# *Hirschmanniella miticausa* n. sp. (Nematoda : Pratylenchidae) and its pathogenicity on taro *(Colocasia esculenta)* [1]

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SUMMARY

*Hirschmanniella miticausa* n. sp. from taro *(Colocasia esculenta)* corms in the Solomon Islands is described and figured. The new species is closest to *H. gracilis*, *H. diversa* and *H. microtyla*. It differs from *H. gracilis* in shape of lip region and tail, length of oesophageal glands in relation to body length, and length of non-annulated part of tail. It has a shorter stylet than *H. diversa* and smaller b, b′ and c′ values. It is distinguished from *H. microtyla* by the greater body length, a more rounded lip region, tail shape and a longer non-annulated tail terminus. In a pathogenicity test, *H. miticausa* caused typical symptoms of taro corm rot disease known as "mitimiti" which did not occur in the absence of the nematode.

RÉSUMÉ

Hirschmanniella miticausa *n. sp. (Nematoda : Pratylenchidae), description et pathogénie envers le taro* (Colocasia esculenta)

*Hirschmanniella miticausa* n. sp. découvert aux îles Salomon sur bulbe de taro *(Colocasia esculenta)* est décrit et figuré. Cette nouvelle espèce est voisine de *H. gracilis*, *H. diversa* et *H. microtyla*. Elle diffère de *H. gracilis* par la forme de la région labiale et de la queue, par le rapport entre la longueur des glandes œsophagiennes et la longueur du corps ainsi que par la longueur de la partie non annelée de la queue. Son stylet est plus court que celui de *H. diversa* et ses coefficients b, b′ et c′ sont plus faibles que chez cette espèce. Elle se distingue de *H. microtyla* par la plus grande longueur du corps, une région labiale plus arrondie, la forme de la queue et la plus grande longueur de la partie non annelée de la queue. Dans un test de pathogénie, *H. miticausa* a provoqué des symptômes typiques de la maladie des racines de taro connue sous le nom de « mitimiti » qui n'apparaissaient pas en l'absence de nématodes.

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Nematodes of an undescribed species of *Hirschmanniella* were found associated with a serious corm rot of taro in parts of Solomon Islands (Mortimer, Bridge & Jackson, 1981). The disease is known locally as "mitimiti", the name in pidgin English given to affected corms because of their similarity to uncooked fatty meat. Internally corms with mitimiti show irregular, 1-10 mm wide, zones of dry brown rot which originate from the base of the corms. The areas of decay are initially confined to the vascular tissues and the undecayed tissues adjacent to the areas of rot are red. Often the basal parts of the corms are completely decayed by brown soft rot.

Detailed morphological studies identified the nematode as a new species and a description of *Hirschmanniella miticausa* n. sp. is given below. This paper also provides evidence that the nematode is the primary causal agent of mitimiti disease.

Living nematodes were extracted from corm tissues of taro originating from the Solomon Islands. Specimens were killed by heat relaxation, fixed in T.A.F., processed by Seinhorst's (1959) method and mounted in glycerine.

## **Hirschmanniella miticausa** n. sp.
(Figs 1 & 2)

### Measurements

*Females :* (paratype ; $n = 20$) : L = 1.72 (1.60-1.86) mm ; a = 53.5 (49.2-58.8) ; b = 11.6 (10.5-12.6) ; b′ = 4.4 (3.8-4.8) ; c = 17 (15.2-18.9) ; c′ = 4.1 (3.4-4.8) ; V = 53.7 (49.4-57.2) ; stylet = 20 (19-21) µm ; m = 48.5 (47-50) ; O = 20.5 (18.4-25) ; d.o.* = 4 (3.5-5) µm ; stylet knob width = 4 (3.5-4.5) µm.

