1974

Biology of Nematodes in Desert Ecosystems

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IBP

RESEARCH MEMORANDUM

RM 72-12

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DESERT BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

1971 PROGRESS REPORT

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MAY 1972

ABSTRACT

During 1971, nematodes were extracted from soil largely by the Cobb sieving-decanting technique after moistening and incubating soils for a few days to a few weeks. Several hundred permanent slides have been prepared but the bulk of the extracted and fixed nematodes are still being processed. Faunistic lists have been prepared for the Colorado, Mohave and Amargosa deserts, and for ecological niches within these areas. The nematode fauna associated with the rhizospheres of dominant plant species have been characterized and special emphasis made in identifying plant-parasitic species.

INTRODUCTION

The first-year studies of this project have dealt largely with a survey of nematodes present in desert soils, which constitute a fauna of which very little is known at present. Their microscopic size and delicate anatomy present particular problems in their preparation for permanent collections and study, in that the procedures involved are time-consuming and laborious. Nevertheless, substantial progress has been made in developing a collection representative of the Southwestern deserts. Identification of the species collected has been particularly challenging since the bulk of the material is composed of little-studied taxonomic groups.

OBJECTIVES

Research during 1971, the initial year of this study, concentrated mainly on a survey of nematode genera and species associated with desert soils and dominant desert flora. The development of suitable methods for extracting nematodes from desert soils was also a primary consideration.

METHODS

Moistening extremely dry soil samples with a fine spray during collection, and placement in polyethylene bags, was found advantageous for best nematode recovery. Extremely gravelly soils of the Mohave and Colorado Desert sites were coarse-screened at the sampling sites before bagging for subsequent laboratory examination. Rehydration of soils and incubation for several days to a few weeks was adopted as a standard procedure and improved extraction of nematodes from soil. The more laborious Cobb sieving-decanting technique was most successful for recovering nematodes -- probably due to the relatively low numbers of nematodes per unit quantity in most desert soils.

Nematodes extracted from soil samples were fixed routinely in 5% formalin solution and stored as Mass collections for processing to permanent slides by Seinhorst's glycerol-ethanol method (1959). Other methods were occasionally used (Southey, 1970). Several hundred permanent slides of nematodes representative of the faunas of various soils sampled have been prepared to date. Mounted specimens are categorized according to family and genus, geographic area, and dominant plant rhizospheres.

FINDINGS

Rehydration of samples from dry soils and storage (stabilization) for about 3 weeks improved recovery of all types of soil nematodes about two-fold. Nematode numbers rapidly declined in dry soils not processed immediately, and remaining nematodes were often in bad condition (DSCODE A3UMB22).

Most of the faunistic collection is still being processed but dominant genera recovered, categorized by geographic areas most frequently sampled, are given in Tables 1-3. These lists are incomplete but reflect the dominant genera recovered. Microbial-feeding (microbivorous) nematodes are the most numerous types in total numbers of individuals in virtually all soils sampled to date. Preliminary faunistic lists of nematodes associated with rhizospheres of dominant flora and geographic features such as dried lake beds, desert water holes and marshes, dunes, etc., have been prepared but are not included here. Plant-parasitic genera associated with some common plants are given in Table 4.

Identification of specimens collected was mainly limited to assignment to genera, although identification to species was attempted whenever possible. Most of the species observed in desert soil samples represent groups which have hitherto received little attention from nematologists. A great deal of effort was made to acquire the necessary literature for the identification of these populations, and complete listings of the Dorylaimida and Rhabditida have been prepared for use with this project.

Table 1. Faunistic list: Amargosa Desert.

Tylenchida	*Tylenchus* *Ditylenchus* *Tylenchorhynchus* *Aphelenchus* Aphelenchoides *Stictylus* (Neotylenchidae)
Rhabditida	*Acrobeles* Acrobeloides *Cephalobus* *Eucephalobus* *Chiloplacus* *Cervidellus* *Pelodera*
Dorylaimida	*Eudorylaimus* *Melodorylaimus* *Aporcelaimellus* *Tylencholaimus* *Labronema* *Carcharolaimus* *Xiphinema*
Monhysterida	*Prismatolaimus* *Monhystera*
Enoplida	*Mononchus*

Table 2. Faunistic list: Mohave Desert.

