Revue de Nématologie* 12:7-15.

Dagger Nematode

1

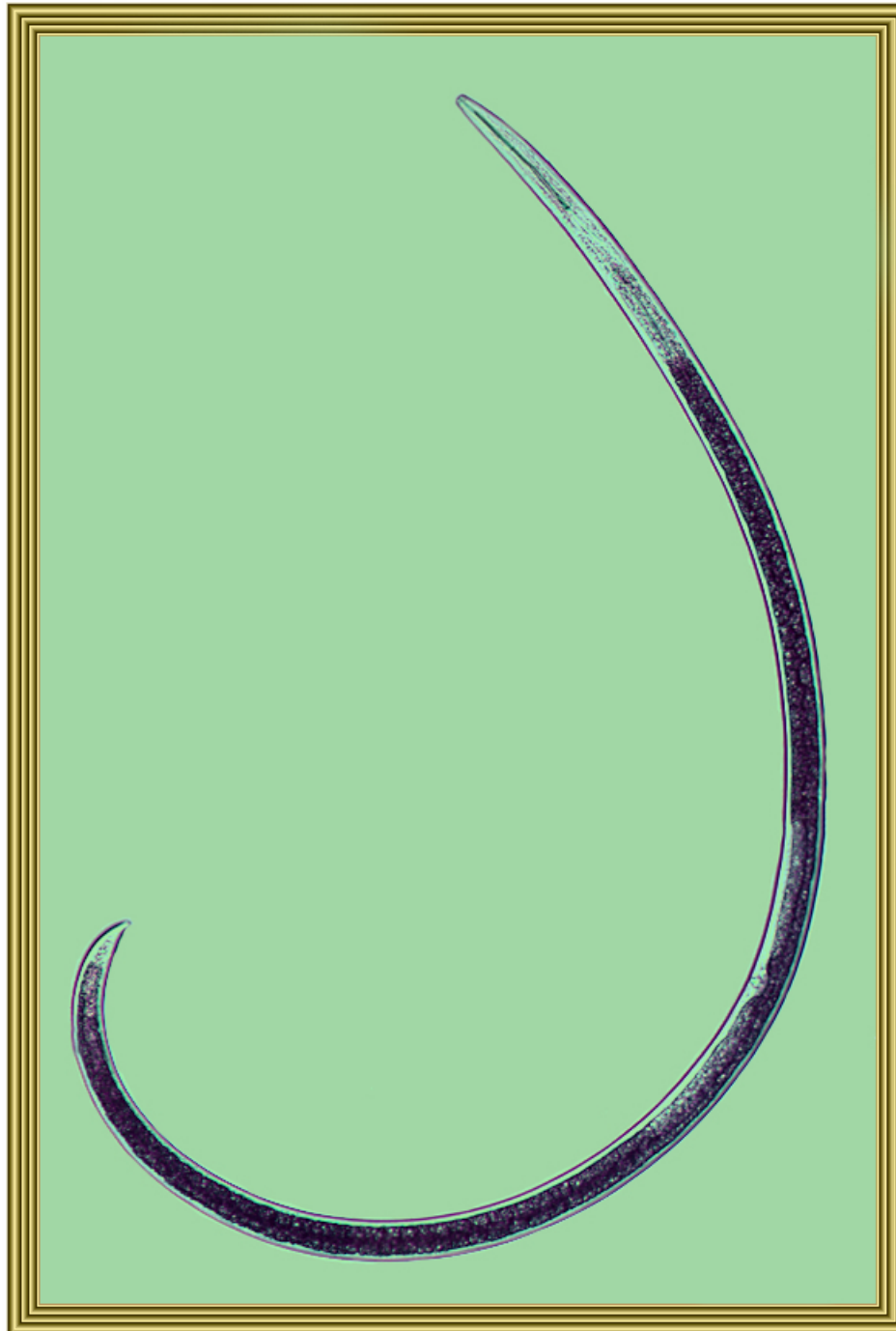
• CLASS •
Adenophorea

• ORDER •
Dorylaimida

• FAMILY •
Longidoridae

• GENUS & SPECIES •
Xiphinema americanum

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Long and thin body
- Sluggish movement
- Long and thin stylet
- Stylet with extension
- Extension with three flanges
- Guide ring posterior
- Procorpus narrow
- Corpus wide
- Esophagus not overlapping
- Vulva midbody
- Two ovaries
- Tail conical and dagger-like

DISTRIBUTION AND HOSTS

- Widely distributed in the USA in agricultural and forest soils
- Maize
- Soybean
- Strawberry
- Cherry, peach, apple
- Raspberry
- Sugarcane
- Wheat
- Grape
- Sycamore, pine, oak, spruce, etc.

IMPORTANT KEYS TO SPECIES

Lamberti, F., and M. Carone. 1991. A dichotomous key for the identification of species of *Xiphinema* (Nematoda: Dorylaimida) with the *X. americanum*-group. *Nematologica Mediterranea* 19:341-348.

Loof, P.A.A., M. Luc, and P. Baujard. 1996. A revised polytomous key for the identification of species of the genus *Xiphinema* Cobb, 1913 (Nematoda: Longidoridae) with exclusion of the *X. americanum*-group: Supplement 2. *Systematic Parasitology* 33:23-29.

Ring Nematode

2

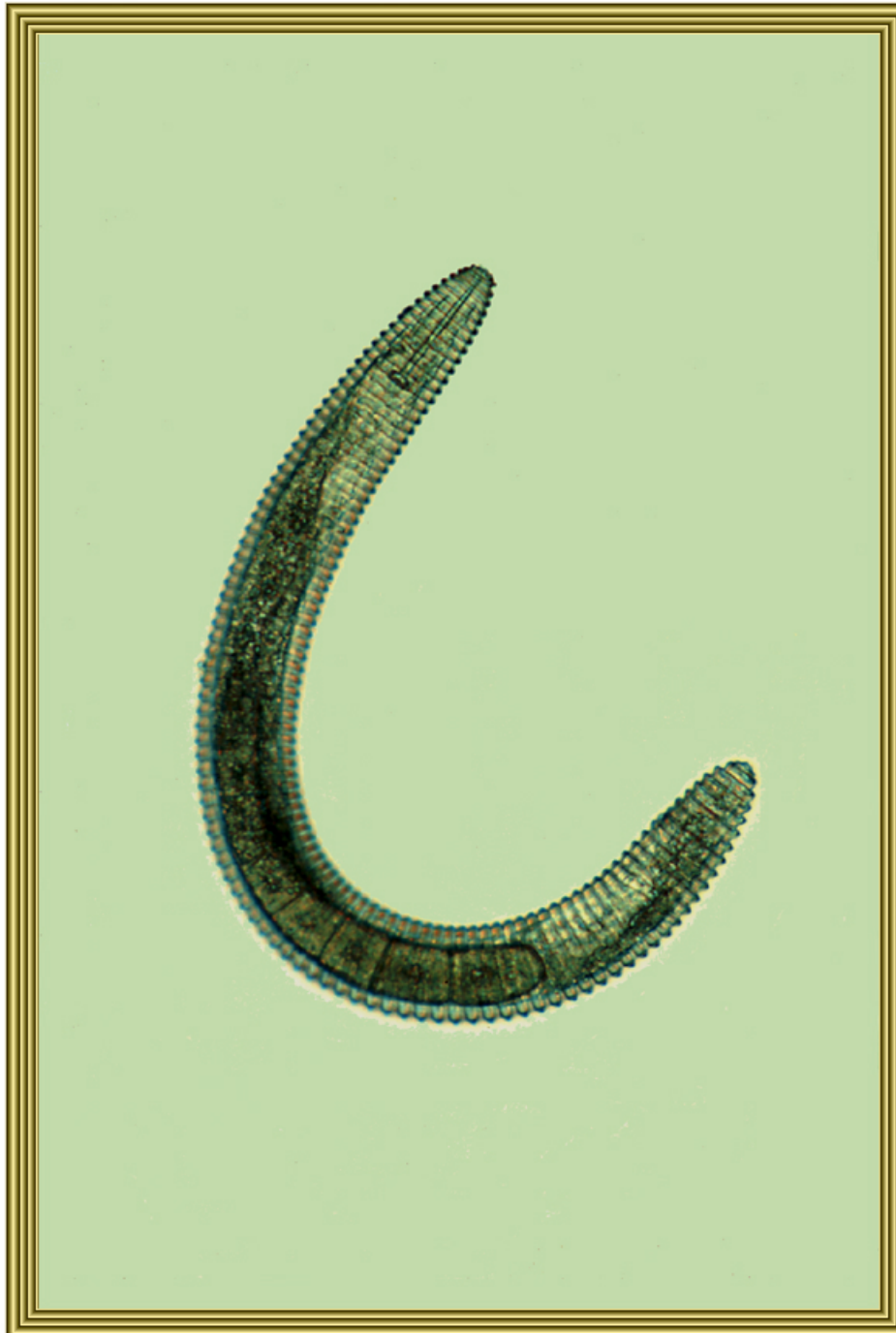
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Criconematoidea

