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ABSTRACTS OF PAPERS PRESENTED AT THE NINETEENTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS NEW ORLEANS, LOUISIANA AUGUST 10-13, 1980

ALBERT, P. S., and D. L. RIDDLE. *Abnormal sensory ultrastructure in mutants of Caenorhabditis elegans unable to form dauer larvae.*

Upon starvation, the second stage larvae of this free-living nematode may molt into a developmentally arrested stage, the dauer larva. We have isolated genetic variants unable to form dauer larvae. These mutants fail to respond normally to known chemical attractants. Serial section electron microscopy of second stage larvae reveals abnormal sensory morphology in the mutants. Of the three mutant strains examined, one (CB1377) exhibits blocked amphid channels due to abnormal sheath cell development. The other two strains (CB1379 and CB1387) are affected in several classes of ciliated sensory neurons. Hermaphrodites of one strain (CB1379) exhibit abnormalities in phasmid neurons in the tail. Defects in tail sensory structures may explain why the CB1379 mutant males are not capable of mating successfully, even though they contain sperm. The existence of a single gene mutation which affects development of similar sensory neurons in both the head and tail suggests that these neurons share common developmental steps.—*Division of Biological Sciences, University of Missouri, Columbia, MO 65211.*

ALBY, T., J. M. FERRIS, and V. R. FERRIS. *Dispersion and distribution of selected nematodes in soybean fields in Indiana.*

Species of nematodes representing three orders were found to be unevenly distributed in soybean fields which appeared homogeneous with respect to soil types and topography. Variance/mean ratios were large in most instances. Morisita's index of dispersion (I_δ) was calculated for each species and each sampling date. Values of I_δ tended to behave in a different though predictable manner for each of the species considered. They were generally more volatile for *Helicotylenchus pseudorobustus* and less volatile for a *Mesodorylaimus* sp. near *M. macrophallus.* Other species considered behaved in a fashion intermediate between *H. pseudorobustus* and the *Mesodorylaimus* sp. The I_δ values tended to be similar for the same species in consecutive years, and for species within the same order, and dissimilar for species in different orders. These values indicted that populations occurred in a Poisson or more contagious distribution. Parametric statistical methods were therefore not appropriate for further analysis. Frequency data for each species treated were compared to several common distributions using nonparametric methods. Results provided further indication that the species were distributed in a contagious manner. *H. pseudorobustus* generally maintained a highly contagious distribution whereas the *Mesodorylaimus* sp. maintained a level of contagion only slightly higher than that of a Poisson dis-

tributed population.—*Department of Entomology, Purdue University, West Lafayette, IN 47907.*

ATU, U. G. *Relationship between root-knot nematode population and damage to seed-yam.*

In glasshouse and microplot experiments, damage done by *Meloidogyne* to white yam, *Dioscorea rotundata* cv Obiaturugo, was proportional to initial inoculum concentration. Various populations up to 425 eggs/100 g soil were tested; noninfested soil served as a control. At 30 C the economic threshold (tolerance limit) was 25 eggs/100 g soil in the glasshouse and 75 eggs/100 g of sandy loam soil in microplot experiments. The rate of nematode population increase was inversely related to initial inoculum concentration. More juvenile nematodes were recovered from feeder roots than from tubers. Plants inoculated with more than 225 eggs/100 g soil showed senescence earlier than plants inoculated with fewer eggs.—*National Root Crops Research Institute, Umudike-Umuahia, Nigeria.*

ALVARADO-SOTO, M., and R. LOPEZ-CHAVES. *Recovery of Meloidogyne incognita larvae from three tropical soils by modifications of the centrifugal-flotation technique.*

