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# Systematic Collections of the Agricultural Research Service

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## Abstract

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The survival of humanity and the other organisms with which we share this planet depends on a detailed knowledge of numerous plant and animal species, varieties, breeds, cultivars, or strains exploited for food or fiber. This knowledge requires well-organized collections of reference specimens, which can be stored and retrieved as sources of information. Many such collections are included in the systematic collections of the Agricultural Research Service (ARS), U.S. Department of Agriculture.

This report describes in detail 12 systematic collections under the care of various ARS laboratories. Information is provided on the purpose, history, location, size, major achievements, and associated research programs and other provided services such as loans or identification of specimens. Many other ARS scientists curate smaller, specialized collections for their own research. Computerized databases have been developed for most of the collections. Information from some of the collections is available on the World Wide Web, and specimen records of some collections can be accessed online.

The audience for this publication includes researchers, teachers, students, and administrators concerned with the study and care of plants and animals and the broad range of living organisms that affect them by affecting the agricultural environment.

**Keywords:** collections, fungi, germplasm, grasses, grasshoppers, herbarium, insects, legumes, nematodes, parasites, potatoes, *Rhizobium*, seeds, species identification, systematics, taxonomy

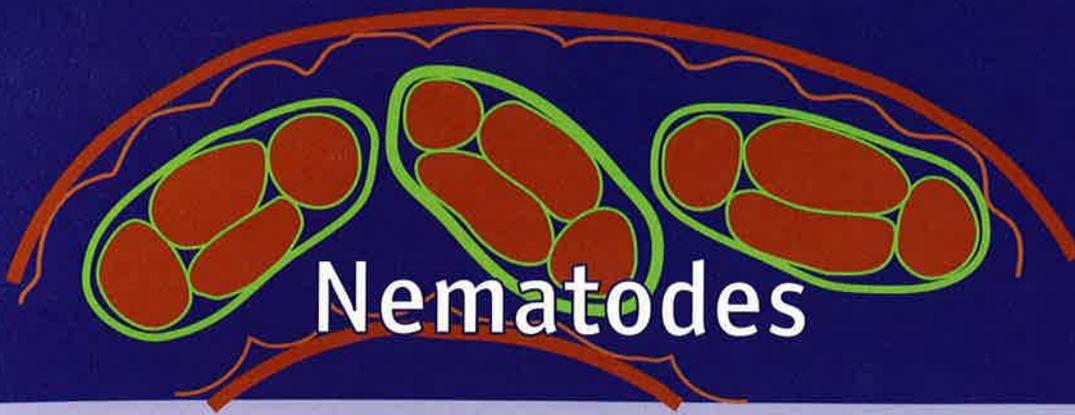
While supplies last, single copies of this publication may be obtained at no cost from the curators of the individual collections (names, phone and fax numbers, and e-mail and mailing addresses provided on the first page of each collection's section in this publication).

Copies of this publication may be purchased from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161; telephone (703) 605-6000.

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Coming soon—A version of this publication will be available on the ARS Information Staff's World Wide Web home page <<http://www.ars.usda.gov/is>>



# Nematodes

## USDA Nematode Collection

By Zafar Ahmad Handoo, A. Morgan Golden, and  
Donna M.S. Ellington

- Location** U.S. Department of Agriculture, Agricultural Research Service,  
Nematology Laboratory, BARC-West, 10300 Baltimore Boulevard, Building 011A,  
Room 159, Beltsville, MD 20705-2350
- Loans** To recognized scientists and institutions
- Associated libraries** 20,000 reprints and volumes
- Number of accessions** 34,000 permanent slides and vials; 19,500 species
- Types** 1,500 species
- Curators** Zafar A. Handoo, A. Morgan Golden, Donna M.S. Ellington  
Phone: (301) 504-6666 • fax: (301) 504-5589  
e-mail: <nematax@asrr.arsusda.gov>
- Home page** <<http://www.barc.usda.gov/psi/nem/tax-page.htm>>

**T**he U.S. Department of Agriculture (USDA) Nematode Collection at Beltsville, MD, is one of the largest and most valuable international resources of information for nematode taxonomic research and identifications. It is widely used by U.S. and foreign scientists to resolve various taxonomic and nomenclatural problems. Identifications of nematode species within some species complexes are possible only through the use of the collection. It also provides substantial data on nematode hosts, occurrence, and distribution on a worldwide basis.