• GENUS & SPECIES •
Mesocriconema xenoplax

• GROUP 4 •
Ectoparasitēs



KEY FEATURES

- Body short and stout
- Very sluggish movement
- Deep annulations
- Annulation edges smooth
- Stylet long and thick
- Anchor shaped knobs
- Procorpus fused with metacarpus
- Vulva near tail tip
- One ovary
- Males very rare

DISTRIBUTION AND HOSTS

- Widely distributed
- Woody plants
- Turf grasses
- Peach
- Grape
- Apple
- Plum
- Walnut
- Cherry
- Almond
- Pine
- Maple
- Lettuce

IMPORTANT KEYS TO SPECIES

Loof, P.A.A., and A. DeGrise. 1989. Taxonomic and nomenclatorial observation of the genus *Criconemella* DeGrise & Loof, 1965 sensu Luc & Raski (Criconematidae). Meded. Fac. Landbouww. Rij. Gent 54:53-74.

Luc, M., and D.J. Raski. 1981. Status of the genera *Macropostonia*, *Criconemoides*, *Criconemella*, and *Xenocriconemella* (Criconematidae: Nematoda). Revue de Ném. 4:3-21.

Awl Nematode

3

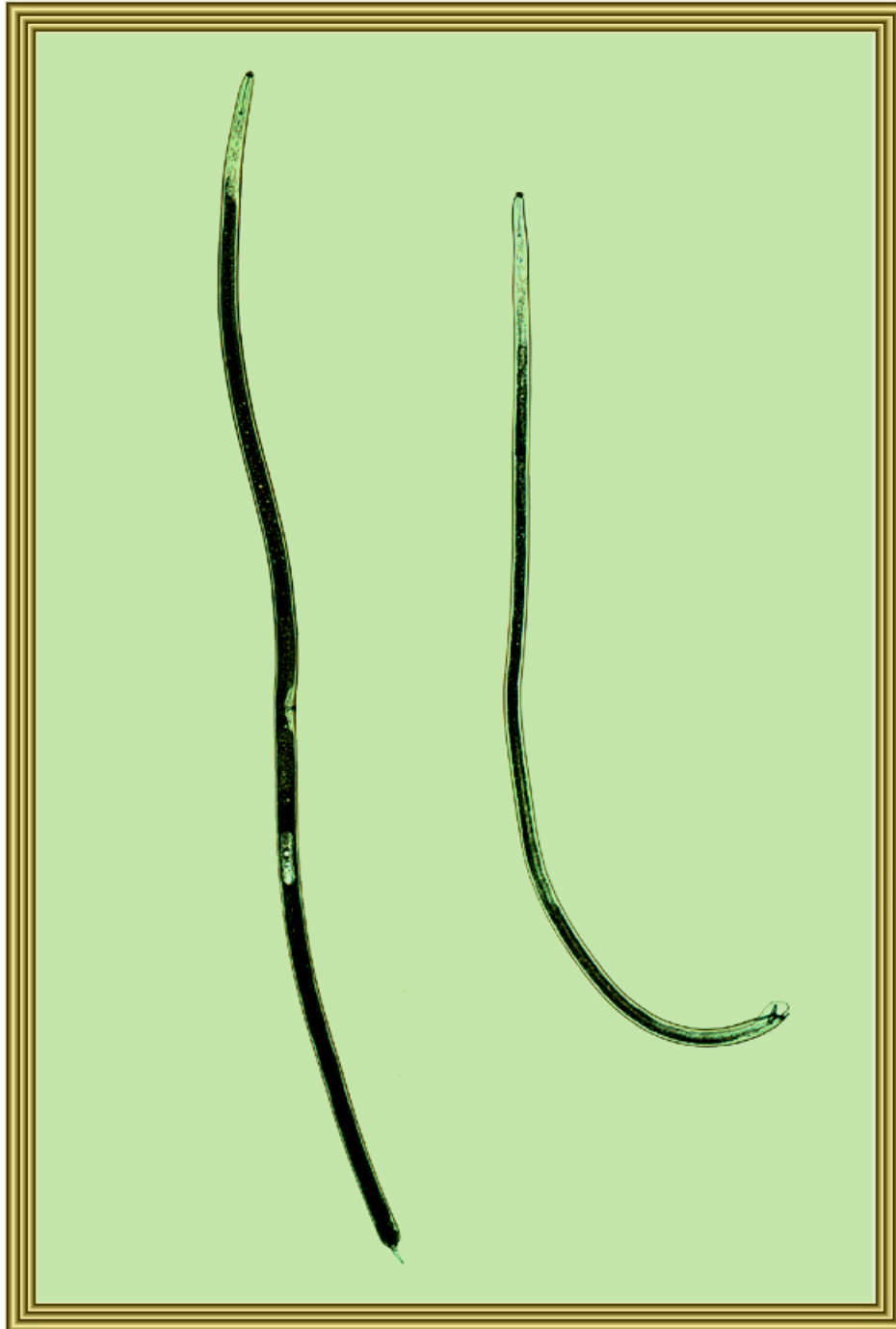
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Dolichodoridae

• GENUS & SPECIES •
Dolichodorus heterocephalus

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Long and thin body
- Head region rounded and distinctly set-off
- Stylet long and thin with well-developed knobs
- Procorpus swollen
- Median bulb large
- Esophagus does not overlap the intestine
- Vulva near midbody
- Two ovaries
- Tail rounded with long and pointed tip
- Males with large bursae

DISTRIBUTION AND HOSTS

- Eastern USA, especially Florida
- Sweet corn
- Water chestnut
- Celery
- Bean
- Tomato
- Pepper
- Turfgrasses

IMPORTANT KEYS TO SPECIES

Smart, G.C., Jr., and N.B. Khoung. 1985. *Dolichodorus miradvulvus* n. sp. (Nematoda: Tylenchida) with a key to species. *Journal of Nematology* 17:29-37.

Lewis, S.A., and A.M. Golden. 1981. Description and SEM observations of *Dolichodorus marylandicus* n. sp. with a key to species of *Dolichodorus*. *Journal of Nematology* 13:128-134.