The influence of sample size (50, 100, or 150 cm^3), number of washings (one, two, or three), time of suspension before washings (20, 40, or 60 s), arrangement of the sieves (A: one 50 and two 325 mesh; B: one 100 and two 325 mesh; C: one 100 and one 325 mesh), time of centrifugation (3, 4, or 5 min at 3,000 rpm) and sugar solution density (1.12, 1.15, or 1.18) on the recovery of *Meloidogyne incognita* larvae from naturally infested Ustult, Ustropept, and Tropept soils from Costa Rica was investigated. In the Ustropept soil, significantly higher numbers of larvae were recovered with one as compared to three washings, whereas in the Tropept soil, one washing recovered significantly higher densities than two or three. A suspension time of 60 s before washings yielded significantly fewer larvae than 20 or 40 s in the Ustult soil. Significantly more larvae were recovered in the Ustropept soil using the B rather than the A set of sieves. No significant differences among treatments were found in any of the three soils regarding the other evaluated factors.—*Laboratorio de Nematologia, Escuela de Fitotecnia, Universidad de Costa Rica, San Jose, Costa Rica.*

BHATTI, D. S., M. R. DALAL, R. S. DAHIYA, and S. C. DHAWAN. *Integrated control of Heterodera avenae in wheat.*

Field experiments were conducted in Mohindergarh district (Haryana State, India) during 1975–77 to evaluate the combined effect of sowing time and nematicidal application on wheat growth and population of *Heterodera avenae.* At village Kanwi, wheat cv. S 308 was sown on 1 and 15 Nov. and 1 and 15 Dec. 1975 in 5 x 4-m plots. One set was untreated, and the other set was treated with aldicarb (Temik 10 G) at 2 Kg a.i./ha. All the treatments were replicated four times and randomised in blocks. The presowing nematode infestation was 32 cysts/200 g soil. Aldicarb was applied by mixing with recommended quantities of fertilizers and drilling the mixture. At harvest, observations were recorded on grain yield and cyst population/200 g soil. Plots sown with wheat on the four dates and treated with aldicarb yielded 4,832, 4,632, 2,659, and 3,590 kg/ha as compared to 3,690, 3,686, 2,378 and 3,342 kg/ha in the untreated plots, respectively. The respective decreases in cyst population in treated plots compared to the untreated ones were 81.6, 23.2, 48.4 and 75.3%. In 1976 the experiment was repeated at village Silarpur. The results obtained were similar to those of the preceeding year. The two field results reveal that sowing of wheat in *H. avenae* infested fields in early November yields more than late sown crops even when a nematicide is not applied. However, early

sowing in aldicarb treated, nematode-infested fields brings about a significant gain in the yield.—*Department of Nematology, Haryana Agricultural University, Hissar, India.*

BHATTI, D. S., S. C. DHAWAN, R. S. DAHIYA, and INDRA MALHAN. *Penetration of wheat roots by Heterodera avenae juveniles.*

Pot experiments were conducted during 1974–77 to determine the time for maximum penetration of wheat roots by *Heterodera avenae* juveniles. Seed were sown in sandy loam soil naturally infested with 30–40 cysts/kg soil in 15-cm earthen pots. Germination took place in 6–12 d and the plants thinned to one/pot. Counts of the number of *H. avenae* juveniles that penetrated the roots were made at weekly intervals after emergence for 7 wk. Each observation sample included four plants. The roots of sampled plants were washed, stained with acid fuchsin-lactophenol, cleared in lactophenol for 2 d, and observed for larval counts under stereoscopic binocular microscope.

The maximum mean larval numbers observed 5 wk after emergence were 35, 34, 405, 472, 218, and 165 for wheat cv. 308 planted on 23 Nov. 1974 and cv. Kalyan Sona planted on 23 Oct. 1975, 1 and 15 Nov. 1976, and 1 and 15 Dec. 1976, respectively. Wheat sown on 1 Dec. 1976 and examined 7 wk after emergence had 283 juveniles. At the last sampling date there appeared to be a conspicuous reduction in the nematode population. This was perhaps due to formation of adult males and their egress into soil.

