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ABSTRACTS OF PAPERS PRESENTED AT THE EIGHTEENTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS SALT LAKE CITY, UTAH JULY 23-26, 1979

Meeting dedicated to the memory of Professor Gerald Thorne, a native of Utah

ANDERSON, R. V., and K. RAMSEY. *Temperature as a niche dimension decreasing competition in populations of bacteria-feeding nematodes.*

Laboratory, and Veterinary Medicine, Colorado State University, Fort Collins, Colorado 80523.

The effects of temperature on reproduction, size, and population growth was investigated for six species of bacteria-feeding nematodes. Four of the species (*Mesodiplogaster lheritieri, Acrobeloides* sp., *Pelodera* sp., and *Caenorhabditis* sp.) were cohabitants of the rhizosphere of blue grama grass from which they were isolated. These nematodes were obtained from a comparatively xeric shortgrass prairie in northeastern Colorado. A second *Pelodera* sp. was isolated from revegetation plots over spent oil shale in arid northwestern Colorado. The sixth species, *Rhabditis,* was isolated from a xeric phase of a mixed-grass prairie in southwestern Montana. The growth response of these nematodes was determined at six temperatures between 10 and 35 C. The temperature for optimum reproduction and growth differed significantly between the species. *Pelodera* sp. reached highest population densities at 10 C and had a relatively narrow range of temperature tolerances. The Montana *Rhabditis* sp. was most productive at 35 C and also had a narrow tolerance range. The other species were most active at about 25 C. Tolerance ranges varied, however, from very wide for *M. lheritieri* to quite narrow for *Acrobeloides* sp. Optimum temperatures differed considerably between cohabiting species. The range of thermal optima may decrease competitive interactions among nematodes with similar food and habitat preferences.—*Natural Resource Ecology*

BALDWIN, J. G., and A. H. BELL. *A new genus of Tylenchida possessing some morphological characters of Tylenchorhynchidae and others of Hoplolaimidae.*

Specimens were examined with the light and scanning electron microscope (SEM) to determine morphological relationships of a new genus, comprising at least six species, with other Tylenchida. Specimens were fixed in 5% formalin and infiltrated with glycerin for observation with the light and SEM. Esophageal glands of individuals of the new genus comprise a basal bulb similar to that of Tylenchorhynchidae, but the strong ventral curvature of each relaxed specimen, a short tail with phasmids near the level of the anus, and a dorsal gland orifice relatively distant from the stylet, resembles Hoplolaimidae. With SEM, a common pattern of the lip regions was observed for the six species. The pattern closely resembles that of *Aphasmatylenchus* and other Hoplolaimidae but has little resemblance to patterns observed in Tylenchorhynchidae. The oral opening of individuals of the new genus is slitlike, with a parallel row of three conspicuous apertures of the labial sensillae on each lateral side. The labial disc is large and nearly round, with an obscure slitlike amphidial opening at each lateral edge. The most anterior lip annule, about one-fifth of the diameter of the labial disc, comprises two subdorsal,

two subventral, and two slightly smaller lateral sectors. These observations support inclusion of the six species in a single genus in the Hoplolaimidae.—*Department of Nematology, University of California, Riverside, California 92521.*

BARKER, K. R., and F. A. TODD. *Potential of root-gall and root necrosis indices for estimating losses of tobacco caused by Meloidogyne species.*

Data from 12 years of field experiments and 2 years of microplot tests were analyzed to relate tobacco yield losses to root galling and/or necrosis from *Meloidogyne* species. Disease indices (0–100) are based on percentage of roots galled or necrotic shortly after final harvests. Regression analyses of microplot data in a loamy sand (91% sand, 3.3% clay and 5.7% silt) with *M. incognita, M. hapla, M. arenaria,* or *M. javanica* indicated that tobacco yield decreased linearly with disease indices. In 1976, initial numbers of a given species (P_i) of 0, 750, 1,500, and 3,000 eggs and larvae/500 cm³ of soil resulted in a 7.5% yield loss for each 10% increment of root galling [$\hat{Y}$ = 517.5 grams – 3.89 X; r = –0.95**]. The linear regression was similar in 1977, with P_i's ranging from 0 to > 6,000/500 cm³ of soil [$\hat{Y}$ = 504 grams – 3.30 X; r = –0.89**]. Root necrosis indices were also correlated negatively with yield [1976: $\hat{Y}$ = 466.6 grams – 3.60 X; r = –0.89**; 1977: $\hat{Y}$ = 449.8 grams – 4.0 X; r = –0.92**]. The limited root necrosis in *M. hapla*–infected roots significantly affected the slope (flattening) and intercept of the regression across the four species. Root-gall indices from nematicide tests were also correlated significantly with yields; e.g., in a field test near the microplots, yield loss was 6.2% for each 10% increment of root galling [$\hat{Y}$ = 2,945 kg/ha – 18.49 X; r = –0.92**]. These relations were relatively consistent except for fields in which tobacco had little galling. The relative degrees of root galling, root necrosis, yield losses, and rates of reproduction increased in a stepwise sequence from *M. hapla* to *M. incognita* to *M. arenaria* to *M. javanica.*—*Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27650.*

BENSON, D. M., and K. R. BARKER. *Postplanting applications of ethoprop, oxamyl, phenamiphos, or fensulfothion for control of Meloidogyne incognita on Japanese boxwood and M. arenaria on Japanese holly.*

Three-year-old Japanese boxwood (*Buxus microphylla* var. *japonica*) and Japanese holly (*Ilex crenata* var. *Helleri*) respectively infected with *Meloidogyne incognita* and *M. arenaria* were given postplant treatments with ethoprop (33.7 kg a.i./ha), phenamiphos (22.4 kg a.i./ha), fensulfothion (49.2 kg a.i./ha), or oxamyl (40.9 kg a.i./ha), in 6 liters H_2O/0.44 m². Some plants were given a combination of ethoprop and oxamyl. The granular nematicides were broadcast over the microplots and incorporated 5–10 cm deep. All plots were irrigated (2.5 cm) immediately after nematicide applications. Soil temperature at 15 cm was 17 C in holly plots and 20 C in the field boxwood plots. Boxwoods were planted in a Lynchburg loamy fine sand and hollies in a Fuquay loamy sand. Nematodes in roots and soil were assayed 0 and 3 months after treatment of boxwood and at 0, 7, and 12 months after treatment of holly. The ethoprop-oxamyl combination was the most effective treatment on boxwood. Numbers of *M. incognita* eggs and larvae/500 cm³ soil were 158 in ethoprop-oxamyl plots and 5,093 in control plots. Ethoprop, oxamyl, or fensulfothion alone did not reduce nematode density significantly after 3 months. On holly, ethoprop, ethoprop + oxamyl, and phenamiphos were equally effective in controlling *M. arenaria. M. arenaria* numbers/500 cm³ soil were 2–10 in treated plots and 603 in control plots, 12 months after treatment.—*Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27650.*

BERNARD, E. C. *Distribution of plant-parasitic nematodes on Adak Island, Alaska.*

Twenty-eight soil and root samples from Adak Island, Alaska, collected by University of Tennessee plant ecologists, were forwarded for study of the nematode fauna. Samples were collected at various sites on the northern half of the island: beach terraces at Kuluk Bay and Shagak Bay, bare soil at Andrew Bay, and two sites on Mt. Moffett. Except for the Andrew Bay site, ground cover at the sampling areas consisted primarily of a dunegrass, *Elymus arenarius* (Poaceae), with occasional spotty growth of a trailing herb, *Honckenya peploides* (Caryophyllaceae). Although 13 genera and 15 species of plant-parasitic nematodes were found on Adak, species distribution was extremely localized; each species was apparently confined to a single site. Nine species were found at Kuluk Bay, and three each at Shagak Bay and on Mt. Moffett. The Andrew Bay site had none. Apparently undescribed spp. of *Helicotylenchus* (2), *Macroposthonia, Meloidodera, Meloidogyne, Merlinius, Paratylenchus, Pratylenchoides,* and *Thecavermiculatus* were found. Also represented were *Hemicycliophora, Hoplolaimus, Tylenchorhynchus, Xiphinema,* and a second sp. of *Paratylenchus.* Species of *Meloidogyne, Meloidodera, Pratylenchoides,* and *Thecavermiculatus* were common on *E. arenarius* at Kuluk Bay, frequently occurring together on the same root segments. *Anguina radicicola,* causing galls on *E. arenarius,* was recovered from Shagak Bay samples. The nematode fauna of this island appears to be highly endemic, with little geographical spread of the various species. Similarities to the faunas of other Aleutian islands, mainland Alaska, or Siberia are unknown. *—Department of Agricultural Biology, University of Tennessee, Knoxville, Tennessee 37916.*

CARTER, R. F., and K. A. WRIGHT. *Odontostyle formation in Xiphinema americanum.*

Xiphinema americanum were extracted from soil samples of a vineyard in Vineland, Ontario. Intermolt and molting larvae were staged after fixation in glutaraldehyde, postfixing in OsO_4, and embedding for transmission electron microscopy. Results from molting worms indicated that the odontostyle is formed by the cooperation of two cells, one anterior to the other. The nucleus and cell body of the anterior cell are at the level of the odontophore flanges. The posterior cell, which actually synthesizes the odontostyle material, has abundant rough endoplasmic reticulum and Golgi, and extends from the region of the future odontophore. A deep cylindrical invagination develops into the posterior cell, while the anterior cell extends a tubular sheath around the invagination and forming odontostyle. Electron-dense granules produced from the Golgi in the posterior cell exocytose into the deep area of the forming pocket, which is fluid-filled and surrounded by longitudinally oriented microfilaments in the cell cytoplasm. The granule contents coalesce to form an extracellular odontostyle. The invagination and sheath appear to deepen posteriorly as synthesis proceeds, so that they eventually reach down to the loop as the odontostyle nears completion. In the following intermolt storage period, the odontostyle remains extracellular but is still interiorized by the synthetic cell, which now appears to be inactive. The anterior cell and its sheath are not evident, but fibrous material in the synthetic cell surrounds the odontostyle.—*Department of Microbiology and Parasitology, University of Toronto, Toronto, Canada, M5S 1A8.*

CHAPMAN, R. A. *Interrelations between concomitant Heterodera trifolii and H. glycines.*

Reproduction of a tetraploid *Heterodera trifolii* (CCN) and *H. glycines* (SCN) was measured on 'Kenland' red clover (RC) and 'Kobe' lespedeza (L) in pots (10–15 plants/pot) in a greenhouse. Numbers of cysts recovered from RC 65 days after inoculation with 50 CCN, 25 CCN + 75 SCN, 50 CCN + 50 SCN, and 75 CCN + 25 SCN larvae were respectively 0.26, 0.40, 0.62, and 0.71 per initial CCN larva. Comparable numbers of SCN did not reproduce on RC. The

numbers of cysts per initial larva recovered from L inoculated with 525 CCN, 375 SCN, and 525 CCN + 375 SCN larvae were respectively 0.16, 0.41, and 0.08 CCN + 0.01 SCN 56 days after inoculation and 2.5, 16.9, and 1.6 CCN + 1.6 SCN 83 days after inoculation. Invasion of roots was measured in seedlings inoculated with various combinations of CCN and SCN over a range of 10–60 larvae per plant. RC was invaded by 33–50 and 5–15% of applied CCN and SCN larvae, respectively. In various combinations, invasion of RC by CCN was usually increased to 40–60%, whereas invasion by SCN was unchanged. L was invaded by 33–50% of applied larvae of both species, and entrant SCN matured more rapidly than entrant CCN. Invasion and relative maturation of both species were unchanged when various combinations of CCN and SCN were applied to L. The increased reproduction of CCN in the presence of SCN in RC, a host suitable for CCN but not SCN, can be explained by increased invasion by CCN larvae. The marked reduction of reproduction by both species in concomitant infections of L, a host suitable for both species, is caused not be reduced invasion but by competition during development after invasion.—*Department of Plant Pathology, University of Kentucky, Lexington, Kentucky 40546.*