Spiral Nematode

4

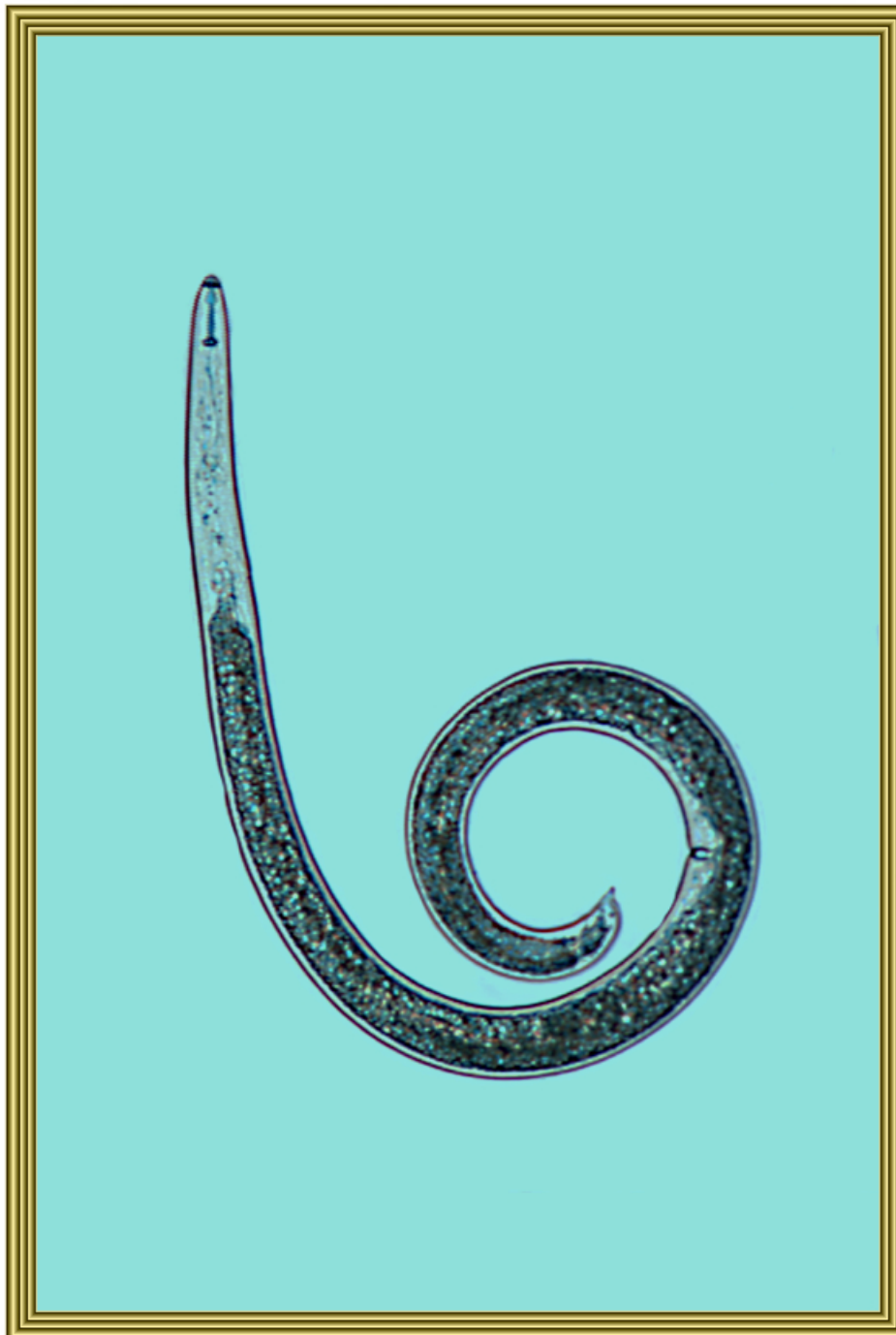
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Hoplolaimidae

• GENUS & SPECIES •
Helicotylenchus dihystera

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Moderately long body, cylindrical
- Spiral shaped when relaxed or cold
- Head region conical, framework weak
- Strong, short to moderately long stylet
- Vulva near midbody
- Two ovaries
- Tail usually offset, often with a small projection
- Males are rare

DISTRIBUTION AND HOSTS

- Widely distributed, almost cosmopolitan
- Wide host range
- Sugarcane
- Banana
- Potato
- Rice
- Tea
- Maize
- Coffee
- Bean
- Turfgrasses
- Soybean
- Wheat

IMPORTANT KEYS TO SPECIES

Firoza, K., and M.A. Maqbool. 1994. A diagnostic compendium of the genus *Helicotylenchus* Steiner, 1945 (Nematoda: Hoplolaimidae). *Pakistan Journal of Nematology* 12:11-50.

Fotedar, D.N., and V. Kaul. 1985. A revised key to the species of the genus *Helicotylenchus* Steiner, 1945 (Nematoda: Rotylenchoidinae). *Indian Journal of Nematology* 15:138-147.

Lance Nematode

5

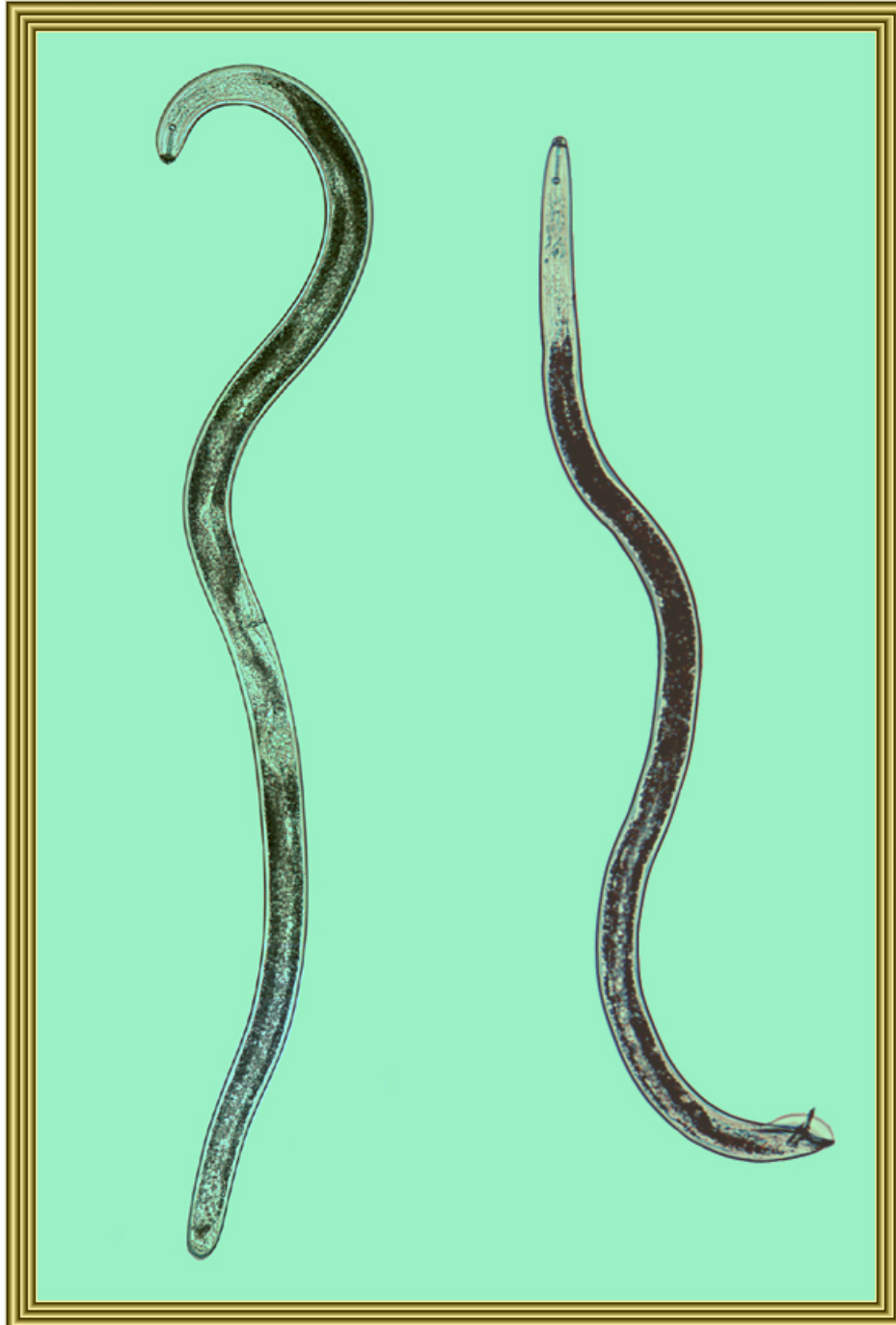
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Hoplolaimidae

• GENUS & SPECIES •
Hoplolaimus galeatus

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Very long and thick
- Robust stylet with anchor shaped knobs
- Sluggish movement
- Set-off head cap
- Esophagus overlaps intestine dorsally
- Short, rounded tail in females and juveniles
- Pointed tail in male with small bursae

DISTRIBUTION AND HOSTS

- USA
- Woody and graminaceous plants
- Turfgrasses
- Cotton
- Pine
- Sugarcane
- Alfalfa
- Clover
- Soybean
- Peach
- Wheat

IMPORTANT KEYS TO SPECIES

Handoo, Z.A., and A.M. Golden. 1992. A key and diagnostic compendium to the species of the genus *Hoplolaimus* Daday, 1905 (Nematoda: Hoplolaimidae). *J. Nematology* 15:45-53.

