A Diagnostic Compendium of the Genus *Meloidogyne* (Nematoda: Heteroderidae)

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ABSTRACT: Tabular morphometric and morphological data supported by illustrations are presented to facilitate identification of 35 species of *Meloidogyne*. *M. acrita* and *M. bauruensis*, formerly subspecies, are established at a specific level, and *Hypsoperine megriensis* becomes *Meloidogyne megriensis* (Pogosyan, 1971) n. comb.

Diagnostic compendia are engendered by necessity. Addition of new species in an already large genus tends to render existing taxonomic keys obsolete. Species determination also consumes excessive amounts of time in the search for, and comparison of, diverse species descriptions.

The diagnostic compendium differs from dichotomous keys in that keys go directly to a single species using gross and finite characteristics. The compendium eliminates most species from consideration and provides one or more specific possibilities that are confirmed by the original description or descriptions using finite characteristics. Keys become obsolete the moment a species (that is not contained in the key) is described. New species can be included in the compendium table as they occur, thus preventing early obsolescence.

The principal objective of this work is to facilitate the identification of *Meloidogyne* species.

The first Meloidogyne compendium was constructed in 1966 on 5 × 7 cards. Each card included male, female, larva, and egg characteristics. New cards were prepared as new species were described. After 2 years of use, the cards were mimeographed (6), an explanation added, and the compilation sent to a number of nematologists for comment.

Whitehead (1968) published a monograph of Meloidogyne, which included an excellent literature review and contributed invaluable data to many species in the genus. In his work *M. poghossianae* described by Kiryanova (1963) was placed in *species inquirenda*.

The senior author assisted and was taught identification of *Meloidogyne* spp. by B. G. Chitwood in the years 1956–57. Chitwood's system of identification was to first diagnose the female posterior cuticular pattern characteristics, and then corroborate his diagnosis with larval, male, female, and egg characteristics. Corroboration of stages was employed in the 1966 and subsequent compendia. Whitehead came to a similar conclusion regarding stage corroboration in his analysis of the genus in the 1968 monograph.

The compendium tables presented here comprise selected data considered essential for identification of the developmental stage represented in each table. Identification criteria selection was based on the following: The structure must be readily observable (*en face* views not utilized); the structure must be easily measurable (esophageal gland measurements rejected); the measurement must be well represented by all species (anal body diameter rejected); and the measurement must be sufficiently discrete to use comparatively (male body length rejected). The criteria selected and rejected in the establishment of the tables are presented below.

Female (Table 1)

Posterior protuberance: The first consideration in female differentiation was given to the presence of a posterior protuberance on the mature female body (Fig. 1A). In most species having this character, the protuberance is pronounced and unmistakable. Posterior cuticular patterns on a protuberance are not subject to maximum cuticle stretching, therefore lateral incisures are apt to be deeper and more pronounced (Fig. 5O, N). Female tail tips also are likely to be more definitive (Fig. 5O). In *M. spartinae* (Rau and Fassuliotis, 1965; Whitehead, 1968), a well-defined tail

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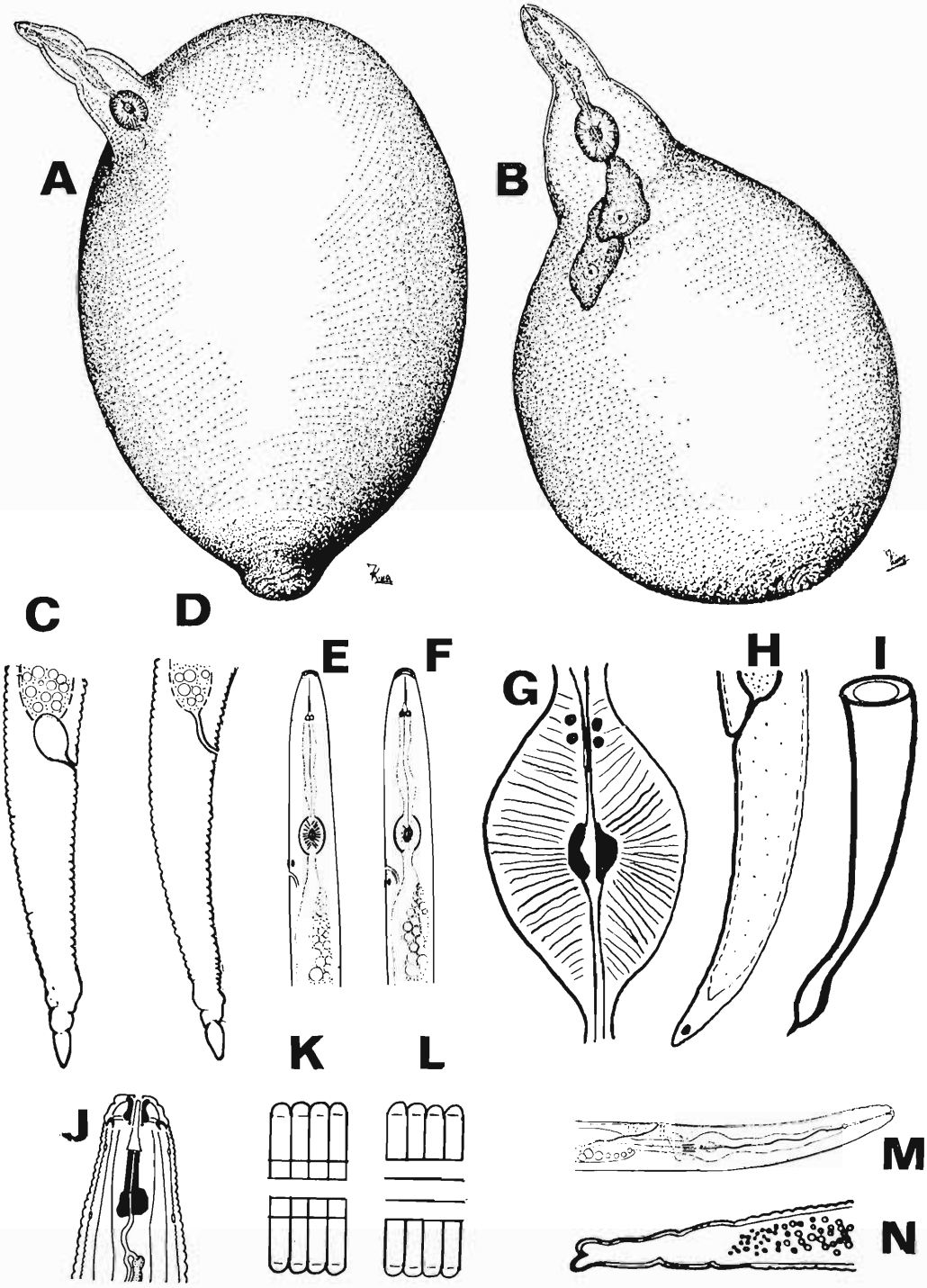
Florida Agricultural Journal Series No. 6083.