The constituent divisions of the USDA Nematode Collection are as follows:

**Type collection**—for designated types (fig. 17).

**General collection**—for species from many different hosts and areas, especially useful for comparison and reference purposes and variation studies.

**Mass collection**—a reservoir for problematical and undescribed taxa, most of which will be studied and described as groups are revised.

**Demonstration collection**—for exhibits showing symptoms and effects of various kinds of nematodes on a wide range of host plants (fig. 18).

**Gerald Thorne collection**—for slides of important plant and soil species and higher taxa.

**Steiner Mermithid collection**—for slides of nematode (mermithid) parasites of insects, with many original types.

**Sample records division**—for data on all samples and nematodes examined.



Figure 17. Slides in the type collection. All type slides and most others are kept in fireproof safes.

## Background

From 1908 until his death in 1932, N.A. Cobb did extensive taxonomic research on plant, soil, freshwater, and marine nematodes. In 1918, he was joined by G. Steiner, who made major contributions in taxonomy, including insect parasites, until his retirement in 1956. Concurrently, Gerald Thorne joined USDA in Utah and for the next 38 years made major contributions in nematode taxonomy, almost exclusively in plant and soil forms. Other USDA scientists made significant contributions in taxonomy and other areas of nematology in the Washington, DC, area during the 1920's and 1930's, including B.G. Chitwood, J.R. Christie, and A.L. Taylor.

Most of the specimens used by these earlier workers were retained as individual collections within the agency rather than in an organized, unified system. Unfortunately, over the years, many valuable specimens deteriorated and others were misplaced or their records lost. Extant specimens are being salvaged and incorporated into the USDA Nematode Collection. Fortunately, the Gerald Thorne collection, developed by Thorne in Utah between 1918 and 1956, was well organized and well kept, and now forms an important segment of the present collection.

The USDA Nematode Collection was officially established by A. Morgan Golden in 1960, shortly after initiation of the current nematode taxonomy program. The collection is well organized, and records of all specimens are filed according to genus, species, host, and origin. This is an open-ended system and allows ready retrieval of specimens with pertinent data and also has permitted easy conversion to computerization of collection records.

Growth of the collection resulted from a number of factors, including restudy of material of earlier workers; the deposition of type and other specimens by colleagues in the United States and various foreign countries; the gradual, ongoing incorporation of material identified for researchers and other scientists within the United States and abroad; and the personal collecting and unstinting efforts of A.M. Golden since 1956. Although most of the specimens are plant and soil nematodes, some are insect parasites and free-living soil, freshwater, and marine forms. Most specimens, including all types with pertinent records, are kept in fireproof safes (fig. 17).

## Identification Service

The service responsibilities of the Nematology Laboratory are an essential and important part of a diverse research program in nematology. Each year more than 300 samples of nematodes are received, processed, and examined for nematode identifications by ARS scientists, other Federal and state researchers and regulatory agencies, graduate students, and foreign scientists. Nematode samples often include several different genera and species of both plant-parasitic and soil nematodes.

These identifications provide basic support for biological control projects and diverse research, extension, and control activities of Federal and state agencies and other organizations in the U.S. and abroad. This service provides useful information on nematode hosts, occurrence, and distribution and can reveal new or potentially harmful species of nematodes associated with previously unknown agricultural problems, and aids in the development of quarantine or regulatory procedures to prevent their spread. Also, quick and accurate nematode identifications are provided to inspectors from the Animal and Plant Health Inspection Service (APHIS) for the release of shipments of various foreign crops and wood products detained at various ports for the determination of exotic pests.