Sher, S.A. 1963. Revision of the Hoplolaiminae (Nematoda). II. *Hoplolaimus* Daday, 1905 and *Aorolaimus* n. gen. *Nematologica* 9:267-295.

Pin Nematode

6

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Paratylenchidae

• GENUS & SPECIES •
Paratylenchus sp.

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Very small body
- Long, thin stylet
- Procorpus and metacarpus fused
- Metacarpus lining distinct
- Esophagus does not overlap intestine
- Vulva located posteriorly
- Body diameter reduced posterior to vulva
- Tail curved, tapered to a point
- Males often common

DISTRIBUTION AND HOSTS

- Eastern USA
- Canada
- Europe
- Russia
- New Zealand
- Turfgrasses
- Alfalfa
- Celery
- Azalea
- Clover
- Pine and oak trees
- Rose
- Strawberry
- Onion

IMPORTANT KEYS TO SPECIES

Esser, R.P., 1992. A diagnostic compendium to species included in Paratylenchinae Thorne, 1949 and Tylenchocriconematinae Raski & Siddiqui, 1975 (Nematoda:Criconematoidea). *Nematologica* 38:146-163.

Geraert, E. 1965. The genus *Paratylenchus*. *Nematologica* 11:301-334.

Pin Nematode

7

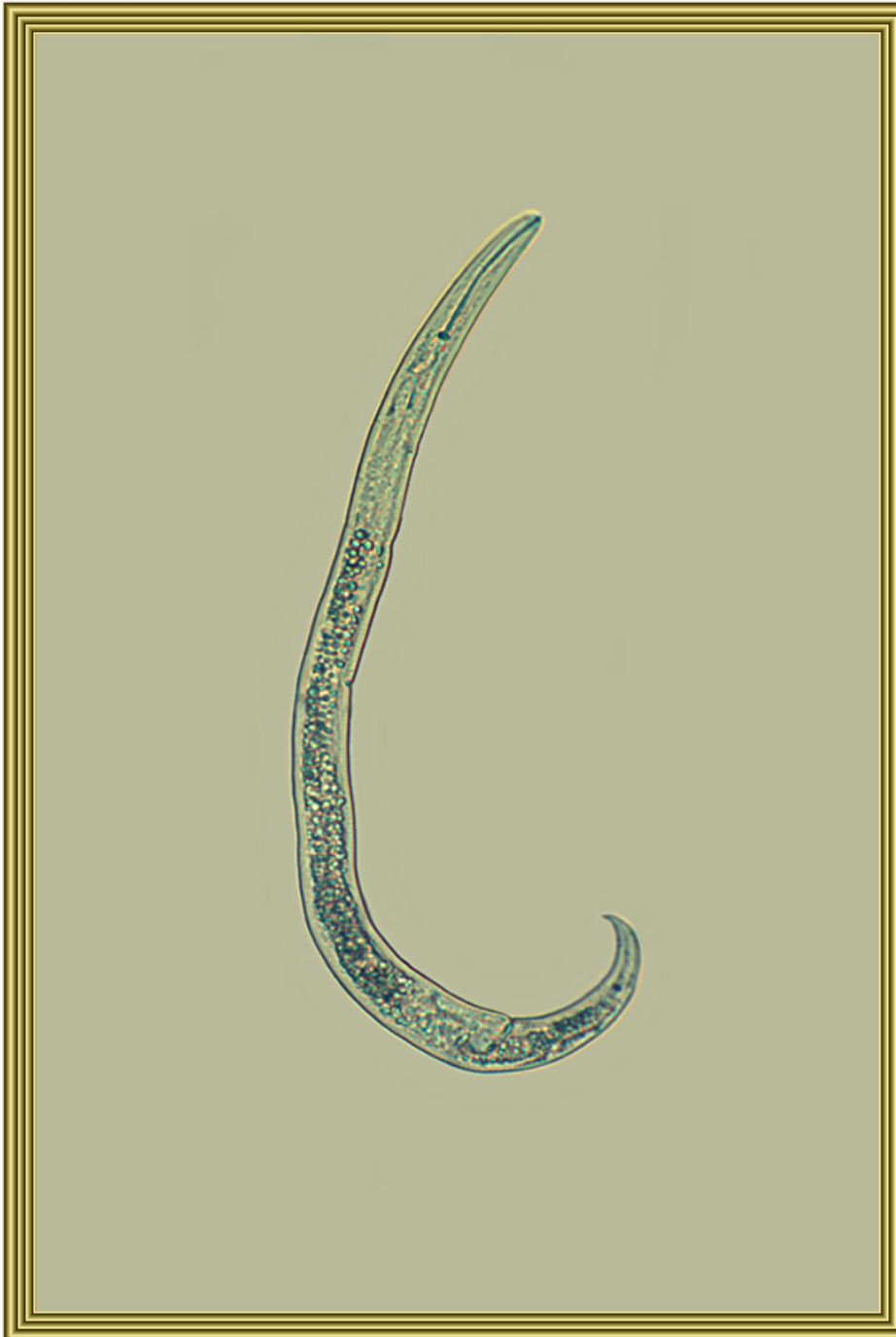
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Paratylenchidae

• GENUS & SPECIES •
Gracilacus sp.

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Very small body
- Long, thin stylet
- Procorpus and metacarpus fused
- Metacarpus lining distinct
- Esophagus does not overlap intestine
- Vulva located posteriorly
- Body diameter reduced posterior to vulva
- Tail curved, tapered to a point
- Males often common

DISTRIBUTION AND HOSTS

- Eastern USA
- Canada
- Europe
- Russia
- New Zealand
- Turfgrasses
- Alfalfa
- Celery
- Azalea
- Clover
- Pine and oak trees
- Rose
- Strawberry
- Onion

IMPORTANT KEYS TO SPECIES

Esser, R.P., 1992. A diagnostic compendium to species included in Paratylenchinae Thorne, 1949 and Tylenchocriconematinae Raski & Siddiqui, 1975 (Nematoda:Criconematoidea). *Nematologica* 38:146-163.

Geraert, E. 1965. The genus *Paratylenchus*. *Nematologica* 11:301-334.

