ABSTRACTS OF PAPERS PRESENTED AT THE THIRTEENTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS, RIVERSIDE, CALIFORNIA, 18-21 AUGUST 1974

BAINES, R. C. *Susceptibility and tolerance of eight citrus root-stocks to the citrus nematode, Tylenchulus semipenetrans.*

The susceptibility and tolerance of eight citrus rootstocks to the citrus nematode *Tylenchulus semipenetrans* were tested in 8-liter pots in a sandy loam soil at 26 C. After 10 mo the dry weight of the tops and level of infection on roots was determined for eight replicates. Limoneira rough lemon, red rough lemon, Olivelands sweet orange, standard sour orange, Homosassa sweet orange, Olivelands sour orange, Troyer citrange, and Hall grapefruit are in descending order of dry weight of the noninfected trees. The two most susceptible hosts were Limoneira rough lemon and red rough lemon with 19.8 and 18.8 adult females per cm of feeder root and 51.6 and 55.5% weight reduction, respectively. Hall grapefruit had 20.9 adult females/cm of root, and weight of infected trees was decreased 42.8%. Homosassa sweet orange, Olivelands sweet orange, and Standard sour orange contained 14.3, 13.2, and 11.5 adult females per cm of root, and dry weight of the seedlings were decreased 33.6, 34.3 and 31.5%, respectively. Olivelands sour orange was moderately susceptible, 7.7 adult females per cm of root; also it was highly tolerant to the citrus nematode since weight of the infected seedlings was not decreased. Tree weight was not correlated with susceptibility or tolerance.—*Department of Nematology, University of California, Riverside 92502.*

BAINES, R. C., and R. H. SMALL. *Evidence of modes of action of oxamyl nematicide on Tylenchulus semipenetrans.*

Neither three foliage sprays of 1:1,000 (w/w) oxamyl at 4-wk periods on sweet orange trees in pots, nor one foliage spray of 8:1,000 (w/w) oxamyl on 7- and 11-yr-old trees decreased numbers of larvae of *T. semipenetrans* on roots. Forty to 320 μg/ml oxamyl drenched in soil in pots, decreased the numbers of larvae on roots by 89-91%. Oxamyl, 36 kg/ha, rototilled into surface soil and sprinkler-irrigated decreased numbers of larvae in soil 0-60 cm deep by 84-91%. Oxamyl-treated roots washed and incubated yielded 49-240% more larvae than nontreated roots. Three applications 6 wk apart of 18 kg oxamyl/ha in furrows with irrigation decreased numbers of larvae by 87% in 0-60 cm of soil in an 8-yr-old orchard. Approximately 5 ppm of oxamyl in sandy loam A (1.2% organic matter and pH 7) decreased by 98% numbers of adult females per gram of feeder roots that developed from inoculations made with larvae 9 or 21 days after applying oxamyl. In sandy loam B (3.7% organic matter and pH 7.9) it did not decrease numbers of adult females. Soils A and B containing 8.2% and 9.5% water and 1.0 μg/ml oxamyl were stored in stainless steel pails. Four sweet orange seedlings were planted in 1-liter pots for each soil at weekly intervals and inoculated with 40,000 larvae/pot. Adult females/g of roots in soil A were 10, 31, 33, 119, 117, 170, and 113% and in Soil B 76, 65, 89, 312, 213, 315 and 150% of those on control trees after 0, 1, 2, 3, 4, 5, and 7 wk of storage. The data indicate that oxamyl degrades in soils and that degradation products may increase numbers of nematodes that develop in orange roots.—*Department of Nematology, University of California, Riverside 92502.*

BARKER, K. R. *Pest management—the need to relate nematode densities to crop performance.*

The concept of pest management, as envisioned in optimizing crop productivity, should include consideration of nematodes. A shift from traditional preventive chemical control of nematodes to a "pest management" approach will require the development of comprehensive research programs to quantify relationships between various nematode species and crop yields. Promising empirical methods for elucidating these relationships include the use of: (i) chemical soil treatments; (ii) crop rotations; (iii) resistant cultivars; and (iv) microplot methodology. Results from all four approaches have been utilized as a basis for an experimental nematode diagnostic and advisory program in North Carolina. Microplots and nematicides were employed to determine economic threshold densities, and to generate regression models and

correlations for seven nematode species on selected field and vegetable crops. Evaluations of five sampling methods and four assay procedures showed that different methods frequently are required to monitor populations of different nematode species. In correlating numbers of *Meloidogyne incognita* at monthly sampling intervals with subsequent crop yields, high negative correlations were obtained for fields with high infestations, regardless of sampling time. However, fall assays were most reliable for fields with low densities of *M. incognita,* as well as for species such as *Belonolaimus longicaudatus* which usually occur in low numbers and decline rapidly during winter.—*Department of Plant Pathology, North Carolina State University, Raleigh 27607.*

BOPARAI, J. S., and N. G. M. HAGUE. *The response of the potato cyst nematode, Heterodera rostochiensis, and the root knot nematode, Meloidogyne incognita to Dowco 275.*

Dowco 275 (*0-0* Diethyl *0*-(6-fluoro-2 pyridyl)phosphoro-thioate) granules were applied to soil infested with *H. rostochiensis* and *M. incognita* as follows: *H. rostochiensis.*—The dosages applied were 0, 1, 2, 4, and 8 mg. a.i. per kg soil. Small potato seedlings were planted immediately after treatment, and the following assessments were made weekly after the second week: (i) The number of second-stage larvae emerging from cysts; (ii) the number of second-stage larvae in soil; (iii) the number of developing larval stages in roots; and (iv) the final population 12 wk after application. There was a delay in emergence from cysts. Although root invasion was reduced and delayed in the higher treatments, the most marked effect was that no fourth-stage larvae developed at 8 mg/kg which resulted in a lower final population than in the initial infestation. *M. incognita.*—In a similar experiment, soil infested with *M. incognita* was treated at 0, 2, and 4 mg/kg and assessed weekly for 4 wk after treatment. Dowco 275 was more effective against *M. incognita* than against *H. rostochiensis;* the number of *Meloidogyne* larvae in soil and roots was markedly reduced and fourth-stage larvae did not develop in the roots. The mode of action of Dowco 275 differs from that of the carbamyl oxime nematicides, aldicarb and thioxamyl (oxamyl). Although all three compounds delayed emergence and invasion of *H. rostochiensis,* only Dowco 275 seems to have any effect upon nematodes in the roots. Both the carbamyl oximes are effective in preventing larvae from penetrating roots.—*Department of Zoology, University of Reading, Reading, Berks., U.K.*

BRAUN, A. L., and B. F. LOWNSBERY. *The pin nematode, Paratylenchus neoamblycephalus, and its effect on Myrobalan plum.*

Elimination of *Paratylenchus neoamblycephalus* from soil by fumigation with 1,2-dibromoethane increased the weight of Myrobalan seedlings grown in it. Addition of a suspension of *P. neoamblycephalus* to Myrobalan seedlings reduced their growth compared to uninoculated controls. When nematodes were removed from the suspension by settling, the supernatant liquid did not cause stunting. Roots of Myrobalan seedlings inoculated with surface-sterilized *P. neoamblycephalus* were smaller, darker, and had fewer feeder roots than those of uninoculated controls. Nematodes were observed feeding ectoparasitically, but with heads in as far as the cortex, associated with small lesions and death of lateral roots. Clusters of nematodes were common at ruptures in the epidermis, and where lateral roots emerged. Limitation of Myrobalan growth was greater at 20 and 27 C than at 30 C, and was not affected by pH. Rose, apricot, peach, and all *Prunus cerasifera* selections and hybrids tested, were hosts for *P. neoamblycephalus.* The nematode could not be cultured on a variety of herbaceous plants or on Myrobalan callus tissue.—*Department of Nematology, University of California, Davis 95616.*

BRODIE, B. B. *The relation of starlings to the spread of Heterodera rostochiensis.*

The possible spread of soil-borne plant pests by birds is an important consideration, particularly with a quarantined pest such as *Heterodera rostochiensis.* Starlings (*Sturnus vulgaris*) were used to determined (i) the time required for cysts of *H. rostochiensis* to pass through the digestive system, (ii) the effects of

passage on nematode viability, and (iii) the effects of excrement on the emergence of larvae from the cysts. Birds were fed a mixture of turkey starter mash and dog meal (1:1, v/v) to which cysts were added to equal a soil population density of 2×10^9 cysts per hectare. Excretum was collected on a polyethylene sheet at various intervals after feeding, and examined for cysts and nematode viability. Cysts were recovered within 15 min after feeding. After 2.25 h total evacuation of cysts from the digestive system of all birds had occurred. The greatest number of larvae emerged from cysts that passed through the digestive system within 15 min. No larvae emerged from cysts that were retained more than 1.25 h. Regardless of length of time retained in the digestive system, cysts that remained in contact with excreta for 72 h after passage failed to hatch when subjected to a hatching stimulant. Also, cysts failed to hatch when exposed for 1 wk to excrement filtrates (30 g excreta in 200 ml of water) exceeding a concn of 20%. These experiments indicate that the spread of *H. rostochiensis* by starlings is unlikely.—*USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, N.Y. 14850.*

BROWN, B. J., and E. G. PLATZER. *The effect of temperature, light, larval age and exposure time on the infectivity of preparasitic larvae of Reesimermis nielseni.*