Table 1. Diagnostic characters of mature females.

Species	Posterior protuberance	Lateral incisures	Stylet length	Vulva lip striae	Perinium striae	Zone 1 striae	Zone 2 striae	Zone 3 striae	Zone 4 striae	Fig. 5	Excretory pore to stylet	Ex. pore* level in stylet lengths
mali	slight	yes	13–17	no	no	no	SBf	SBa	SBf	Z	posterior	2
*naasi***	slight	no	11–15	no	1	few	SU	SU-SBm	SBf	CC	anterior	¾
graminis	yes	yes (deep)	10(12–13)16	no	no	few	SBf	SBf	SBf	O	posterior	1
africana	yes	yes	15	yes	no	few	SBa	SBm	SBa	C	posterior	3
ardenensis	yes	weak	15–19	no	few	few	SBa	SBa	SBa	E	anterior	½
ottersoni	yes	no	10–12	no	no	no	SBa	SBm	SBm	EE	posterior	1
acronea†	yes	no	10(11–13)14	no	few	few	SBm	SBa	SBm	B	posterior	3
spartinae	yes	no	11–17	no	few	few	SBf	SBa	SU	HH	posterior	1½
megriensis	yes	no	13–18	no	few or no	few	SBa	SBa	SBa	BB	posterior	2
decalineata	yes or no	no	12–17	no	few	few	SBa	SBa	SBa	J	posterior	1½
megadora	yes or no	obscure	13–17	no	many	many	SBa	SBa	SBa	AA	anterior	½
lucknowica	yes & no	yes	15–21	no	many	many	SBf	SBf	SBf	Y	posterior	2
hapla	no	no	10(12–14)	no	no	no or few	SU or SBf	SBf	SBf	P	posterior	1½
graminicola	no	no	11	no or few	few	few	SBf	SBf	SBf	N	posterior	2½
exiqua	no	no	(11)14	no	few	few	SBa	WBa	SBf	M	posterior	2
ethiopica‡	no	no	11–15	no	few	few	SBm	SBa	SBf	L	posterior	2
artiellia	no	no	12–16	no	no	no	0	SU	SBa	F	posterior	1¾
oteifae	no	no	13–14	yes	yes	many	SBm	SBa	SBa	DD	posterior	1
incognita	no	no	15–16	no	no	no or few	WBf	WBf	WBf	Q	posterior	1
arenaria	no	no	14–16	no	few or no	few	SBf	SBf	SWBm	D	posterior	2
inornata	no	no	15–17	no	few	few	SBm	SBa	SBm	S	posterior	2½
coffeicola	?	no	15–18	no	SUa	SU	SU	SU	SU	I	posterior	1½
acrita	no	no	16	no	no	few	SBf	SBf	SBf	A	?	?
deconincki	no	no	16–20	no	few	few	SBa	SBm	SBf	K	anterior	½
ovalis	no	no	17–24	no	no	few	SU	SU	SU	FF	posterior	1½
brevicauda	no	no	17(22)25	no	SUm	many	SU	SBm	SBf	H	anterior	½
indica	no	sometimes	12–16	no	many	many	SBm	SBm	SU	R	posterior	1
lordelloi	no	yes	12–15	no	SBa	many	SBm	SBm	SU	X	posterior	4
kirjanovae	no	yes	13–15	no	many	many	SBf	SBf	SU	V	?	?
kikuyensis‖	no	yes	14–16	no	few	many	SBa	SBf	SBf	U	posterior	2
javanica	no	yes	14(16)18	no	1 or 0	few	SWf	SWf	SBf	T	posterior	2½
bauruensis	no	yes	14(15–17)18	no	no	few	SBm	SWf	SWBf	G	anterior	½
litoralis	no	yes	14–18	yes	few	few	SBm	SBf	SBf	W	anterior	½
tadshikistanica	no	yes	15	yes	many	many	WU	SU	SU	II	?	?
thamesi	no	yes	15–18	no	no	few	SBf	SBf	SBf	JJ	?	?

