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**Plant-parasitic and Free-living Nematodes in Hawaii<sup>1</sup>**

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INTRODUCTION

Investigations of plant-parasitic and soil-inhabiting nematodes in Hawaii have naturally centered on the more important parasites of two major crops, sugar cane and pineapple, but minor parasites, predators, and free-living species have been mentioned in numerous papers by various workers. Cobb's pioneer contributions of 1906 and 1909, issuing from the Experiment Station of the Hawaiian Sugar Planters' Association, stood alone until 1926. Then, during a five-year period, later investigators in the Hawaiian Sugar Planters' Association dealt further with various parasites of sugar cane and with some other forms. Investigations at the Pineapple Experiment Station, beginning in 1926, are still being continued with earlier emphasis on the lethal effects of the physical environment and on measures of direct nematode control. More recently, with increasing recognition of the complexity of problems involved, nematode biology and factors in biological control have been dealt with. Recognition, during this latter phase, of the importance of free-living nematodes in the biological control balance, has directed to these forms more attention than they were earlier accorded.

This paper is an annotated list of species reported from or known to occur in Hawaii, incorporating citations to relevant literature. Included are 56 genera and 85 species of which several genera and 38 species are reported from Hawaii for the first time, being forms encountered by the writer in the course of routine surveys

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and miscellaneous samplings. These nematodes are indicated in the following alphabetical list by asterisks. Synonyms included are those appearing in the literature on local nematodes. It is hoped that this paper will make more readily accessible the information now available concerning plant-parasitic and free-living nematodes in Hawaii.

Grateful acknowledgment for suggestions and assistance in identification is made to Dr. T. Goodey, Institute of Agricultural Parasitology of the London School of Hygiene and Tropical Medicine, and to Dr. G. Steiner, Dr. J. R. Christie, and Mr. Gerald Thorne, Bureau of Plant Industry, United States Department of Agriculture. Particular appreciation is extended to Dr. Christie for his descriptions of Hawaiian species of predaceous *Aphelenchoides* and to Mr. Thorne for identification of members of the Cephalobidae and Dorylaimoidea.

#### ANNOTATED LIST OF SPECIES

- \**Acrobelles ctenocephalus* Thorne, 1925. Molokai and Oahu pineapple fields and sand dune Laie, Oahu; never found in great abundance; most common in weedy, neglected areas; saprophagous.
- \**Acrobelloides butschlii* (de Man, 1884) Steiner and Buhner, 1933. Pineapple area, Wahiawa, Oahu; abundant in weedy areas and where plant trash is decomposing; saprophagous.
- Actinolaimus* Cobb, 1913. Widespread in gardens, forest soils and in wetter pineapple fields; never very abundant; predaceous (41)<sup>2</sup>.
- Actinolaimus elaboratus* (Cobb, 1906) Cassidy, 1930. (Synonym: *Dorylaimus elaboratus* Cobb, 1906). Described by Cobb (7) from soil about diseased cane, Kohala, Hawaii; ectoparasitic, commonly associated with roots of sugar cane and coffee (2). Occurrence in Hawaii noted by Thorne (53).
- \**Alaimus primitivus* de Man, 1880. Waianae Mountains, Oahu; a few individuals in soil from native forest.
- \**Amphidelus dolichurus* (de Man, 1876) Thorne, 1939. Mount Kaala, Oahu; several individuals collected from mountain top bog at 4,030 ft. elevation.
- Anthonema* Cobb, 1906. Manoa, Oahu; few individuals found in a single collection from a vegetable garden.
- Anthonema revoluta* Cobb, 1906. Hilo, Hawaii; described from about roots of diseased sugar cane (7).
- Aphelenchoides* Fischer, 1894. Among the 6 species enumerated, 5 are predaceous in the manner described by Linford (38) and Linford and Oliveira (41). The predaceous species were described and identified by Christie (5) from agar plate cultures sent from Hawaii.
- Aphelenchoides linfordi* Christie, 1939. Waipio, Oahu; Hanalei and Hanapepe, Kauai; frequent and abundant in pineapple fields of these localities; predaceous.

<sup>2</sup> Numbers in parentheses refer to Literature Cited, p. 370.