COX, DIANA L., and DAVID C. COLEMAN. *Competitive interactions between bacteria-feeding nematodes.*

The competitive interactions between two bacteria-feeding nematodes isolated from the rhizosphere of blue grama grass, one of the dominant plants in the shortgrass prairies, were examined using temperature and soil porosity as niche dimensions. Mixed populations of *Caenorhabditis* sp. and *Pelodera* sp. were cultured on 2% water-agar plates inoculated with *Pseudomonas cepacia.* The effect of incubation temperature on competitive interactions was observed at 15 and 24 C. At 24 C, the population densities of *Pelodera* sp. in the mixed cultures were reduced or eliminated over time as compared with monocultures of *Pelodera* sp. At 15 C in mixed cultures, reduction of *Pelodera* numbers was less, and the *Caenorhabditis* sp. population declined. Because the species differ in fecundity, the ratio of inoculated gravid females in the mixed cultures affects the population dynamics and competitive interactions. A factor in the outcome of competitive interactions between *Caenorhabditis* sp. and *Pelodera* sp. was variable soil porosity, obtained by mixing sterile Renohill-Shingle soil with silt or sand.—*Department of Zoology and Entomology, and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado 80523.*

EISENBACK, J. D., and HEDWIG HIRSCHMANN. *SEM comparisons of males of five populations of Meloidogyne hapla and one population each of M. arenaria, M. incognita, and M. javanica.*

The external morphologies of males of five populations of *Meloidogyne hapla* and one population each of *M. arenaria, M. incognita,* and *M. javanica* were compared by scanning electron microscopy (SEM). The populations of *M. hapla* belonged to two cytological races (A and B). Populations of race A of *M. hapla* included three with haploid chromosome numbers of 15, 16, or 17 which reproduce by facultative parthenogenesis. Race B populations consisted of two mitotically parthenogenetic populations with somatic chromosome numbers of 45 and 48. The populations of *M. arenaria, M. incognita,* and *M. javanica* had respectively 54, 41–43, and 44 chromosomes. These species reproduced by mitotic parthenogenesis. Observations were made on head structures, lateral field, excretory pore, and tail. The expression of labial and cephalic sensilla, shape and proportion of labial disc and lips, and markings on the head region were distinctly different for each species. Populations of *M. hapla* race A were different from each other but showed intrapopulation variation among individuals. Populations of race B were similar to each other and stable in head morphology. The two cytological races were dissimilar in head morphology. The structure of the lateral field, excretory pore, and

tail was of little value in distinguishing species or populations because of inter- and intrapopulation variation.—*Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27650.*

ERBA, P. S., and D. W. DICKSON. *Disc electrophoretic analysis of two Florida populations of Meloidogyne javanica.*

Soluble proteins and several enzymes of *Meloidogyne javanica* females were compared by disc electrophoresis. Nematode populations were reared on *Lycopersicon esculentum* Mill. (cv. Rutgers) under greenhouse conditions, and extracted from the roots after 45 days. Females were homogenized with a glass tissue homogenizer in an equal volume of extraction buffer. Homogenates were centrifuged, and the clear supernatant was used for electrophoretic analysis. This protein preparation was analyzed for soluble protein, four dehydrogenases (lactate, malate, α-glycerophosphate, and glucose-6-phosphate), and three hydrolases (esterase, alkaline and acid phosphatase). Two extraction buffer systems were compared for clarity, stability, and number of soluble protein and enzyme bands. The extraction buffer of 0.05*M* potassium phosphate, 0.85% NaCl, and 0.001*M* $MgCl_2$ at pH 7.4 was found to be superior for disc electrophoretic analysis. Most of the enzymes were found to be stable if the homogenates were frozen at –70 C immediately after they were prepared. Profiles of the two populations of *M. javanica* were found to be alike. Eight isozyme bands for esterase, three for malate dehydrogenase, and two for α-glycerophosphate dehydrogenase were resolved. Only one enzyme band was found for lactate dehydrogenase, glucose-6-phosphate dehydrogenase, alkaline phosphatase, and acid phosphatase. The protein and enzyme patterns found concurred with previous investigations on different populations of this species.—*Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611.*

EVANS, K. *Is there genetic control of hatching in cyst-nematodes?*

Two types of juveniles were obtained from the same cysts of *Globodera rostochiensis* by first placing the cysts in water and 3 weeks later transferring the cysts to potato root diffusate. Juveniles which emerged either in water or root diffusate were added to soil in which Katahdin potato plants were growing and 3 months later the new cysts produced by the two types of juvenile were collected. In subsequent hatching tests, hatch in water was initially twice as fast from cysts derived from water-hatched juveniles as from cysts derived from diffusate-hatched juveniles. This difference seemed to be related to a difference in resistance to hypertonic solutions. Progeny of water-hatched juveniles continued to move in both water and 0.1 M sucrose, while progeny of diffusate-hatched juveniles continued to move only in water and were immobilized in 0.1 M sucrose. Ability to hatch without the stimulus of a hatching factor may depend on an ability to remain active when subjected to osmotic stress. If this ability to remain active or not is genetically controlled it could be the difference between genotypes able to hatch in water and those that require a hatching stimulus. Cropping schemes might exert selection pressures on cyst-nematode populations and be the cause of variation in hatching response between different field populations of the same species.—*Department of Plant Pathology, Cornell University, Ithaca, New York 14853.*

FERRIS, H. *Quantifying the decision process in nematode pest management.*

Many of the factors contributing to nematode pest management decisions are quantifiable, either from documented research or empirically from field experience. The main components of the decision are pest damage and control costs and efficiency as affected by physiographic, climatic, and edaphic conditions. Primary functions are developed relating crop damage and control parameters to nematode population densities. Secondary functions express the effect of environmental factors on the shape and

position of the primary functions. The secondary functions are based on some experimental data from specific locations but, for the most part, represent hypotheses derived from knowledge of nematode biology and ecology. The broad constraints adopted in the interest of implementation allow and demand both appropriate research and intuitive quantification and interpretation of the vast quantities of available data. Interactive computer programs provide a vehicle for weighting the variables and producing a nematode pest management decision which maximizes the economic returns of a farming operation.—*Department of Nematology, University of California, Riverside, California 92521.*

FRIEDMAN, P. A., E. G. PLATZER, and E. J. CARROLL, JR. *Tubulin characterization in embryos of Ascaris suum.*

Anthelmintic benzimidazoles are known to act on adult parasitic nematodes; however, there have been numerous reports that these drugs prevent cleavage in developing parasite embryos. Cleavage and embryogenesis are dependent on functional tubulin, a structural protein of microtubules and the mitotic apparatus. To determine the mechanism of action of benzimidazole drugs in nematode embryos, we have characterized the proposed drug receptor, i.e., embryo tubulin, in 8-day embryos of *Ascaris suum.* We have described embryo tubulin on the basis of its specific binding to colchicine and the properties of the tubulin-colchicine interaction known for other eukaryotic organisms. Embryo cytosolic fractions maintained at 37 C exhibited significant colchicine binding, reaching pseudo-saturation at 6 h. No binding was detected in samples incubated for 8 h at 0 C. The colchicine-binding activity of embryo cytosolic fractions in the absence of guanosine 5′-triphosphate (GTP) and vinblastine sulfate decayed with first-order kinetics with a half-life ($t_{1/2}$) of 377 min and a decay constant (k) of 1.84×10^{-3} min^{-1}. In the presence of 1.0 mM GTP, $t_{1/2}$ = 563 min, $k = 1.23 \times 10^{-3}$ min^{-1}, or 0.5 mM vinblastine sulfate, $t_{1/2}$ = 877 min, $k = 0.79 \times 10^{-3}$ min^{-1}, the colchicine tubulin interaction was stabilized. The association constant (K_A) of colchicine for soluble embryo tubulin was 2.23×10^5 liters/mole. Colchicine binding was competitively inhibited by 2.0×10^{-6} M podophyllotoxin with an inhibitor constant (K_I) of 1.1×10^{-6} M. The tubulin concentration in 8-day embryos was estimated to be 0.3% of the total soluble embryo protein. On the basis of these colchicine-binding parameters, tubulin from *A. suum* embryos shares the general colchicine-binding properties exhibited by tubulin in other animal species.—*Departments of Nematology and Biology, University of California, Riverside, California 92521.*

GOLDSTEIN, P., and A. C. TRIANTAPHYLLOU. *Pachytene karyotype analysis of diploid, tetraploid, and hybrid forms of Heterodera glycines following electron microscopy and three-dimensional reconstruction of serial sections.*

A comparative study of the karyotypes of a diploid (n = 9) and a tetraploid (n = 18) population of *Heterodera glycines* was conducted by three-dimensional reconstruction of the synaptonemal complexes (SC) of oocyte nuclei at pachytene. Included was analysis of a hybrid (n = 14) produced by a cross between the diploid and tetraploid. The SCs appear to be similar to those reported in other amphimictic organisms, consisting of two lateral elements (9 nm each) and a central element (20 nm). Pairing of homologous chromosomes in the diploid and tetraploid is complete. However, only 25% of the total karyotype consists of normal SC regions in the hybrid. Several unique "modified synaptonemal complex regions" (MSC) have been observed along the SCs in all three forms. These MSCs are short regions of the normal SC which are surrounded by a dense heterochromatic mass, within which the structure of the SC appears disorganized. Outside the MSC, the SC is normal. These MSCs may have a role in the sex-determination system. In the tetraploid, there is a large mass of chromatin displaced to one side of the nucleus. Two SCs are associated with this mass. Such a structure is absent from both

the diploid and hybrid. The formation of the hybrid karyotype illustrates both homologous and nonhomologous pairing of chromosomes.—*Departments of Plant Pathology and Genetics, North Carolina State University, Raleigh, North Carolina 27650.*

GOODELL, P. B., and H. FERRIS. *Distribution of five plant-parasitic nematodes in alfalfa.*

A 7-ha alfalfa field was intensively sampled in July 1977 by removing 1,936 cores (2.54 cm diam) to a deph of 45 cm in a systematic manner from a 6 × 6-m grid network. Additional samples were removed in September from six 1-m-square areas. Five populations of nematodes were noted: *Meloidogyne arenaria, Pratylenchus minyus, Merlinius brevidens, Helicotylenchus digonicus,* and *Paratrichodorus minor.* The goodness of fit of each observed frequency distribution of each population to a negative binomial was tested. For the entire field, *Meloidogyne, Merlinius,* and *Helicotylenchus* fit this model. When the field was separated into sand and clay areas, all five populations fit the negative binomial, but only three (*Meloidogyne, Merlinius,* and *Paratrichodorus*) fit the sand. In the meter-square areas, all populations fit the model in all cases except for *Helicotylenchus* and *Pratylenchus* at two sites.—*Department of Nematology, University of California, Riverside, California 92521.*

GRANEY, LORRAINE S., and L. I. MILLER. *Morphology of second-stage larvae of four isolates of Heterodera schachtii.*