CODE: *S* mooth; *W* avy; *U* nbroken; *B* reaks; *f* ew; *m* oderate; *a* bundant.
* Stylet lengths measured from apex of head.
** Phasmids conspicuous.
† Posterior cuticular pattern very obscure.
‡ Posterior cuticular pattern analysis based on photos in Whitehead (1968).
‖ Lateral vulva cheeks.



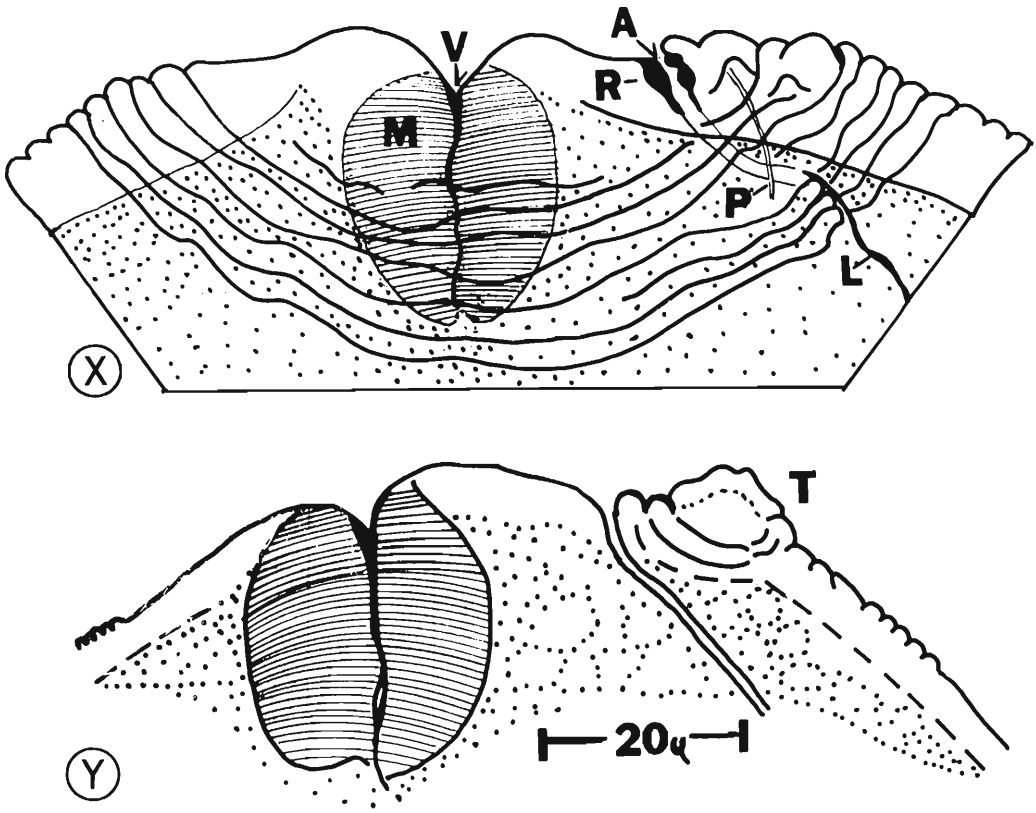


Figure 2. *M. arenaria* (Neal, 1889) (Chitwood, 1949) (X), nonprotuberant posterior region of a mature female: A. Anus; L. Lateral incisure; M. Muscular area of vagina; P. Phasmid lumen; R. Rectum; and *M. spartinae* (Y), protuberant posterior region of a mature female. T. Tail.

tip was seen in a lateral view (Fig. 2Y). In some posterior cuticular patterns of this species the tail appeared as a small round balloon. The set-off tail resembled that of *M. poghossianae* (Fig. 5GG). Other specimens had less defined but definite protuberant tail remnants.