- Aphelenchoides oahuensis** Christie, 1939. Kunia, Oahu, in pineapple area; predaceous.
- Aphelenchoides oliveirae** Christie, 1939. Haleakala, Maui; soil from grazing land 3,500-5,000 ft. elevation; predaceous.
- Aphelenchoides parietinus** (Bastian, 1865) Steiner, 1932. Pineapple fields Kunia and Wahiawa, Oahu and West Maui; truck garden, Wahiawa, Oahu; probably widespread; especially abundant when plant waste is decomposing (36, 42); feeding on fungi (6) confirmed locally (38).
- Aphelenchoides tenuicaudatus** (de Man, 1865) Goodey, 1933. Wahiawa and Waipio, Oahu, and windward Maui in pineapple areas; Linford (38) and Linford and Oliveira (41) reported this species preying on nematodes of several genera including the plant parasites *Heterodera marioni* and *Pratylenchus pratensis*.
- Aphelenchoides winchesi** (Goodey) Filipjev var. *filicaudatus* Christie, 1939. Oahu; pineapple soil; predaceous.
- Aphelenchus** Bastian, 1865. (Synonym: *Isonchus* Cobb, 1913.) Widespread; first reported from Hawaii by Muir, Henderson and van Zwaltuvenburg (47); may enter root tissue of sugar cane (31, 45) and pineapple (31).
- Aphelenchus avenae** Bastian 1865. Probably the species mentioned in local literature under the name "*Isonchus* sp." (see above). Widespread throughout the islands in cultivated soils; very abundant in pineapple soils in which plant material is decomposing (36, 42); very often associated with *Aphelenchoides parietinus* and like it a fungus feeder (38, 40) which may invade rotting roots.
- Axonchium** Cobb, 1920. Prevalent in sugar cane areas (46), gardens and forest lands throughout islands; of the nematode species found in soil around roots of sugar cane, Muir (45) reports *Axonchium* "by far the most abundant and widely spread"; ectoparasitic on cane roots (31); occurrence in Hawaii and symptoms on roots recorded by Goodey (27).
- Axonchium magnicollis** (Cobb, 1906) Thorne and Swanger, 1936. (Synonym: *Dorylaimus magnicollis* Cobb, 1906.) Niulii, Hawaii; "about the roots of diseased cane" (7). Occurrence in Hawaii noted by Thorne (53).
- \***Bastiana** de Man, 1876. Mount Kaala, Oahu; several individuals in one collection from mountain top bog at 4,030 ft. elevation.
- Bunonema** Jägerskiöld, 1905. Included in a list (2) of nematodes known to occur in Hawaii; fairly common in forest soils and in rotting wood; found occasionally in pineapple fields of the wetter districts; numbers recovered small, but multiplication is rapid in agar plates containing plant debris; saprophagous food habits indicated.
- \***Butlerius** Goodey, 1929. Mount Kaala, Oahu; several individuals in a collection from bog at 4,030 ft. elevation.
- Cephalobus** Bastian, 1865. Various members of the Cephalobidae have appeared under this generic designation (36, 42).
- Cephalobus filicaudatus** Cobb, 1906. Described from about the roots of diseased sugar cane, Olaa, Hawaii (7). Thorne (52) considers this a *species inquirenda* noting that it is "probably a *Prismatolaimus*."

- Cephalobus hawaiiensis** Cobb, 1906. Described from about roots of diseased sugar cane, Hilo, Hawaii (7). Thorne (52) includes this species among *species inquirendae* with the following notation: "*Tricephalobus?* Median swelling mentioned."
- \***Cephalobus parvus** Thorne, 1937. Described by Thorne (52) from material sent from Hawaii; fairly abundant in pineapple fields in which plant material is undergoing decomposition; apparently saprophagous.
- Chitinotylenchus** Micoletzky, 1922. Noted as "known to occur in Hawaii" by Muir, Henderson, and van Zwaluwenburg (47).
- Chitinotylenchus annulatus** (Cassidy, 1930) Filipjev, 1936. (Synonyms: *Tylopharynx annulatus* Cassidy, 1930; *Anguillulina annulata* (Cassidy, 1930) Goodey, 1932.) Cassidy (2) reported and described this nematode as occurring "very abundantly about roots of sugar cane growing upon land previously in rice." Synonymy and occurrence in Hawaii noted by Goodey (26).
- Chromadora** Bastian, 1865. Cassidy (2) lists this genus as associated with sugar cane in Hawaii.
- Criconema** Hofmänner and Menzel, 1914, and **Criconemoides** Taylor, 1936. (Synonym: *Iota* Cobb, 1913.) Reported in association with sugar cane roots (2, 46); taken from collections made in sand dunes, forest soils, gardens, and occasionally from pineapple field samples.
- \***Criconema squamosum** (Cobb, 1913) Taylor, 1936. Laie, Oahu; in association with roots of sand dune vegetation.
  - \***Criconemoides crotaloides** (Cobb, 1924) Taylor, 1936. Mount Kaala, Oahu; from mossy bog.
  - \***Criconemoides mutabile** Taylor, 1936. Koko Head and Waialua, Oahu; about roots of dry land and pineapple field vegetation.
  - \***Criconemoides rusticum** (Micoletzky, 1917) Taylor, 1936. Laie, Oahu; from sand dune weeds.
  - \***Criconemoides sphaerocephalum** Taylor, 1936. Laie, Oahu; numerous among roots of weeds growing on sand dunes.
- Cyatholaimus** Bastian, 1865. A comparatively rare genus; associated with sugar cane (2) and taken from a garden on Kauai and from grassland on Oahu.
- \***Cylindrolaimus** de Man, 1880. Collected in small numbers from a sand dune on Oahu and from a rice field on Kauai.
- Diplogaster** Schultz, 1857. Oahu and Maui in pineapple fields and forest soil; distribution limited to wetter areas; as a rule individuals are few in field collections, but multiply rapidly on agar plates at the expense of other nematodes; forms met with active in the destruction of nematodes, piercing cuticle and sucking out body contents.
- Diplogaster intermedius** Cobb, 1906. Described from Hilo, Hawaii, from about the roots of diseased cane (7).
- Discolaimus** Cobb, 1913. Nematodes of this genus appear to be widespread but are never very numerous; found in sugar areas (31, 45, 47), pineapple fields, gardens, and in virgin land; predaceous propensities exhibited (41).