Penetration behaviour of *H. avenae* is being exploited by sowing wheat cv. C 306 early (third week of October) as a trap crop, ploughing it under the soil, and then sowing wheat cv. S 308 as a normal crop. Based on the larval penetration behaviour study, the use of a trap crop for the control of *H. avenae* is presently in progress; field results will be reported in due course.—*Department of Nematology, Hargana Agricultural University, Hissar, India.*

BERNARD, E. C. *Reassessment of resistance among soybeans to Meloidogyne incognita.*

Eggs of five isolates of *Meloidogyne incognita* from West Tennessee soybean fields were inoculated onto roots of 12 soybean cultivars to reassess resistance of soybean to this nematode. Both field and greenhouse experiments were conducted. The nematode isolates were earlier found to produce average gall ratings of 1.6–5.0 on several soybean cultivars. Six of the cultivars in the present study have been considered susceptible (Dare, Essex, FFR-666, McNair-500, Pickett-71, York), three moderately resistant (Bedford, Bragg, Coker-136), and three resistant (Centennial, Forrest, Lee-74). Root systems were harvested 60 d after inoculation. Gall and egg-mass ratings were made visually on a 0–5 scale (5 = more than 100 galls or egg masses/root system). Eggs were collected and counted, and numbers were calculated as eggs/root system and eggs/g root. In general, gall ratings corresponded with resistance ratings better than did egg-mass ratings when galling by all five isolates was averaged. Dare and Essex had high gall ratings but low egg-mass ratings. Egg-mass ratings were more closely correlated with eggs/root system and eggs/g root than were gall ratings. Resistance appeared to depend more on the nematode isolate than on the cultivar. One isolate reproduced greatly regardless of cultivar, another increased moderately, two maintained themselves, and one declined. The highly successful isolate resembled *M. incognita wartellei* in reproductive capability but differed morphologically. These results suggest that several isolates of varying reproductive success on soybean should be used to screen cultivars for resistance.—*Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37916.*

BRODIE, B. B. *Control of Globodera rostochiensis in relation to method and time of application of nematicides.*

Aldicarb, ethoprop, oxamyl, and phenamiphos were applied (5.6 kg/ha) immediately before planting, at time of planting,

or 2 or 4 wk after planting potatoes (cv. Katahdin) in clay loam infested with *Globodera rostochiensis*. When applied before planting, the nematicides were broadcast on the soil surface and incorporated in the top 5 cm of soil with a disc. When applied at planting they were banded (12 cm) in the seed furrow. Postemergence application were side dressed 10 cm deep on each side of the row (2 wk) or spread on the surface over the row and covered during the hilling procedures (4 wk). Two rows 15 m long represented a plot. Random soil samples were taken from each plot before treatment and after harvest from which cysts were extracted and number of viable units/200 ml of soil determined. The greatest reduction in population density was obtained when the nematicides were broadcast on the soil surface before planting and incorporated in the top 5 cm of soil. Aldicarb reduced the density 81%, ethoprop 61%, phenamiphos 51%, and oxamyl 7%. When applied in the seed furrow at time of planting, none of the nematicides reduced nematode density, but increase in density was significantly less in treated plots than it was in nontreated plots. Neither method of the postemergence treatment significantly suppressed density increase. Depending upon initial population density, yield of potatoes was generally related to degree of *G. rostochiensis* control.—*USDA, SEA, AR, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

BROWN, M., R. M. RIEDEL, and R. C. ROWE. *Effects of Pratylenchus penetrans or Verticillium dahliae on growth and yield of Solanum tuberosum cv. Superior in microplots.*

Unglazed 24.5 (ID) x 30.5-cm clay tile microplots were established in Rifle peat, Wooster silt loam, and Kibbie sandy loam to study the effects of four levels of *Pratylenchus penetrans* and three of *Verticillium dahliae* on growth and yield of *Solanum tuberosum* cv. Superior in Ohio. Known amounts of nematodes from monoxenic alfalfa callus and microsclerotia grown in soil culture were added to fumigated soil (67% methyl bromide-33% chloropicrin at 320 lb/A). Actual at-plant populations of nematodes and *Verticillium* were determined, respectively, by a modified Baermann funnel technique for 24 h in water and dilution plating. Nematode levels at the three sites were as follows: high 235, medium high 120, medium 60, and low 20/100 cm^3 soil. Microsclerotial levels were as follows: high 9,000, medium 900, and low 90/cm^3 soil. Infested soil was placed in the microplot and planted with a pathogen-free seedpiece. Treatments were replicated 15 times in a completely randomized design. Plant spacing simulated commercial production. At harvest, roots and soil separately were extracted for *Pratylenchus* as above and stem sections were cultured for *Verticillium*. Final root and soil counts showed that nematode populations between treatments remained significantly different throughout the season. High levels of nematodes reduced shoot and root growth in Rifle peat and Kibbie sandy loam. Nematodes did not significantly decrease tuber weight. *Verticillium* significantly decreased root and shoot growth in Rifle peat and Wooster silt loam, but only significantly decreased tuber weight in Rifle peat.—*Department of Plant Pathology, Ohio State University, Columbus, OH 43210; and the Ohio Agricultural Research and Development Center, Wooster, OH 44691.*