The purpose of this study was to obtain more information on the ecological physiology of *Reesimermis nielseni* and facilitate the rational use of *R. nielseni* in the biological control of mosquito larvae. The ability of the preparasitic larvae of *R. nielseni* to infect the first instar of *Culex pipiens* was tested in a multifactorial experiment, including combinations of constant light or dark, 18 and 27 C, preparasitic larvae aged 1 to 4 days, and exposure times from 2 to 48 h. The time for host location and infection increased as the preparasitic larvae aged at all combinations of illumination and temp. *R. nielseni* infected mosquito larvae more efficiently under constant darkness. Low temp increased the time required for *R. nielseni* to locate and infect the host, but also increased the survival time of the preparasitic larvae. The survival time (ST) of preparasitic larvae was determined at the following temperatures: 4, 11, 18, 27, 32, and 39 C. The ST_{50} at each temperature was 3.8, 5.4, 4, 3, 2.6, and 1.4 days, respectively. The ST_{10} at each temp was 7.8, 9.2, 7.7, 4.4, 3.9, and 2.0 days, respectively. The optimum temp for survival of preparasitic *R. nielseni* was 11 C.—*Department of Nematology, University of California, Riverside 92502.*

BUECHER, E. J., and E. L. HANSEN. *Sex expression in Aphelenchus avenae.*

A parthenogenetic strain of *Aphelenchus avenae* was axenized and grown continuously at 23-28 C in a liquid medium composed of chemically defined components supplemented with serum and chick embryo extract. When incubated at 30 C, the population developed almost entirely to males. Males developed also if eggs deposited at 23 C were moved to 30 C before the first molt, provided this temp was maintained at least until the late second-stage. If the temp was decreased before development had reached the second-stage, females resulted. Eighty-nine per cent of the adults were males at 30 C in monoxenic culture on *Rhizoctonia solani;* 80% were males in axenic culture at 28 C when 2% ethyl alcohol was added or when incubated in a gas phase of 15% CO_2. To obtain some insight into the mechanism controlling the development of males at 30 C, mitomycin C (a DNA inhibitor) was added at 10-20 μg/ml for varying periods during development. If exposed only at the egg stage, 10% became female. With increasing duration of exposure up to the late second- or early third-stage (and beyond), the percentage of females increased to 100%. If incubated first in control medium, and then exposed to mitomycin C at the late second- or early third-stage, only males resulted. Younger larvae exposed to mitomycin C became females. These findings suggest a need for de novo DNA synthesis at the second-stage if males are to develop at 30 C. Abnormality in the secondary sexual characteristics was observed in both males and females in mitomycin C. Due to the absence of a developed vulva in the females, larvae hatched in utero; if removed surgically and put into control medium at 28 C, they developed to parthenogenetic females.—*Colorado Women's College, Denver, Colorado 80220; and Clinical Pharmacology Research Institute, Berkeley, California 94702, respectively.*

CARTER, W. W. *Histological responses of resistant and susceptible Gossypium arboreum to Rotylenchulus reniformis.*

Gossypium arboreum 'Nanking' (C.B. 1402) possessed a high level of resistance to *Rotylenchulus reniformis*. Development of the nematode and reaction of root cells were compared in the resistant Nanking, a susceptible selection of *G. arboreum*, and susceptible *G. hirsutum* 'Deltapine 16.' The nematode entered roots of each cultivar equally within 48 h; and no specificity for root tissue of a particular age was observed. Larvae penetrated the cortex and endodermis perpendicular to the stele and fed in the pericycle, usually in cells adjacent to a protoxylem pole. Hypertrophy appeared in several cells of the pericycle near feeding sites in both resistant and susceptible roots. Cytoplasm of the cells in the immediate vicinity of the nematode became dense and granular. Neither nuclear proliferation nor cell wall disintegration was observed. Nematodes developed equally in resistant and susceptible cultivars for six days after penetration. Further development of the nematode in the resistant cultivar appeared to be restricted, and cells had begun to degenerate in the immediate vicinity of the nematode. Cell walls immediately adjacent to the nematode head were thickened and more highly lignified more in the resistant than in the susceptible cultivars. Between 6 and 12 days after penetration, complete necrosis occurred in cells surrounding the nematode head in the resistant cultivar resulting in the eventual death of the nematode.—*USDA National Cotton Pathology Research Laboratory, College Station, Texas 77840.*

CAVENESS, F. E. *Plant-parasitic nematode population differences under no-tillage and tillage soil regimes in western Nigeria.*

Mixed populations of *Pratylenchus* spp. were 5:1 greater in soil and 4:1 greater in maize roots in plots grown to maize for seven consecutive cropping seasons (3.5 yr) under a soil management regime of tillage and nontillage respectively at Ibadan, Nigeria. *Helicotylenchus pseudorobustus* and *Meloidogyne incognita* juveniles were 6:1 and 3.5:1 greater in nontillage soils over tillage soils, respectively. Pigeon pea, soybean, and cowpea following six continuous crops of maize reduced numbers of *Pratylenchus* spp. under both soil management regimes. Tillage soils had more than twice the number of *Pratylenchus* spp. than nontillage soils when grown to pigeon pea and soybean. Grass and broadleaved weed fallow maintained population reservoirs of all three genera. D-D (1,2-dichloropropane and 1,3-dichloropropene) applied by hand-operated fumigun at the rate of 600 liters per hectare controlled *Pratylenchus* spp. equally well in tillage and nontillage soils.—*International Institute of Tropical Agriculture, P.M.B. 5320, Ibadan, Nigeria.*

DICKSON, D. W., and D. J. MITCHELL. *Nematode and soil-borne disease control on peanut.*

Meloidogyne arenaria and several fungi including *Pythium myriotylum, Rhizoctonia solani, Macrophomina phaseolina, Aspergillus niger, Trichoderma* spp., and *Fusarium* spp. were associated in a disease complex that resulted in severe galling and rotting of roots, pegs, and pods and even death of peanut plants in Florida. Disease control, as measured by yield data and isolation frequencies, was evaluated on the peanut cultivar Florigiant. Chemicals evaluated were: DBCP (10.3 and 27 kg/hectare (ha), one or two chisels per row, and injected or sprayed overall, respectively); 1,3-D (79 and 113 liters/ha single chisel per row and overall, respectively); methyl bromide (0.9 kg/9.3 m^2 under tarp); sodium azide (4.5 kg a.i./ha preplant + 9 kg a.i./ha at pegging in combination with either DBCP or carbofuran). Yields were significantly increased by all treatments except the overall spray application of DBCP. Treatments yielded 29-219% more than controls with the highest yields obtained from plots treated with methyl bromide or injected DBCP. These treatments resulted in an avg increase in yield of 179% over the controls, whereas carbofuran and 1,3-D treatments resulted in increases of 83% and 74%, respectively, over the control. The method of applying DBCP appeared to be one of the more important factors in determining its effectiveness. Overall applications by injection resulted in yield increases of 10 and 15% over two-chisel

applications, respectively. Treatments with methyl bromide resulted in gall-free pods and the lowest soil population, and isolation frequencies of both fungi and root-knot nematode larvae from pods. Sodium azide plus DBCP or carbofuran also reduced the total frequencies of both fungi and nematodes in pods.—*Departments of Entomology and Nematology, and Plant Pathology, respectively, University of Florida, Gainesville 32611.*

ESSER, R. P., and V. G. PERRY. *A diagnostic compendium of the genus Meloidogyne (Nematoda:Heteroderidae).*

A key to 36 *Meloidogyne* spp. based on characters of males, females, and larvae is presented. Three tables containing morphometrics and pertinent illustrations are also utilized. Identification of species in this genus rarely can be made from study of a single stage of development, but should be based on corroborative morphometrics and characteristics of males, females, and *larvae.—Division of Plant Industry, Florida Department of Agriculture and Consumer Services, and Department of Entomology and Nematology, respectively, University of Florida, both at Gainesville 32611.*

FELDMESSER, J., and A. M. GOLDEN. *Bionomics and control of nematodes in a large turf area.*

As a part of continuing investigations of the occurrence and importance of nematodes in the northeastern USA, nematode damage symptoms (chlorosis, stunting, bare spots, lack of response to water, fertilizer, and insecticides) were detected in the 3.7-hectare (ha) bluegrass parade ground (called the "Plain") at the U.S. Military Academy, West Point, N.Y. The damage was related to the presence of a mixed population of nematodes composed primarily of *Tylenchorhynchus dubius, Criconemoides rusticus, Helicotylenchus pseudorobustus,* and small numbers of *Pratylenchus crenatus,* and it has required the annual replacement of 279-372 m^2 of the most unsightly of the sod. The location and purpose of the "Plain" made it pertinent to treat the entire area uniformly. In April, 1973, ethoprop (*O*-ethyl *S, S*-dipropyl phosphorodithioate) was applied at the rate of 224.5 kg 10G (22.45 kg a.i.)/ha broadcast. Microplots (steel cylinder sunk in four separate symptomatic locations) were covered during the application. Samples of turf roots and surrounding soil from treated areas and from microplots collected 2 and 6 mo after treatment, indicated 85-95% nematode reductions. Four months after treatment, chlorosis was sharply reduced and grass growth had increased, making sod replacement unnecessary. Cost-benefit analysis favors yearly treatment on the basis of $800 for treatment (chemical cost, labor, and equipment use) vs. $2,000-$2,500 for sod replacement (purchase, labor, and extra maintenance) plus intangible increased value due to cosmetic improvement.—*Nematology Laboratory, Plant Protection Institute, ARS, U.S. Department of Agriculture, ARC-W, Beltsville, Maryland 20705.*

FELDMESSER, J., J. U. MC GUIRE, JR., and W. FRIEDMAN. *Evaluation of nematode recovery rates in a soil-sampling model.*

