Development of Meloidogyne hapla in Peanut

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ABSTRACT

The development of *Meloidogyne hapla* in *Arachis hypogaea* 'Spantex' was studied in a controlled environment chamber on a 16-hr day, 28-20 C regime. Larvae remained vermiform up to 5 days after inoculation. Enlargement began on the sixth day and on the eighth day a hemispherical posterior end, terminated by a spike had developed. The second (first parasitic) and third molts of the earliest-developed larvae were observed on the 11th and 12th day after inoculation, respectively. On the 13th day a few nematodes had already completed the fourth molt and had shed the molted cuticles. Oviposition occurred in 23 days, and infection by second generation larvae was observed after 39 days.

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Additional key words: root-knot, *Arachis* spp., nematode development.

Studies on the development of root-knot nematodes have been reported and reviewed (2, 4). Although the pattern of development of these nematodes, as a group, is fairly well understood, knowledge of the life history of each species is still inadequate.

In snapdragon, oviposition and infection by second generation larvae of *Meloidogyne hapla* occurred at 20.4 C in 30 and 68 days, respectively (6, 7). In tomato, these stages occurred in 39 and 63 days after inoculation (6).

At temperatures ranging from a nightly minimum of 11.1 C to a daily maximum of 40.5 C, the onset of parasitic molts of *M. javanica* and *M. hapla* occurred as early as the 14th day after inoculation in tomato (2). Bird believed that the three parasitic molts occurred within about 3 days and oviposition started on the 29th day (2).

No report on the development of *M. hapla* in peanut has been made. This study involves determination of stages and developmental groups in the life cycle of *M. hapla* in peanut.

MATERIALS AND METHODS.—*Arachis hypogaea* L. 'Spantex', susceptible to *M. hapla* Chitwood, was used in this study. Plants were grown singly in the greenhouse in 180-ml paper cups that contained methyl bromide-sterilized soil. After 2 weeks, an aliquot suspension containing ca. 1,000 freshly hatched *M. hapla* larvae was poured on the exposed roots of each plant. The plants were grown in a controlled environment chamber on a 16-hr day/8-hr night, 28-20 C regime with 3,500 ft-c light intensity throughout the study. A 2-day penetration period was allowed in all plants, except for the one-day treatment. After these periods, root systems were washed to remove larvae that had not penetrated, and the plants were transplanted in 10-cm diam pots containing sterile soil. At daily intervals up to 40 days, one plant was removed to determine nematode development. The entire root system of plants removed 1 to 10 days after inoculation were fixed in triethanolamine-formalin and stained by McBeth's acid fuchsin technique (5). Only the galled portions of roots removed after 10 days were observed. Stained root portions were crushed between glass slides and nematode development determined by microscopic examination. The nematodes, adult males included, were placed in developmental groups following Christie's (3) procedure. In the first trial, stained nematodes in roots that had been infected for 1-21 days were dissected out at daily intervals. The nematodes were mounted in glycerine by Baker's (1) method and examined to determine molting periods. At least 10 nematodes were examined for each day interval, but only the most advanced stage was recorded. The experiment was replicated four times.

RESULTS.—All larvae were vermiform until the fifth day. They began to enlarge on the sixth day and on the eighth day had acquired a hemispherical posterior end which was terminated by a spike. The second (Fig. 1 A-C) and third (Fig. 1D) molts of the earliest-developed larvae were observed on the 11th and 12th day after inoculation, respectively. The tail spike was lost after the second molt (Fig. 1B), except in one larva (Fig. 1C). A few nematodes had completed the fourth molt and shed the molted cuticles on the 13th day.

Group A nematodes of the first generation were recovered through the 31st day. Group B nematodes first appeared 8 days after inoculation and persisted through the 39th day. Nematodes in groups C, D, and M were observed as early as the 13th, 18th, and 19th day, respectively. Group E nematodes were first noted on the 23rd day and infection by second generation larvae was observed in 39 days.