LATERAL INCISURES: The presence or absence of lateral incisures usually is a strong differentiating character. Occasionally some weak incisures will be seen in a posterior cuticular pattern of a species where such lines normally do not occur. One must guard

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Figure 1. Selected diagnostic morphological characteristics: A. Mature *M. graminis* with vulva on a protuberance. B. *Meloidogyne* sp. without vulva on a protuberance. C. Larval tail with dilated rectum. D. Larval tail with undilated rectum. E. Larvae with hemizonid anterior to excretory pore. F. Larvae with hemizonid posterior to excretory pore. G. Vesicles in metacorpus of *M. naasi* larva. H. *Subterminal spot on tail tip of *M. africana* (Whitehead, 1959). I. Inflated tail tip of *M. spartinae*. J. *M. megadora* Whitehead, 1968, male with indented telorhabdions. K. Lateral fields areolated. L. Lateral fields not areolated. M. Minute telorhabdions of *M. hapla* (Chitwood, 1949) larva. N. Bifid tail tip of *M. thamesi* (Chitwood in Chitwood, Specht and Havis, 1952).

* Thought to be a phasmid in the original description.

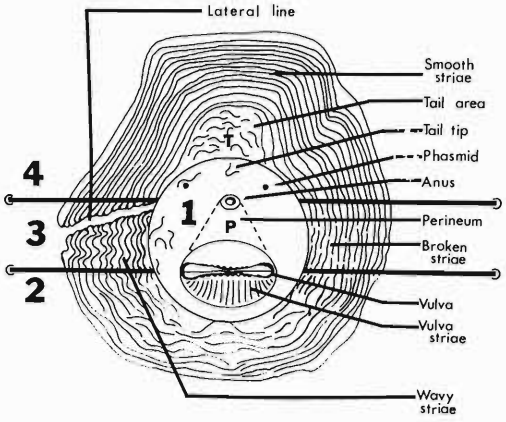

Figure 3. Schematic posterior cuticular pattern, P = perineum, T = tail area. 1. Zone 1: area in pattern center containing perineum and adjacent area usually free of continuous striae; 2. Zone 2: striated area just below (anterior to) vulva; Zone 3: striated area lateral to but bounded by perineum; Zone 4: striated area above (posterior to) anus and tail area.

against the interpretation of folds in the posterior cuticular pattern as lateral incisures.

STYLET LENGTH: Stylet length ranges are rather narrow, and 25 of 36 species fall within a single range. They have, however, some use as a supporting character. In Table 1, stylet lengths are presented in increasing order of magnitude within each equiponderant lateral incisure group.

VULVA LIP STRIAE: Five species have this feature (Table 1). A few lip striae were observed on two specimens of *M. graminicola* (Golden and Birchfield, 1965). Several other specimens of the same species did not have vulva lip striae.

POSTERIOR CUTICULAR PATTERN: Original descriptions contain detailed information concerning striae development and modifications, each peculiar to itself. No attempt is made in this work to include such data due to interpretive diversity. In the final diagnostic step the posterior cuticular pattern under study should be compared with the pattern in the original description. Whenever possible, each species in this work is represented by a posterior cuticular pattern illustration from the original description. A single pattern illustration can rarely represent the variation that occurs in a single population but, it can serve as a guide in the analysis. An unsuccessful attempt was made to utilize morphometric procedures in pattern interpretation. Anus vulva distance, vulva width, and anus vulva width times distance from the anus to the apogee of the pattern were considered. Intraspecific variability in these measurements and anal obscurity in some species negated the attempt. Using any pattern perimeter side as a point of reference is questionable since such boundaries under oil immersion are not clearly defined.

To utilize the features of the posterior cuticular pattern more effectively it was divided into 4 definitive zones (Fig. 3). The first area is the perineum within Zone 1 which is defined in this work as the triangle formed by the anus and the vulva slit (Fig. 3P). Zone 1 (Fig. 3) is a roughly circular area in the center of the pattern usually free of continuous striae. Striae of Zone 1 are usually few, broken, and scattered. Zone 2 (Fig. 3) is the area under (anterior to) the vulva, and specifically refers to the mass or band of striae directly below (anterior to) the perineum. Zone 3 encompasses the group of striae lateral to the perineum (Fig. 3). Zone 4 is that group of striae above (posterior to) the anus. The tail area (Fig. 3T) is a roughly circular area just above the anus characterized by the tail and short broken striae. Tail area is not considered in pattern striae analysis. When lateral incisures are present they should be considered as discrete structures and not broken striae in the analysis.

Analysis of patterns revealed that certain characteristics of each zone could be of value in differentiating patterns. Absence of striae in the perineum (Fig. 5C, O, Z); presence of a single striae (Fig. 5CC); presence of many Zone 1 striae (Fig. 5H, R, AA, DD); unbroken Zone 2 striae (Fig. 5H, I, FF); wavy Zone 3 striae (Fig. 5G), and abundant breaks in Zone 4 striae (Fig. 5AA, CC) are all useful in the analysis of patterns. Some patterns have individual characteristics, such as the pronounced phasmids in *M. naasi* (Franklin, 1965) (Fig. 5CC), obscurity of the *M. acronea* Coetzee, 1956, pattern, sparseness of inner striae in *M. artiellia* Franklin, 1961 (Fig. 4), and the pronounced lateral cheeks in *M. kikuyensis* (DeGrisse, 1960) (Fig. 5U).