A miniature physical model, consisting of small beakers, soil, and a cork borer as the sampling tool, was used to determine the capability of recovering positive samples (those containing nematodes) from soil containing randomly-distributed known numbers of brown cysts of *Heterodera trifolii.* Each subsample consisted of 0.1 ml of soil. Ten were removed from each beaker. A composite sample, when used in our calculations, consisted of all 10 subsamples from any one beaker. Each subsample was transferred to a 149-μm (100-mesh) U.S. Standard Sieve and washed with tap water. The residue retained on the sieve was examined for cysts. An approximately even chance exists of recovering a positive single subsample when population densities are the equivalent of 1.0 cyst and 0.75 cyst per subsample, respectively. At these same nematode density levels, all composite samples were positive. To describe the results, the mean of a Poisson distribution was computed for each population density level using the frequency-of-zeroes method. On regressing these estimated Poisson means

against the known population density levels, a linear relationship was shown to fit the data. The opposite linear regression was then computed. This allows us to use the estimated Poisson means from sampling results to make theoretical estimates of the probable ($P = 0.05$) nematode population density levels in a larger area.—*Plant Protection Institute, ARC-W, and Biometrical Staff, Northeastern Region, ARC-E, ARS, and Plant Protection and Quarantine, APHIS, ARC-W, U.S. Department of Agriculture, Beltsville, Maryland 20705.*

FERRIS, H., and M. V. MC KENRY. *Observations on the spatial distribution of Xiphinema americanum in California vineyard soils.*

Spatial distribution of *Xiphinema americanum* was studied through extensive soil sampling in a 35-yr-old vineyard (*Vitis vinifera* 'Thompson Seedless') during a period of 13 mo. Samples were taken at different depths and distances from the vine, both in and between rows. The population of *X. americanum* concd in the upper 60 cm of undisturbed soil in the vine row, with fewer nematodes at greater depths or in the disturbed, compacted soil between rows. The greatest population densities were in the upper 15-cm of soil in the row where soil moisture and temp conditions were least stable. Factors affecting the distribution remain speculative; however, root presence, oxygen availability, and lack of soil disturbance are probably involved. Our results suggest that soil samples for determination of *X. americanum* densities in vineyards should be taken from the top 60-cm of soil in the vine row. Sample variability studies indicate that the most uniform sampling area is 30-45 cm from the vine in the row. The shallow concn and ectoparasitic nature of the nematode species explains successes with postplant applications of DBCP (1,2-dibromo-3-chloropropane). It also suggests that some cultural practices such as row-plowing may have application in a pest management program. Row-plowing would disturb and spread the ridge of soil in the vine row during the winter months; however, potential root damage during this process should also be considered.—*Department of Nematology, University of California, Riverside 92502.*

FRECKMAN, D. W., R. MANKAU, and S. A. SHER. *Population dynamics of nematodes associated with dominant desert shrubs.*

A nematode sampling program from March 1973 to March 1974 in undisturbed desert soils at Rock Valley, Nevada, emphasized the functional roles, biomass, and spatial distribution of nematodes. One plant of each of four shrub species was sampled weekly in a random sampling program at three depths (10, 20, and 30 cm) and three positions; (i) at the plant base, (ii) under the canopy, (iii) three times the mean radius of the shrub canopy. The nematodes were extracted by the Byrd, Barker, and Nusbaum modified sugar-flotation method. Nematodes were counted, identified, and placed in the following trophic groups: Microbial feeders-Cephalobidae; Fungal Feeders-*Aphelenchus avenae, Aphelenchoides* spp., and *Ditylenchus* spp.; Omnivores and Predators-Dorylaimina; Plant Parasites-*Tylenchorhynchus* and other miscellaneous Tylenchida; and Unidentifiable. The greatest number of nematodes in all trophic groups occurred at the top 10-cm of soil near the plant and decreased significantly with depth and lateral position from the base of the plant. Average biomass was 0.034 g/m^2 at random interspaces between plants and 0.115 g/m^2 for samples taken randomly under the plant canopies. Cephalobidae and the Dorylaimina contributed more biomass and greater numbers of individuals than the other trophic groups. The biomass of Tylenchida was low and only five species of tylenchid plant parasites have been identified.—*Nematology Department, University of California, Riverside 92502.*

GASTON, J. S., H. H. SHOREY, and E. G. PLATZER. *Reproductive behavior of Rhabditis sp.*

Behavioral studies were conducted on *Rhabditis* sp. isolated from earthworms. Virgin females had the longest life span (12.1 $\pm$ 0.7 days) and infrequently oviposited eggs, all nonviable. Females that were allowed to mate once had a shortened life span (10.8 $\pm$ 0.6 days) and generally oviposited all (129.4 $\pm$ 28.1) of their viable eggs within 3 days after mating. Females maintained with five males

each had the shortest life span (7.4 ± 0.4 days), though they produced three times more viable eggs than females which mated once, and oviposition continued until death (approximately 5 days after the first mating). Pheromone studies indicated that males were attracted to female exudates.—*Department of Entomology and Department of Nematology, University of California, Riverside 92502.*

GOLDEN, A. M. *Meloidogyne incognita: a single, homogeneous species or a complex of two or more taxa?*

Increasing data on host response and morphology of the root-knot nematode, *Meloidogyne incognita* suggests that two or more taxa are involved in this species complex. Many workers currently view this as a single species, and when used in this manner, it encompasses *M. incognita acrita* also. Certain plants (e.g., azalea) are attacked by the *"incognita* type" but not the *"acrita* type", while some other plants (e.g. *Capsicum annuum*) are parasitized by the *"acrita"* but not the *"incognita* type." Rather typical morphological characters, especially perineal patterns, are associated with these two types. A third unnamed form with a different pattern in the *incognita* group is known by the author on *Iris speculatrix* from Hong Kong. Primarily on the basis of perineal patterns, the "*acrita* type" is far more prevalent in the United States than the *"incognita* type." Where possible, making a distinction between the two types as Chitwood originally did, and preferably as subspecies now, seems worthwhile. This would be helpful to research workers, especially plant breeders in developing resistant varieties.—*Nematology Laboratory Plant Protection Institute, ARS, USDA, Beltsville, Maryland 20705.*

GRIFFIN, G. D. *Determination of Heterodera schachtii populations and their relation to economic losses of sugarbeets.*

Two methods were used to determine field populations of *Heterodera schachtii:* (i) viable cysts per kilogram of soil, and (ii) viable larvae per gram of soil. Cysts were collected from the soil with a gravimetric-aspirator method, broken, and viability determined. Larvae were obtained by mascerating cysts in a grinding vessel. *H. schachtii*-infested fields with different crop rotation histories were chosen in climatically different areas (Idaho, Oregon, and Utah). Sugarbeet yields from aldicarb- and DD-treated and nontreated plots were correlated with nematode populations. Direct correlations occurred between sugarbeet yields and nematode populations when the counts of viable larvae per gram of soil were used. The viable-cysts-per-kilogram-of-soil method was unsatisfactory in determining nematode populations. Comparative studies were made of two *H. schachtii*-infested fields in northern Utah with comparable populations of viable cysts per kilogram of soil. Field 'A' had a 3-yr cropping history of sugarbeet, and Field 'B', a 1-year crop rotation of grain. Aldicarb increased the yield in field 'A' by 72% and in field 'B' by 42%. Determination of the sugarbeet nematode populations, using the viable-larvae-per-gram-of-soil method, showed a 96% greater nematode population in field 'A' than in field 'B'. Soil temp at time of planting, was important in predicting the effect of *H. schachtii* populations on sugarbeet yields. A 19% increase in sugarbeet yield was obtained from a soil fumigation treatment when seed was planted at a soil temp of 3 C in the Treasure Valley area of Idaho. A comparable treatment, and nematode population (viable larvae per gram of soil), resulted in a 67% increase in northern Utah when seed was planted at a soil temp of 11 C.—*Agricultural Research Service, U.S. Department of Agriculture and Utah State Experiment Station. Crops Research Laboratory, Utah State University, Logan Utah 84322.*

HACKNEY, R. W. *The use of chromosome number to identify Meloidogyne spp. on grapes.*

Chromosome number facilitates identification of *Meloidogyne* to species. *Meloidogyne* spp. were taken from grape (*Vitis vinifera,* 'Thompson Seedless') in the San Joaquin Valley of California. Single-egg-mass greenhouse cultures were established on tomato (*Lycopersicon esculentum,* 'Pearson'). Perineal patterns from all nematodes except *M. javanica* were extremely

variable and, using that criterion, most nematodes were originally identified as *M. arenaria*. Chromosome numbers of 43, 47, 42, 37, 52, and 17 were obtained indicating, respectively, *M. javanica, M. javanica, M. incognita, M. arenaria* (2*n* form), *M. arenaria* (3*n* form), and *M. hapla* race A. A number of 43 indicated either *M. javanica* or *M. incognita,* but the consistency of *M. javanica* patterns made separation possible. Chromosome number may be useful in recognizing biotypes and in avoiding confusion created by using differential hosts for identification. For modeling population dynamics of root-knot nematodes on grape, chromosome number facilitates the separation of *M. hapla* race A (amphimixis and meiotic parthenogenesis) from *M. hapla* race B (mitotic parthenogenesis). Variation and the technical accuracy required to detect differences between some *Meloidogyne* spp. limit the usefulness of larval measurements. Our most useful scheme for identifying *Meloidogyne* spp. consists of chromosome number plus other findings (when typical) such as perineal pattern and larval measurements.—*Department of Nematology, University of California, Riverside 92502.*

HART, W. H., and A. R. MAGGENTI. *The use of systemic nematicides on ornamental bulb crops.*