- Discolaimus bulbiferus** (Cobb, 1906) Thorne and Swanger, 1936. (Synonym: *Dorylaimus bulbiferus* Cobb, 1906.) Kihei, Maui; "about the roots of dead and dying cane" (7); also found about grass roots in sandy pasture, Laie, Oahu. Occurrence in Hawaii noted by Thorne (53).
- \***Discolaimus major** Thorne, 1939. Wahiawa, Oahu; often found with dorylaims in association with pineapple roots; predaceous on nematodes.
- \***Discolaimus similis** Thorne, 1939. Laie, Oahu, in sandy pasture; Manoa, Oahu, in garden; pineapple areas, Oahu; appears to be comparatively widespread, but is never very abundant; predaceous.
- Ditylenchus dipsaci** (Kühn, 1858) Filipjev, 1936. (Synonyms: *Anguillulina dipsaci* (Kühn, 1858) Gerv. and v. Ben., 1859; *Tylenchus dipsaci* (Kühn, 1858) Bastian, 1865.) Haleakala, Maui, in *Hypochaeris radicata* from grassy pasture land and volcanic ash at 3,300 to 9,500 ft. elevation; restricted to this one locality and host; typically parasitic in above-ground portions of plant (14); occurrence in Hawaii recorded by Goodey (26, 27); feeding reported by Linford (39).
- Ditylenchus intermedius** (de Man, 1880) Filipjev, 1936. Wahiawa, Waipio and Robinson districts, Oahu; abundant during decomposition of plant material (42); this nematode heretofore regarded as free-living (26, 27) was found as an internal parasite of the pineapple root. Adult males and females, larvae and eggs have all been recovered from root cortical tissue. Infested roots show red to brown necrotic areas or streaks, color intensity progressing with tissue breakdown. The invading nematodes are recovered, for the most part, just in advance of discolored tissue. Laboratory studies (38) have demonstrated fungus-feeding propensities for this species.
- Dolichodorus** Cobb, 1914. Reported in association with sugar cane (2) as an endoparasite (31).
- \***Dorylaimellus** Cobb, 1913. Laie and Mount Kaala, Oahu; a few immature specimens found.
- \***Dorylaimoides** Thorne and Swanger, 1936. Oahu, forest and rice field; Kauai, rice field; probably widespread in very wet habitats throughout islands.
- Dorylaimus** Dujardin, 1845. Widespread throughout islands and notable for the comparatively great number of species present; originally considered of some importance as a sugar cane root parasite (7, 31); of late, interest has centered on the predaceous habits (38, 41) of members of this genus. General discussion or mention of the genus is included in the following (42, 46, 47, 49, 50).
- \***Dorylaimus centrocerus** de Man, 1880. Haiku, Maui; Oahu; from many habitats including pineapple fields; widespread but not abundant; predaceous.
- Dorylaimus granuliferus** Cobb, 1893. Kauai and Oahu; weedy areas and gardens. Occurrence in Hawaii recorded by Thorne (53).
- Dorylaimus hawaiiensis** Cobb, 1906. Hilo, Hawaii; described from about roots of diseased cane (7); occurrence in Hawaii recorded by Thorne and Swanger (54).
- \***Dorylaimus irritans** Thorne and Swanger, 1936. Manoa, Oahu; garden soil; limited distribution suggested; predaceous.
- \***Dorylaimus krygeri** Ditlevsen, 1928. Waipio, Oahu; pineapple field soil; abundant in localized area; predaceous.