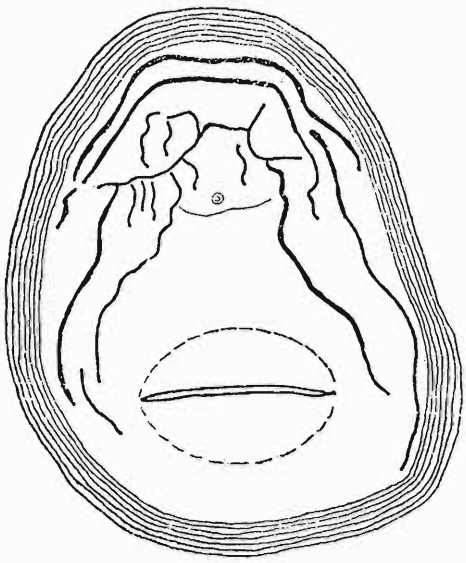

Figure 4. Posterior cuticular pattern of *M. artiellia* showing coarse inner striae, fine outer striae, and an absence of inner striae in Zone 2.

An analysis of pattern zones is presented in Table 1, which complements the basic female morphometric data. Two types of striae are considered. First is the prominent, usually coarse striae that comprises nearly all of the posterior cuticular pattern (inner striae) (Fig. 4). Second is the perimeter of fine, usually unbroken striae (outer striae) (Fig. 4) that surrounds most inner striae. In *M. artiellia* (Fig. 4) outer striae predominate. Inner striae in this species are represented by a few coarse lines in the anterior two-thirds of the pattern; Zone 3 area is almost all outer striae. The circular sclerotized pre-anal part of the rectum (Fig. 2R, 3P, 4A) is the best point of reference for the perineum, since the actual anus appears as a thin ill-defined slit often not apparent in a posterior cuticular pattern.

EXCRETORY PORE:[1] The excretory pore of the female lies anterior to the telorhabdions in seven species (Table 1). Position of the excretory pore should serve as a good corroborating character in the analysis. It is best seen in freshly prepared specimens. In Table 1 an excretory pore value of ½ means the pore is at the level of ½ the stylet length from the head apex. A value of 1 indicates the pore opens just behind the telorhabdions and a value of 3 means the pore lies 3 stylet lengths from the head apex.

REJECTED CRITERIA: Body length and alpha measurements were omitted due to excessive variation. Beta was excluded from all tables due to the difficulty and unreliability of esophageal gland measurements. Dorsal gland orifice (DGO) distance from the telorhabdion base was rejected due to overlap in a restricted range. Twenty-nine species had a DGO of 4 μ within their range.

Male (Table 2)

Stylets are presented in increasing magnitude of lower range length.

Dorsal gland orifice, spicule length, and head annules are useful to corroborate the analysis. The head annule number is subject to morphological clarification, intraspecific variation (Whitehead, 1968) and differences in observer interpretation so its utilization as a differentiating character is rejected. Lateral lines and areolation (Fig. 1K, L) are definitive and easily seen and can therefore be used with some degree of reliability. The hemizonid of *M. spartinae* only was located posterior to the excretory pore.

REJECTED CRITERIA: Length, alpha, and gamma of males were omitted due to the extreme range length. Males of 33 species had an average variation between minimum and maximum length of 662 μ. The maximum variation between minimum and maximum length was 1,947 mm in *M. kirjanovae* (Terenteva, 1965). Such extremes expand alpha and gamma ranges to impractical limits.

Larvae (Table 3)

BODY LENGTH: Larval length was selected as the starting point in the table and larvae were placed in increasing magnitude of lower range length.

RECTUM DILATION: This character (Fig. 1C) is readily seen with an oil immersion objective in live specimens, and is considered a strong point in the diagnosis. Fixation procedures tend to obscure this character.

[1] Suggested usage as a differentiating character by A. M. Golden.