Various contact and "systemic" phosphate and carbamate insecticides-nematicides were compared in greenhouse and field experiments for control of *Ditylenchus dipsaci* and *D. destructor*. Treatments were dips of planting stock and drenches, sprays and side-dressings of granular formulations on or around growing plants. In the greenhouse, granular formulations were spread on the soil surface, cultivated lightly and watered. In greenhouse trials with bulbous iris cultivar "Wedgwood" (*Iris xiphium* × *I. tingitana* 'Wedgwood'), best control of *D. destructor* was obtained by dipping bulbs in phenamiphos (250 μg/ml for 20 min) and by side-dressing established plants with granular aldicarb (2.8 kg/hectare) or granular oxamyl (4.45 kg/hectare). Side-dressings with granular phorate (16.8 or 33.6 kg/hectare) gave good nematode control, but suppressed plant growth. In greenhouse tests with narcissus (daffodil) (*Narcissus pseudo-narcissus* 'King Alfred') best control of *D. dipsaci* was obtained with granular aldicarb (5.6 kg/hectare) distributed over bulbs in the planting furrow. Little or no control was obtained with other chemicals applied in this way, or by sprays of growing plants.—*Department of Nematology, Agricultural Extension Service, University of California, Davis 95616.*

HEALD, C. M. *Citrus nematode control with a low annual rate of DBCP.*

Annual applications of 1,2-dibromo-3-chloropropane (DBCP) (12.4 liter/hectare) to a 25-yr-old grapefruit orchard at one-third the triennial rate (37.4 liter/hectare) kept the citrus nematode (*Tylenchulus semipenetrans*) at a much lower population density than did the triennial rate. Two and one-half years after a mean post-treatment density of one, the population in triennial-application plots had risen to a mean density of 35,493 citrus nematodes/3 g of root and 100 g of soil, while densities from the annual applications had risen from a post-treatment count of 40 to only 158. Second-year yield of fruit, hand-picked using a ring 9.5 cm diam for minimum size, yielded 96 kg/tree in the plots receiving DBCP yearly, while plots receiving a triennial application yielded 81 kg. Check plots yielded 61 kg/tree. Ninety percent of the fruit from the first picking graded No. 1 in size and quality, and the remainder graded No. 2. Fruit from the second picking was used for juice. Differences between total fruit yield were much less since plots receiving annual applications yielded 136 kg; the triennial plots 129 kg and the check 115 kg/tree.—*U.S. Department of Agriculture, P.O. Box 267, Weslaco, Texas 78596.*

HÖGGER, CH. H., and G. W. BIRD. *Weeds and covercrops as overwintering hosts of plant parasitic nematodes of soybean and cotton in Georgia.*

Surveys were conducted 1-2 mo before planting cotton and soybean to determine whether winter annual and perennial weeds could serve as overwintering hosts of

Meloidogyne incognita and *Hoplolaimus columbus*. Juvenile and adult specimens of *M. incognita* were recovered from roots and rhizosphere soil of *Stellaria media, Sorghum halepense, Cyperus esculentus, C. rotundus,* and *Geranium carolinianum*. All stages of *H. columbus* were recovered from roots and/or rhizosphere soil of *Lamium amplexicaule, S. halepense, C. esculentus* and *C. rotundus*. In greenhouse tests using infested field soil, *M. incognita* reproduced on *C. esculentus, C. rotundus,* and *Cerastium vulgatum;* and *H. columbus* reproduced on *S. halepense, S. media, G. carolinianum, Lepidium virginicum, Trifolium incarnatum* and *L. aplexicaule*. In field plots kept weed-free throughout the winter, initial spring population densities of *H. columbus* were low and included no juveniles. Adults and juveniles of *H. columbus* however, were recovered from roots and rhizosphere soil of plots containing *Sibara virginica, T. incarnatum, G. carolinianum,* but not from *Secale cereale* plots. This study indicates that natural weed flora and covercrops can serve as overwintering hosts of plant parasitic nematodes and decrease the normal rate of winter mortality which occurs among nematode populations associated with soybean and cotton production in Georgia.—*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, 30602 and Department of Entomology, Michigan State University, East Lansing, 48824, USA.*

HUSSEY, R. S., and K. R. BARKER. *Effects of nematodes with different feeding habits on nodulation of legumes.*

The effects of *Meloidogyne incognita* (MI), *M. hapla* (MH), *Pratylenchus penetrans* (PP), and *Belonolaimus longicaudatus* (BL) on nodulation of soybean, peanut, cowpea, and garden pea were investigated in the greenhouse. *Meloidogyne* spp. stimulated nodule formation and growth of soybean and cowpea, but had an adverse effect on N_2-fixation. Nodules on these crops were smaller and less efficient in fixing nitrogen and frequently formed on the surface of root-knot galls. *Meloidogyne* spp. developed more readily within nodular tissues of soybean than on other legumes tested. The presence of these parasites in soybean nodules did not destroy their structural integrity; however, bacteroids did not develop adjacent to nematodes. *Meloidogyne*-infected nodules, however, deteriorated earlier than noninfected nodules. MI severely stunted garden pea, and inhibited nodule development. PP was the least destructive nematode, having little effect on nodulation and N_2-fixation in soybean, peanut, and cowpea. However, this nematode penetrated and extensively damaged nodules on garden pea. On the other legumes, PP penetrated tissues only at the point of nodule attachment. BL stunted all hosts but had an adverse effect on nodule number only on soybean. The nodules that developed were larger and more efficient in fixing N_2 than nodules on plants free of nematodes. Although BL induced necrotic lesions in root meristems, this parasite caused only slight damage in nodular tissues.—*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, 30602, and Department of Plant Pathology, N.C. State University, Raleigh, 27607.*

INSERRA, R. N., and J. H. O'BANNON. *Rearing migratory endoparatisic nematodes in citrus leaf callus tissue and root culture.*

Detached entire leaves with petioles from several citrus varieties were enclosed in dishes with the basal portion embedded in moist sand. Aqueous solutions of 2,4-D, NAA and water were applied to leaves and effect on callus development measured. Temperatures of 15, 20, 25, and 30 C were used. A 4 μg/ml 2,4-D solution at 25 and 30 C gave best callus development. Chase rough lemon, Estes rough lemon, Milam lemon (*Citrus limon*); Algerian navel orange, Ridge Pineapple sweet orange (*C. sinensis*), and Carrizo citrange (*C. sinensis* × *Poncirus trifoliata*) formed callus more readily than sour orange (*C. aurantium*) and Cleopatra mandarin (*C. reticulata*), and rooted in the following order: Chase rough lemon > Estes rough lemon > Carrizo citrange > Milam lemon. Nematode development studies in callus-tissue and root cultures were maintained in sand in dishes. Tissues were inoculated with ten females and one male. *Radopholus similis* and *Pratylenchus coffeae* were pipetted on or around callus. One generation was completed in 20-30 days at 25 C. Males appeared before

females and between 142 and 264 nematodes in all life stages of development were extracted from rough lemon callus 40 days after inoculation. Inoculations of *P. coffeae* on rough lemon callus produced 55 to 70% fewer *P. coffeae* compared to *R. similis* over a 40-day period. Rootstocks resistant to *R. similis* (Algerian navel, Milam lemon, and Ridge Pineapple) showed the same degree of infection as susceptible rough lemon leaf callus. *R. similis* living specimens recovered after 30 days were 48-105 in Algerian navel, 55-315 in Milam, and 40-115 in Ridge Pineapple compared to 78-219 in rough lemon. Carrizo citrange roots from leaf cuttings produced 29-433 *R. similis*.—*Agricultural Nematology Laboratory, National Council Research, Bari, Italy, and U.S. Horticultural Research Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Orlando, Florida 32803.*

JOHNSON, A. W., C. C. DOWLER, and E. W. HAUSER. *Seasonal population dynamics of selected plant parasitic nematodes on four monocultured crops.*

Seasonal fluctuations in field populations of *Meloidogyne incognita, Pratylenchus zeae, P. brachyurus, Criconemoides ornatus, Trichodorus christiei,* and *Helicotylenchus dihystera* on monocultured corn, cotton, peanut, and soybean grown on Tifton sandy loam were determined at monthly intervals for 4 yr. From July until January, populations of *M. incognita* were significantly greater on corn and cotton than on peanut and soybean. During all months except May and June, populations of *Pratylenchus* spp. were significantly greater on corn and soybean than on cotton and peanut. Populations of *C. ornatus* were greater on corn and peanut than on cotton and soybean. Populations of *C. ornatus* on corn and peanut were highest in July and lowest in October. There was no significant seasonal increase in populations of *T. christiei,* except on corn in June. From August through December, populations of *H. dihystera* were significantly greater on cotton and soybean than on corn and peanut.—*Agricultural Research Service, U.S. Department of Agriculture, Southern Region, Coastal Plain Experiment Station, Tifton, Georgia 31794.*

JOHNSON, D. E. *Observations on soil conditions and effective soil fumigation.*

Over a period of years, attempts have been made to evaluate reasons for the success or failure of nematicide applications, both pre- and postplanting, indicated by plant response. Many of these unsuccessful treatments have involved perennial plantings; i.e., stone fruits (*Prunus* sp.) and grape (*Vitis* sp.). Apparent lack of success becomes obvious in about the third-leaf stage when plants should have been well established, growing vigorously, and about to produce the first marketable crop. Observations from several nematode control trials indicate a satisfactory level of nematode control, but poor plant response. Subsequent study of the soil profiles has indicated the presence of profile discontinuities or layers which have the effect of limiting the ability of plant roots to explore the soil to any significant depth.—*University of California, San Joaquin Valley Research and Extension Center, Parlier 93648.*

KINLOCH, R. A. *Influence of cropping on nematode fauna of Southern Coastal Plain woodlands.*