A comparison was made of the intraspecific variation of several morphological characters of second-stage larvae of field isolates of *Heterodera schachtii* from New York (N) and Florida (F) with cabbage as the host plant and from California (C) and Michigan (M) with sugar beet as the host plant. Measurements (in μm) of 30–40 larvae hatched from eggs of cysts from the four isolates were as follows. Body length: N 440–540 (mean 490.6, standard deviation ± 23.1), F 400–566 (485.6 ± 39.8), C 400–520 (454.4 ± 26.5), M 420–535 (468.2 ± 26.8). Body breadth: N 20.4–26.0 (23.9 ± 2.0), F 19.0–27.0 (24.0 ± 1.9), C 19.0–25.0 (21.2 ± 1.4), M 20.0–25.5 (21.9 ± 1.6). Stylet length: N 26.0–28.0 (26.8 ± 0.6), F 23.0–28.8 (26.5 ± 1.2), C 21.3–27.0 (25.4 ± 1.3), M 25.0–28.5 (27.0 ± 0.6). Dorsal gland orifice to stylet base: N 4.0–6.0 (5.1 ± 0.6), F 3.0–6.5 (5.1 ± 0.8), C 4.0–5.4 (4.9 ± 0.4), M 4.0–6.0 (5.0 ± 0.6). Excretory pore to head end: N 104.0–125.0 (111.3 + 4.9), F 93.0–129.0 (110.6 ± 9.0), C 93.0–115.3 (105.6 ± 4.5), M 98.0–121.0 (108.6 ± 5.4). Tail length: N 42.5–53.0 (47.7 ± 2.6), F 39.0–55.0 (46.6 ± 4.9), C 41.0–49.0 (44.8 ± 2.2), M 40.0–55.0 (47.1 ± 4.0). Tail terminus length: N 20.0–29.5 (24.5 ± 2.4), F 16.6–33.5 (26.2 ± 3.7), C 19.5–33.0 (24.1 ± 2.6), M 21.2–33.0 (26.9 ± 2.6). Dimensions measured for the four isolates overlap and they overlap with published measurements of *H. glycines.*—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.*

HAFEZ, S., and D. J. RASKI. *Action of systemic nematicides in control of Xiphinema index on grape.*

Aldicarb 10 G at 4.5 kg a.i./ha., phenamiphos 15 G at 22 kg a.i./ha., oxamyl L at 4.5 kg a.i./ha., and no treatment were applied to soil around potted Thomson Seedless rooted grape cuttings growing in 15-cm clay pots in a greenhouse. Grape plants in each treatment were inoculated with *Xiphinema index* either 2 weeks after chemical treatment or at treatment. Half of the plants receiving chemical treatment 2 weeks before nematode inoculation were transferred to new untreated soil at the time of nematode inoculation. The different timings for chemical treatments and nematode inoculation were used to determine mode of action. There were six replicates of each treatment. Five hundred nematodes were added to four holes around the root system in each pot. Nematode population and grapevine growth in the different treatments were measured 60 days later. When nematodes and nematicides

were applied at the same time, nematode populations were reduced from the initial 500 to respectively 5, 1, and 4 for aldicarb, phenamiphos, and oxamyl. In the untreated control the population increased to 2,703. Control was slightly better (respectively 3, 1, and 2) when the nematicides were added first and the nematodes 14 days later. Control was less (respectively 83, 112, and 1,346 *X. index* remained) when plants were washed free of soil and repotted at the time of nematode inoculation. Plant growth was inversely related to the level of nematode population resulting from the treatments.—*Division of Nematology, University of California, Davis, California 95616.*

HAFEZ, S., and D. J. RASKI. *The residue dynamics in grapevine of aldicarb and its biologically similar active metabolites.*

The residue dynamics in grapevine of the nematicide aldicarb [2-methyl-2-(methylthio) propionaldehyde-O-(methylcarbamoyl) oxime] and its biologically similar active metabolites, aldicarb sulfoxide and aldicarb sulfone, were determined by gas chromatographic techniques. Residues were found in the roots, trunks, stems, and leaves of grapevine 120 days after application. Residues in leaves were respectively as high as 1.40 and 8.89 ppm from application of 4.5 and 9 kg a.i./ha, but by 180 days had declined to 0.55 and 1.10 ppm. In roots, trunks, and stems the residues had also declined by 180 days. No residues were detected in the newly forming immature fruit. By 270 days the residues in roots, trunks, stems, and leaves declined further, but residues in mature fruit at harvest time were respectively 0.03 and 0.05 ppm from applications of 4.5 and 9 kg a.i./ha. These residues in fruit, much lower than those in other plant parts, are within the accepted tolerance level of 0.6 ppm for aldicarb for grape.—*Division of Nematology, University of California, Davis, California 95616.*

HEALD, C. M. *Effect of the reniform nematode on cantaloup quality and yield.*

The effect of the reniform nematode, *Rotylenchulus reniformis,* on the quality and yield of cantaloup, *Cucumis melo* 'Perlita,' was compared in fumigated and unfumigated plots in the Lower Rio Grande Valley of Texas. In 1975 and 1976, plots of 15 × 1 m were established in a sandy loam field naturally infected with the reniform nematode. Treatments, Telone II (1,3-dichloropropene) 46.7 L/ha chiseled 25 cm deep, and an untreated control, were arranged in paired rows replicated eight times. In 1977, plots of 21 × 2 m were established in a randomized block design with two treatments replicated four times. Treatments were DBCP (1,2-dibromo-3-chloropropane) at 9.3 L/ha to a depth of 25 cm and unfumigated check plots. In 1975, 1976, and 1977, fumigated rows of cantaloup had respective increases in melon yields of 105, 82, and 79% over unfumigated rows. Reniform nematode populations were significantly reduced by soil fumigation as determined in soil samples from around cantaloup roots. In 1975, percent soluble solids were significantly higher in fumigated than in unfumigated plots. Melon quality is affected by the reniform nematode.—*U.S. Department of Agriculture, SEA Agricultural Research, Weslaco, Texas 78596.*

HUETTEL, R. N., and D. W. DICKSON. *Cytogenetic differences between two Florida races of Radopholus similis.*

Two morphologically indistinguishable races of *Radopholus similis* from Florida are presently identifiable only by host preference tests. Cytogenetic studies reported here have shown that there is a difference in chromosome number between the two races. The chromosome number of n = 4 has been established for the "banana race" of *R. similis* and, similarly, n = 5 has been established for the "citrus race." The possibility must be considered that these races are actually sibling species. Karyotypic uniformity has been established in two Florida populations of the "citrus race." The two races reproduce regularly by amphimixis and produce male-female populations.

Under certain conditions, tychoparthenogenesis can occur in both races, resulting in all-female populations. Bisexual reproduction, however, seems to be the normal mode of reproduction.—*Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611.*

HUSSEY, R. S., and R. W. RONCADORI. *Influence of Aphelenchus avenae on an endomycorrhizal fungus on cotton.*

Although mycophagous nematodes are often present in the rhizospheres of agronomic crops, little is known about their effect on endomycorrhizal formation and subsequent plant development. We investigated the influence of *Aphelenchus avenae* (AA) on the vesicular-arbuscular endomycorrhizal fungus, *Gigaspora margarita* (GM), on cotton (*Gossypium hirsutum* Stoneville 213) in the greenhouse. Treatments consisted of single inoculations with AA (6,000 nematodes/plant), or GM (250 azygospores/plant), joint inoculations (3,000 or 6,000 AA applied with GM at transplanting and 3 weeks after GM), and appropriate controls. GM stimulated shoot and root growth by 40% and 77%, respectively, over that of nonmycorrhizal controls by 80 days after transplanting. In concomitant culture, AA did not affect shoot weight at either inoculum level or inoculation time interval compared with plants inoculated only with GM, but suppressed root growth response to GM at the high inoculum levels. AA reproduced more when the nematode was added 3 weeks after GM. Azygospore production was not affected by AA. This study indicates that a mycophagous nematode at densities higher than normally found under natural conditions had a minimal influence on plant growth response to an endomycorrhizal fungus.—*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, Georgia 30602.*

IBRAHIM, I. K. A., H. A. A. KHALIL, and M. A. REZK. *Root-knot nematodes on cotton in northern Egypt.*

A nematological survey was conducted over the cotton-producing areas of Alexandria and Behera governorates. A total of 160 soil samples were collected from the rhizosphere of cotton plants at a depth of 30–40 cm. Nematodes were extracted from soil and roots by sieving and Baermann funnel, respectively. *Meloidogyne* spp., *Rotylenchulus reniformis, Pratylenchus* spp., *Hoplolaimus* spp., *Helicotylenchus* spp., *Tylenchus* sp., and *Tylenchorhynchus* spp. were recovered. Root-knot nematodes occurred in 40% of the soil samples, at an average concentration of 680 second-stage larvae/200 ml soil. Both *M. incognita* and *M. javanica* were found in galled cotton roots. *Meloidogyne incognita* was relatively common in the collected root samples, whereas *M. javanica* was found less frequently.

The response of the cotton cultivars Giza 69 (*Gossypium barbadense* L.) and Acala 4-42 (*G. hirsutum* L.) to *M. javanica* was tested in the greenhouse. *M. javanica* infected the roots of Giza 69 and induced heavy galling, with egg masses, and significant growth reduction. The nematode life cycle was completed within 34 days of inoculation. In contrast, Acala 4-42 gave a resistant reaction, with few root galls, no egg masses, and no growth reduction.—*Department of Plant Pathology, College of Agriculture, Alexandria University, Alexandria, Egypt.*

INGHAM, RUSSELL E., and JOHN A. TROFYMOW. *A gnotobiotic method for investigating the effect of ectoparasitic nematodes on rhizosphere biota and plant growth.*

A method was developed for studying interactions between root-feeding nematodes and other rhizosphere organisms. Soil microcosms were designed which would be strictly gnotobiotic. The systems are constructed of 1000-ml Berzeleus beakers with a foam collar and covered with a 150-ml glass petri dish. Sterile water is added to the culture chamber by syringe through a serum cap fitted on latex tubing which enters the microscosm between the foam and the glass. Soil is added to the chamber and the entire unit is sterilized. Sterile seedlings

were then planted in the soil in a laminar-flow hood. Seedlings were produced from sodium hypochlorite-treated seeds germinated on nutrient agar to confirm sterility. Where an experimental design required microfloral additions, they were made at the time of planting. Sterile nematodes were not added until 10 days later, when plants had sufficient root growth to support them. After inoculation, the microcosms remained sealed until sampled. Moisture levels were maintained at about field capacity by aseptic additions of water through the latex tubing. By this procedure, plants have been maintained axenically for several months in growth chambers. The microcosms are being used to study the influence of the ectoparasitic nematode *Helicotylenchus* sp. on the growth of blue grama (*Bouteloua gracilis*) and the effect of the nematode's grazing activity on rhizosphere microflora.—*Department of Zoology and Entomology, and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado 80523.*

INSERRA, R. N., and N. VOVLAS. *Life-cycle and biology of Rotylenchulus macrodoratus.*