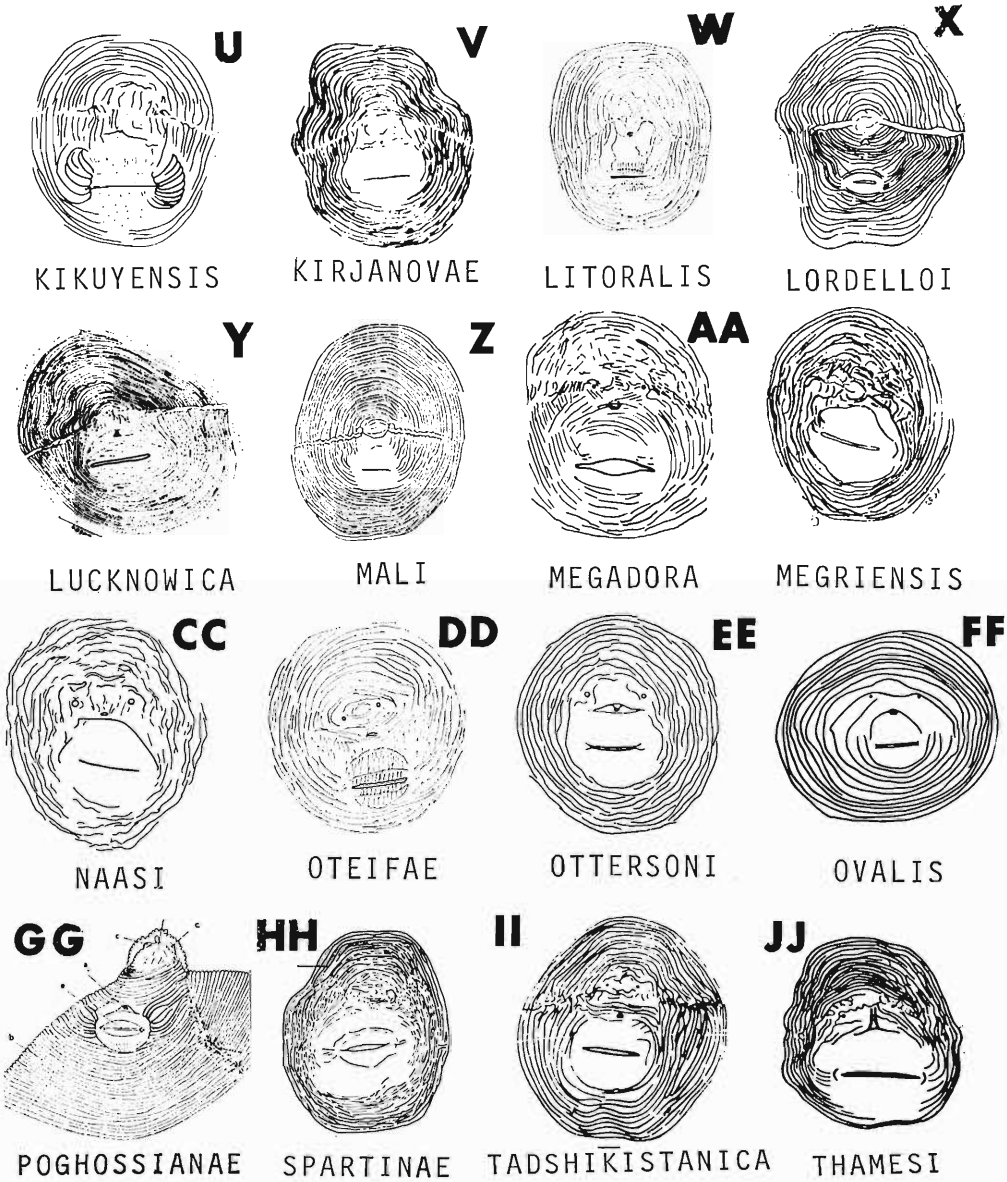

Figure 5. A–JJ Posterior cuticular patterns of the genus *Meloidogyne*. Illustration credit B,J,L,N,P,R, and AA from Whitehead, 1968; C, Whitehead, 1960; D, Santos, 1967; E,Q,T, and JJ, Chitwood, 1949; G, Lordello, 1956 (redrawn); H, Loos, 1953; I, Lordello and Zamith, 1961; K,W,DD, Elmilgy, 1968; M, Lordello and Zamith, 1958; S, Lordello, 1956; U, Grisse, De, 1960; V, Terenteva, 1965; X, Ponte, 1969; Y, Singh, 1969; Z, Itoh, Ohshima, and Ichinohe, 1969; DD, Pogosyan, 1961; CC, Franklin, 1965; EE, Thorne, 1969; FF, Riffle, 1963; GG, Kirjanova, 1963; HH, Rau and Fassuliotis, 1965; II, Kirjanova, and Ivanova, 1965.

Table 2. Diagnostic characteristics of *Meloidogyne* males.

Species	Stylet	Dorsal gland orifice	Spicule length	Lateral Incisures		Head annules
				no.	areolated	
megriensis	13–18	3–4	23–30	4–6	no	2
ottersoni	14–16	?	19–23	4–5	yes	2
ethiopica	14–24	2	29–36	4–5	yes	2
lucknowica	15–24	?	?	6	no	1
graminicola	16–17	3–4	27–29	4–8	yes	2
naasi	16–19	2–4	25–30	4	yes	3
acronea	(16–18)20	2–7	24(32–34)36	4	yes & no	1
kikuyensis	17–20	5–6	31–35	4	yes	1
spartinae	17–21	4–7	25–40	4	no	?
hapla	(17–18)23	3(4–6)	22(29–31)	4	no	2
ardensis	17–24	3–4	28–38	4–5	yes	4
artiellia	17–27	5–7	25–30	4–5	no	1
indica	18	?	?	4	yes	2
*exigua**	18–20	3	(20–26)27	4	yes	1
graminis	(18–19)21	(2–3)5	21(28–29)30	4	no	1
mali	18–22	6–13	28–35	4	(tail only)	1
*megadora***	18–22	4–8	25–36	4–6	yes	1
ovalis†	(18–23)25	3–5	31–38	4	no	2
decalineata	19–20	4	33–37	10	no	2
africana	19–22	4–6	26–35	5	yes	?
oteifa	19–23	3–4	29–37	4–5	yes	2
litoralis	19–24	4–5	29–33	5	yes	3–4
javanica	20–21	3	30–31	4	no	3
bauruensis	20–23	3–4	28–33	4	yes	2
arenaria	20–24	4–7	31–24	4	yes	2
brevicauda	(20–21)24	5–8	30(34–43)	4	yes	1
acrita	20–24	2–4	29–34	4	?	3
kirjanovae	20–24	2–3	28–36	4	no	1
inornata	20–25	4–5	27–33	4–5	yes	2
thamesi†	21–28	3	22–28	4–6	yes	2
tadshikistanica	22–25	5	27–37	4	no	4
deconincki	22–28	5–7	29–37	5	yes	1–2
coffeicola	23–26	4–5	20–29	4–5	yes	1
incognita	(23–26)33	1(2–4)	29(34–36)40	4	yes & no	3
lordelloi	Males unknown					