Population changes of plant parasitic nematodes were monitored for 2 yr on an area that was cleared for agricultural use in 1971. The area was planted to replicated plots of peanut, soybean, sorghum, bahiagrass, and field corn during 1972 and 1973. Control plots of native Southern Coastal Plain woodland were maintained adjacent to the cleared area. During the 2-yr period there were few changes in the nematode fauna of the control plots, where 50% of the species belonged to Tylenchida. Genera of Tylenchida and the average number per 100 cc of soil of individuals of each species were *Tylenchus* spp.-43, *Helicotylenchus* spp.-17, *Aphelenchoides* sp.-7, *Meloidodera floridensis*-6, *Hoplolaimus galeatus*-4, *Criconemoides ornatus*-2, *Belonolaimus longicaudatus*-1, and *Aphelenchus* sp.-1. In addition, *Xiphinema americanum*-4 and *Trichodorus christiei*-2 were detected in the woodland samples. Cultivation eliminated, or reduced to levels that escaped detection, species belonging to *Meloidodera, Hoplolaimus,* and *Belonolaimus*. Similarly, numbers of *Helicotylenchus* declined under

peanut, soybean, and bahiagrass, but were maintained on sorghum and corn. Numbers of *Tylenchus* and *Aphelenchoides* were not affected by cropping. There was a drastic increase in the numbers of *Criconemoides ornatus* following 2 yr of cultivation of all crops. This species reached levels of 590-, 467- and 34 /100 cc soil under peanut, sorghum, and corn, respectively. *Pratylenchus brachyurus,* which escaped detection in the woodland plots, reached levels of 207 and 128/100 cc soil under sorghum and corn. Similarly, a trace infestation of *Meloidogyne* sp. was recovered after 2 yr of corn cultivation. *Xiphinema* disappeared under peanut, soybean, and corn, but increased on sorghum and bahiagrass, whereas *Trichodorus christiei* increased on sorghum and soybean.—*University of Florida, Agricultural Research Center, Jay 32565.*

LEWIS, S. A., F. H. SMITH, and C. W. BLACKMON. *Host range, distribution, and control of Hoplolaimus columbus.*

Fourteen cultivars of nine crop species were evaluated for suitability as hosts of *Hoplolaimus columbus* Shev. Plants were grown in 20-cm diam glazed crocks in a greenhouse for periods of 90 days. Nematode-infested Dothan loamy sand containing 250 *H. columbus*/100 cc of soil and autoclaved Dothan loamy sand to which 750 *H. columbus*/crock were added, served as treatments. Controls were planted in autoclaved Dothan loamy sand which had received nematode aqueous extract. Numbers of nematodes per 10 cm of root length and per 100 cc of rhizosphere soil were used as indicators of host suitability. Three cultivars each of soybean and cotton and one of sweet corn were hosts. The nematodes also reproduced on several weed species common in the Southern Coastal Plains. Numbers of *H. columbus* increased slightly on field corn, as determined by soil extraction procedures, but no yield loss or fresh top weight differences were observed for the tested cultivar. Maximum yields of soybean and cotton on infested lands were obtained by applying nematicides. Injection of a nematicide behind a subsoiling shank is preferred where hard subsurface conditions exist. *Hoplolaimus columbus* is present in at least 14 counties of the South Carolina Coastal Plains, three counties in northern Georgia, and in a limited area of Florida.—*Department of Plant Pathology and Physiology, Clemson University, Clemson, S.C. 29631.*

LEWIS, S. A., F. H. SMITH, and WILLIAM M. POWELL. *Histopathology of infection by Hoplolaimus columbus on cotton and soybean and aspects of its pathogenicity.*

Seedlings of 'Hampton 266' soybean and 'Deltapine-16' cotton were used in tissue and cellular studies of *Hoplolaimus columbus* infection. Plants were grown in 238-ml glass bottles filled with sterilized quartz sand, and were harvested every other day for 30 days. One-hundred lance nematodes in various stages of development were surface-sterilized in a solution of streptomycin sulfate and added to the plant cultures at the time germinated seeds were added. Nematode penetration and migration damage was observed in cotton and soybean roots. Several layers of discolored cells surrounded the penetration wound and the path of the nematode through the cortex. Surface depressions were seen where the nematode entered cotton roots. Altered staining reactions were observed in cotton endodermis adjacent to the nematode anterior region. Penetration of endodermis, pericycle, and phloem tissues occurred in soybean roots. Phloem tissue exhibited abnormal staining reaction several cells in both directions from the point of penetration. Nematodes were sometimes seen in regions of root primordia. Eggs were laid in and along cotton roots as early as 7 days after infestation of the sand cultures and were also observed in areas of the cortex vacated by the nematode. *H. columbus* fed semi-endoparasitically on Deltapine-16 cotton and endoparasitically on Hampton 266 soybean.—*Department of Plant Pathology and Physiology, Clemson University, Clemson, S.C. 29631.*

MAUZA, B. E. *Effect of Pratylenchus penetrans and Fusarium solani on the growth of alfalfa seedlings.*

A preliminary experiment indicated that *Pratylenchus penetrans,* but not *Fusarium*

solani, decreased the yield of clippings of 'Vernal' alfalfa (*Medicago sativa*) taken during an 8-mo period. Therefore the effect on alfalfa seedlings of inoculating *P. penetrans* alone, *F. solani* alone, and of both together was investigated. An aqueous suspension of 10,000 *P. penetrans* was inoculated into 6-liter tubs of soil just prior to seeding, and an *F. solani* spore suspension (a mixture of macro- and microconidia) containing 3.2×10^6 conidia, was injected 1 wk later. Each treatment consisted of one tub planted with 100 pre-germinated seeds. After 7 wk the number of leaves per seedling was significantly ($P \leqslant 0.01$) less on inoculated plants than on uninoculated control plants. Seedling growth, as measured by height, was significantly ($P < 0.01$) decreased by all inoculated treatments. Heights of seedlings inoculated with *P. penetrans* alone were 50% those of the controls; seedlings inoculated with both nematode and fungus were 56% those of the control. After an additional 2 wk of growth (nine weeks total), relative heights were unchanged for the single inoculations, but the effects of the combined *P. penetrans*-*F. solani* treatment were significantly greater ($P < 0.01$) in that the seedlings measured only 40% of control heights.—*Supported by grants to Dr. J. M. Webster from the Canada Department of Agriculture and the National Research Council of Canada.* *Pestology Centre, Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, B.C., Canada.*

MC KENRY, M. V., and I. J. THOMASON.
The Influence of cis-1,3-dichloropropene on grape rootings.

In order to determine the duration of the waiting period between fumigant application and planting time, knowledge concerning the toxicity of the fumigant to the ensuing crop should be available. Dormant rootings of 'Ruby Cabernet' and 'Thompson Seedless' grapes (*Vitis vinifera*), in pots of sandy soil, were placed in fumigation chambers containing gaseous *cis*-1,3-dichloropropene (1,3-D). Exposure times ranged from one to five days with five replicates per treatment. The dosage product (concn × time) is reported as mg 1,3-D/liter (w/v)·day. During exposure the above-ground portions of the plants were wrapped in Saran Wrap® to protect the dormant buds. The fumigation chamber was maintained at 22 C. After exposure, the rootings were placed in a greenhouse for 60 days to induce growth. Vines exposed to a vapor-phase dosage of 5 mg 1,3-D/liter·day did not survive the treatment, and no leaves developed. Vines treated at dosages between 1 and 4 mg 1,3-D/liter·day survived but the period of time required for budbreak was increased by 30 days at the higher dosages. The exposure of actively growing rootings and stems of Thompson Seedless and Ruby Cabernet to 1,3-D resulted in a similar vine response; however, all above-ground leaves were defoliated at dosages above 4 mg 1,3-D/liter·day. After 4 days in the dark fumigation chamber, the vines were moist and green. After being placed in sunlight for 1.0 h the aboveground tissues appeared necrotic.—*Nematology Department, University of California, Riverside 92502.*

MINTON, N. A., and M. B. PARKER.
Interaction of four soybean cultivars with subsoiling and a nematicide.

Soybean cultivars representing maturity groups very early (IV)-'Essex'; early (VI)-'Davis'; medium (VII)-'Ransom'; and late (VIII)-'Hutton' grown in Tifton sandy loam soil infested with *Meloidogyne incognita* were compared in subsoiled and fumigated plots. Yields of all cultivars except Essex were increased significantly with 1,2-dibromo-3-chloropropane (DBCP) over the control; however, root-knot indices indicate that Essex has only moderate resistance to *M. incognita*. Yield of all cultivars was increased with subsoiling as compared with no subsoiling. DBCP or subsoiling increased mean yields of the four cultivars 538 kg/ha or 21.6% over controls. DBCP plus subsoiling increased yields 706 kg/ha or 28.3% over untreated controls. Root-knot indices differed significantly among cultivars with Davis the most severely galled and Hutton the least. DBCP or subsoiling reduced galling significantly. However, when DBCP was applied, subsoiling did not further reduce galling. The number of larvae was low 1 July but high 12 September. On the latter date, larvae were most numerous at 0-20 cm, intermediate at 20-33 cm and least numerous at 33-46 cm depth. Cultivars had no significant effect on number of larvae 1 July,

but on 12 September Davis plots contained significantly more larvae than did the other cultivars in the two upper soil levels. The lower soil level in Davis plots had significantly more larvae than did Hutton. DBCP significantly reduced larval populations at all levels, but subsoiling did not.—*Agricultural Research Service, U.S. Department of Agriculture and University of Georgia, Coastal Plain Experiment Station, Tifton 31794.*

MJUGE, S. G., and D. R. VIGLIERCHIO. *Physiological therapy methods for plants parasitized by nematodes.*