- \**Dorylaimus minor* Cobb, 1936. Waimea, Oahu; single collection of a few individuals from soil about grass roots.
- \**Dorylaimus microdorus* de Man, 1880. Laie, Oahu; numerous larvae and females from weeds in sandy soil.
- \**Dorylaimus obscurus* Thorne and Swanger, 1936. Brodie and Wahiawa, Oahu; abundant in pineapple field soils; the most prominent dorylaim of the Hawaiian nematode fauna; predaceous.
- \**Dorylaimus obtusicaudatus* Bastian, 1865. Waipio, Oahu; fairly abundant in pineapple area of this district; predaceous.
- \**Dorylaimus pratensis* de Man, 1880. Kilauea, Kauai; several individuals in a collection from garden soil.
- \**Dorylaimus productus* Thorne and Swanger, 1936. Laie, Oahu; males, females and larvae recovered from grass roots growing in sandy soil.
- \**Dorylaimus pseudostagnalis* Micoletzky, 1927. Rice field, Kauai; considerable numbers of males, females and larvae taken from an inundated rice field.
- Dorylaimus pusillus* Cobb, 1906. Widely distributed throughout islands in wet garden and forest soils; reported in association with sugar cane roots by Cobb (7); occurrence in Hawaii recorded by Thorne and Swanger (54).
- Dorylaimus striaticaudatus* Cobb, 1906. Described from about the roots of diseased cane, Kipahulu, Maui (7); occurrence in Hawaii recorded by Thorne and Swanger (54).
- \**Dorylaimus subtilis* Thorne and Swanger, 1936. Manoa, Oahu; numerous in garden soil; predaceous.
- \**Enchodelus macrodorus* (de Man, 1880) Thorne, 1939. Laie, Oahu; sand dune vegetation; few individuals in one collection.
- Eucephalobus latus* (Cobb, 1906) Thorne, 1937. (Synonym: *Cephalobus latus* Cobb, 1906.) Reported from Hilo, Hawaii, about the roots of diseased sugar cane (7); abundant in Oahu pineapple fields during decomposition of plant waste and in weed borders; saprophagous food habits indicated.
- \**Eucephalobus oxyuroides* (de Man, 1876) Steiner, 1936. Wahiawa and Robinson, Oahu; in garden soils and pineapple fields; abundant in presence of decaying organic matter; saprophagous.
- Heterodera marioni* (Cornu, 1879) Goodey, 1932. (Synonym: *Heterodera radiccicola* (Greiff, 1872) Müller, 1884.) Widespread and abundant, occurring in cultivated and virgin soils of all islands of the group; considered most serious nematode parasite of the pineapple plant, truck crops and ornamentals; first reported from Hawaii by Cobb (8) from sugar cane roots. Extensive work on various phases of biology, occurrence, control, environment, injury, etc., has been reported by Cassidy and van Zwaluwenburg (4); Collins and Hagan (10); Godfrey (12, 15, 16, 17); Godfrey and Hagan (18, 19, 20); Godfrey and Hoshino (21, 22); Godfrey and Oliveira (23); Godfrey, Oliveira and Gittel (24); Godfrey, Oliveira and Hoshino (25); Goodey (27); Hagan (28, 29); Hagan and Collins (30); Henderson (31); Hoshino and Godfrey (32); Johnson (33); Johnson and Godfrey (34); Larsen (35); Linford (36, 37, 38, 40); Linford, Yap and Oliveira (42); Lyon (43); Magis-

- tad and Oliveira (44); Muir and Henderson (46); Muir, Henderson and van Zwaluwenburg (47); Parris (48); and Stewart et al (49).
- Heterodera schachtii** Schmidt, 1871. Oahu and Maui; reported parasitic in sugar cane roots; not seen by the writer in Hawaiian material. Distribution, description, and injury discussed by Cassidy and van Zwaluwenburg (4), Goodey (27), Henderson (31), Muir and Henderson (46), Muir, Henderson and van Zwaluwenburg (47), Stewart et al (49), and Stewart and Hansson (50).
- Hoplolaimus** Daday, 1905. Emend. Cobb, 1923. Mokapu, Oahu from soil about roots of sand dune vegetation; Henderson (31) reports an unnamed species of this genus as an endoparasite of sugar cane roots and notes that it is "widely distributed throughout the Islands and is most frequently found in soil in the immediate vicinity of roots." See also: Muir (45), Muir, Henderson and van Zwaluwenburg (47), and Stewart et al (49).
- Ironus** Bastian, 1865. Oahu and Kauai in rice fields; found associated with sugar cane roots (2); apparently a species restricted to wetter habitats.
- Labronema pacificum** (Cobb, 1906) Thorne, 1939. (Synonym: *Dorylaimus pacificus* Cobb, 1906). Described from diseased cane roots (7); occurrence in Hawaii recorded by Thorne (53) and Thorne and Swanger (54); abundant throughout islands; predaceous.
- Monhystera** Bastian, 1865. Kauai and Oahu rice fields; bog, Mount Kaala, Oahu; a nematode genus which is never very abundant, but is widespread in very wet areas.
- Monhystera impetuosa** Cobb, 1906. Hilo, Hawaii; described from about roots of diseased cane (7).
- Monhystera sub-rustica** Cobb, 1906. Hilo, Hawaii; described from about roots of diseased cane (7).
- Mononchus** Bastian, 1865. This genus is represented in Hawaii by eleven species which are well distributed through the islands and occur in considerable abundance in favorable locations. Naturally wet, or well-irrigated soils form the most favorable habitat, which precludes occurrence in any abundance in pineapple fields, the majority of which are located in drier areas of the islands. Practically all of the Hawaiian species have been observed feeding on nematodes of other genera. General discussion of the genus is included by Cassidy (2, 3), Cassidy and van Zwaluwenburg (4), and Stewart et al (49).
- Mononchus brachylaimus** Cobb, 1917. Hawaii and Oahu; abundant in sugar cane fields (2, 3); less abundant in pineapple areas, being restricted to fields of high rainfall; demonstrated by Cassidy (3) to be an effective nematode predator. See also: Goodey (27).
- Mononchus brachyuris** Bütschli, 1873. Hawaii (7), Maui, Oahu; in sugar cane fields (46), pasture land at 7,000 ft. elevation (3), in gardens and upland pineapple areas; predaceous (2).
- Mononchus hawaiiensis** Cassidy, 1931. Described (3) from Oahu; in soils rich in humus; a comparatively rare species, limited in distribution and abundance.
- Mononchus index** Cobb, 1906. Hawaii, Maui and Oahu; from sugar cane areas on first two islands (3, 7, 9); from a vegetable garden on Oahu; predaceous.