* Body untwisted.
** Telorhabdions indented (Fig. 1J).
† Telorhabdions asymmetric.

HEMIZONID: Hemizonid position (anterior or posterior) to the excretory pore is considered a strong larval characteristic.

Alpha, gamma, and stylet length are considered corroborating characters, but stylet length might be untrustworthy since one rarely knows at what point anterior to the telorhabdion base the original measurements were made. A suggestion is made that future describers of species in this genus measure from the telorhabdion base to the top of the head as a stylet measurement and state the procedure in their methodology.

Lateral line number and areolation were omitted due to the difficulty in seeing these structures in larvae. Measurements of the dorsal gland orifice distance posterior to the stylet base were omitted since little change occurred in this measurement among 35 species.

Diagnosis

SPECIMEN REPRESENTATION: Prior to analysis it should be ascertained that sufficient larvae and females are available to make an adequate diagnosis (at least 10 each). Males confirm the diagnosis but are not essential to all identifications.

Table 3. Diagnostic characteristics of *Meloidogyne* larvae.

Species	Length	Rectum	Hemizonid to excretory pore	Alpha	Gamma	Spear
exigua	289(334–359)370	undilated	?	(22–26)29	7–8	9(11)
kikuyensis	290–360	undilated	anterior	17–23	10–12	12–15
artiellia	301(334–370)	undilated	anterior	20(22–26)	(13–16)21	10(14–16)
ovalis	302(350–430)	undilated	anterior	19(21–24)	8–9	9–12
hapla	312(395–466)*	undilated	anterior	20(28–35)	7(8)10	8(10)11
oteifa	320–400	undilated	anterior	22–29	8–9	11–13
litoralis	330–450	undilated	?	19–30	10–12	11–15
coffeicola	337–424	undilated	?	22–25	10–14	9–11
lordelloi	340–380	?	?	25–28	?(Anus obscure)	10–11
deconincki	340–400	undilated	anterior	27–33	7–10	10–11
javanica	340–400	d or u	anterior	24–26	6–7	10
bauruensis	345–352	undilated (obscure)	?	23–29	7–11	11–12
acrita	345–396	undilated	anterior	22–28	7–8	10–11
tadshikistanica	350–435	undilated	?	32	9	12–15
acronea	354(440–460)	undilated	anterior	22(32)35	8(9)11	10(12)
megriensis	358–467	?	?	19–26	6–8	13–15
kirjanovae	359–433	?	?	20–30	6–8	11
incognita	360–393	d	anterior	29–33	8–9	10
ardenensis	372–453	undilated	posterior	22–32	9–12	9–14
*inornata**	375–420	obscure	?	28–36	12–13	10–13
africana	380–470	undilated	?	22–28	7–14	12–18
indica	381–448	undilated	?	?	21–31	10–14
ethiopica	383–432	dilated	anterior	29–35	8–10	9–11
mali	390–450	undilated	?	27–31	12–15	12–15
graminis	409(420–510)	d or u	posterior	24(29–34)	(6–7)8	10(12–13)
*thamesi***	410–476	dilated	posterior	30–38	8–9	10–13
lucknowica	410–575	dilated?	?	21–37	9–14	11–18
megadora	413–548	undilated	anterior	23–33	8–11	11–13
graminicola	415–484	undilated	anterior	22–27	6–7	11–12
naasi†	418–465	undilated	anterior	25–32	6	13–15
ottersoni	430–500	undilated	anterior	23–30	?	13–15
arenaria	450–490	d or u	?	26–32	6–8	10
brevicauda	460–590	undilated	anterior	23–33	21–29	(14)16
decalineata	471–573	undilated	anterior	33–40	10–12	11–14
spartinae‡	612–912	u(obscure)	posterior	43–65	7–9	14–17

* Telorhabdions minute (Fig. 1M).
** Bifid or trifid tail (Fig. 1N).
† Vesicles in metacorpus (Fig. 1G).
‡ Swollen spiked tail tip (Fig. 1I).