Tylenchida	*Ditylenchus* *Pratylenchus* *Tylenchorhynchus* (*cylindricus*) *Hirschmaniella* *Helicotylenchus* (Erythrinae) *Meloidogyne* *Heterodera* *Aphelenchus* (*eremitus*) Aphelenchoides Criconemoides *Paratylenchus* (*hematus*) *Thada* (Neotylenchidae)
Dorylaimida	*Dorylaimus* *Eudorylaimus* *Discolaimus* *Carcharolaimus* *Tylencholaimus* *Longidorella* *Xiphinema* (*americanum*) *Trichodorus*
Enoplida	*Mylonchulus*
Rhabditida	*Acrobeles* Acrobeloides *Cephalobus* *Chiloplacus* *Stagelleta* *Cervidellus* *Placodira* *Panagrolaimus*
Monhysterida	*Monhystera* *Prismatolaimus*
Chromadorida	*Paracyaltholaimus*
Araeolaimida	*Chronogaster*

Table 3. Faunistic list: Colorado Desert.

Tylenchida	*Ditylenchus* *Tylenchorhynchus* *Meloidogyne* *Heterodera* *Aphelenchus* Aphelenchoides *Paratylenchus*
Dorylaimida	*Eudorylaimus* (*monohystera, diminutivus* ...) *Mesodorylaimus* *Discolaimus* *Tylencholaimus proximus* *Carcharolaimus* *Discolaimium* *Dorylaimus*
Enoplida	*Mononchus* *Mylonchulus*
Rhabditida	*Acrobeles* Acrobeloides *Cephalobus* *Eucephalobus* *Cervidellus* Protodiplogestoroides
Monhystera	*Primatolaimus*
Araeolaimida	*Aphanolaimus*

Table 4. Plant-parasitic nematodes associated with major desert plants (Colorado and Mohave Deserts).

Plants	Criconemoides	Helicotylenchus	Heterodera	Meloidogyne	Pratylenchus	Trichodorus	Xiphinema	Tylenchorhynchus	Paratylenchus
Cholla (*Opuntia bigeloria*)			X		X			X	
Creosote Bush (*Larrea divaricata*)			X	X	X			X	X
Desert Senna (*Cassia armata*)					X			X	
Goat Nut (*Simmendsia chinensis*)	X			X				X	
Joshua Tree (*Yucca brevifolia*)		X		X	X		X	X	X
Rabbit Bush (*Chrysothamnus noseosus*)							X		
Smoke Tree (*Dalea spinosa*)		X							
Squaw Bush (*Rhus trilobata*)						X	X	X	X

Tylenchs of doubtful or unconfirmed plant-parasitic habit were not included in this listing.

DISCUSSION

A clearer concept of the nematode fauna of desert soils has been gained and will provide the basis for a further examination of the role of nematodes in soil biology. Now that the fauna has been sufficiently characterized in most cases, an understanding of the role and population dynamics of trophic types can be attempted.

Sophisticated equipment (Oostenbrink elutriator) for nematode extraction arrived late in the year and modifications in its use for better performance with desert soils are being carried out. Readily reproducible extraction methods which allow for quantitative studies are thus hopefully anticipated.

EXPECTATIONS

A complete faunistic profile of representative desert soils from various geographic areas should be accomplished, as well as the range and distribution of important nematode species. Experiments designed to examine the role of nematodes in organic matter decomposition in desert soils and to examine the effects of plant parasitic species on important desert plants are planned and more attention can now be given to trophic groups.

Continued sampling and processing of desert nematode taxa is expected to develop one of the largest arid land collections available. A great deal of time will have to be devoted to taxonomic studies and identification.

LITERATURE CITED

Seinhorst, J. W. 1959. A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. Nematologica 4:67-69.

Southey, J. F. 1970. Laboratory methods for work with plant and soil nematodes. Her Majesty's Stationery Office. London. 148 pp.