- Mononchus lacustris** Cobb, 1893. Oahu, Maui and Molokai; in cane and pineapple soils (3).
- Mononchus longicaudatus** Cobb, 1893. Hilo, Hawaii, in cane fields (7, 9); Oahu, in cane lands and upland pineapple fields (3); predaceous (2).
- Mononchus mauiensis**, nov. nom. (Synonym: *M. cobbi*, Cassidy 1931. Not *M. cobbi* (Cobb, 1917) Micoletzky, 1922. Synonym: *M. similis* Cobb, 1917.) "This species is found in gravelly soils at high elevations on the island of Maui . . . considered highly voracious as a large percentage of all examined specimens was found to contain the ingested remains of one or more nematodes" (3). Thorne (personal communication) called attention to the fact that "*M. cobbi* was preempted by Micoletzky, 1922, p. 344, as a new name for *M. similis* Cobb." Cassidy is aware of, and in agreement with, the renaming of this species.
- Mononchus muscorum** (Dujardin) Bastian, 1865. Haleakala, Maui; gravelly slopes at 7,000 to 8,000 ft. elevation; probably predaceous (3).
- Mononchus papillatus** Bastian, 1866. Maui, Oahu, Kauai and Molokai; most abundant and widely distributed local species; taken in soil samples from sugar cane areas (2, 7, 49), pineapple lands (2), grassy areas and gardens; predaceous.
- Mononchus parvus** de Man, 1879. Maui and Hawaii; in sandy soils (3).
- Mononchus sigmaturus** Cobb, 1917. Oahu; most abundant Oahu sugar cane field species; predaceous (3).
- \***Nygolaimus brachyurus** (de Man, 1884) Thorne, 1930. "A few specimens were received from Mrs. Cassidy in 1931 from about roots of pineapple. They are not identical to the specimens I collect here but are very close, so I consider them as a geographical variation." (Thorne, personal communication.)
- \***Nygolaimus vulgaris** Thorne, 1930. Laie, Oahu; several individuals in a collection from sand dune vegetation; reported by Thorne (51) as predaceous on oligochaete worms.
- \***Oxydirus oxycephalus** (de Man, 1885) Thorne, 1939. Maunawili, Oahu, and other wet forest areas of Oahu.
- \***Panagrolaimus rigidus** (Schneider, 1866) Thorne, 1937. Wahiawa, Oahu; abundant in weed borders of pineapple fields; saprophagous.
- Paratylenchus** Micoletzky, 1921. Reported by Muir, Henderson and van Zwaluwenburg (47) among genera "at present known to occur in Hawaii."
- \***Paratylenchus besoekianus** Bally and Reydon, 1931. (May be identical with *P. bukovinensis* Micoletzky, 1921.) Wahiawa and Brodie districts, Oahu; not widespread but very abundant where found; intimately associated with roots, attached to surface, or more rarely within as reported by Bally and Reydon (1) in coffee from Java; association with weeds more common than with pineapple roots; obligate parasite.
- \***Plectus cirratus** Bastian, 1865. Wahiawa, Oahu; abundant in restricted areas; in weed borders rather than in cultivated fields; saprophagous.