Stubby Root Nematode

8

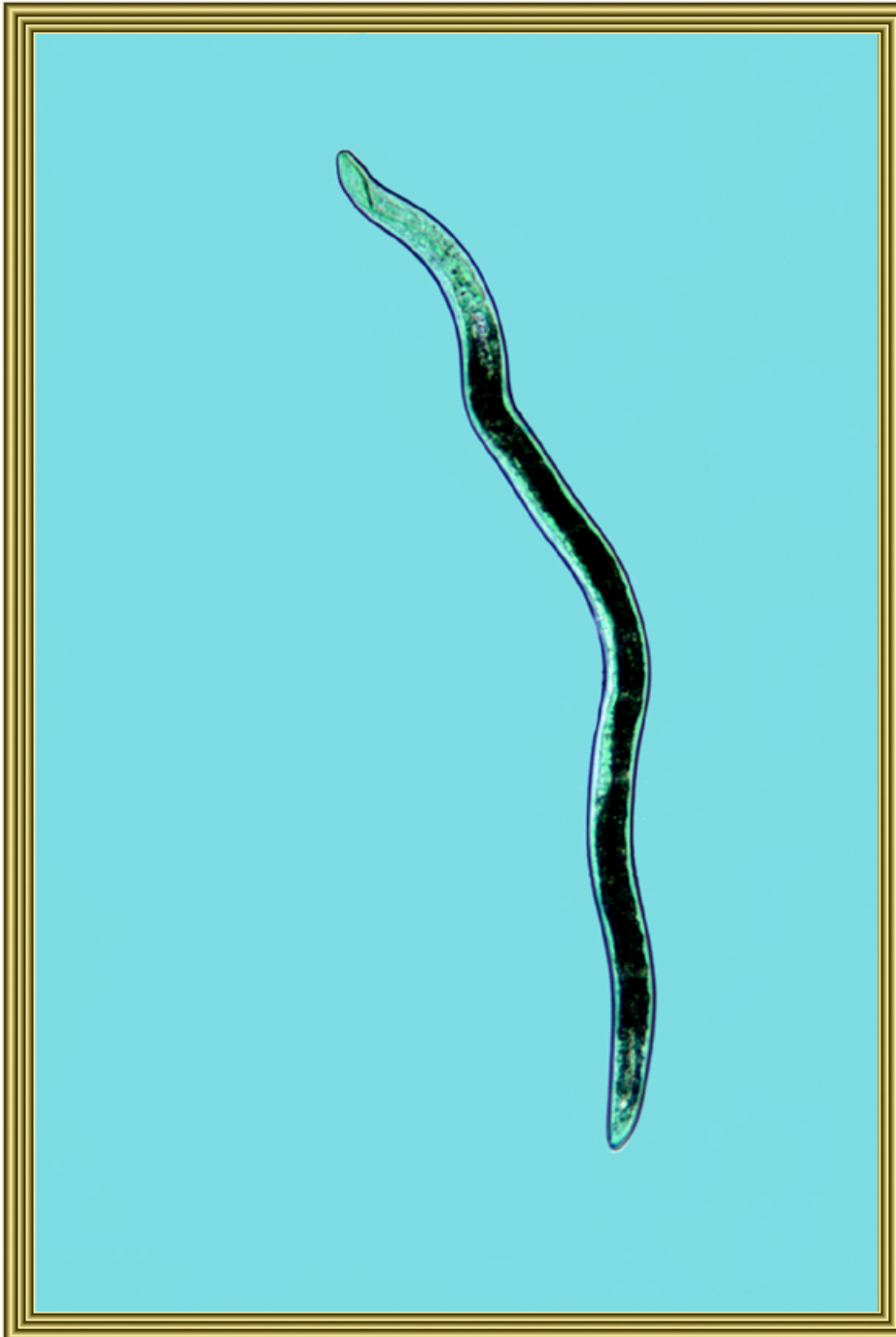
• CLASS •
Adenophorea

• ORDER •
Triplonchida

• FAMILY •
Trichodoridae

• GENUS & SPECIES •
Paratrichodorus minor

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Medium to thick body, cigar-shaped
- Stylet distinctly curved dorsally
- Knobs absent
- Esophagus not overlapping intestine
- Vulva near midbody
- Head and tail bluntly rounded
- Tail short
- Cuticle thick, often doubled
- Males rare

DISTRIBUTION AND HOSTS

- Occurs mainly in warmer soils
- Turfgrasses
- Pasture grasses
- Sugarcane
- Maize
- Strawberry
- Tomato
- Banana
- Tobacco
- Clover
- Potato
- Rice

IMPORTANT KEYS TO SPECIES

Decraemer, W. 1980. Systematics of the Trichodoridae (Nematoda) with keys to their species. *Revue de Nématologie* 3:81-99.

Loof, P. A. A. 1974. Taxonomy of Trichodoridae. Pp. 103-127, in, F. Lamberti, C. E. Taylor and J. W. Seinhorst, eds. *Nematode Vectors of Plant Viruses*. Plenum Press, New York.

Needle Nematode

9

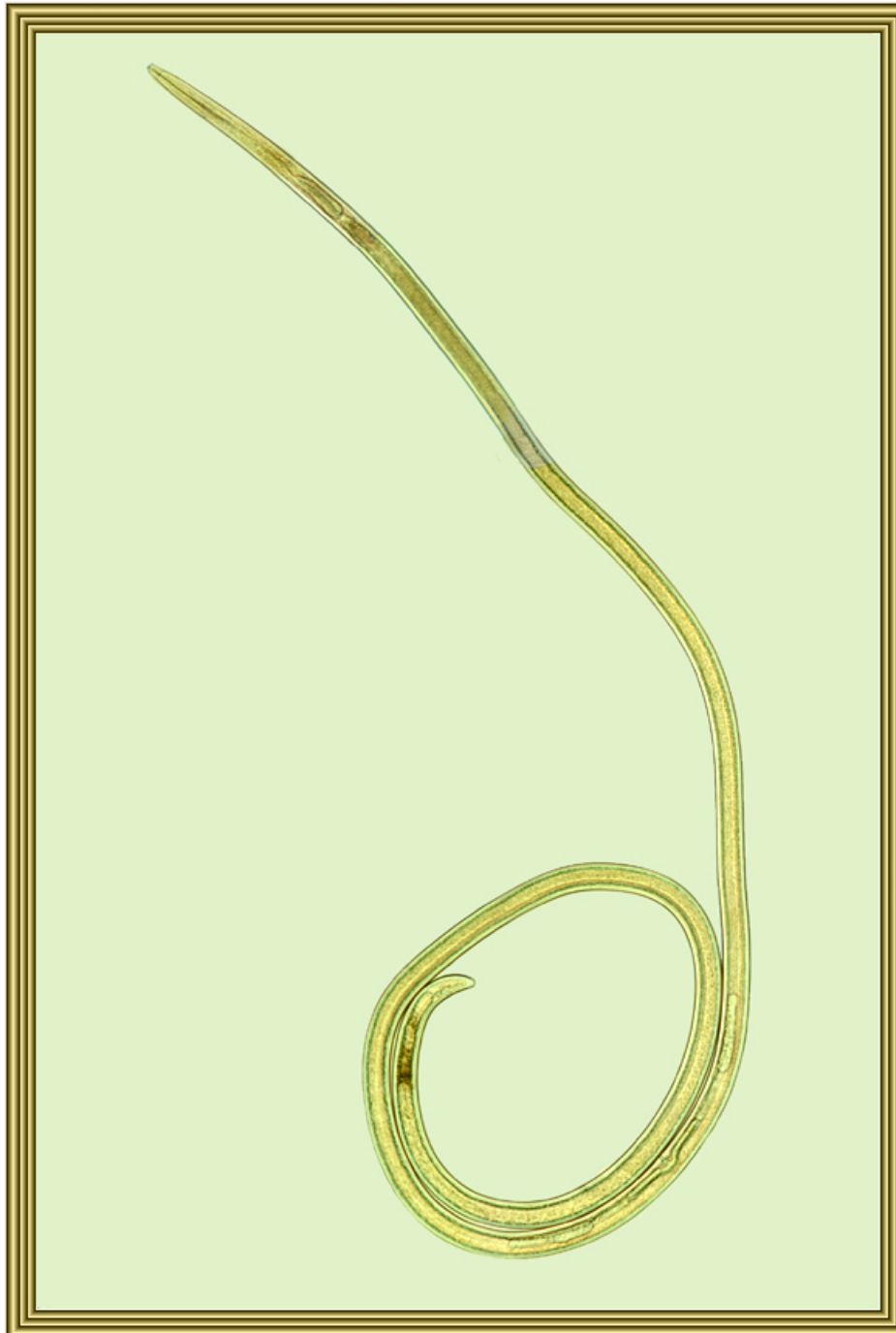
• CLASS •
Adenophorea

• ORDER •
Dorylaimida

• FAMILY •
Longidoridae

• GENUS & SPECIES •
Longidorus elongatus

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Very, very long and thin
- Stylet very long, flanges absent
- Guiding ring near lip region
- Dorylamoid type of esophagus
- Vulva posterior to mid-body
- Two ovaries, short and reflexed
- Tail short, conical
- Males rare

DISTRIBUTION AND HOSTS

- Widespread in temperate areas and sandy soils
- USA
- Europe
- Russia
- Greece
- India
- South Africa
- Numerous herbacious annuals and perennial crops
- Strawberry
- Peppermint
- Sugarbeet
- Rye grass

IMPORTANT KEYS TO SPECIES

Arias, M., and M. A. Bravo. 1997. Identification of genera and species in the subfamily Longidoridae. Pp. 127-176 in *An introduction to virus vector nematodes and their associated viruses*. M. S. Santos, I. M. Abrantes, D. J. Brown, and R. M. Lemos, eds. Instituto do Ambiente e Vida; Coimbra, Portugal.