Laboratory studies and field observations on the biology of *Rotylenchulus macrodoratus* were conducted in Italy. On olive (*Olea europaea*) seedlings, this nematode completed its life cycle from egg to egg in about 45–55 days. The embryogenic development from egg laying to hatching took about 16–19 days using freshly deposited eggs maintained in water at 18–32 C. Only immature or swollen females were found attached to the olive roots. There was no evidence of juvenile invasion. Eggs were laid by mature swollen females in a gelatinous matrix on the surface of the root. The maximum number of eggs per egg mass was 55. Males were common and had a reduced stylet. Olive roots ranging from 1.5 to 9 mm in diam were infested by the nematode. The female population density was higher in the 1.5-mm feeder roots (150 females/g) than in the 9-mm (1–7 females/g). Woody plants such as almond (*Prunus amygdalus*), apricot (*P. armeniaca*), fig (*Ficus carica*), grape (*Vitis* sp.), loquat (*Eryobotrya japonica*), and olive were the preferred hosts of this species but it was found also on herbaceous plants such as carnation (*Dianthus caryophyllus* and *D. barbatus*), ivy (*Hedera helix*), pellitory (*Parietaria officinalis*), and soybean (*Glycine hispida*). A single giant cell with a single hypertrophic nucleus originated from the endodermis in infested roots of all hosts examined. *Rotylenchulus macrodoratus* appears to be distributed only in the Mediterranean region and has been reported from France, Greece, Israel, Italy, and Malta.—*Laboratorio di Nematologia agraria, C.N.R., 70126 Bari, Italy.*

JAFFEE, B. A. *Reduced penetration of alfalfa roots by Pratylenchus penetrans with increased alfalfa root/soil ratio.*

A study was conducted to determine whether the number of plant-parasitic nematodes penetrating roots is influenced by the amount of roots in a given volume of soil. One hundred and twenty cc of an autoclaved loamy sand was placed in 150-ml beakers. Water was added to the soil to bring the moisture content to 16% (–0.10 bar), which corresponded to field capacity. One, two, six, or twelve alfalfa seeds (cv 'DuPuits') were planted in a shallow ring (2.2 cm diam) inscribed on the soil surface. The beakers were sealed in plastic bags and incubated at 20 C with a 15-h photoperiod and a light intensity of 21,000 lux. Two days after planting, 750 *Pratylenchus penetrans* suspended in 1 ml water were added to the soil surface at the center of each beaker. Four days after inoculation, the seedlings were removed, washed, and weighed, and the nematodes within the roots were extracted and counted.

The mean numbers of *P. penetrans* recovered from seedlings in beakers containing 1, 2, 6, or 12 seedlings were respectively 52, 71, 82, and 108. A significant correlation ($r = -0.92$; $P = 0.01$) was found between root weight per beaker and the number of penetrations per gram root. Penetrations per gram root were reduced from 2,120 to 1,060 when root weight per beaker was increased from 0.03 to 0.08 gram. These data

indicate that root density influences the number of penetrations per gram root and thus may affect the amount of disease of a particular inoculum level.—*Department of Plant Pathology, Cornell University, Ithaca, New York 14853.*

JATALA, P., and RENATE KALTENBACH. *Survival of Nacobbus aberrans in adverse conditions.*

The false root-knot nematode *Nacobbus aberrans,* an important nematode parasite of potatoes in several Andean regions of South America, maintains its populations regardless of such adverse soil conditions as freezing or drying in the absence of their potato host. To measure the persistence of *Nacobbus aberrans* under desiccated conditions, a soil sample from a heavily infested field was air-dried and kept dry for 1 year (relative soil humidity varying from 7 to 9%). Periodically, the status of the nematode population in this soil was determined by bioassay on tomato, and by extraction of vermiform nematodes and egg masses. *N. aberrans* withstood desiccation for at least 8 months. After 8 months, egg masses extracted from the desiccated soil contained eggs, and a few viable larvae and immature adult females were recovered from soil. Also studied was survival under freezing conditions. Infected roots and infested soil samples were kept in a freezer at −13 C, and nematodes were assayed periodically by bioassay and by extraction from soil. Larvae and immature females survived 4 months. Soil adhering to potatoes can disseminate this nematode.—*Department of Nematology and Entomology, International Potato Center, Apartado 5969, Lima, Peru.*

JATALA, P., RENATE KALTENBACH, and MARCIA BOCANGEL. *Biological control of Meloidogyne incognita acrita and Globodera pallida on potatoes.*

The majority of eggs of *Meloidogyne incognita acrita* on potato roots collected near Huanuco, Peru, were found to be infected with a fungus, *Paecilomyces lilacinus* (Thom.) Samson. Fungal isolates from these eggs were inoculated on nematode-infected potato plants. Egg masses were examined for fungal infection after 1 month. The fungus consistently infected eggs and occasionally infected females of *M. incognita acrita.* This fungus grows and sporulates prolifically within 48 h at 25 C on a medium containing V8 juice and $CaCo_3$. It penetrates the eggs within cysts of *Globodera pallida* and egg masses of *M. incognita acrita* in 10 to 12 days, grows, and eventually destroys the embryo. Penetration of mature *Meloidogyne* females is generally through the anus or vulva. *G. pallida* cysts are penetrated through the vulva and the broken or exposed neck region. Within 1 month, 70 to 90% of the eggs of these nematodes became infected. Although the reproduction rate of fungus-inoculated *M. incognita acrita* may be the same as that of uninoculated nematodes in the first generation, 80-90% of the eggs of the fungus-inoculated nematodes were found to be destroyed by the fungus. Apparently, *P. liiacinus* does not infect plants. Use of this fungus under field conditions is being studied.—*Department of Nematology and Entomology, International Potato Center, Apartado 5969, Lima, Peru.*

JOHNSON, A. W., W. A. ROHDE, D. R. SUMNER, C. C. DOWLER, N. C. GLAZE, and R. B. CHALFANT. *Influence of ethoprop on root-knot nematodes in an intensive cropping system.*

A multiple-cropping sequence of turnip-corn-southern pea was grown in field plots each year for 4 successive years. Soil treatments were: 1) methyl bromide and 2) DD-MENCS applied annually + ethoprop before planting of each crop, 3) ethoprop. applied before planting of each crop, and 4) untreated control. Root-knot nematodes (*Meloidogyne incognita*) were suppressed to low levels with methyl bromide and DD-MENCS on turnip and corn, but increased on southern peas. Ethoprop, applied before planting of each crop, did not suppress nematode numbers or increase yields ($P = 0.05$) when compared with the control. Ethoprop concentrations in the soil of 4.3

to 5.6 ppm for 2 days did not control root-knot nematodes adequately. Statistical analysis indicated that variation in the concentration of ethoprop in the soil was influenced more by the amount of water which plots received than by soil temperature ranging from 10 to 19 C and 31 to 41 C, and more by soil temperature than by water when the maximum soil temperatures were 17 to 33 C. Additional data from greenhouse studies indicate that under an intensive multicrop system where ethoprop is applied to the same area three times each year, a population shift to ethoprop-tolerant types of root-knot nematodes might evolve.—*Science and Education Administration, Agricultural Research, U. S. Department of Agriculture, and the University of Georgia College of Agriculture Experiment Stations, Coastal Plain Experiment Station, Tifton, Georgia 31794.*

JORGENSON, E. C. *Comparative penetration, development, and parasitism of Meloidogyne incognita in tolerant, resistant, and susceptible cotton at different temperatures.*

The responses of cottons tolerant, resistant, and susceptible to *Meloidogyne incognita* to various population levels of the parasite were tested at several temperatures in the greenhouse and in growth chambers. At all temperatures tolerant and resistant cottons emerged sooner than susceptible cottons. Nematode penetration into all cottons was about equal for the first 96 h. Continued development and parasitism differed between the cottons tested, being essentially uninhibited in the susceptible cultivars, especially at temperatures optimum for plant growth. In tolerant cottons, high temperature increases susceptibility to the nematode and injury to the plants. Cotton characterized as resistant usually remained resistant with increasing temperature. Resistant cottons have not been field tested for yield, whereas tolerant cotton has been shown to withstand 10 to 100 times higher population levels than susceptible commercial cotton with essentially no decrease in yield for 3 years and only a 4% average decrease for 4 consecutive years. Commercial cotton averaged a 26% decline in yield over the 4-year period.—*U. S. Dept. Agriculture, SEA Agricultural Research, 17053 Shafter Avenue, Shafter, California 93263.*

KERRY, B. R. *Fungal parasites of females of cyst-nematodes.*

During studies on the population dynamics of the cereal cyst-nematode, *Heterodera avenae,* a fungus was found which parasitised nematode females on roots and prevented cyst formation. This fungus has recently been described as *Nematophthora gynophila* Kerry and Crump, an oomycetous fungus which produces biflagellate spores. Infected females rapidly become flaccid as the fungus destroys the cuticle of the nematode, which is penetrated by a number of discharge tubes through which the motile spores are released into the soil. A section of the vegetative mycelium and the discharge tube form the sporangium within which the zoospores develop. Each sporangium may produce up to 120 spores, and up to 200 sporangia develop in each female. Eventually the nematode becomes filled with resting spores, which are produced laterally on undifferentiated vegetative hyphae. *N. gynophila* is widespread in cereal fields in the United Kingdom and is the major fungal parasite which controls the cereal cyst-nematode when cereals are grown intensively. In laboratory tests, *N. gynophila* infected females of *H. schachtii, H. cruciferae, H. carotae,* and *H. trifolii,* but not of *Globodera rostochiensis.*

The activity of *N. gynophila* is inhibited when soils become dry, presumably because the mobility of the biflagellate spores is reduced, and females do not become infected. Parasitism was more or less eliminated in soils treated with formalin (38% formaldehyde) at 3,000 L/ha. In such soils, most females survived to form cysts, and nematode populations increased.

After *N. gynophila* was found attacking females of *H. avenae,* two other fungi were recorded as killing females of cyst-nematodes in the United Kingdom. *Catenaria auxiliaris* (Kühn) Tribe has been

identified from females of *H. schachtii* and *H. avenae* in field soils, and it killed females of *G. pallida* in laboratory tests. A lagenidiaceous fungus has recently been found which parasitises females of *H. avenae* and *H. schachtii*. Both fungi produce motile spores. The role of these fungi as biological control agents is being investigated.—*Nematology Department, Rothamsted Experimental Station, Harpenden, Hertfordshire, England. AL5 2JQ*

KIRCHNER, THOMAS B., and RICHARD V. ANDERSON. *Computer model for life-history strategies of free-living nematodes.*

A computer simulation model for carbon flow and population dynamics of soil-dwelling bacteriophagic nematodes was used to simulate a nematode-bacteria-ameba system. The model can simulate two different responses to environmental stress: 1) the formation of dauer larvae and intrauterine larval development; or 2) the formation of cryptobiotic states. Development rates, including ecdysis, were based upon consumption and growth rather than age-scheduled events. Responses for species of *Acrobeloides* and *Mesodiplogaster* were simulated, and the results compared favorably to those from agar plate cultures.—*Department of Zoology and Entomology, and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado 80523.*

KOENNING, S. R., and M. A. McCLURE. *"Pinwheel" inclusions and virus particles of two potyviruses in syncytia of Meloidogyne incognita.*

Chili pepper plants, *Capsicum frutescens* var. Anaheim, were maintained in aquaculture in a modified Hoagland's solution. The plants were uniformly infected by pipetting a suspension of freshly hatched larvae (500/plant) onto the roots placed between two layers of Miracloth. The plants were returned to the growth medium 24 h after mottle virus inocula were prepared from inoculation. Tobacco etch virus and pepper mottle virus inocula were prepared from infected leaves. The plants were inoculated mechanically. Inoculations with virus were performed in various sequences: simultaneously with nematode inoculations, and 2, 5, and 14 days later. Appropriate controls were maintained and processed with experimental plants. Twenty-one days after nematode inoculation the plants were removed from the growth medium and prepared for electron microscopy. The majority of galls sectioned and examined in the electron microscope showed no evidence of virus infection. About one-fourth of the galls examined contained syncytia with evidence of virus infection, having either pinwheel inclusions, virus particles, or both. Cells surrounding the syncytia showed no evidence of viral infection.—*Department of Plant Pathology, University of Arizona, Tucson, Arizona 85721.*