- \**Plectus granulosis* Bastian, 1865. Waianae Mountains, Oahu; in soil from native forest.
- Plectus hawaiiensis* Cobb, 1906. Hilo, Hawaii; collected and described by Cobb (7) from about roots of diseased sugar cane.
- Pratylenchus pratensis* (de Man, 1881) Filipjev, 1936. (Synonyms: *Anguillulina pratensis* (de Man, 1881) Goffart, 1929; *Tylenchus brachyurus* Godfrey, 1929.) Widespread and abundant throughout islands; infests wide range of host plants including crop plants, ornamentals, and native Hawaiian species; responsible for the most serious recognized nematode injury to pineapple roots next to gall formation by *Heterodera marioni* according to Johnson (33). Linford (40) has demonstrated the attractiveness of plant tissues to this nematode.
- One characteristic of *Tylenchus brachyurus* as described by Godfrey (11) was the absence of males. Subsequently, however, males have been found which agree with males of *P. pratensis* in Goodey's collection. Goodey (26) has pointed out that measurements on which *T. brachyurus* was established as a species, are covered by the range of variability within *P. pratensis*. See also: Goodey (27).
- Prismatolaimus* de Man, 1880. Probably on all islands; reported from sugar cane soils (49); common in forest soil; recovered in small numbers from pineapple fields of high moisture and organic content.
- Prismatolaimus hawaiiensis* Cobb, 1906. Described (7) from Hilo, Hawaii, from soil about the roots of diseased sugar cane.
- \**Psilenchus hilarulus* de Man, 1921. Kemo and Manoa, Oahu; few individuals collected from pineapple field and garden soil.
- Pungentus ichthyuris* (Cobb, 1906) Thorne and Swanger, 1936. (Synonym: *Dorylaimus ichthyuris* Cobb, 1906.) Hilo, Hawaii; described (7) from soil about diseased cane roots; occurrence in Hawaii recorded by Thorne (53), and Thorne and Swanger (54).
- Rhabditis* Dujardin, 1845. Widespread; present in pineapple field soils in great numbers during decomposition of organic matter (36, 42); saprophagous.
- Rhabditis monhystrera* Bütschli, 1873. Hilo, Hawaii; reported by Cobb (7) from about roots of diseased sugar cane.
- Rhabdolaimus* de Man, 1880. Included by Cassidy (2) in a list of nematode genera associated with sugar cane in Hawaii.
- Rotylenchulus reniformis* Linford and Oliveira, 1940. Oahu; distribution restricted; host range includes crop plants, ornamentals and weeds in 30 families; obligate root parasite causing local necrosis and mild hypertrophy (41a, 41b).
- Rotylenchus multicinctus* (Cobb, 1893) Filipjev, 1936. (Synonyms: *Anguillulina multicincta* (Cobb, 1893) Goodey, 1932; *Tylenchus olae* Cobb, 1906; *Tylenchus spiralis* Cassidy, 1930.) Throughout the islands; extremely widespread and abundant in forest soils, grasslands, and cultivated areas; parasitic on roots causing red, cortical lesions at points of penetration (31). Further consideration of this species by Cassidy (2); Cobb (7); Goodey (26, 27); Linford (40); and Muir (45).
- \**Rotylenchus robustus* (de Man, 1876) Filipjev, 1936. Waialua, Oahu, in pineapple field; Manoa, Oahu, in garden; not at all abundant.

- Rotylenchus similis** (Cobb, 1893) Filipjev, 1936. (Synonyms: *Anguillulina similis* (Cobb, 1893) Goodey, 1932; *Tylenchus bififormis* Cobb, 1909; *Tylenchus similis* Cobb, 1893.) Widespread throughout the islands in sugar cane areas; the most serious nematode parasite of sugar cane roots; restricted in host range; reported from pineapple roots (4, 27) but infection is mild and extremely rare (12). See also: Cassidy (2, 3), Cobb (8), Goodey (26), Henderson (31), Muir and Henderson (46), Muir, Henderson and van Zwaluwenburg (47), Stewart et al (49), and Stewart and Hansson (50).
- \***Sectonema ventralis** Thorne, 1930. Wahiawa, Oahu; rare and limited in distribution; reported by Thorne (51) as predaceous.
- \***Teratocephalus terrestris** (Bütschli, 1873) de Man 1876. Mount Kaala, Oahu; few specimens in a collection from mountain top bog at 4,030 ft. elevation.
- Trichodorus** Cobb, 1913. Included by Muir, Henderson and van Zwaluwenburg (47) among genera known to occur in Hawaii.
- \***Trilobus** Bastian, 1865. Oahu and Kauai; found in bogs, taro patches, and rice fields.
- Tripyla** Bastian, 1865. Oahu and Kauai; reported in association with sugar cane (2); also in garden and forest soils; apparently widespread in wet or irrigated areas.
- \***Tripyla affinis** de Man, 1880. Waianae Mountains, Oahu; several specimens in native forest soil.
- Tylencholaimellus** M. V. Cobb, 1915. West Maui; encountered by Stewart et al (49) in sugar cane soil.
- \***Tylencholaimus** de Man, 1876. Oahu; collections made on small, dry, rocky, off-shore islands, and in dry, weedy areas and sand dunes have yielded nematodes of this genus in small numbers.
- Xiphenema** Cobb, 1913. Widespread but not abundant; reported in close association with sugar cane roots (2, 31); also as an ectoparasite (45); found occasionally in soil about pineapple roots. See also: Muir and Henderson (46) and Muir, Henderson and van Zwaluwenburg (47).
- Xiphenema truncatum** Thorne, 1939. Collected by William Hartung in 1928 from soil about pineapple roots. Occurrence in Hawaii noted by Thorne (53).
- \***Zeldia punctata** (Thorne, 1925) Thorne, 1937. Laie, Oahu; few individuals in a collection from sand dune vegetation.