*Males :* (paratype ; $n = 10$) : L = 1.58 (1.52-1.65) mm ; a = 52.1 (49.1-54.7) ; b = 11.2 (10.7-12.3) ; b′ = 4.3 (3.7-4.6) ; c = 18 (17-19.2) ; c′ = 4.5 (4.1-4.9) ; stylet = 19 (18.5-20) µm ; m = 47 (44-50) ; O = 19 (17-22) ; gubernaculum = 9.5 (9-11) µm ; spicules = 33 (31-37) µm ; d.o.* = 3.5 (3-4.5) µm ; stylet knob width = 4 (3.5-4.5) µm.

*Holotype* (female) : L = 1.71 mm ; a = 55.3 ; b = 11.9 ; b′ = 4.2 ; c = 16.3 ; c′ = 4.2 ; V = 52.8 ; stylet = 20 µm ; m = 50 ; O = 18.4 ; d.o.* = 3.5 µm ; stylet knob width = 4 µm.

* d.o. = distance from stylet base to dorsal œsophageal gland opening.

### Description

*Females :* Body slightly curved or straight after heat relaxation. Lateral field with four incisures ; areolated at extremities and with indistinct, incomplete areolation along rest of body. Lip region continuous, hemispherical with raised labial disc and five to six indistinct annules ; head skeleton prominent. Stylet knobs rounded ; anterior portion of stylet slightly shorter than or same length as posterior portion. Hemizonid three to four annules long, three to four annules anterior to excretory pore, opposite or slightly anterior to oesophago-intestinal junction. Oesophageal glands elongate, overlapping intestine ventrally and tapering posteriorly. Genital branches paired, outstretched ; spermathecae round to oval with sperms. Intestine not overlapping rectum. Tail terminus non-annulated with rounded or pointed ventral projection sometimes with mucron. Phasmids small, indistinct, about 1/3 tail length or 19-25 annules from tail terminus.

*Male :* Similar to female with same variable tail terminus. Gubernaculum non-protruding.

### Type habitat and locality

Corms and roots of taro, *Colocasia esculenta* (L.) Schott, from the island of Choiseul, Solomon Islands.

### Type material

*Holotype* (female) : slide 58A/11/1 deposited in the Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., England.

*Paratypes* : females and males at the same place (19 ♀♀, 17 ♂♂) and deposited in the following institutions : Laboratoire des Vers, Muséum national d'Histoire naturelle, 61 rue de Buffon, 75005 Paris, France (12 ♀♀, 6 ♂♂) ; Nematology Department, University of California, Riverside, U.S.A. (9 ♀♀, 5 ♂♂).

### Diagnosis

The new species is closest to *H. gracilis* (de Man, 1880) Luc & Goodey, 1964, *H. diversa* Sher, 1968 and *H. microtyla* Sher, 1968. It has a more rounded head than *H. gracilis*, a more variable tail shape, longer oesophageal glands in relation to body length (smaller b′ value), and the tail terminus has a longer non-annulated part. It differs from *H. diversa* in