KOLODGE, C. M., J. D. RADEWALD, and F. SHIBUYA. *A revision of the host range of Longidorus africanus from the Imperial Valley in southern California.*

In 1969 a southern California isolate of *Longidorus africanus* was reported to be a pathogen of lettuce, sorghum, and sugarbeets. Reports of damage to carrots by this nematode in the Imperial Valley prompted a reevaluation of its host range. Twenty-eight plant cultivars were started from seed in 15-cm plastic pots filled with air-steamed field soil in which *L. africanus* had been detected previously. All plants were maintained in a glasshouse at a soil temperature range of 19–29 C. Two weeks after germination four replicates of each cultivar were infested with 30 hand-picked juveniles and adults of *L. africanus*. The mean number of *L. africanus* obtained from plants and a moist fallow control after 2—3 months were: wheat 196, bermuda grass 270, barley 300, corn 234, oat 53, sorghum 487, cotton 172, okra 154, sunflower 38, lettuce 254, pea 63, lima bean 266, alfalfa 12, bush bean 649, carrot half long Nantes 48, carrot Imperator 24, carrot Danvers 49, squash 35, cantaloup 130, cucumber 282, tomato 189, pepper 45, eggplant 348, spinach 74, sugarbeet 87, onion 19, mint 45, cauliflower 2, wet fallow

11. These results differ from a previous finding where 20 of these same cultivars would not support reproduction of *L. africanus,* carrots included.—*Department of Nematology, University of California, Riverside, California 92521.*

KRAUS-SCHMIDT, HELMUTH, and STEPHEN A. LEWIS. *Dynamics of concomitant populations of Scutellonema brachyurum, Hoplolaimus columbus, and Meloidogyne incognita on cotton.*

Seedlings in a greenhouse and a growth chamber were inoculated with *Scutellonema brachyurum, Hoplolaimus columbus,* and *Meloidogyne incognita,* singly and in all possible combinations, at two initial population levels (100 and 300/100 cm^3). *Scutellonema brachyurum* alone was not pathogenic to cotton at the population levels tested. It was primarily an ectoparasite, but matured and reproduced within the root when it penetrated. Populations of *S. brachyurum* increased in the presence of *H. columbus,* but were suppressed when simultaneously inoculated with *M. incognita. Hoplolaimus columbus* suppressed ($P = 0.05$) dry shoot weights of cotton at initial population levels of 300/100 cm^3 soil. Simultaneous inoculation with *H. columbus* and either *M. incognita* or *S. brachyurum* increased *H. columbus* populations over treatments with *H. columbus* alone, 60 and 90 days after inoculation. Of the three nematodes tested, *M. incognita* was the most pathogenic to cotton. All treatments with *M. incognita* suppressed cotton shoot weights significantly ($P = 0.05$) at 100 or 300 nematodes/100 cm^3 soil. Inoculation with *S. brachyurum* increased root-knot nematode populations 60 days after inoculation, while *H. columbus* suppressed populations of *M. incognita.* Most larvae of *M. incognita* did not develop to maturity in the presence of *H. columbus.* Giant cells seemed to be aborted and appeared necrotic 20–25 days after inoculation. This inhibitory effect appeared to be of a physiological nature and deserves further investigation.—*Department of Plant Pathology and Physiology, Clemson University, Clemson. South Carolina 29631.*

MACDONALD, D. H. *Plant-parasitic nematodes associated with field crops grown in monoculture in Minnesota.*

Plots in south-central Minnesota on well-drained silt loam soil were cropped continuously to either corn, wheat, soybeans, flax, or oats for 10 growing seasons and then sampled a maximum of 14 times in the next 4 years. The soil of the continuous corn plots contained the largest populations of pathogenic nematodes, the most abundant species being *Pratylenchus hexincisus, Helicotylenchus pseudorobustus,* and *Xiphinema americanum.* The dominant species in the continuous wheat plots were *Paratylenchus projectus, H. pseudorobustus,* and a *Gracilicus* sp. resembling *G. marylandicus,* and species frequently detected were *Tylenchorhynchus* sp., *Hoplolaimus galeatus,* and *X. americanum.* Only *P. projectus* was numerous in the continuous soybean plots and consistently detected in the continuous flax plots. *P. hexincisus* was detected in 79 of 102 samples from flax plots but was never numerous. Oats, the poorest of the five field crops as a host for parasitic nematodes, consistently supported only limited numbers of *P. projectus.* Adjacent land cropped in a randomized rotation to these same five field crops was only infrequently found to be infested with any plant-parasitic nematodes other than *P. projectus* and *H. pseudorobustus.* The populations associated with continuous corn did not develop in the rotation plots even after 4 successive crops of corn. Nematode population manipulation by crop rotation appears to be an important factor affecting corn production in Minnesota.—*Department of Plant Pathology, University of Minnesota, St. Paul, Minnesota 55108.*

MACGUIDWIN, A. E., and G. C. SMART, Jr. *Effect of the bark beetle nematode, Contortylenchus brevicomi, on gallery construction and fecundity of Dendroctonus frontalis.*

Field-collected *D. frontalis,* a major pest of pine trees in the southeastern United States, were reared in loblolly pine bolts in a controlled environment. Male-female beetle pairs retrieved from galleries 1, 2, or

3 weeks after introduction into bolts were examined for internal parasites. Data on gallery length, egg niche production, and progeny survival were obtained for each pair. *C. brevicomi* was found in 25% of all beetles which established galleries. A microsporidian parasite, *Unikaryon minutum,* was present in 65% of all colonizing beetles. Female beetles infected with *C. brevicomi* produced fewer (P = 0.05) eggs and shorter (P = 0.05) galleries than did uninfected females after 2 and 3 weeks. Healthy females mated with nematode-infected males showed similar but nonsignificant trends in the 2- and 3-week tests. No differences in gallery length or egg production between nematode-infected and uninfected pairs were evident after 1 weeks. Progeny survival was not affected by parasitism of either parent beetle. Microsporidian infection in female beetles, alone or in combination with *C. brevicomi,* had no effect on measured variables at any week.—*Department of Entomology and Nematology, University of Florida, Gainesville, Florida 32611.*

MARBAN-MENDOZA, N., and D. R. VIGLIERCHIO. *Behavioral responses of Pratylenchus vulnus to carbofuran and phenamiphos.*

A series of experiments were conducted under various controlled conditions to compare certain behavioral responses of *Pratylenchus vulnus* to the carbamate nematicide carbofuran and the organophosphate phenamiphos. The nematode activities assessed were immobilization (inability to respond to mechanical stimulation), dispersion (capacity to move by own efforts), and attraction to bean root emanations. Effects of increasing chemical concentrations and exposure times, and reversibility of the treatment effects after removal of the chemicals, were tested. The results showed that carbofuran and phenamiphos were physiologically active on *P. vulnus* over a wide range of concentrations. Phenamiphos was active at lower concentrations than carbofuran. The concentration of carbofuran required to immobilize third-stage or adult *P. vulnus* (0.5 m*M*) was 100 times the concentration required of phenamiphos (0.005 m*M*), after 6 days of incubation. Five times as much carbofuran (0.05 vs. 0.01 m*M*) was required to fully inhibit nematode dispersion on sand discs after 12 h; and 20 times as much (0.001 vs. 0.00005 m*M*) to inhibit *P. vulnus* attraction to bean root emanations, after 48 h. Also, different responses to both chemicals were found among *P. vulnus* stages.—*Colegio de Postgraduados, Rama Fitopatologia, Chapingo, Edo. de Mexico, Mexico, and Nematology Division, University of California, Davis 95616.*

MCKEWAN, JEANETTE A., *Studies on the biology and life history of Hemicycliophora similis.*

A greenhouse study was made of *Hemicycliophora similis* from cranberry bogs in Bandon, Oregon, to determine preferred hosts and optimum environmental conditions such as temperature, soil type, and pH, and to obtain information on its life history. Evaluated as hosts were carrot and various other taprooted vegetables, peppermint, tomato, and cranberry. The germination of carrot seedlings was severely restricted in nematode-infested soil. Adults and larvae were observed feeding behind root tips and on nematode-induced galls. To evaluate temperature and soil optima, carrots were planted in sandy soils infested with 225 nematodes/450 cc with pH adjusted to 6.0, 6.5, and 7.0. Styrofoam cups were equipped with a capillary watering system to provide uniform soil moisture. The cups were placed at 30 C day and 24 C night, 22 C day and 14 C night, or 20 C day and 6 C night. All received 12 h light. Population increase was greatest at pH 6.5, 22 C day and 14 C night, reaching 570 nematodes/cup in 3 months. Rooted cranberry cuttings were planted in similar cups in a sterile bog soil of pH 4.5 and inoculated with 225 nematodes. After 3 months at 30 C day and 24 C night and a 12-h photoperiod, populations increased to 2,000/cup. With a 22 C day and a 14 C night, 1,600 nematodes/cup were obtained. Eggs mature to first-stage larvae, without sheath or spear, in 4 days, and hatch as second-stage larvae in 8–10 days. Second-stage larvae inoculated onto carrot seedlings matured into third-

stage larvae in 12–15 days. Fourth-stage larvae appeared in 25–28 days, and adults were present in 35–38 days.—*Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon 97331.*

MCSORLEY, R. *Damage to snap beans as a function of population gradients of Meloidogyne incognita in the field.*

A field planted to snap beans (*Phaseolus vulgaris* 'Sprite') on a Rockdale fine sandy loam soil near Homestead, Florida, contained an uneven infestation of *Meloidogyne incognita*. At harvest, 10 plants were collected at each of 10 locations in the field, beginning in an area of high infestation and proceeding at 5-m intervals into an area of low infestation. Data were taken on severity of galling and on marketable bean weight for each plant, and means were computed for each location. Gradients were apparent in yield and in *Meloidogyne* level. Mean yield per plant in grams (Y) was negatively correlated (P = 0.01) with the mean number of galls per gram of fresh root weight (X1), with log (X1 + 1) (X2), with mean number of galls per plant (X3), and with the mean root-knot index (X4), a rating of galling on a 0–5 scale. The corresponding regression equations were: Y = –0.281 X1 + 27.26; Y = –17.84 X2 + 43.22; Y = –0.487 X3 + 26.10; Y = –7.682 X4 + 37.64. The respective r^2 values were 0.839, 0.798, 0.785, and 0.812. Such equations provide several alternative methods for estimating the root-knot component of the overall crop loss resulting from pest complexes. In this instance, *Rhizoctonia* was present on all plants sampled, and beans were culled at a low level (3%) for stink bug damage.—*University of Florida, Agricultural Research and Education Center, Homestead, Florida 33031.*

MINTON, N. A., and M. B. PARKER. *Effects of split applications of nematicides on soybean yields and nematode populations.*