Each year, on request, the collection provides loans to various U.S. and foreign scientists for use in taxonomic research, identification, and preparation of monographs. Generally, only a few species of a particular group are loaned to an individual or organization at one time, and loans are made for a limited time. These procedures provide maximum use and availability of valuable scientific material.

## Research

The USDA Nematode Collection is the basis for research on systematics, morphology, and identification of soil and plant-parasitic nematodes and serves as a valuable asset for further knowledge or revision of material described earlier. The current staff of the collection (one nematode systematist from the Agricultural Research Service, one support scientist, and one retired volunteer) places major emphasis on taxonomy and identification of economically important plant-parasitic nematodes. New morphometric data and techniques, such as scanning electron microscopy and digitized image analysis measurement systems, are used to characterize and classify any species difficult to identify. Emphasis is placed on the preparation of keys and compendia to major groups of plant-parasitic nematodes to facilitate accurate identification of species.



Figure 18. Exhibits in demonstration collection

## Databases

The computerization of the USDA Nematode Collection has started, and new accessions are being entered into the database. A broad range of data is stored for each accession, including genus, species, host, origin, collector, date collected, and date received. Included in the taxonomic data are generic names, specific and infraspecific names, distribution records, and taxonomic reference citations.

Descriptive data are now kept in Paradox for Windows 7.0. Online access to the Internet is forthcoming.

## Selected Achievements

- |      |   |
|------|---|
| 1949 | Produced first modern classification of root-knot nematodes ( <i>Meloidogyne</i> spp.), providing a sound basis for species identification and development of resistant crop varieties for individual species |
| 1967 | Monographed Sphaerularidae, a family of insect parasitic nematodes  |
| 1967 | Established Encholaimoidea, a new monotypic superfamily phylogenetically linking soil and marine nematodes  |
| 1969 | Identified and described rice root-knot nematode ( <i>Meloidogyne graminicola</i> Golden and Birchfield), a major new pest of rice in several countries   |
| 1970 | Revised Aphelenchoidea, a nematode superfamily containing plant parasites, predators, fungus feeders, and insect parasites  |
| 1971 | Revised order Tylenchida, containing majority of plant nematodes  |
| 1972 | Revised insect parasitic nematode family Mermithidae, presenting new information on life cycles and host ranges   |
| 1974 | Documented first occurrence in United States of oat cyst nematode ( <i>Heterodera avenae</i> Wollenweber), a major world-wide pest of cereals   |
| 1980 | Identified and described for the first time Columbia root-knot nematode ( <i>Meloidogyne chitwoodi</i> Golden et al.), a major new pest of potato in the United States and foreign countries                  |
| 1983 | Monographed Heteroderidae, a family of worldwide economically important cyst-forming nematode genera and species  |
| 1983 | Documented first occurrence in United States of corn cyst nematode ( <i>Heterodera zaeae</i> ), an economically important pest of corn  |
| 1986 | Published a comprehensive book chapter on morphology and identification of cyst nematodes (Heteroderidae) of the world  |

**Selected  
Achievements  
(cont.)**

- 1989 Published key and compendium to the 63 species of the genus *Pratylenchus* (lesion nematodes), an economically important group of plant-parasitic nematodes attacking a wide variety of crops throughout the world
- 1989 and 1992 Published survey results of many kinds of nematodes on a wide variety of economically important crops in Arkansas, Idaho, and eastern Oregon
- 1992 Published key and compendium to economically important group of plant-parasitic nematode genus *Hoplolaimus* (lance nematodes); emended its diagnosis and evaluated the validity of several species of the genus with a list of all valid species
- 1994 Discovered for the first time pea cyst nematode in western Washington, a devastating pest of peas in several countries