Development of *Meloidogyne* sp. within roots of a host can be a function of the hormone balance within the roots. With other parasitic nematodes the development is a function of the relative rates of synthesis and hydrolysis of proteins and carbohydrates. By modification of these equilibria it is possible to influence both nematode development and plant growth. Tomato plants infected with *M. hapla* (which exudes an auxin-inactivating system) responded differently from plants infected with *M. incognita* (which does not exude an auxin-inactivating system) when treated with indoleacetic acid (IAA) and maleic hydrazide (MH). Plant height and gall weights were reduced with MH and increased with IAA. Aseptic carrot slices inoculated with *Pratylenchus vulnus* then treated with a series of biologically active compounds differed in the ability of the host to support *P. vulnus* reproduction. Glutathione enabled the *P. vulnus* population to increase 200% over controls, whereas phenols and other thiols were inhibiting and reduced population levels below that of controls.—*University of Massachusetts, Laboratory of Experimental Biology, East Wareham 02538, and Department of Nematology, University of California, Davis 95616, respectively.*

MOJTAHEDI, H., and B. F. LOWNSBERY. *Pathogenicity of Criconemoides xenoplax to prune and plum rootstocks.*

In a lathhouse experiment using 12-liter cans, elimination of *Criconemoides xenoplax* from a prune orchard soil by fumigation with ethylene dibromide (EDB) at the rate of 42 μl/liter of soil (equivalent to about 13 gal/acre) improved the growth of Myrobalan plum. Addition of *C. xenoplax* to Myrobalan or Marianna 2624 plum seedlings in the greenhouse resulted in destruction of cortical root tissue, darkening of roots, a dearth of feeder roots, reduction in plant weight, and lowering of nutrient levels in leaves. Water stress in the Myrobalan seedlings in this experiment was measured several times during the course of the experiment using a pressure bomb technique. Early in the experiment this stress was lower in seedlings infested with *C. xenoplax* than in uninfected controls. The stress in nematode-infected plants increased with time, however, finally surpassing that of the uninfected controls. Infection of Myrobalan and Marianna 2624 plum with *C. xenoplax* increased their susceptibility to bacterial canker in a lathhouse experiment. *C. xenoplax* increased on all nine *Prunus cerasifera* varieties and hybrids tested, including those used commonly as rootstocks for prunes and plums. *Rhizoctonia solani* was isolated from Myrobalan seedlings infected with *C. xenoplax*. This fungus caused lesions on the hypocotyls of young Myrobalan seedlings in the laboratory, but had no effect on older seedlings, and did not alter the effect of *C. xenoplax* in the greenhouse.—*Department of Nematology, University of California, Davis 95616.*

NICKLE, W. R. *A new mermithid nematode genus parasitic in the boll weevil in Louisiana.*

A new mermithid nematode was found to be parasitic in the boll weevil in Louisiana. The spicules are diagnostic because there is a large keel-like structure near the tip of each spicule. The female has a long S-shaped vagina. Eighty percent of a collection of 500 weevils that emerged early from the ground trash hibernation site were parasitized by this nematode. It appears that the parasite made the boll weevils hungry and thirsty, which triggered an instinct to come out of hibernation one month or so before the cotton was even planted, fly into the empty fields, and die.—*Nematology Laboratory, Plant Protection Institute, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md. 20705.*

ORR, C. C., and E. D. MOREY. *Anatomical response of grain sorghum roots to root-knot nematodes.*

Although grain sorghum has resistance to the cotton root-knot nematode, some nematodes live and reproduce in the roots. Syncytia were formed in the cortex or in the stele of lateral roots. Giant cells formed singly with few nuclei or in groups with many nuclei. In the latter, the giant cells could not be distinguished from those found in susceptible hosts. The pericycle and endodermis were interrupted at the site of nematode invasion. Large areas of these tissues were absent for one-third of the circumference of the stele and extended 1.5 mm longitudinally along the root. In the areas where pericycle and endodermis were absent, parenchyma of the cortex extended to the vascular elements. Abnormal xylem was observed surrounding giant cells, and extending into the region of the cortex where endodermis and pericycle were absent. Root-knot galls were found on sorghum roots as elongate swellings, discrete knots or swellings with root proliferation. Galls were not observed on brace roots.—*Agricultural Research Service, U.S. Department of Agriculture, Lubbock, Texas 79401.*

PITCHER, J. R. *Reduction of resistance of tomato to Fusarium oxysporum f. sp. lycopersici by Meloidogyne javanica.*

Infection of 'Pearson VF_{11}' tomato (*Lycopersicon esculentum*), which is moderately resistant to *Fusarium oxysporum* f. sp. *lycopersici* race 1, with *Meloidogyne javanica* reduced its resistance. The extent of this disease interaction, measured by a comparison of disease symptoms and fungal colonization of plants infected with both *M. javanica* and *Fusarium* with those of plants infected with *Fusarium* alone, was determined under various controlled experimental conditions. A greater disease interaction occurred: (i) in 4-wk-old than in 8-wk-old plants; (ii) with increasing inoculum levels (up to 10,000 larvae per plant) of *M. javanica;* and (iii) with increasing time intervals (up to 35 days) between inoculation of *M. javanica* and subsequent inoculation of *Fusarium*. Nematode-infected roots harbored more *Fusarium* propagules than did nematode-free roots, but *Fusarium* colonization did not extend into the stems. A positive disease interaction occurred when each pathogen was inoculated on a separate root system of the same plant, though this was not as great as when both were inoculated on the same root system. This study has provided further support for the hypothesis that changes in a plant's physiology due to nematode infection influence its subsequent response to fungal invasion.—*Supported by an operating grant (#A4679) to J. M. Webster from the National Research Council of Canada. Department of Biological Sciences, Simon Fraser University, Burnaby, B.C., Canada.*

POINAR, G. O., JR. *On the structure of the preparasitic juveniles of mermithids.*

The structure of the preparasitic juveniles of *Hydromermis conopophaga, Filipjevimermis leipsandra, Hydromermis contorta, Gastromermis viridis, Reesimermis nielseni* and *Mermis nigrescens* were studied and compared. The first two nematodes also were examined with the electron microscope. Although the parasitic, postparasitic, and adult stages of these mermithids exhibit morphological modifications resulting from parasitism which make their structure unique, the preparasitic juveniles resemble free-living nematodes. The preparasitic juveniles which were examined all possessed a stylet, paired penetration glands, a stichosome with associated stichocytes, and an intestine joined to the stichosome. Sixteen head papillae or axon groups were identified for the first time in mermithids. Also, a stylet extension, intestinal microvillae, and the stichosome accessory structure were newly characterized for this nematode group.—*Division of Entomology and Parasitology, University of California, Berkeley 94720.*

RADEWALD, J. D., S. T. BESEMER, and F. SHIBUYA. *Control of the root-knot nematode, Meloidogyne incognita, on carnations with multiple foliar sprays of oxamyl and preplant applications of granular nematicides.*

The root-knot nematode, *Meloidogyne incognita,* is a serious and widespread

problem on carnations in California. A greenhouse heavily infested with *M. incognita* was used to evaluate the following nonvolatile granular formulated nematicides: 2,3-dihydro-2, 2-dimethyl-7-benzofuranyl methylcarbamate (carbofuran) at 4.9 and 9.8 kg/hectare; S-methyl-1-(dimethylcarbamol)-N-[(methyl-carbamoyl)oxy]thioformimidate (oxamyl) at 4.9 and 9.8 kg/hectare; and ethyl-4 - (methylthio) - m-tolyl isopropylphosphoramidate (phenamiphos) at 9.8 kg/hectare. The granular materials listed were all applied at planting, 5 cm from the row and 10 cm deep. Additional treatments consisted of foliar sprays with oxamyl, and an untreated control. Sprays were applied at the rate of 4.54 kg (a.i.) oxamyl/378 liter of water and applied eight times on a monthly basis. Plot size was 2 × 6 m and replicated four times. No granular treatments provided adequate nematode control, and, the control plants died prior to flower production. The plants treated with oxamyl sprays produced the highest flower yield and was rated essentially nematode-free at the completion of the experiment.—*Department of Nematology, University of California, Riverside 92502, and (Besemer) Agricultural Extension Service, San Diego, CA 92123.*

RADEWALD, J. D., R. ENDO, and F. SHIBUYA. *Pathogenicity of Meloidogyne incognita and its interaction with Rhizoctonia solani and Pythium ultimum on Dichondra repens.*

In surveys, the root-knot nematode, *Meloidogyne incognita,* has been found in 85% of the areas sampled in southern California. Areas surveyed included the fields of commercial sod producers and seed growers, commercial landscape plantings, and homeowners' sod. Pathogenicity trials were established in a greenhouse in soils with a sand, silt and clay content of 94%, 3% and 3%, respectively. Plants were grown in 15-cm pots and each treatment was replicated nine times. After seedlings emerged, nematode treatments were inoculated with 14,000 larvae per pot. Additional treatments consisted of inoculations with *Rhizoctonia solani, Pythium ultimum* and all combinations of the three organisms plus the appropriate controls. Clipping weights of the dichondra were taken four times and nematode counts and root isolations were made from each pot of each treatment when the experiment was terminated. Pathogenicity of *M. incognita* under our experimental conditions was evident. No nematode-fungus additive effects were observed. Both fungi were isolated from the roots when the experiment was terminated, but growth retardation or root deterioration was evident only when the nematode was present.—*Agricultural Extension Service, Department of Nematology and Department of Plant Pathology, University of California, Riverside 92502.*

REBOIS, R. V., B. J. ELDRIDGE, and R. E. WEBB. *Reniform nematode effect on tuber yields of four potato cultivars under greenhouse conditions.*