Nematicides were evaluated on a soil infested with *Hoplolaimus columbus* (HC) and on one with *Meloidogyne incognita* (MI). Whole-plot treatments were: untreated check, DBCP, ethylene dibromide-chloropicrin mixture (EDB-C), phenamiphos, carbofuran, and aldicarb applied ca 2 wk before planting on the HC area and at planting on the MI area. Subplot treatments were: untreated check, DBCP, phenamiphos, carbofuran, and aldicarb applied ca 3 wk after planting. Soybean yields on the HC area ranged from 1183 kg/ha (for the check plots) to 2493 kg/ha (for the best treatment). Check plots on the MI area yielded 1075 kg/ha, compared with the high yield of 2843 kg/ha. All chemicals except carbofuran increased yields when applied only before planting, at planting, or after planting in both soils. Carbofuran increased yields only when applied after planting in the HC area. Fumigants were more effective than contact materials. No postplant treatment applied to plots treated before or at planting with DBCP increased yields. DBCP applied after planting to plots treated at planting with EDB-C on the MI area increased yields. Yields were not increased by any postplant treatment, except DBCP in the MI area, in plots that received phenamiphos before or at planting. DBCP applied after planting increased yields in both areas in plots treated with aldicarb before or at planting. Yields were increased by postplant applications of all nematicides in the HC area and by all except the postplant application of carbofuran in the MI area in plots that received carbofuran before or at planting.—*Agricultural Research, Science and Education Administration, U. S. Department of Agriculture; and the University of Georgia, Coastal Plain Station, Tifton, Georgia 31794.*

MYERS, R. F. *Interaction of yield and nutritional status of tomatoes with Pratylenchus penetrans.*

A field study designed to determine optimal fertilizer requirements for fresh market tomatoes (Campbell's 1327) was conducted in soil infested with *Pratylenchus penetrans*. The design was a randomized 4 × 2 × 3 × 2 factorial in four blocks: four rates of N (0, 44.8, 89.7, and 134.5 kg

N/ha), two of P (0 and 112.1 kg P_2O_5/ha), and three of K (0, 168.1, and 336.2 kg K_2O/ha) applied before planting over two pH levels (pH 5.5 and 6.0) to sassafras sandy loam soil. Plots were 4.88 m wide × 5.49 m long and contained four rows 1.22 m apart with 0.61 m between plants. Lesion nematodes were extracted from soil samples taken after plants had been killed by frost and started to decay. Ca, N, Mg, K, and P levels were determined in soil and leaf samples. Results were subjected to multiple regression, analyses of variance, correlation, and other analyses. Final numbers of *P. penetrans* ranged from 75 to 6140/250 cc of soil. In general, low fertility treatments resulted in higher nematode numbers. Nematode numbers were affected negatively by increased N fertilization and leaf P but related positively to higher pH, soil and leaf Mg. Highest yield (58.1 t/ha) of No. 1 tomatoes (exceeding 6.3 cm diameter and without visual defects) was obtained with 44.8, 112.1, 336.2 (NPK) at pH 6.0 and the additional loss due to nematodes was calculated as 7.8 t/ha. The data indicate that yield, mineral nutrition, and nematodes have many interesting and complex interactions.—*Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, New Jersey 08903.*

NOLING, J., and G. W. BIRD. *Joint action of nematicides and nitrogen fertilization on control of Pratylenchus penetrans and growth of Solanum tuberosum.*

The joint role of three levels of nitrogen fertilization (82.2, 164.4, and 328.8 kg/ha) and four nematicides [aldicarb, 3.3 kg a.i./ha; 1,3-dichloropropene (1,3-D) and methylisothiocyanate (MIC), 93.5 L/ha; carbofuran, 3.3 kg a.i./ha; and thiofanox, 3.3 kg a.i./ha] were evaluated in the production of potatoes in Michigan in 1977 and 1978. Growth and development of the potato plant, and the population dynamics of *Pratylenchus penetrans,* were monitored throughout the season using a completely randomized block factorial design with each treatment replicated five times. Yields were greater at the higher nitrogen rate for each nematicide treatment. Tuber yields were higher ($P = 0.05$) from nematicide-treated plots than from controls. Yields were highest with 328.8 kg/ha nitrogen and aldicarb or 1,3-D and MIC. Aldicarb reduced ($P = 0.05$) both soil and root population densities of *P. penetrans* at all nitrogen levels. No yield interactions were observed between nematode control and nitrogen fertilization levels. Nitrogen fertilization had no significant influence on nematode population dynamics. Carbofuran at the highest nitrogen rate increased ($P = 0.05$) early-season root weight. Thiofanox at the high nitrogen rate delayed early growth and development of foliage and tubers, resulting in significantly higher foliage and tuber weights at harvest. Carbofuran and thiofanox increased root weight, delayed senescence, and resulted in the highest final soil and root population densities of *P. penetrans.*—*Department of Entomology, Michigan State University, East Lansing, Michigan 48824.*

P. C. O'BRIEN. *A localized expression of resistance in Hudson potato to Globodera rostochiensis.*

The rate and duration of invasion of a resistant (Hudson) and susceptible (Kennebec) potato by juveniles of *Globodera rostochiensis* were varied in pot experiments to evaluate the effect of invasion on the expression of resistance. Resistance was always expressed by an inability of juveniles to establish and develop into adults. Development of both female and male nematodes was inhibited in Hudson, where few females were found and numbers of males were 10–20% of the number developed on Kennebec. These results are consistent with induction of either a systemic resistance which prevented invasion of juveniles into roots developing later, or a localized resistance which caused juveniles to emigrate from the older roots. Invasion of roots of Hudson and Kennebec growing in peat pots by 0, 12, 36, 39, 75, or 171 juveniles per gram of root did not affect invasion and development of juveniles which invaded roots growing later, outside the peat pots. Field observations of these varieties revealed that the patterns of nematode invasion and

development in each variety were similar in each region of root system examined, with no interactions between these regions. Resistance in Hudson was similar in each region of the root system, was not affected by an earlier invasion of different numbers of juveniles, and most of the juveniles invading this variety left the roots following the induction of a localized resistance.—*Department of Plant Pathology, Cornell University, Ithaca, New York 14853.*

ORION, D., W. P. WERGIN, and B. Y. ENDO. *The influence of two synthetic media on development of the root-knot nematode on excised tomato roots.*

Two different media were used for aseptic culture of the root-knot nematode (*Meloidogyne incognita*) on excised roots of tomato (*Lycopersicon esculentum* cv Marglobe). The media were: 1) a formulation by Skoog, Tsui, and White (STW) containing a normal complement of inorganic salts plus glycine, pyridoxine, nicotinic acid, and thiamine; and 2) a formulation by Murashige and Skoog (MS) containing a considerably higher concentration of inorganic salts but only inositol and thiamine as organic constituents. Root infection, nematode development, and gall formation were examined in sectioned and fractured tissues, respectively with light and scanning electron microscopes. On STW medium, root growth was normal and gall formation and nematode development occurred within 4 weeks. Fractured tissues generally revealed syncytia consisting of 3–5 giant cells. These cells had dense cytoplasmic contents, and peripheral walls with extensive ingrowths. The peripheral walls comprising the syncytium were generally apposed by the secondary walls of the xylem tissue, which became extensively proliferated in the gall region. By 4 weeks a cavity was formed near the posterior end of the nematode. The cavity became filled with a gelatinous matrix and eggs from the mature female. On the MS medium, root growth was nearly normal. However, roots fractured at the gall site contained only 1–2 syncytia-like cells, frequently void of contents. Ingrowths from the peripheral walls of the syncytia were relatively few or absent, and the xylem failed to develop and encircle the syncytium. By 4 weeks, only 30% of the nematode population had reached maturity. Differences in gall formation and nematode development observed in the two media are probably related to inorganic salt concentrations or organic constituents.—*Nematology Laboratory, Plant Protection Institute, Beltsville Agricultural Research Center, Beltsville, Maryland 20705. Permanent address of the senior author: Division of Nematology, Agricultural Research Organization, Volcani Center, Bet-Dagan, Israel.*

ORR, C. C. *Effect of inoculum rate of Nothanguina phyllobia on control of Solanum elaeagnifolium.*

Nothanguina phyllobia Thorne has been shown to be highly parasitic on silverleaf nightshade (*Solanum elaeagnifolium* Cav.), an important perennial weed of the Southwestern U.S. In a field control trial, *Nothanguina*-infected silverleaf nightshade leaves were applied at three levels, 36, 3.6, and 0.36 kg/ha, to a 1-ha area infested with the weed. Treatments were arranged in a completely randomized block and replicated five times. The number of viable nematode larvae was calculated to be 50–100/cm^2 of soil at the 36-kg/ha rate. The inoculum was scattered evenly over the plots and disced into the soil. Silverleaf nightshade density was ca 9 plants/m^2. Inoculum was applied in August 1978, and galled plants were counted in October 1978. The percent of infested plants in the 36-kg/ha plots was 82 and ranged as high as 94. Percent infestation was ca 40 and 12 for the 3.6- and 0.36-kg/ha rates. In previous tests, over 50% of infested plants were killed, and injury to remaining plants increased in subsequent years.

N. phyllobia galls are infrequent on plant species other than silverleaf nightshade. Careful examination of many plant species has shown that infective *N. phyllobia* larvae occasionally penetrated nonhost tissue but seldom became embedded in the tissue; galls fail to develop, and no nematode reproduction has been observed.—

Science and Education Administration, United States Department of Agriculture, Lubbock, Texas 79401.

PINKERTON, J. N., and H. J. JENSEN. *Effects of carbamate nematicides on nematode populations and yield of peppermint.*

Longidorus elongatus is a common pest of peppermint, *Menta piperita,* in flood plain areas of western Oregon. Symptomatic of infested fields are sparse stands and stunted plants with poor feeder-root development. The efficacies of carbamate nematicides for controlling this pest were determined during 1977 and 1978. Foliar applications of oxamyl at 1.1, 2.2, and 3.4 kg (a.i.)/ha were made one, two, or three times at 2-week intervals to a declining 5-year-old stand. Single applications of oxamyl granules at 3.4, 6.7, and 10.1 kg (a.i.)/ha were broadcast on this stand. Mint hay yields were improved ($P = 0.05$) with three foliar applications at all rates, two applications at 2.2 kg (a.i.)/ha, and granular treatments at the two higher rates. In a similar series with rooted cuttings planted in infested soil, all treatments significantly increased hay yields. Nematode populations before treatment, at midseason, and at harvest showed no apparent differences between treated and untreated plots. Yield increases were probably due to temporary protection of the feeder roots early in the growing season. In 1978 trials were conducted to test the effects of six application timings: fall (late November), winter (early March), spring (mid-June), fall-winter, winter-spring, and fall-spring. Oxamyl, both liquid and granular, and aldicarb were broadcast at 0.6, 1.1, or 2.2 kg (a.i.)/ha at each timing. Single winter treatments and double-application plots that included one winter application produced the most significant responses with both nematicides.—*Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon 97331.*

PINKERTON, J. N., and H. J. JENSEN. *Investigations of the cereal (oat) cyst nematode in Oregon.*

With discovery of *Heterodera avenae* in Oregon in 1973, various studies were initiated, including biotype identification, host-range trials, resistant variety tests, and control with chemicals. Biotype identification, based upon selective feeding on indicator plants as recommended by European investigators, indicated that the nematode found in Oregon closely resembles the most common western European biotype (Dutch C; Danish, English, and Swedish 2). Host-range studies included numerous varietal selections resistant to various biotypes and more than 400 cereals, grasses, other crops and weeds. Injury to spring-planted crops, in declining order of severity, was observed in oats, barley, wheat, rye, *Triticale,* and grasses. Fall-planted hosts did not show injury despite numerous cysts attached to the roots. The pattern of resistance in barley, oats and wheat varieties was similar to that shown by the common western European biotype. Applications of granular aldicarb, oxamyl, or sulfone (wettable powder) at 5.6 and 11.2 kg ai per ha produced excellent yields. Population of nematodes in terms of cysts per 200 g soil rarely showed an inverse correlation with yield. Chemical control is not an economically feasible alternative for this pest in Oregon.—*Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon 97331.*