## LITERATURE CITED

1. BALLY, W. AND REYDON, G. A., De tegenwoordige stand van het vraagstuk van de woortelaatjes in de koffie-cultuur: Arch. Koffiecult. in Nederl-Indië. 5(2) : 23-216, 1931.
2. CASSIDY, GERTRUDE, Nematodes associated with sugarcane in Hawaii: Hawaiian Planters' Rec. 34(4) : 379-387, 1930.
3. —, Some Mononchs of Hawaii: Hawaiian Planters' Rec. 35(3) : 305-339, 1931.
4. CASSIDY, G. HENDERSON AND VAN ZWALUWENBURG, R. H., Nematodes in relation to growth failure of sugarcane in Hawaii: Rept. Assn. Hawaiian Sugar Tech. 6th Ann. Mtg. pp. 10-15, 1927.

5. CHRISTIE, J. R., Predaceous nematodes of the genus *Aphelenchoides* from Hawaii: Jour. Wash. Acad. Sci. 29(4) : 161-170, 1939.
6. — AND ARNDT, C. H., Feeding habits of the nematodes *Aphelenchoides parietinus* and *Aphelenchus avenae*: Phytopath. 26(7) : 698-701, 1936.
7. COBB, N. A., Fungus maladies of the sugarcane—with notes on associated insects and nematodes: Hawaiian Sugar Planters' Assn., Div. Path. and Physiol. Bull. 5: 63-195, 1906.
8. —, Fungus maladies of the sugarcane: Hawaiian Sugar Planters' Assn., Div. Path. and Physiol. Bull. 6: 63-73, 1909.
9. —, The Mononchs: Soil Science 3(5) : 431-486, 1917.
10. COLLINS, J. L. AND HAGAN, H. R., Nematode resistance of pineapples. Varietal resistance of the pineapple roots to the nematode *Heterodera radiculicola* (Greeff) Müller: Jour. of Heredity 23(11) : 459-511, 1932.
11. GODFREY, G. H., A destructive root disease of pineapples and other plants due to *Tylenchus brachyurus* n. sp.: Phytopath. 19(7) : 611-629, 1929.
12. —, Some technique used in the study of the root-knot nematode *Heterodera radiculicola*: Phytopath. 21(3) : 323-329, 1931.
13. —, The host plants of the "burrowing nematode" *Tylenchus similis*: Phytopath. 21(3) : 315-322, 1931.
14. —, *Tylenchus dipsaci* on *Hypochoeris radicata* in Hawaii: Phytopath. 21(7) : 759, 1931.
15. —, Indicator plants for measuring soil populations of the root knot nematode *Heterodera marioni* (Cornu) Goodey: Soil Science 38(1) : 3-27, 1934.
16. —, Experiments on the control of the root-knot nematode in the field with chloropicrin and other chemicals: Phytopath. 25(1) : 67-90, 1935.
17. —, The pineapple root system as affected by the root-knot nematode: Phytopath. 26(5) : 408-428, 1936.
18. — AND HAGAN, H. R., Influence of soil hydrogen-ion concentration on infection by *Heterodera radiculicola* (Greeff) Müller: Soil Science 35(3) : 175-184, 1933.
19. — AND HAGAN, H. R., A study of the root-knot nematode trap crop under field soil conditions: Phytopath. 24(6) : 648-658, 1934.
20. — AND HAGAN, H. R., Some measurements of detrimental effects of the root-knot nematode on the pineapple plant: Phytopath. 27(4) : 515-530, 1937.
21. — AND HOSHINO, HELENE MORITA, Studies on certain environmental relations of the root-knot nematode, *Heterodera radiculicola*: Phytopath. 23(1) : 41-62, 1933.
22. — AND HOSHINO, HELENE MORITA, The trap crop as a means of reducing root knot nematode infestation: Phytopath. 24(6) : 635-647, 1934.
23. — AND OLIVEIRA, JULIETTE, The development of the root-knot nematode in relation to root tissues of pineapple and cowpea: Phytopath. 22(4) : 325-348, 1932.
24. —, OLIVEIRA, JULIETTE AND GITTEL, ERNA B. H., The duration of life of the root-knot nematode, *Heterodera radiculicola*, in soils subjected to drying: Soil Science 35(3) : 185-195, 1933.