Studies of the disease potential of *Rotylenchulus reniformis* are important, not only because the reniform nematode is known to parasitize potatoes, but also because of its wide geographical distribution, wide host range, and known damage to a number of economically important crops. Potato (*Solanum tuberosum*) cultivars 'Yampa', 'Peconic', 'Katahdin', and 'Red Pontiac' were grown under greenhouse conditions in nematode-free and inoculated soil. Final nematode populations in soil were highest in the presence of 'Red Pontiac' followed in decreasing order by 'Peconic', 'Katahdin', and 'Yampa'. No significant differences in the dry weights of tops or roots resulted from parasitism. Considerable suberization of the peel was noted on all tubers taken from *R. reniformis* infested soil. The average fresh weight of No. 1 tubers (4.5 cm minimum diam) per plant was significantly ($P < 0.05$) reduced by 30% when all cultivars were considered together. 'Peconic' and 'Yampa' had significant reductions in total yields while the former was the only cultivar showing significant reduction in No. 1 tuber yield. 'Red Pontiac' appeared to be the most tolerant to *R. reniformis* infection because it supported the highest soil population, had the highest total tuber yield, and the lowest (5%) No. 1 tuber yield reduction. This work demonstrates that *R. reniformis* has the potential to reduce the physical appearance,

size, and yield of potato tubers.—*U.S. Dept. of Agriculture, ARS, Plant Protection Institute, ARC-W. Beltsville, Md. 20705.*

REBOIS, R. V., P. A. MADDEN, and B. J. ELDRIDGE. *Electron microscopy of syncytia development in susceptible and resistant soybean roots infected with Rotylenchulus reniformis.*

Female *Rotylenchulus reniformis* nematodes penetrated intracellularly through the cortex of soybean roots to the endodermis where they inserted their stylets, secreted, and initiated syncytial formation. The observed initial cell of a syncytium (ICS) was endodermal. During early development the syncytium was usually composed of the ICS plus the adjoining pericycle cells. Developed syncytia were composed of approximately 100-200 interconnected transformed and hypertrophied pericycle cells, plus a few xylem parenchyma and endodermal cells. Syncytia of susceptible 'Lee' soybean went through two basic phases of development: an initial partial cell wall lysis and separation phase which lasted ~ 2-4 days; and an anabolic phase, characterized by organelle proliferation and development accompanied by thick secondary wall deposits. The anabolic phase was very evident 4 days after inoculation, and generally continued for the remainder of the 21-day observation period. As the syncytium aged, several organelle changes occurred including the appearance of many irregular cup-shaped mitochondria. Syncytia were formed primarily by the coalescence of the cytoplasm of adjacent cells resulting from cell wall dissolution and separation rather than endomitosis. The resistant reaction of 'Peking' soybean lacked the anabolic phase and was characterized by a continued, usually accelerated, and uncontrolled lysis phase. This resistant reaction, a syncytial cavity composed of almost completely lysed cell walls and cytoplasm, is usually very evident four days after inoculation.—*U.S. Department of Agriculture, Agricultural Research Service, Plant Protection Institute, ARC-West, Beltsville, Maryland 20705.*

RODRÍGUEZ-KÁBANA, R., P. A. BACKMAN, and P. S. KING. *Effect of fungicide-nematicide combinations for control of soil-borne diseases in Alabama potato fields.*

Soil fungicides in combination with the fumigant nematicide DD (1,3-dichloropropene-1,2-dichloropropane) were evaluated over a 2-yr period for control of plant parasitic nematodes and stem canker of Irish potatoes caused by *Rhizoctonia solani.* Experiments were located in south Alabama in three fields with severe stem canker and heavily infested with *Meloidogyne incognita* and *Helicotylenchus dihystera.* Fungicides used were PCNB applied at planting at 25 kg a.i./hectare (ha) and sodium azide (NaN_3) applied 1 mo before planting at 15 and 30 kg (a.i.)/ha. DD was injected to a depth of 30-40 cm in the row at 100 liters/ha one month before planting. PCNB gave a significant yield increase ($P = 0.01$) of 11% with a corresponding decline in stem canker. Similarly, significant yield increases of 10% and 26% were obtained with NaN_3 for the rates of 15 and 30 kg/ha, respectively. NaN_3 significantly reduced ($P = 0.01$) stem canker and spiral nematodes when applied at 30 kg/ha, but had no effect at either rate on *M. incognita* larvae. Plots receiving DD showed a 26% increase in yield with significant reductions ($P = 0.01$) in *H. dihystera* and *M. incognita* larvae. Combinations of DD with PCNB or with NaN_3 had no significant additive effect on yield or control of plant parasitic nematodes and stem canker. Laboratory tests indicated that field rates of DD were fungicidal or fungistatic to *R. solani,* and its control may have been involved in yield increases where DD was used. *Supported by Project Ala. 300. Department of Botany and Microbiology, Auburn University Auburn, Alabama 36830.*

RUTHERFORD, T. A. *Transcuticular uptake of glucose by the entomophilic nematode Mermis nigrescens from the hemocoel of the desert locust.*

Because the mermithid nematode, *Mermis nigrescens,* has some potential as a biocontrol agent of locusts and grasshoppers, an investigation was made of its mode of nutrition as a prelude to studies on its in vitro culture. The complete digestive tract that is present in the infective larval stage of *M. nigrescens* is absent in the parasitic larval stage by the 14th day of infection, which is during the period of their most active growth. Consequently, the function of the mouth and

esophagus of the parasitic larval stage in nutrient uptake is questionable as, furthermore, the larval cuticle is permeable to intra vitam stains. Adult desert locusts, *Schistocerca gregaria,* were infected with *M. nigrescens* ova, and, 14 and 21 days later, they were dissected and the developing larvae removed and incubated in either ^{14}C-glucose or ^{14}C-trehalose labelled insect saline. Glucose rather than trehalose was taken up by the larvae, and much more rapidly by the 14-day-old than by the 21-day-old larvae. Furthermore, this uptake occurred along the entire length of the nematode rather than via the mouth and esophagus. Uncoupling of oxidative phosphorylation with 10^{-4}M 2,4-dinitrophenol inhibited glucose uptake to the same extent as did 10^{-5} M phloretin, a noncompetitive inhibitor of glucose transport. When 14- and 21-day-old larvae were incubated in media of different glucose concns, the rate of glucose incorporation was related to the cuticle thickness as 14-day-old larvae incorporated glucose eleven times faster than 21-day-old larvae which possess a much thicker cuticle. The process of diffusion across the cuticle appears to be facilitated by a glucose-active transport system, probably in the cells of the trophosome, which are actively sequestering glucose from the nematode's pseudocoel, and thus maintaining a diffusion gradient across the thin larval cuticle.—*Supported by a National Research Council of Canada Postgraduate Scholarship and NRC Operating Grant #A4679 to Prof. J. M. Webster, Pestology Centre, Dept. of Biological Sciences, Simon Fraser University, Burnaby, British Columbia, Canada.*

SAWHNEY, R., and J. M. WEBSTER. *A further understanding of the susceptible and resistant responses of tomato to Meloidogyne incognita.*

An investigation was done to ascertain the effect of some plant growth hormones and inhibitors on the response of different cultivars of tomato (*Lycopersicon esculentum*) to *Meloidogyne incognita.* Three-day-old tomato seedlings were exposed together and separately to naptheleneacetic acid (NAA) and kinetin in Hoagland's solution under aseptic conditions in petri dishes, and then infected with *M. incognita* larvae. These hormones in combination stimulated galling and larval development in the susceptible 'Bonny Best', whereas, in the resistant 'Nematex', it stimulated galling, and greatly increased the number of larvae that penetrated the roots, but enabled only a few larvae to develop to maturity. Exposure of similarly infected seedlings to abscisic acid and cyclohexamide inhibited the necrosis typical of the hypersensitive response of the resistant Nematex, but did not facilitate gall formation. It is proposed that two factors, namely (i) a balance of plant growth hormones and (ii) a factor for necrosis may be responsible for the response of tomato to *M. incognita.*—*Research supported by the National Research Council of Canada. Pestology Centre, Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, B.C., Canada.*

SAYRE, R. M. *Observations on aberrant root-knot nematode larvae.*

Occasionally severely deformed larvae of *Meloidogyne incognita acrita* were observed in a nematode population hatched from egg masses taken from the roots of greenhouse grown pepper (*Capsicum annuum*). Aberrant larvae usually had only caudal deformities, but in some as much as one-third of the posterior part of the body was swollen or grossly malformed. Some individuals had normal tails, but were swollen elsewhere. Some were swollen at regular intervals along most of their bodies. Of the 50 egg masses examined, 20 yielded aberrant larvae. In one population, 31% of the larvae were defective. The percentage of deformities increased with the age of the egg mass indicating that the abnormalities may impair hatching and nematode motility. To remove the nematode from the possible mutagenic effects of greenhouse spray treatments and into more controlled conditions, nematodes were cultured in the laboratory on excised tomato roots. Of the 50 successful cultures, 24 cultures yielded aberrant larvae. In one culture, as many as 21% of the larvae were abnormal. The origin and nature of these abnormalities, which may be due to genetic or pathological factors, are being investigated further by rearing the nematode in gnotobiotic conditions.—*Nematology Laboratory, Plant Protection Institute, Agricultural Research Center (W), Beltsville, Maryland 20705.*

SIDDIQUI, I. A., and D. R. VIGLIERCHIO. *Ultrastructure of the esophageal region of the marine nematode, Deontostoma californicum.*