PINOCHET, J. *Nematode-fungus associations in bananas and plantains.*

An extensive survey was made of the most common soil fungi associated with nematode lesions in bananas and plantains. Plant material was gathered from many banana-producing areas throughout the world (Honduras, Panama, Costa Rica, Colombia, Martinique and Guadaloupe, Dominican Republic, Eduador, Somalia, Sumatra, and the Philippines). Fungi were isolated from new and old nematode lesions in root and rhizome tissue, and from the four most common nematodes associated with bananas and plantains, *Radopholus*

similis, Pratylenchus coffeae, Helicotylenchus spp., and *Meloidogyne* spp. Fungi were obtained from 1,834 of 4,338 isolations from bananas. Four fungi occurred in 71% of the isolations from nematode lesions. They were: *Acremonium stromaticum* 22%, *Fusarium solani* 18%, *Cylindrocarpon musae* 17%, and *Fusarium moniliforme* 14%. Apparently these fungi are part of the root and rhizome flora of bananas throughout the world. Nematode-fungus associations on plantains were studied only in Honduras. Isolations were generally made from lesions caused by *Pratylenchus coffeae,* the nematode encountered most frequently on plantains. The fungi associated with nematode lesions on plantains are the same ones found on bananas. Fungi were obtained from 170 of 428 isolations. *Acremonium stromaticum* and *Cylindrocarpon musae* were recovered from 74% of the isolations.—*Division of Tropical Research, United Fruit Company, La Lima, Honduras, Central America.*

PLATZER, E. G. *Phosphoenolpyruvate metabolism and oxidoreductase reactions in Mermis nigrescens.*

The nature of phosphoenolpyruvate metabolism and cytoplasmic oxidoreductase reactions was investigated in *Mermis nigrescens.* Parasitic stages of *M. nigrescens* were obtained 14, 16, 21, and 30 days postinfection, and postparasites were obtained 16 and 40 days postemergence from locusts (*Schistocerca gregaria*). The characteristics of pyruvate kinase (PK), phosphoenolpyruvate carboxykinase (PEPCK), lactate (LDH), and malate dehydrogenases (MDH) were determined in homogenates of parasitic nematodes. In general, the pH optima, substrate, cofactor and ion requirements, and apparent affinity constants of these enzymes were similar to those reported for other eukaryotic organisms. The specific activity of MDH remained constant in all stages of the nematode, whereas LDH activity declined precipitously to very low levels in 21-day parasites and postparasites. This finding indicates that MDH is primarily responsible for maintenance of the cytoplasmic redox state in maturing parasitic and postparasitic stages of *M. nigrescens.* PK activity declined slightly during nematode development within the host, and upon emergence. PEPCK activity was not detectable in 14-day parasites, but it appeared by 19 days and remained at low levels in the parasitic and postparasitic stages. The low PEPCK activity suggests that CO_2 fixation is of little importance in *M. nigrescens,* although further metabolic studies are necessary to substantiate the supposition.—*Department of Nematology, University of California, Riverside, California 92521.*

PROT, J.-C., and S. D. VAN GUNDY. *The effect of clay particles on the migration of Meloidogyne incognita toward and into tomato roots.*

The effect of four soil types on the attraction and migration of *M. incognita* juveniles toward tomato roots was tested in 20-cm PVC columns attached to styrofoam cups and separated from the root system by a 35-μm screen. Only the juveniles that had migrated 20 cm and penetrated the roots in 7 days were counted in roots stained with 0.05% cotton blue. About 300 juveniles, not more than 24 h old, were introduced into the soil at the bottom of the column. The experiments were repeated three times, five replications per experiment, and maintained at 26 C in a growth chamber with 12-h illumination. The percent juveniles found were respectively <1%, 35%, 25%, and <1% in roots grown in: a) silica sand composed of 250-μm particles; b) silica sand with 5% clay (modeling clay) added and thoroughly mixed; c) silica sand with 10% clay; and d) silica sand with 5% clay as a layer at the bottom of the cup but not between the roots and the nematodes. If the juveniles were introduced directly around the roots growing in silica sand, about 70% of the juveniles penetrated the roots. It is hypothesized that the clay particles added to silica sand aid in the attraction of root-knot juveniles over long distances to plant roots by adsorbing and holding some root exudate, which helps the nematodes locate the roots by sensory perception.—*Department of Nematology, University of California, Riverside, California 92521.*

RICH, J. R., and J. T. JOHNSON. *Effects of subsoiling, 1,3-D before planting, and 1,3-D or carbofuran at planting on yield of field corn grown in nematode-infested soil.*

Treatments were arranged in a split-plot design with three subsoiling variables as main plots and seven nematicide treatments as subplots. Nematicide treatments included: a control; 67.3 and 100.9 kg/ha 1,3-dichloropropene–1,2-dichloropropane (DD) applied before planting; 33.6 and 67.3 kg/ha DD and 1.3 and 2.5 kg a.i./ha carbofuran (Furadan 10G) applied at planting. The DD was injected in the row 15–20 cm deep, and the carbofuran was applied as a 20-cm band over the seed furrow in the 91-cm-wide rows. Soil in the test site was a sandy loam with a plowpan at a depth of 15–20 cm. Soil samples taken before planting indicated 164 *Meloidogyne incognita,* 314 *Pratylenchus* sp., and 2 *Trichodorus christei* per 250 cm^3 of soil. No reduction in plant emergence or obvious symptoms of phytotoxicity resulted from any of the treatments. All nematicide treatments resulted in more grain yield (P = 0.05) than the control, and the 100.9 kg/ha DD treatment before planting significantly outyielded all the other treatments. No yield differences were found among the other DD treatments or the carbofuran treatment at 2.5 kg a.i./ha, all of which produced more grain (P = 0.05) than the carbofuran treatment of 1.3 kg a.i./ha. Subsoiling increased yields by 17 to 25%. A significant interaction between subsoiling and nematicide application was observed.—*University of Florida, Departments of Nematology and Agronomy, respectively, Agricultural Research Center, P. O. Box 657, Live Oak, Florida 32060.*

ROBERTS, P. A., and A. R. STONE. *Globodera host-ranges in the genus Solanum.*

Globodera species (*G. pallida, G. rostochiensis, G. solanacearum, G. tabacum, G. virginiae,* and the Mexican cyst-nematode) represented by 35 populations were compared on 22 accessions of 19 wild *Solanum* subgenus *Leptostemonum* species from both the Old World and the Americas. Plants grown in 9-cm-diam plastic pots in the greenhouse at approx 20 C were inoculated with 10,000 free eggs of each *Globodera* population tested. Each population was replicated five times. Cyst production was assessed by root-ball counts and total cyst counts, respectively at 12 and 14 weeks. Six European potato cyst-nematode (PCN) pathotypes (Ro1, Ro2, Ro3, Ro4, and Ro5 of *G. rostochiensis,* and Pa2 of *G. pallida*) failed to multiply on 18 of the *Solanum* accessions. However, European pathotypes Pa1 and Pa3 of *G. pallida,* a Bolivian population of *G. rostochiensis,* the Mexican cyst-nematode, and North American populations of the other *Globodera* species multiplied on most. Distribution of resistance did not correspond directly to the taxonomic subgroupings of species within *Solanum.* Old World solanums were uniformly susceptible except to cerain European PCN pathotypes. Resistance was found mainly in indigenous South American species. The data indicate that susceptibility is the basic condition in *Solanum,* and that distribution of resistance is influenced by the geographic and altitudinal distribution of the host and parasite groups.—*Department of Nematology, University of California, Riverside, California 92521; and Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., UK.*

SLANA, L. J., J. R. STAVELY, and A. M. GOLDEN. *Reaction of Nicotiana species to Meloidogyne grahami.*

The reactions to *Meloidogyne grahami* of 61 *Nicotiana* species, five subspecies, and two *N. tabacum* cultivars were determined 6 weeks after uniform inoculation of greenhouse-grown plants with 750 freshly hatched larvae/plant. Each accession was tested in a minimum of 10 replicated pots. The washed roots were indexed on a root-galling scale of 0–5 (0 = no galling; 5 = severe galling) and the results were analyzed statistically. The *Nicotiana* species tended to have three levels of response to infection: 1) high resistance with development of few galls or egg-bearing females, and low disease indices of 0.75 to 0.93 in *N. paniculata,*

N. repanda, N. nudicaulis, and *N. knightiana;* 2) moderate resistance, with disease indices of 1.30 to 2.16 in *N. glauca, N. thrysiflora, N. longiflora, N. plumbaginifolia;* and 3) light to no resistance in the remaining 53 species, 5 subspecies, and *N. tabacum* cvs Hicks and NC 95, with disease indices ranging from 2.8 to 5.0. This is the first report of the reactions of these species to *M. grahami.*—*United States Department of Agriculture, Tobacco Laboratory, Plant Genetics and Germplasm Institute: the Nematology Laboratory, Plant Protection Institute, Beltsville Agricultural Research Center, Beltsville, Maryland 20705. Portions of Ph.D. thesis research, Department of Botany, University of Maryland, College Park, Maryland 20742.*

SPIEGEL, Y., E. COHN, and U. KAFKAFI. *Influence of different nitrogen nutrition of tomato on parasitism by the root-knot nematode.*

Tomato seedlings inoculated with the root-knot nematode *Meloidogyne javanica* were treated with Hoagland's solutions containing three different sources of nitrogen: NO_3^-; NO_3^- + NH_4^+; NH_4^+. One and two months after inoculations, plant samples were removed and weighed, root and shoot N, P, K, and Mg were analyzed, degree of nematode infection was determined, and the activity of nitrifying and denitrifying bacteria in the soil was evaluated. In the NO_3^--treated nematode-infected plants, metabolites accumulated in roots at the expense of shoots. Shoot:root weight ratios were 0.7 after the first month, and 0.5–0.6 after the second month. Accumulation of N, P, and particularly of K in the infected roots was especially marked in the NO_3^- treatment, where K accumulation increased with time, and was more than twice as great as with NH_4^+ nutrition. Nematode infection was high, and unaffected by the nutrition treatments. The percentage of males increased slightly in the NH_4^+ treatment. Populations of nitrifying and denitrifying bacteria were lower in the nematode-infested soils than in the nematode-free soils. These results support the existence of a metabolic sink in roots of *Meloidogyne*-infected plants and suggest an increased tolerance to root-knot nematodes in plants receiving NO_3^- nutrition.—*Division of Nematology and Division of Chemistry and Plant Nutrition, Agricultural Research Organization, Volcani Center, Bet-Dagan, Israel.*

SPIEGEL, Y., E. COHN, and SARAH SPIEGEL. *Use of lectins for detecting saccharide residues on surface cuticular structures of phytophagous nematodes.*