The number of group A nematodes was highest in 6 to 10 days, decreased continuously through 31 to 35 days and then increased in 36 to 40 days with the appearance of the second generation larvae (Table 1).

Group B nematodes were most abundant in 11 to 15 days, after which they decreased continuously until the termination of the experiment. Both group C and D nematodes increased through 21 to 25 days, then decreased. Group M nematodes increased through 31 to 35 days and decreased after 36 to 40 days. Group E nematodes were increasing when the experiment was terminated. Nematode recoveries ranged from 4.0 to 10.7% of the original number of nematodes inoculated.

DISCUSSION.–Some workers (2, 6, 7) have dealt with the development of *M. hapla*, but none determined stages by cuticle counts, duration of developmental groups, and life cycle length. In this

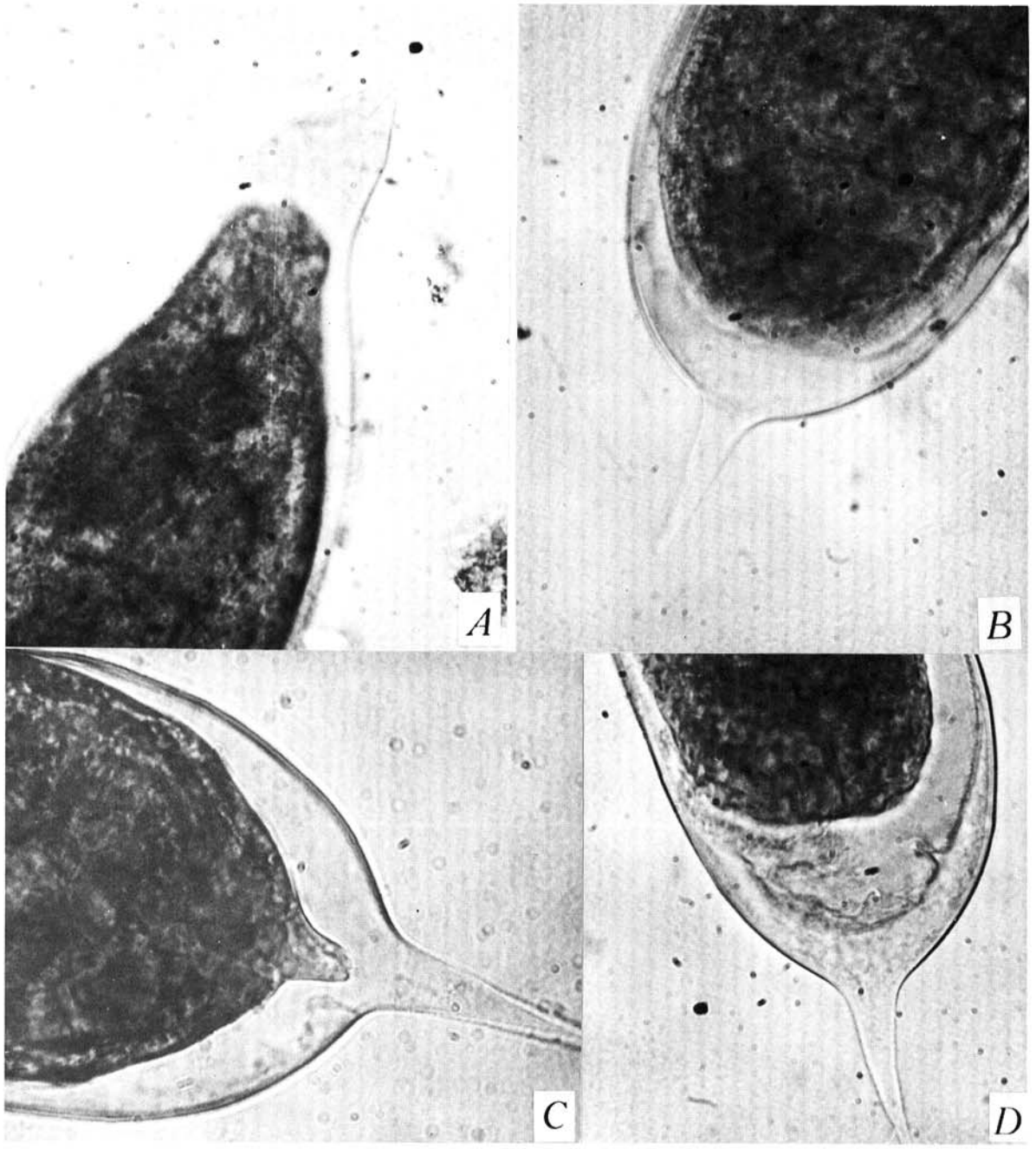

Fig. 1. A-D) Third stage larvae. Note the one molted cuticle. **A)** Head portion; **B)** Tail portion with cuticle of the third stage without a tail spike; **C)** Tail portion with cuticle of the third stage with a tail spike; **D)** Tail portion of fourth stage larva. Note the two molted cuticles.

TABLE 1. Development of *Meloidogyne hapla* on *Arachis hypogaea*[a]

Days after inoculation	Developmental group						Total
	A	B	C	D	M	E	
1 to 5	40.3	0	0	0	0	0	40.3
6 to 10	72.0	9.2	0	0	0	0	81.2
11 to 15	9.2	96.0	2.5	0	0	0	107.7
16 to 20	2.8	44.9	16.8	4.4	0.1	0	69.0
21 to 25	1.2	32.8	22.8	36.7	6.9	1.4	101.8
26 to 30	0.5	9.5	10.5	31.0	8.6	27.8	87.9
31 to 35	0.4	2.1	2.8	26.1	9.2	42.5	83.1
36 to 40	7.3	0.1	1.9	13.6	6.3	46.4	75.6

[a] Values are average recoveries from 20 plants examined during the five-day period indicated.