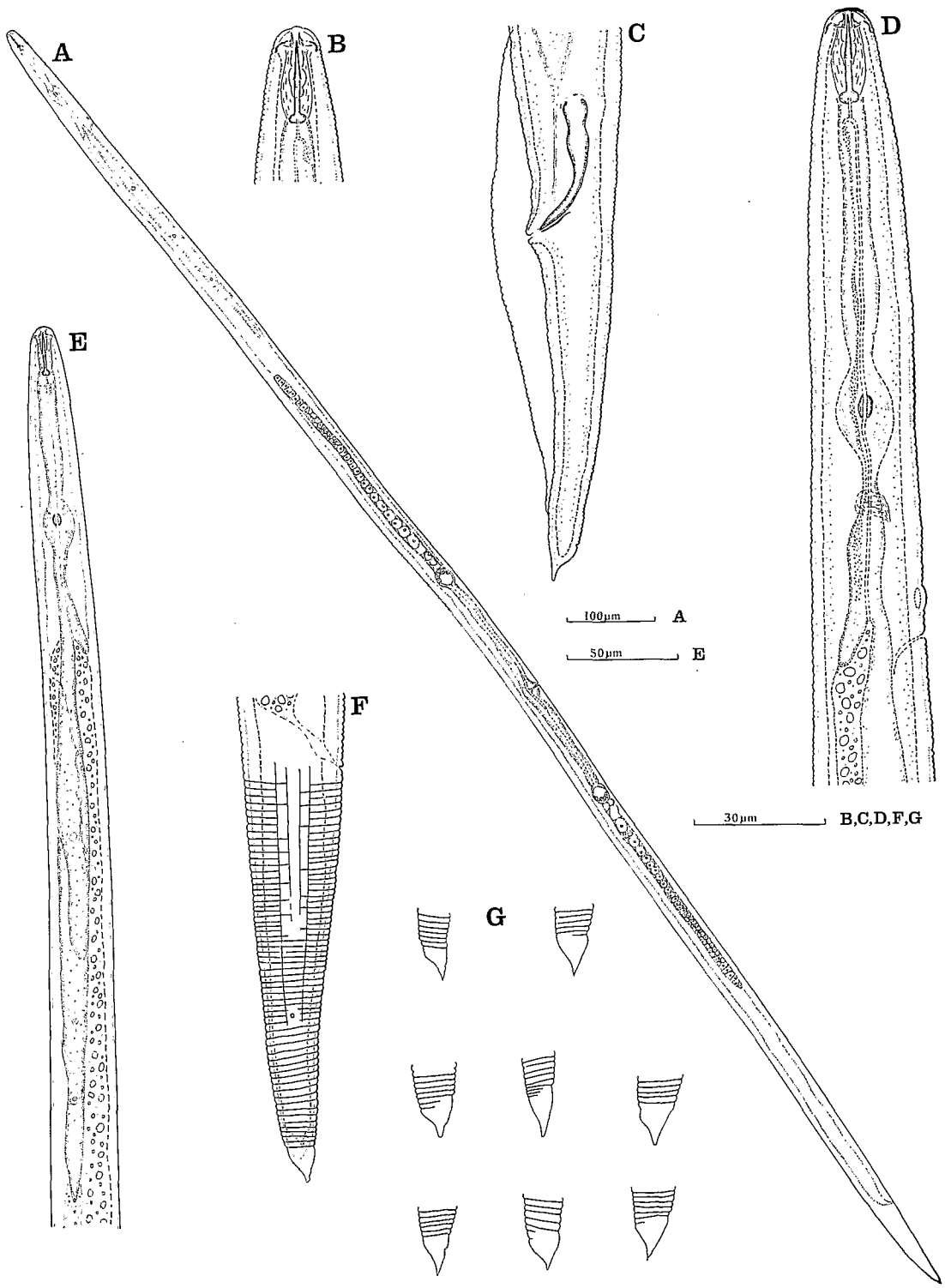


Fig. 1. *Hirschmanniella miticausa* n. sp. Female. A : entire body ; D, E : anterior part of the body ; F : posterior part of body ; G : tail tips. Male. B : head ; C : spicules and tail.