While the use of lectins as a tool for demonstrating the presence of saccharide receptors on cell surfaces of animals and microorganisms is well documented, information is lacking on their effect on nematodes. It is possible that lectins could be used for differentiating nematode populations and explaining host specificity. Three phytonematode species with different host preferences (*Xiphinema index, Tylenchulus semipenetrans,* and *Meloidogyne javanica*) were treated with three lectins with different sugar specificities: wheat-germ agglutinin, concanavaline-A, and soybean agglutinin. Binding of the lectins to the nematodes was examined with the aid of their fluorescein-isothiocyanate-conjugated derivatives. After fixation in heat or glycerin, microscopic preparations were made, and lectin-bounded sites were recognized on the nematode surface. In all cases where binding was recognized, it was shown to be sugar-specific. No fluorescence was observed in the presence of both lectin and its inhibitory sugar.—*Department of Nematology, Agricultural Research Organization, Volcani Center, Bet-Dagan, Israel; and Department of Biophysics, Weizmann Institute of Science, Rehovoth, Israel.*

STARR, J. L. *Plant-parasitic nematodes associated with sorghum, pearl millet, groundnut, pigeonpea, and chickpea at ICRISAT, Hyderabad, India.*

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has a mandate for the improvement of five crops: sorghum, pearl millet, groundnut,

pigeonpea, and chickpea. In 1975 and 1976, growth of pigeonpea was poor in certain fields under monoculture at ICRISAT Center in Hyderabad, India. ICRISAT fields are characterized by two soil types, a deep, black clay loam Vertisol, and a shallow red loamy sand Alfisol. Poor growth of pigeonpea was most prevalent in Vertisol fields. A survey of affected fields revealed high populations of *Heterodera cajani.* Plants whose roots were heavily infected with *H. cajani* were stunted and frequently chlorotic. Detected also in ICRISAT fields were *Pratylenchus, Helicotylenchus, Hoplolaimus, Rotylenchulus, Paratylenchus,* and *Scutellonema* spp. Although *R. reniformis* was found in high population densities in association with pigeonpea, and *Pratylenchus* and *Hoplolaimus* spp. reproduced on sorghum and pearl millet, these nematodes did not appear to be causing serious crop damage. Preplanting soil samples collected just before the onset of the rainy and main cropping season revealed low population densities of all nematodes (4 to 57 plant parasites/500 cm^3 soil). It is probable that the 7-month dry season preceding the rainy season prevents the survival of damaging population densities of most nematode species. *H. cajani,* however, apparently survives at damaging levels from one year to the next. Survival of *H. cajani* appears to be greater in Vertisols than Alfisols because the deeper Vertisols retain more moisture.—*Department of Plant Pathology, North Carolina State University, Raleigh, North Carolina 27650.*

THAMES, W. H., and T. E. BOSWELL. *A bioassay method for the detection of Pratylenchus brachyurus (Nematoda: Tylenchoidea) in soil from peanut fields.*

A bioassay method for the detection of overwintering populations of lesion nematodes, *Pratylenchus brachyurus,* in soil samples from peanut fields was found to be superior to a sieving and centrifugation extraction assay. In the bioassay method, corn was grown for 2, 3, or 4 weeks in 500-g samples of soil taken in March from fields planted to peanuts the previous year. At the end of the growth period the roots were washed free of soil and placed on funnels in a mist chamber for 10 days to recover the nematodes. Lesion nematodes were readily detected after 2 weeks of growth although none could be recovered from duplicate samples with the sieving and centrifugation technique. These results are due most likely to the emergence of overwintering nematodes from organic debris in the presence of the corn roots, although none could be recovered from such debris wet-screened from 500-g samples of the soil.—*Texas Agricultural Experiment Station, Texas A&M University, College Station, Texas 77843.*

TROFYMOW, JOHN A., and DAVID C. COLEMAN. *The influence of nematodes on cellulose decomposition in gnotobiotic systems.*

Decomposition of cellulose was studied over a period of 60 days in gnotobiotic soil microcosms with two levels of added nitrogen. The bacterial decomposition of cellulose in low-nitrogen systems was increased by the presence of a grazing nematode, *Pelodera* sp. The microcosmal levels of nitrogen and CO_2 attained with bacteria and nematodes were similar to those attained with fungus or actinomycete decomposers. Remineralization of nitrogen, and nematode grazing on bacteria, both stimulate bacterial decomposition. Nematode grazing increases the bacterial turnover rate. Large additions of nitrogen lowered the numbers of *Pelodera* sp. and *Aphelenchus avenae,* possibly as a result of ammonia toxicity and decreased cellulose decomposition as compared with lower rates of added nitrogen. Bacteria alone increased cellulose decomposition with the addition of nitrogen. Grazing by *A. avenae* on the cellulose-decomposing fungus *Rhizoctonia solani* resulted in a suppression of cellulose decomposition. The introduction of nematode grazers not only stimulates decomposition by bacteria but also may serve to distribute the bacteria throughout the soil, bringing them into greater contact with cellulose fragments in a heterogeneous substrate.—*Department of Zoology and Entomology, and Natural Resource Ecology Laboratory,*

Colorado State University, Fort Collins, Colorado 80523.

TSAI, B. Y., and W. J. APT. *Anhydrobiosis of the reniform nematode: survival and coiling.*

Anhydrobiosis of the reniform nematode, *Rotylenchulus reniformis,* was studied in stored pineapple soil, a Wahiawa Oxisol, at moisture levels of 14.4, 21.1, 27.8, 28.6, and 41.9% (by oven-dry weight). Survival of *R. reniformis* was affected by moisture content, time, and an interaction between the two. Population declined significantly during a 66-day test period at the two extremes of soil moisture levels, 41.9 and 14.4%, but not in moderately dry soil. The optimum moisture level for survival was 28.6%. Surviving nematodes retained a high percentage of infectivity on cucumber seedlings. The mode of survival was analyzed in terms of eggs, larvae, males, and pre-adult females. Eggs and larvae had higher survivability than pre-adult females and males at moisture levels of 28.6, 27.8, and 21.1%, but not at 41.9 and 14.4%. Pre-adult females had higher desiccation survivability than males. Egg hatch and larval development was inhibited at 28.6% and below. Embryo development was inhibited at 27.8% and below. Coiled nematodes were found in all the soils tested. The percentage of coiled nematodes increased neither with time nor with a decrease in soil moisture, indicating that coiling was not a survival mechanism of *R. reniformis* in desiccated soil.—*Department of Plant Pathology, University of Hawaii, Honolulu, Hawaii 96822.*

VEECH, J. A. *Histochemical localization of catechin and gallocatechin in roots of inoculated and uninoculated root-knot-nematode-susceptible and -resistant cottons.*

(+)-Catechin and gallocatechin, the major phenolics in cotton, or their condensation products have been implicated in resistance to fungi and insects. To determine whether these componuds are active in the mechanism of resistance of cotton to the root-knot nematode (*Meloidogyne incognita*), comparative histochemical studies were made. The anatomical sites of localization of these compounds in roots of uninoculated and inoculated susceptible and resistant cultivars were demonstrated with the dimethoxybenzaldehyde reagent. No differences were found in the sites of localization of constitutive catechin or gallocatechin in susceptible or resistant plants. The compounds were localized in the endodermis, xylem parenchyma, and portions of the hypodermis. Upon infection by the nematode, these compounds appeared to increase in concentration in the endodermis. However, no varietal differences were observed. Catechin and gallocatechin were not observed near the nematode feeding site. Present histochemical data do not support the possibility that catechin and gallocatechin are involved in the resistance of cotton to the root-knot nematode.—*U.S. Department of Agriculture, Science and Education Administration, National Cotton Pathology Research Laboratory, P.O. Drawer JF, College Station, Texas 77840.*

VRAIN, T. C. *Tolerance of carrot cultivars to Meloidogyne hapla.*

In greenhouse and microplot tests, 26 breeding lines or commercial cultivars of carrot were compared with a standard cultivar "Goldpak" for tolerance and resistance to *Meloidogyne hapla.* In the greenhouse, steam-sterilized organic soil was infested with 1,200 to 1,500 larvae per liter, and each treatment was replicated four to eight times. In the microplots, methyl-bromide-sterilized organic soil was infested by adding soil from a greenhouse culture to achieve a final nematode density of 1,600 per liter, and each treatment was replicated six times. Carrots were harvested and graded 120 days after sowing. In the greenhouse, foliage weight and length and weight of the tap root were measured, and the roots were rated from 1 to 4 for each of three kinds of nematode damage: forking, galling and ramifications (excessive branching). A general growth index was calculated as

$$\frac{\log (\text{length} \times \text{weight})}{\log [(\text{forking} \times \text{galling} \times \text{ramifications}) + 1]}$$

Meloidogyne hapla reduced the marketable yield of all lines and cultivars. Several lines showed some tolerance expressed by tap roots which were significantly larger, heavier, and less damaged than those of "Goldpak." Resistance was expressed in some lines by suppression of the reproduction of *Meloidogyne hapla.*—*Agriculture Canada Research Station, Vancouver, British Columbia V6T 1X2.*

WALKER, J. T., and J. MELIN. *Phytotoxicity of nematicide treatments to turfgrass seed.*

Nematicide treatments of agronomic and vegetable seeds offer possibilities for reducing costs and potential environmental problems in application of nematicides to soils. The technique could have potential significance for treatment of turfgrass seed. A study was conducted to ascertain the phytotoxicity of several nematicides to grass seed. Seed lots from 10 improved grass cultivars (Kentucky bluegrass—Bonnieblue, Fylking, Glade, Ram; fescues—Banner chewings, Creeping red, Jamestown, Koket chewings, Koket, Pennlawn red) were soaked for 30 sec in 100-ml acetone solutions containing 0.5, 2.5, and 5.0% (w/v) technical-grade carbofuran, oxamyl, or phenamiphos, air-dried, and planted in methyl-bromide-treated soil. The effect of seed treatments on seedling emergence in a greenhouse was determined 14 days after planting. Treating seeds with nematicides gave generally lower seedling emergence than no treatment, but emergence varied with cultivar, nematicide, and nematicide concentration. Oxamyl was the least toxic at all rates, and all nematicides were nonphytotoxic at 0.5% conc. Tip necrosis of grass blades occurred with 5.0% carbofuran treatments. Phenamiphos was the most phytotoxic, reducing emergence especially at 5.0% conc. Emergence of fescue cultivars was affected more than bluegrass cultivars. The ultimate value of the infusion technique will depend on both the nematicidal effectiveness and phytotoxicity of the chemical used.—*Department of Plant Pathology, University of Georgia College of Agriculture Experiment Stations, Georgia Station, Experiment, Georgia 30212.*

WALSH, J. A. *An intracellular microorganism in tissues of the potato cyst nematode Globodera rostochiensis and the pea cyst nematode Heterodera goettingiana.*

Intracellular bacterium-like microorganisms were first discovered infecting nematodes at Rothamsted Experimental Station, England. The intracellular organisms were found in two species of cyst-nematodes, *Heterodera goettingiana* and *Globodera rostochiensis.* The microorganisms in *G. rostochiensis* and *H. goettingiana* appear identical, although the infected populations came from widely separated places, from Bolivia and Suffolk, England, respectively.

Crosses between the infected Bolivian population of *G. rostochiensis* and an uninfected population suggested that the micro-organisms were passed to offspring transovarially and not via sperm, despite their presence in sperm cells. Observations of ultrathin sections of the reproductive tract of infected females have shown that the germinal and growth zones of the ovaries, the oviducts, seminal receptacles (spermathecae), and uteri are all infected. The micro-organisms were also present in developing oocytes within the ovary, mature oocytes in the oviduct, and unembryonated eggs. Since all the developmental stages of the egg and newly hatched unfed second-stage juveniles are infected, the microorganisms must be passed transovarially from generation to generation.—*Nematology Department, Rothamsted Experimental Station, Harpenden, Hertfordshire, England AL5 2JQ.*