The body wall cuticle of *Deontostoma californicum* in the esophageal region is 10.0- to 13.0-μm thick and consists of an electron-dense membrane, a two-layered cortex, a median layer, four fiber layers, and a basal lamella. The syncytial hypodermis is 0.56- to 1.12-μm thick in interchordal areas, but enlarges to form two lateral, one dorsal, and one ventral chords. Each quadrant of somatic muscles consists of six-to-eight spindle-shaped longitudinal muscle cells. Both the somatic muscle cells and the hypodermal chords project into the pseudocoelom and are lined with a basal layer, 54-90 nm in thickness. Six cephalic papillary and two amphidial nerves run anteriad from the circumesophageal commissure. The cephalic papillary nerves are arranged in subdorsal, subventral, and ventrolateral positions, while the amphidial nerves are dorsolateral. In addition, the hypodermal tissue in the chordal, subdorsal and subventral zones contains several axons that innervate the somatic setae and the muscle cells. The axons are ensheathed either by a basement layer, approximately 62 nm thick, or glial cells which contain microtubules, bundles of dense filaments, mitochondria and vesicles. The esophagus is a cellular structure and is enveloped by a basement layer 0.2- to 0.3-μm thick. It consists of three marginal cells alternating with an equal number of radial cells. A nonmyofibrillar connective tissue in the marginal cells runs between the apex of each ray and the outer wall of the esophagus. The radial cells consist of bundles of obliquely oriented myofibrils and three esophageal gland ducts. Three esophageal enteric nerves run anteriad and lie between the gland ducts and the outer wall of the esophagus.—*Division of Plant Industry, California Department of Food and Agriculture, Sacramento 95184, and Department of Nematology, University of California, Davis 95616, respectively.*

SITARAMAIAH, K., and R. S. SINGH. *The possible effects on Meloidogyne javanica of phenolic compounds produced in amended soil.*

Studies were carried out to determine the effects of phenolic compounds in soil distillates on survival and attraction to tomato roots of larvae of *Meloidogyne javanica*. Larvae and roots were exposed to distillates for various periods of time and the effects were correlated with reduced incidence of root knot in soil amended with oil cakes and sawdust. Distillates were obtained at 80 C under a reduced pressure of 60 mm of mercury, following a 3-wk decomposition period, from nonamended soil and soil amended with 10% (w/w) margosa cake (*Azadirachta indica*) or with a mixture of sawdust from *Dalbergia sissoo* and *Shorea robusta*. The distillates from nonamended, oil-cake-amended and sawdust-amended soil contained 8, 40, and 400 μg/liter of phenolic compounds, respectively. The distillate of nonamended soil resulted in 20% larval mortality while distillates from margosa cake- and sawdust-amended soil resulted in 96-100% larval mortality. Excised tomato roots exposed by soaking in distillates or pure phenol, rinsed several times in distilled water, and kept on agar blocks did not attract larvae. Seedlings raised in noninfested, amended soil showed reduced infection when transplanted in nonamended infested soil. We conclude that phenolic compounds present in soil during decomposition of margosa cake or sawdust may play an important role in controlling the root-knot nematode through larval mortality, and by rendering the host roots less attractive to nematodes.—*Department of Plant Pathology, G. B. Pant University of Agriculture and Technology, Pantnagar, 263145, India.*

SITARAMAIAH, K., R. S. SINGH, and B. P. PAL. *Effect of the gaseous atmosphere produced in amended soil on egg hatch of Meloidogyne javanica.*

Field soil was amended with 0.1 and 0.2% (w/w) of either margosa cake (*Azadirachta indica*) or a mixture of sawdust from *Shorea robusta* and *Dalbergia sissoo* with and without supplemental nitrogen in the form of urea. Urea was added only to mixed sawdust-amended soil at the rate of 228 mg to 1.8 kg of field soil. Nonamended field soil served as controls. Egg masses of similar size were obtained from 7-wk-old infested tomato

plants (*Lycopersicon esculentum* 'Pusa Ruby'). The egg masses were rinsed several times in distilled water to remove any free larvae, and then placed in BPI watch glasses containing 0.5 ml of distilled water. The watch glasses were placed in plastic tubes which had both open ends closed with 60-mesh screen. The tubes were buried in amended or control soil in earthen pots. The gaseous atmosphere from margosa cake or sawdust- and urea-amended soil enhanced egg hatch as compared to hatch in nonamended soil. Sawdust amendment without urea was not as effective. At the lower concns of 0.1%, the larval hatch was enhanced after 14 days, while at the higher concns of 0.2%, the hatch was enhanced after 7 days. Amount of amendment and speed of decomposition appeared to be the factors which determined the concn, and hence the effect, of soil atmosphere. Results suggest that volatile water-soluble substances are formed from amended soil and these stimulate egg hatch.—*Department of Plant Pathology, G. G. Pant University of Agriculture and Technology, Pantnager, 263145, India.*

STEELE, A. E., and H. SAVITSKY. *Quantitative and qualitative evaluation of resistance of interspecific hybrids Beta vulgaris × B. procumbens to Heterodera schachtii.*

Cessation of development of *Heterodera schachtii* larvae in roots of resistant hybrids may occur at any stage, but most frequently occurs at the 2nd and 3rd stages. Resistance is transferred from trisomics and from newly developed diploid sugarbeets obtained from trisomics to 10-15% of the progeny. The trisomic and diploid plants have about the same level of resistance. When nematodes develop to maturity in roots of resistant plants, typical syncytia develop. Cessation of larval development is attended by early collapse of syncytia, necrosis which frequently extends to the root surface, hyperplastic changes, and by extensive disorganization of host plant tissues in areas adjacent to infection loci.—*Agricultural Research Service, U.S. Department of Agriculture, and Beet Sugar Development Foundation, Salinas, California 93901.*

THIRUGNANAM, M. *Growth requirements of Aphelenchoides rutgersi for hemin and nucleic acid supplements.*

The nematode basal medium, M-10, was supplemented with various compounds in order to achieve continuous reproduction of *Aphelenchoides rutgersi.* Partially or completely defined supplements such as chick embryo extract (ultra filtrate), human gamma globulin and beta lipoprotein (Cohn fraction IV-4) failed to improve their reproduction. The crude chick embryo extract (CEE) at 20% concn (v/v) enabled continuous reproduction of *A. rutgersi.* When the CEE was treated with activated charcoal, the nucleic acid supplements and heme-related compounds were removed from this growth supplement. The nematodes introduced into M-10, supplemented with such charcoal-treated CEE failed to reproduce. Inclusion of hemin in the diet (10 μg/ml) restored their reproduction. The nematodes reproduced even in the complete absence of nucleic acid supplements in the culture medium. However, in the presence of these supplements, the egg production increased fourfold and the nematode numbers threefold. The deletion of deoxyribonucleotides and the pyrimidine nucleotides of ribose series from the medium did not affect the egg production of nematodes. When purine nucleotides were deleted, egg production was greatly reduced indicating the limited nutritional essentiality of these compounds.—*Department of Entomology and Economic Zoology, Rutgers University, New Brunswick, New Jersey 08903.*

WANG, L. H., T. K. HODGES, and G. B. BERGESON. *Meloidogyne incognita-induced changes in cell permeability of galled roots.*

Electrolyte leakage of *Meloidogyne incognita*-infected and healthy roots was compared by conductivity measurements and by compartmental analysis using ^{86}Rb. Conductivity measurements indicated that the rate of electrolyte loss (% of root homogenate) was greater from healthy than from galled roots, but due to a much higher concn of electrolytes in the galled root homogenate, the net loss of electrolytes is

likely to be greater from galled roots. Compartmental analysis indicated that: (i) the longer half-time for ^{86}Rb loss from vacuoles of galled root cells could be due to a greater vacuolar content or to decreased tonoplast permeability, (ii) the shorter half-time for loss of ^{86}Rb from the cytoplasm of galled root cells could reflect either a reduced cytoplasmic content or an increased plasma membrane permeability, and (iii) in split-root plants, the permeability of the tonoplast and the plasma membrane of cells in nongalled roots is increased by nematode infection on the other half of the root system. Thus, a mechanism for mobilizing minerals to the infection site is proposed.—*Department of Botany and Plant Pathology, Purdue University, West Lafayette, Indiana 47907.*

WEBSTER, J. M., and R. GORDON. *The cuticle structure of larval Mermis nigrescens and its possible function.*

Larvae of *Mermis nigrescens* Dujardin, parasitic in the desert locust *Schistocerca gregaria* Forskål, were fixed at daily intervals to study their mid-body cuticle with transmission and scanning microscopes. The cuticle increases in thickness from 193 nm at day 7 to 17,967 nm at day 27 (just prior to emergence) of parasitic development, and the fibrous layer increases most. A three-layered membrane, 37-50 nm thick, becomes progressively more distinct on the outside of the amorphous cortical layer of the developing larvae. At the base of the cortical layer is a double layer of oblique giant fibers which does not increase significantly in thickness until day 15, but, thereafter, increases from 85 nm to 3,100 nm in thickness. The fibrous layer, median in the cuticle, is the thickest (14,700 nm at day 27). Its structure is amorphous until about day 11 when bands of electron dense material appear in a vacuolated matrix. The basal layer is thin and not visible until about day 25 of larval development. The margin of the hypodermal layer is greatly convoluted. The hypodermis contains many mitochondria, ribosomes and multivesicular bodies (mvb) and much endoplasmic reticulum. The mvb are frequently closely associated with the hypodermal margin and are believed to function in the formation of the cuticle by the hypodermis. In contrast to the cuticle of adult *M. nigrescens* there are no pores or canals connecting the exterior with the 'inner cortex'. The function of the flexible cuticle as a structure that permits rapid growth and nutrient uptake is discussed.—*Supported by a National Research Council of Canada grant. Pestology Centre, Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, B.C., Canada. V5A 1S6.*