25. —, OLIVEIRA, JULIETTE, AND HOSHINO, H. M., Increased efficiency of chloropicrin for nematode control with better confinement of the gas: *Phytopath.* 24(12) : 1332-1346, 1934.
26. GOODEY, T., The genus *Anguillulina* Gerv. and v. Ben., 1859, vel *Tylenchus* Bastian, 1865: *Jour. of Helminth.* 10(2-3) : 75-180, 1932.
27. —, *Plant parasitic nematodes*: Methuen & Co. Ltd., London, 1933.
28. HAGAN, HAROLD R., Comparisons in the distribution of nematode galls on the roots of pineapple varieties attacked by the nematode *Heterodera radiculicola* (Greef) Müller: *Soil Science* 35(1) : 29-42, 1933.
29. —, Hawaiian pineapple field soil temperatures in relation to the nematode *Heterodera radiculicola* (Greef) Müller: *Soil Science* 36(2) : 83-95, 1933.
30. — AND COLLINS, J. L., Studies on varietal resistance of pineapple plants. Part II. Plant resistance to *Heterodera marioni* (Cornu) Goodey: *Jour. Heredity* 26(1) : 35-46, 1935.
31. HENDERSON, GERTRUDE, Remarks on the genera of spear-bearing nematodes found in Hawaii, with a table for their identification: *Hawaiian Planters' Rec.* 30(4) : 454-459, 1926.
32. HOSHINO, HELENE MORITA AND GODFREY, G. H., Thermal death point of *Heterodera radiculicola* in relation to time: *Phytopath.* 23(3) : 260-270, 1933.
33. JOHNSON, M. O., *The pineapple: Paradise of the Pacific* Press, Honolulu, 1935.
34. — AND GODFREY, G. H., Chloropicrin for nematode control: *Indus. and Engin. Chem.* 24(3) : 311-313, 1932.
35. LARSEN, L. D., *Diseases of the pineapple: Hawaiian Sugar Planters' Assn. Exp. Sta. Path. Series, Bull.* 10, 1910.
36. LINFORD, M. B., Stimulated activity of natural enemies of nematodes: *Science* 85(2196) : 123-124, 1937.
37. —, The feeding of the root knot nematode in root tissue and nutrient solution: *Phytopath.* 27(8) : 824-835, 1937.
38. —, The feeding of some hollow stylet nematodes: *Helm. Soc. of Wash., Proc.* 4(2) : 41-46, 1937.
39. —, Notes on the feeding of *Ditylenchus dipsaci* (Nematoda: Tylenchidae): *Helm. Soc. of Wash., Proc.* 4(2) : 46-47, 1937.
40. —, Attractiveness of roots and excised shoot tissues to certain nematodes: *Helm. Soc. of Wash., Proc.* 6(1) : 11-18, 1939.
41. — AND OLIVEIRA, J. M., The feeding of hollow spear nematodes on other nematodes: *Science* 85(2203) : 295-297, 1937.
- 41a. — AND —, *Rotylenchulus reniformis*, nov. gen., n. sp., a nematode parasite of roots: *Helm. Soc. of Wash., Proc.* 7(1) : 35-42, 1940.
- 41b. — AND YAP, FRANCIS, Some host plants of the reniform nematode in Hawaii: *Helm. Soc. of Wash., Proc.* 7(1) : 42-44, 1940.
42. —, YAP, FRANCIS AND OLIVEIRA, J. M., Reduction of soil populations of the root-knot nematode during decomposition of organic matter: *Soil Science* 45(2) : 127-140, 1938.
43. LYON, H. L., Some local problems in green soiling with additional notes on bean varieties: *Hawaiian Planters' Rec.* 5(3) : 200-210, 1911.

44. MAGISTAD, O. C. AND OLIVEIRA, JULIETTE M., Changes in plant-food intake caused by a population of *Heterodera marioni* (Cornu) Goodey on *Ananas comosus*: *Phytopath.* 24(3): 276-283, 1934.
45. MUIR, FREDERICK, Nematodes considered in relation to root rot of sugarcane in Hawaii: *Rept. Hawaiian Sugar Tech. 5th Ann. Mtg.*: 14-18, 1926.
46. — AND HENDERSON, GERTRUDE, Nematodes in connection with sugarcane root rot in the Hawaiian Islands: *Hawaiian Planters' Rec.* 30(2): 242-245, 1926.
47. —, HENDERSON, GERTRUDE AND VAN ZWALUWENBURG, R. H., A generic list of the spear-bearing nematodes with a revised dichotomous table: *Hawaiian Planters' Rec.* 31(3): 354-361, 1927.
48. PARRIS, G. K., The diseases of truck crops in Hawaii: *Hawaii Agric. Exp. Sta. Extension Bull.* 33, pp. 66, 1938.
49. STEWART, GUY R., MUIR, F., VAN ZWALUWENBURG, R. H., CASSIDY, G. H., AND HANSSON, FRED, The relation between soil treatment and nematode attacks to cane roots in central Maui soils: *Hawaiian Planters' Rec.* 32(2): 205-217, 1928.
50. — AND HANSSON, FRED, The effect of nematodes upon cane roots in sterilized soil: *Hawaiian Planters' Rec.* 32(2): 217-223, 1928.
51. THORNE, GERALD, Predaceous nemas of the genus *Nygolaimus* and a new genus *Sectonema*: *Jour. Agr. Res.* 41(6): 445-466, 1930.
52. —, A revision of the nematode family *Cephalobidae* Chitwood and Chitwood, 1934: *Helm. Soc. of Wash., Proc.* 4(1): 1-16, 1937
53. —, A monograph of the nematodes of the superfamily *Dorylaimoidea*: *Capita Zoologica* 8(5), 1939.
54. — AND SWANGER, HELEN HEINLY, A monograph of the nematode genera *Dorylaimus* Dujardin, *Aporcelaimus* N. G., *Dorylaimoides* N. G., and *Pungentus* N. G.: *Capita Zoologica* 6(4), 1936.