study the parasitic molts of the earliest-developed larvae occurred within 3 days, and the third and fourth molts after 11 and 12 days, respectively. The third and fourth molts occurred within the cuticle shed during the second molt. These findings agree with those of Bird (2) on *M. javanica* and *M. hapla*. However, the molts occurred earlier in peanut than in tomato (2). Recovery of egg-laying females took place earlier than was reported on tomato (2, 6) and snapdragon (6, 7). These variations were probably due to the differences in the experimental conditions and suitability of the host plants.

Plant resistance or susceptibility to root-knot nematodes is usually based on both plant reaction and nematode development. This study provides further criteria for the evaluation of resistant responses of peanut to *M. hapla* and increases our understanding of peanut-*M. hapla* host-parasite relationships.

LITERATURE CITED

1. BAKER, A. D. 1953. Rapid method for mounting nematodes in glycerine. Can. Entomol. 85:77-78.
2. BIRD, A. F. 1959. Development of the root-knot nematodes Meloidogyne javanica (Treub) and Meloidogyne hapla Chitwood in the tomato. Nematologica 4:31-42.
3. CHRISTIE, J. R. 1946. Host-parasite relationships of the root-knot nematode, Heterodera marioni II. Some aspects of the host on the parasite. Phytopathology 36:340-352.
4. CHRISTIE, J. R., & G. S. COBB. 1941. Notes on the life history of the root-knot nematode Heterodera marioni. Helminthol. Soc. Wash., Proc 8:23-26.
5. MC BETH, C. W., A. L. TAYLOR, & A. L. SMITH. 1941. Note on staining nematodes in root tissues. Helminthol. Soc. Wash., Proc. 8:26.
6. TARJAN, A. C. 1952. Life histories of the root-knot nematodes. Phytopathology 42:20 (Abstr.).
7. TARJAN, A. C. 1952. Comparative studies of some root-knot nematodes infecting the common snapdragon, Antirrhinum majus L. Phytopathology 42:641-644.