Stunt Nematode

10

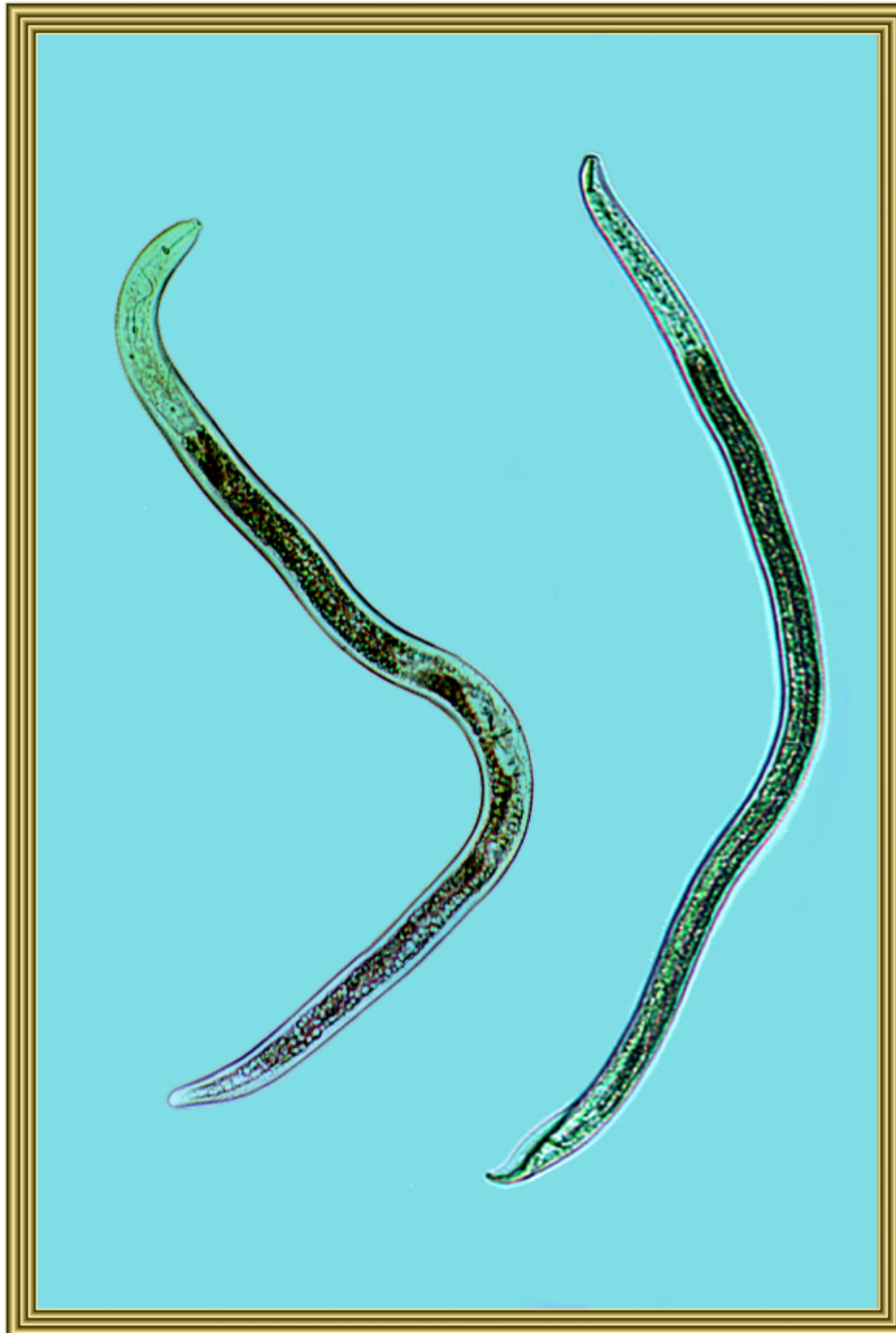
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Tylenchidae

• GENUS & SPECIES •
Tylenchorhynchus claytoni

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Moderate length and width
- Short, moderately strong stylet
- Esophagus does not overlap intestine
- Lip region weakly developed
- Vulva near midbody
- Two ovaries; uteri often clear and elongate
- Tail conical
- Males common
- Mail tail pointed; small bursae

DISTRIBUTION AND HOSTS

- Widely distributed in eastern USA
- Turfgrasses
- Potato
- Maize
- Red maple
- Poplar
- Wheat
- Oats
- Tobacco

IMPORTANT KEYS TO SPECIES

Brzeski, M.W., and C.M. Dolinski. 1998. Compendium of the genus *Tylenchorhynchus* Cobb, 1913 sensu lato (Nematoda: Belonolaimidae). *Russian J. Nematology* 6:189-199.

Fortuner, R., and M. Luc. 1987. A reappraisal of Tylenchina (Nemata). 6. The family Belonolaimidae Whitehead, 1969. *Revue de Nématologie* 10:183-202.

Sheath Nematode

11

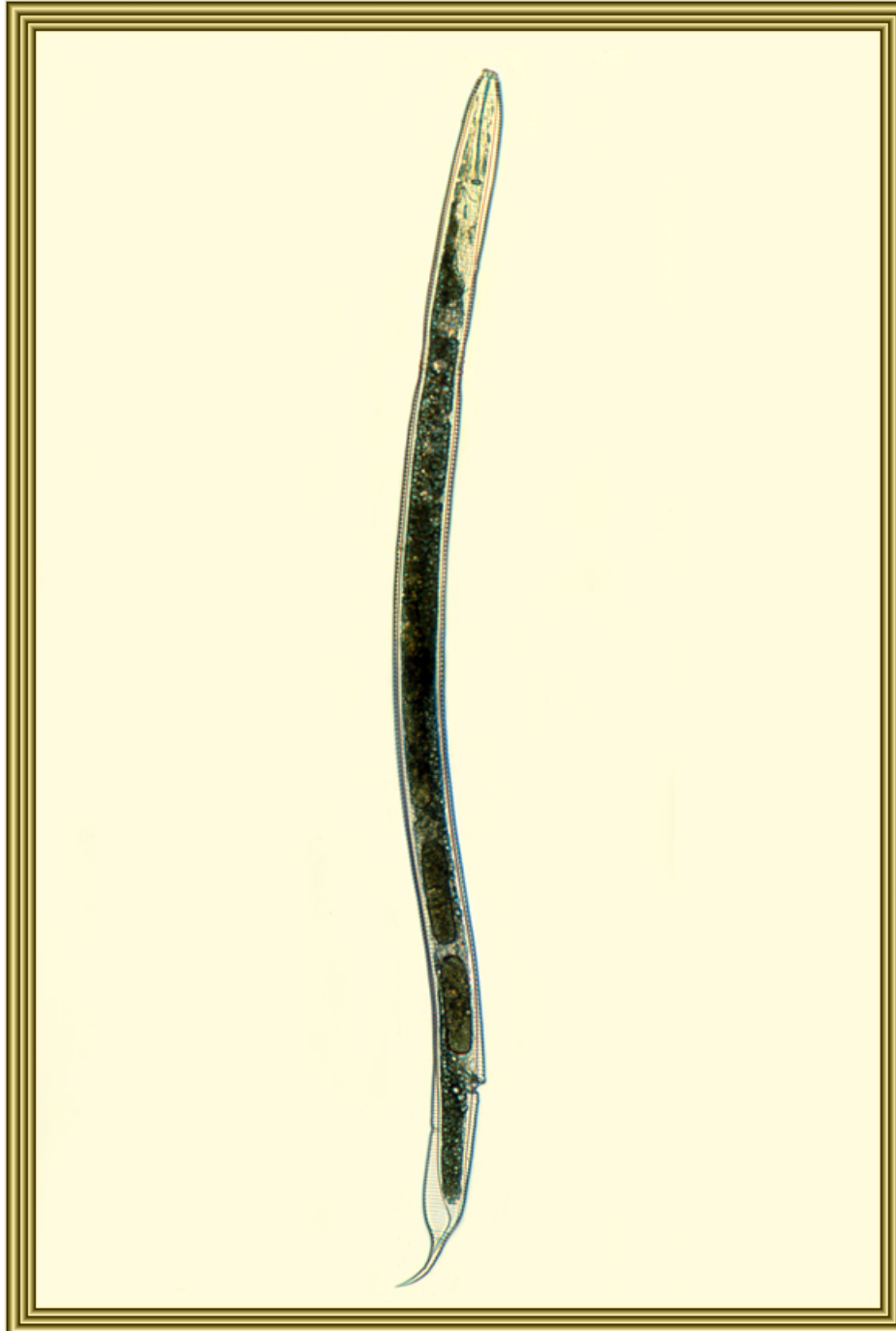
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Hemicycliophoridae

• GENUS & SPECIES •
Hemicyclophora spp.