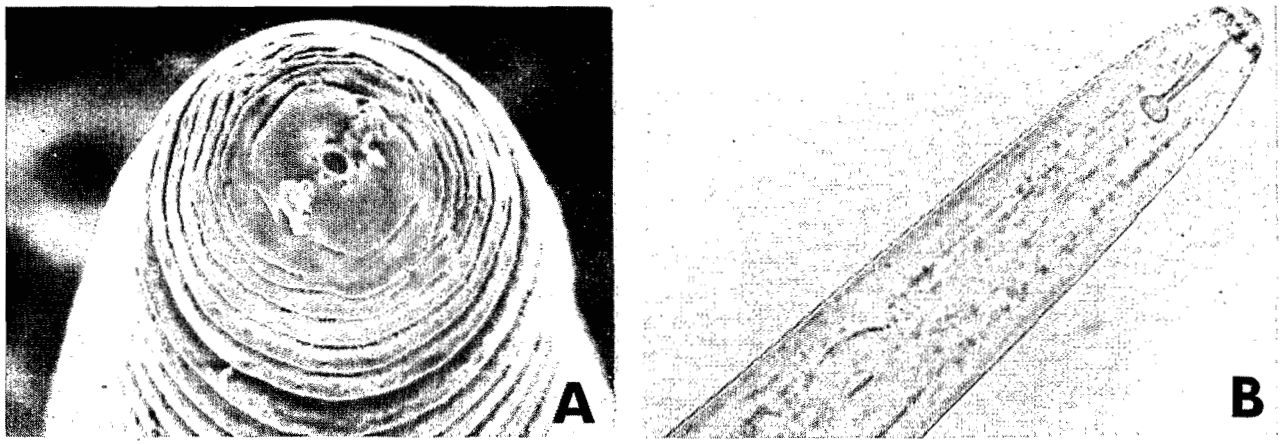


Fig. 2. *Hirschmanniella miticausa* n. sp. A : Scanning electron micrograph of female lip region ( × 5 400) ; B : photomicrograph of female anterior part of body.

having a shorter stylet, irregular shape of tail terminus, longer oesophageal glands in relation to body length (smaller b′ value) and smaller b and c′ values. It is distinguished from *H. microlyla* by the more rounded head, tail shape and a longer non-annulated tail terminus, and greater body length.

The incomplete areolation of the lateral field is only clearly observed with the scanning electron microscope and has not been used here as a diagnostic character. In fixed specimens, the excretory duct has irregular swellings along its anterior part similar to those described for *H. gracilis* (Sanwal, 1957). Males are common and approximately equal numbers of each sex were found in plant tissues.

## Pathogenicity of *H. miticausa* n. sp. on taro

### Materials and methods

Taro corms infested with *H. miticausa* n. sp. collected from the island of Choiseul, Solomon Islands were used to establish a culture of the nematode on taro plants in a heated glasshouse. Nematodes were extracted from corms by suspending small sections of corm tissue on sieves in Petri dishes of water. Young taro plants, cv. Akalomamale, originating from the Solomon Islands, were planted in sterilised soil in 23 cm pots and 2 000 *H. miticausa* n. sp. were added around the base of each of four plants. Four plants were left as controls and decanted water from the nematode extraction (without the nematodes) was added to the soil of each control plant. The taro was grown for ten months in a glasshouse at an ambient temperature of 20-47° and then harvested.

At harvest, corms were cut longitudinally and examined for symptoms of damage. Roots, and plant tissues for nematode extraction from the crowns, bases and centres of main corms, and from the cormels, were macerated in a blender for 15 sec and suspended on a 90 µm aperture sieve for 48 h in a Petri dish of water. Nematodes were extracted from soil by a simplified sieving technique. Fungal isolations from the margins of corm rots were made on tap water agar and potato dextrose agar.

### Results

*H. miticausa* n. sp. was present in all corms and roots growing in soils inoculated with the nematode. All main corms and cormels infested with the nematode had thin, red-brown necrotic lesions towards the base surrounded by extensive areas of soft rot. Corms of control plants were healthy (Fig. 3).

The greatest number of *H. miticausa* n. sp. were extracted from the bases of corms associated with necrotic areas ; less occurred in the apparently healthy, white centre tissues. Few nematodes occurred in the crowns (the top 1 cm) and three of the four crowns of main corms were free of nematodes. Nematodes were also extracted from roots and very small populations of *H. miticausa* n. sp. were present in soils (Tab. 1).

Taro plants infested with *H. miticausa* n. sp. had fewer cormels and reduced total weight (Tab. 1), but main corms of these plants had considerably more