SPECIMEN CONDITION: Diagnostic characters and measurements of males and larvae should be taken from living nematodes or specimens shortly after a gentle death. Immobility in a natural state can be achieved in two ways. Live specimens in water under a coverslip sealed with Zut attain quiescence in about 10 min (Esser, 1973). Specimens mounted in 2% formaldehyde cease movement in a few minutes. In either case all data should be taken within an hour. Within a few hours deterioration characters such as the inflated rectum, hemizonid position, and dorsal gland orifice become obscure. Twenty-four hours after either treatment, striae will be more definitive, and lateral lines and areolation interpretation will be facilitated.

Female criteria can be taken from live or fixed specimens. Galled roots cut up and blended in 100 cc of water for 10–20 sec (succulent tissue), or 30 sec to 1 min (woody tissue) yield cleaned female cuticles with excellent posterior cuticular patterns. When females are abundant 10 to 20 females, either entire specimens or cuticles, may be placed in a small drop of water and an 18 mm coverslip dropped thereon. Three to six excellent fresh posterior cuticular patterns are often obtained in this manner, and female stylet and excretory pore measurements also can be made. When feasible, it is advisable to take posterior cuticular pattern, spear, and excretory pore data from the same specimen. Two or more species of root-knot nematodes may appear on a single root. *M. graminis* (Sledge and Golden, 1964; Whitehead, 1968) and a different species of root-knot have been found side-by-side on roots of St. Augustine grass. *M. graminis* egg masses were yellow and located inside the junction of a branch root. The other species produced a white egg mass at an unbranched root site. In cases where posterior cuticular patterns or larval characteristics show wide variation, mixed populations should be considered.

IDENTIFICATION PROCEDURE: It is suggested that data be taken in the sequence presented in Tables 1, 2, and 3 for each specific stage. For example in Table 3 (larva) length, rectum dilation, hemizonid, alpha, gamma, and stylet length should be recorded in that order. Larva characteristics are the starting point for identification. The diagnostic data of the larval species under analysis is checked with Table 3. This comparison should eliminate all but a few species for the final specific diagnosis. Original descriptions of the species delineated by analysis with Table 3 should be consulted in conjunction with mounted posterior cuticular patterns of the species under diagnosis. Final analysis will be facilitated by utilizing the data in Table 1. If males are present, characteristics of this stage should be used in confirming the diagnosis.

Writing the proper measurements and data horizontally on a paper slip to match the tabular presentation is the easiest method to utilize the compendium tables.

TAXONOMIC CONSIDERATIONS: Whitehead (1968) considered *M. incognita acrita* Chitwood, 1949, a synonym of *M. incognita incognita* Chitwood, 1949. The present authors believe Chitwood erred when he established *M. incognita* var. *acrita* as a variety rather than a species, thereby engendering research and conjecture regarding its validity as a discrete taxon. Terenteva (1967) utilizing variational statistics showed that the two subspecies were discrete. Separation was based on anal vulva plate, stylet head shape, and head height in males; 5.75–8 μ in *M. incognita incognita* and 5.2–6 μ in *M. incognita acrita*. Dr. Chitwood (pers. comm.) considered the undilated rectum of *M. incognita acrita* larva the principal diagnostic character that distinguished it from *M. incognita incognita*. He also separated posterior cuticular patterns of the two species on the basis of striae coarseness. *M. incognita acrita* usually has relatively coarse striae (Fig. 5) and *M. incognita incognita* has fine (close together) usually wavy striae. The difference is well illustrated by Sasser (1954). *M. incognita acrita* also has a smaller alpha and gamma (Table 1) and the male has a smaller spicule (Table 3). Based on these criteria all of which are contained in the original description, *M. incognita* is considered a discrete species (Article 50b, c of the International Code (31)). Chitwood's *M. incognita acrita* is herein recognized and elevated to full specific rank as *M. acrita*. According to Dr. A. M. Golden (pers. comm.) the hololectotype female of *M. acrita* is contained in the USDA nematode collection at Beltsville, Md. (Slide T–268t) in addition to 12 paralectotype slides.

Whitehead (1968) also synonymized *M. javanica bauruensis* (Lordello, 1956) with *M. javanica* (Treub, 1885; Chitwood, 1949). In this work *M. bauruensis* is considered a discrete species based on areolation in the lateral fields of the male, two male head annules, a larger larval gamma, and a difference in appearance of the gross posterior cuticular pattern (Fig. 5G, T).

Following Whitehead's (1968) synonymy of *Hypsoperine* to *Meloidogyne*, *Hypsoperine megriensis* (Pogosyan, 1971) is hereby placed in the genus Meloidogyne as follows: *M. megriensis* (Pogosyan, 1971) n. comb. Syn. *H. megriensis* (Pogosyan, 1971).

M. carolinensis (Fox, 1967) has not yet been properly published according to articles 7, 8, and 9 of the International Code (Stoll et al., 1964).

Acknowledgment

The authors wish to express appreciation to M. W. Brzeski for assistance with species descriptions in Russian; to A. DeGrisse, Mary Franklin, A. M. Golden, J. J. de Ponte, and A. Santos for furnishing specimens or other materials used in this study; and to A. M. Golden, R. H. Mulvey, and A. Weiner for helpful suggestions utilized in this work.

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In Memoriam

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Member since 1927
President 1937–1938
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