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Moderately long, thick body
- Heavy annulations
- Enclosed in a sheath, head and tail may be withdrawn into cuticle
- Stylet long, strong and slightly curved
- Procorpus fused with metacorpus
- Tails of females pointed
- Males have small bursae

DISTRIBUTION AND HOSTS

- Widely distributed around the world
- Maple
- Willow
- Pine
- Cranberry
- Blueberry
- Maize
- Grasses

IMPORTANT KEYS TO SPECIES

Siddiqi, M.R. 1980. Taxonomy of the plant nematode superfamily Hemicycliophoroidea, with a proposal for Criconematina, a new suborder. *Revue de Nématologie* 3:179-199.

Brezski, M.W. 1974. Taxonomy of *Hemicyclophora* (Nematoda, Tylenchida). *Zeszyty Problemowe Postepow Nauk Rolniczych* 154:237-330.

Spiral Nematode

12

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Hoplolaimidae

• GENUS & SPECIES •
Rotylenchus buxophilous

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Small to medium long body
- Strong, short stylet with strong knobs
- Esophagus overlaps intestine dorsally
- Vulva near midbody
- Two ovaries
- Tail conical
- Movement sluggish
- Coils to a spiral when relaxed
- Males are rare

DISTRIBUTION AND HOSTS

- USA
- Spain
- Austria
- Poland
- India
- Bulgaria
- Taiwan
- English boxwood
- Lima bean
- Strawberry
- Sugarcane
- Tomato
- Rye

IMPORTANT KEYS TO SPECIES

Geaert, E. and S. Barooti. 1996. Four *Rotylenchus* from Iran, with a key to the species. *Nematologica* 42:503-520.

Boag, B. and D.J. Hooper. 1981. *Rotylenchus ouensis* n.sp. (Nematoda: Hoplolaimidae) from the British Isles. *Systematic Parasitology* 3:119-125.

Sting Nematode

13

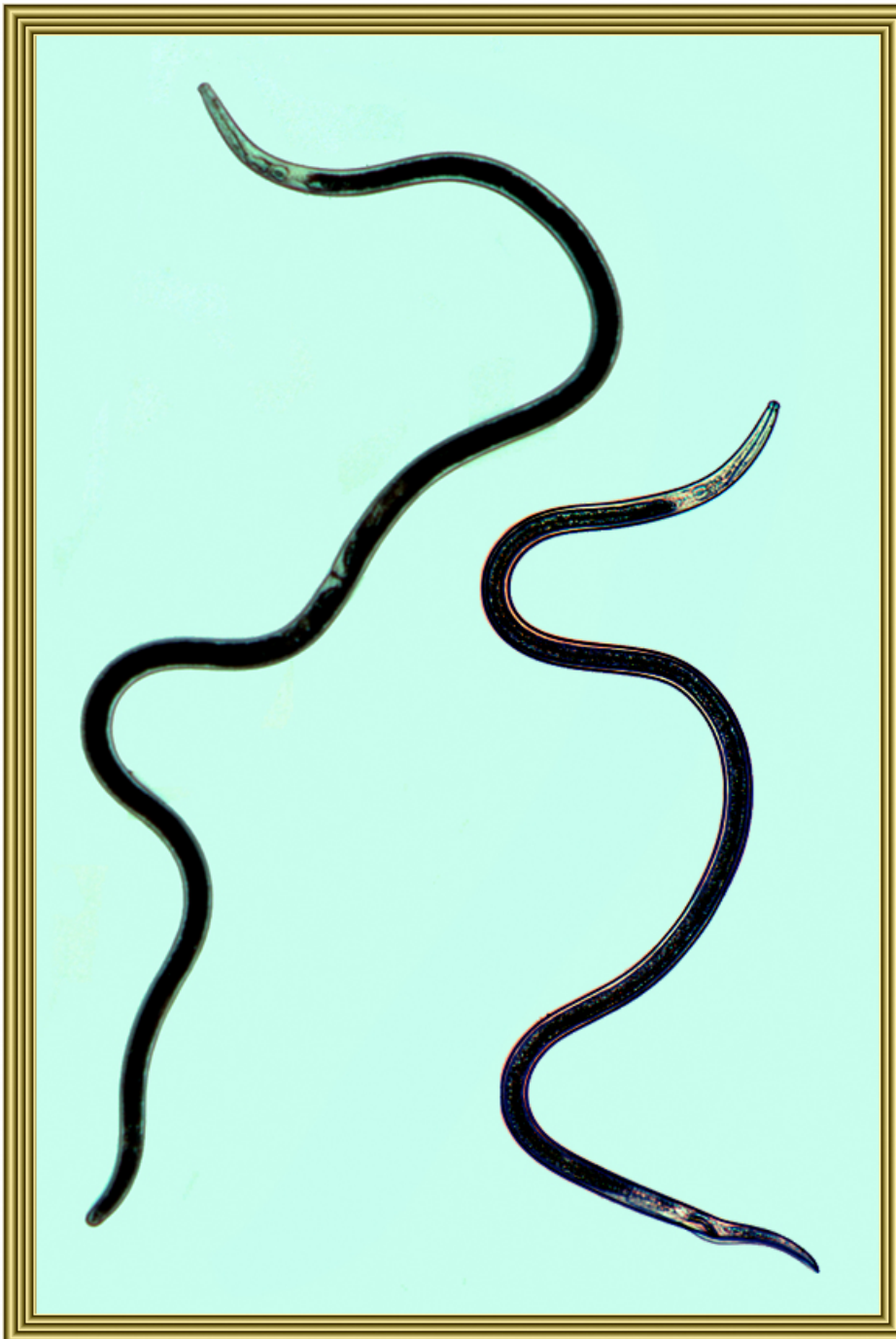
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Belonolaimidae

• GENUS & SPECIES •
Belonolaimus longicaudatus

• GROUP 4 •
Ectoparasites



KEY FEATURES

- Long and slender body
- Moderately active
- Rounded head region, distinctly set off from body
- Stylet long and thin with small rounded knobs
- Esophagus overlaps intestine dorsally
- Vulva near mid-body
- Two ovaries
- Tail rounded
- Males common

DISTRIBUTION AND HOSTS

- Widespread in south eastern USA
- Turfgrasses
- Cotton
- Soybean
- Maize
- Cowpea
- Peanut
- Cantaloupe
- Loblolly pine
- Red maple
- Strawberry
- Tomato
- Grapefruit

IMPORTANT KEYS TO SPECIES

Smart, Jr., G. C., and K. B. Nguyen. 1991. Sting and awl nematodes, *Belonolaimus* spp. and *Dolichodorus* spp. Pp. 627-667, in, W. R. Nickle, ed. Manual of Agricultural Nematology. Marcell Dekker, Inc., New York.

Rau, G.J. 1963. Three new species of *Belonolaimus* (Nematoda: Tylenchida) with additional data on *B. longicaudatus* and *B. gracilis*. Proc. Helm. Soc. Washington 30:119-128.