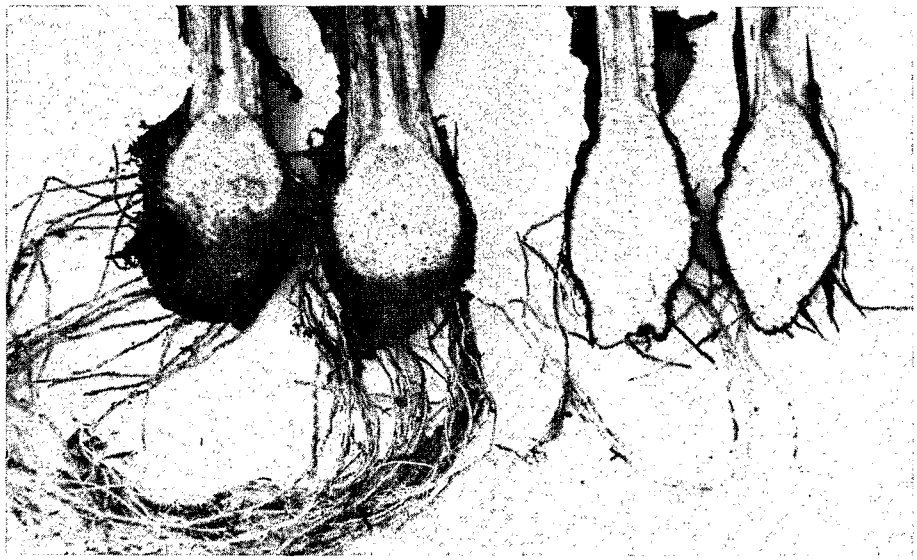

Fig. 3. Main taro corms infested with *H. miticausa* n. sp. (left) and without nematodes (right).

Table 1

Numbers of *Hirschmanniella miticausa* n. sp. and their effect on weight, number of cormels and necrosis of taro after ten months. Means of four replicates.

| *Treatment* | *Total fresh wt (g)* | *Nos cormels /plant* | *% necrosis of corms and cormels* | *Numbers of nematodes In plant tissues (10 g)* | | | | | *In soil (litre)* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Main corms* | | | *Cormels* | *Roots* | |
| | | | | *Top* | *Centre* | *Base* | | | |
| Plants with nematodes | 378.4 | 2 | 100 | 24 | 366 | 1 672 | 568 | 395 | 44 |
| Control | 594.2 | 6.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

root growth than those without nematodes (Fig. 3).

The only fungus isolated from decaying corm tissues was *Corticum solani*.

## Discussion

The results of the pathogenicity test reported here substantiate the suggestion that *H. miticausa* n. sp. is the cause of mitimiti disease of taro corms in Solomon Islands (Mortimer, Bridge & Jackson, 1981). The narrow, irregular areas of necrosis bordered by red, undecayed, corm tissues and the associated extensive rots, particularly at the bases of the corms, seen in plants inoculated with nematodes, closely resembled symptoms of the disease in field-grown plants. Nematode activity most probably predisposes the corms to invasion of secondary pathogens causing rot. No special precautions were taken to maintain axenic conditions in the pathogenicity test, and

*Corticum solani* was isolated from the areas of soft rot but no isolations were done for other organisms. In Solomon Islands, isolations made from plants affected by mitimiti disease have shown that *Pythium vexans*, *Fusarium solani* and *F. oxysporum* can occur in the decayed parts of corms whereas *C. solani* and other fungi, *P. splendens* and *P. middletoni*, occur in the roots.

Planting material infested with *H. miticausa* n. sp. is considered to be the main source of inoculum in new land. A number of methods have been suggested to control the spread of the disease including the use of hot water treatment of corms to establish nematode-free planting material, paring away decayed corm tissue and planting only the tops of corms, and making new plantings of taro above old gardens on hillsides to avoid the risk of infestation in run-off water (Mortimer, Bridge & Jackson, 1981). However, these methods cannot be used in some regions with intensive methods of taro cultivation, where traditionally planting pits are in continuous use and have now become heavily infested with *Hirschmanniella*.

Vegetative propagation of taro permits easy dissemination of the nematodes and mitimiti disease, which has spread to many areas of the Solomon Islands (Mortimer, Bridge & Jackson, 1981) ; also it has now been discovered in another country of the South Pacific. During a recent plant nematode survey of Papua New Guinea by the first author, a red rot disease of taro corms identical to mitimiti disease was identified from Taguru, near Pangia, Southern Highlands Province, and *H. miticausa* n. sp. was isolated from the diseased corms (Bridge & Page, unpubl.).

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