Stem and Bulb Nematode

1

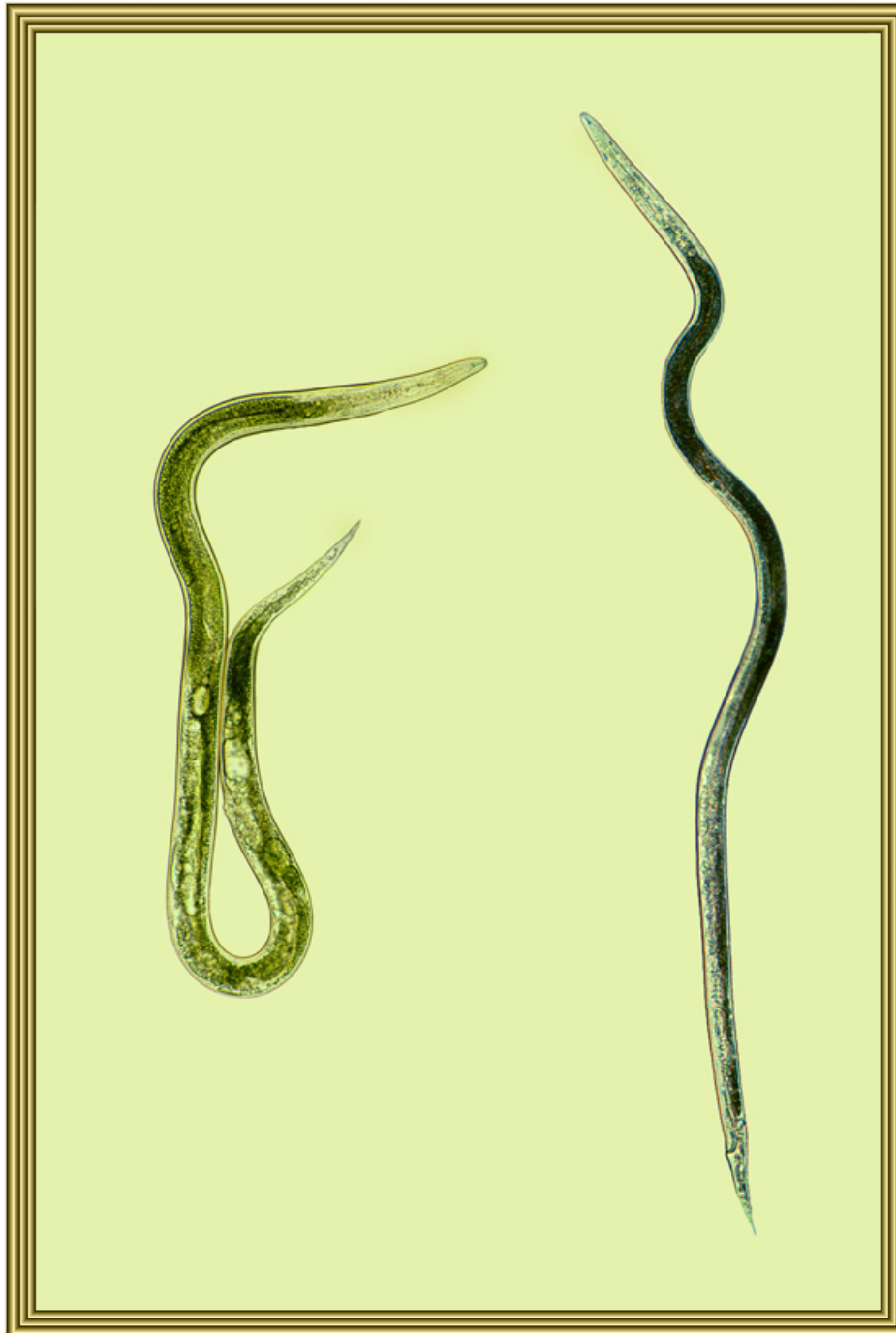
• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Anguinidae

• GENUS & SPECIES •
Ditylenchus dipsaci

• GROUP 5 •
Above Ground Parasites



KEY FEATURES

- Moderately long and wide body
- Short, thin stylet with distinct knobs
- Esophagus slightly overlaps intestine
- Post-vulval uterine sac distinct
- Female tail conoid, sharply pointed
- Male tail sharply pointed
- Small bursa present
- Anterior ends of spicules are curled

DISTRIBUTION AND HOSTS

- Widely distributed in temperate climates
- Daffodil, narcissus, tulip, hyacinth
- Onion, garlic, leek
- Beet, carrot, turnip
- Rye, oats, maize
- Pea, bean, potato
- Clover
- Strawberry
- Tobacco
- Hydrangea
- Phlox

IMPORTANT KEYS TO SPECIES

Brzeski, M.W. 1991. Review of the genus *Ditylenchus* Filipjev, 1936 (Nematoda: Anguinidae). *Revue de Nématologie* 14:9-59.

Wheat Gall Nematode

2

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Anguinidae

• GENUS & SPECIES •
Anguina tritici

• GROUP 5 •
Above Ground Parasites



KEY FEATURES

- Very long and wide body
- Female body obese, spirally coiled when heat relaxed
- Stylet short and thin
- Tail conoid, tapered to an obtuse or rounded tip
- Anterior branch of ovary with two or more flexures
- Simple posterior uterine sac
- Small bursa

DISTRIBUTION AND HOSTS

- All wheat growing areas of the world
- Extinct or rare in the developed world
- India
- Ethiopia
- Romania
- Syria
- Yugoslavia
- Wheat
- Rye

IMPORTANT KEYS TO SPECIES

Chizhov, V.N., and S.A. Subbotin. 1990. Phytoparasitic nematodes of the subfamily Anguininae (Nematoda: Anguinidae). *Revue de Nématologie* 14:9-59.

Foliar Nematode

3

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Aphelenchida

• GENUS & SPECIES •
Aphelenchoides ritzemabosi

• GROUP 5 •
Ectoparasites



KEY FEATURES

- Slender and moderately long
- Short, weak stylet with very small knobs
- Esophagus overlaps intestine dorsally
- One ovary
- Vulva near posterior end of body
- An elongate post-vulvar uterine sac
- Tail conical, tapering to a blunt tip
- Male tail curved ventrally

DISTRIBUTION AND HOSTS

- USA
- Europe
- Russia
- South Africa
- Brazil
- Numerous hosts
- Strawberry
- Chrysanthemum
- Ornamentals
- Small fruits
- Flowers
- Tobacco
- Azalea

IMPORTANT KEYS TO SPECIES

Hunt, D.J. 1993. Aphelenchida, Longidoridae and Trichodoridae: Their systematics and bionomics. CAB International: Wallingford, U.K.

Sanwal, K.C. 1961. A key to the species of *Aphelenchoides* Fischer, 1864. Canadian Journal of Zoology 39:143-148.

Pinewood Nematode

4

• CLASS •
Secernentea

• ORDER •
Tylenchida

• FAMILY •
Aphelenchida

• GENUS & SPECIES •
Bursaphelenchus xylophilus

• GROUP 5 •
Ectoparasites



KEY FEATURES

- Head region set off
- Moderately long
- Short, weak stylet; knobs small
- Esophagus overlaps intestine dorsally
- One ovary
- Vulva posterior, covered by a large flap
- Post vulvar uterine sac very long
- Spicule large, arcuate; prominent transverse bar

DISTRIBUTION AND HOSTS

- USA
- Japan
- China
- Taiwan
- Portugal
- Japanese red pine
- Japanese black pine
- Scotch pine
- Red pine
- Loblolly pine
- Slash pine
- Sand pine
- Maritime pine

IMPORTANT KEYS TO SPECIES

Yin, K.Y., Y. Fang and A.C. Tarjan. 1988. A key to species in the genus *Bursaphelenchus* with a description of *Bursaphelenchus hunanensis* sp. n. (Nematoda: Aphelenchoidae) found in pine wood in Hunan Province, China. *Proc. Helminth. Soc. Wash.* 55:1-11.

Tarjan, A.C. and C.B. Argon. 1982. An analysis of the genus *Bursaphelenchus* Fuchs, 1937. *Nematropica* 12:121-144.