CANTO-SAENZ, M., and B. B. BRODIE. *Host reaction of certain potato clones to Meloidogyne spp.*

Rooted cutting of 12 potato clones (*Solanum tuberosum* spp. *andigena* and *S. sparsipilum* x *S. tuberosum* ssp. *andigena*) were planted in 100-ml pots and grown in a greenhouse (27–32 C). The cuttings were inoculated with 10,000 eggs/pot of either of two populations of *Meloidogyne incognita* (A from North Carolina and B from Georgia). These populations were identified as "Race 1" with Sasser's differentials. Fifty days later, the host efficiency of the clones was determined based on P_f/P_i ratio. Host reaction to other *Meloidogyne* species, based on root gall index, was also recorded. All clones of *S. tbr.* ssp. *andigena* and one clone of *S. spr.* x *S. tbr.* ssp. *andigena* were efficient hosts for both populations. From

S. spr. x *S. tbr* ssp. *andigena,* two clones were nonefficient hosts for population B but efficient hosts for population A. Four clones were nonefficient hosts for both populations. To evaluate nematode damage on five clones of *S. tbr.* ssp. *andigena* and three clones of *S. spr.* x *S. trb.* ssp. *andigena,* rooted cuttings were planted in 5-L pots and inoculated with population B (0, 0.1, 0.5, 1.0, and 5.0 egg/g of soil). Sixty days later P_f/P_i ratio of the nematode was determined. Plant height and root and tuber weights were recorded 60 d after planting and at harvest. One clone of *S. spr.* x *S. tbr.* ssp. *andigena* was resistant. Two clones of *S. tbr.* ssp. *andigena* showed some tolerance; all other clones were susceptible.—*Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

CARTER, W. W. *Interaction of Rotylenchulus reniformis and Macrophomina phaseolina in charcoal rot of cantaloup.*

The incidence and severity of charcoal rot caused by *Macrophomina phaseolina* was significantly greater when cantaloup (*Cucumis melonis*) was parasitized by the reniform nematode, *Rotylenchulus reniformis.* The incidence of charcoal rot and number of dead plants increased 53 and 150%, respectively, when *M. phaseolina* was combined with *R. reniformis* compared to *M. phaseolina* alone. Both *M. phaseolina* and *R. reniformis* significantly reduced top fresh weight, but not root weights, compared to noninoculated plants. The number of *M. phaseolina* sclerotia per gram of root was significantly greater in roots parasitized by *R. reniformis.* No significant differences per gram of root were found in the number of *R. reniformis* adult females, egg masses or eggs per mass among treatments.—*USDA, SEA, AR, Subtropical Fruit and Vegetable Research Unit, Weslaco, TX 78596.*

CASWELL, E. P. *Nematodes associated with Michigan field corn.*

An extensive survey of plant-parasitic nematodes associated with commercial field corn was carried out the summer of 1979. Thirty-eight counties were selected as survey sample sites, and 0.1% of Michigan's 2.7 million acres of field corn was sampled. Historical data obtained from each sample site were the variety of corn and the planting date in 1979, the previous 2 years' crops, insecticides or nematicides used for the previous 3 years, fertilizers applied, tillage practices, and the previous year's corn yield. The degree-day accumulation (above base 50) up to the time of sampling was calculated from the records of the weather station closest to each sampling site. Soil texture classification analysis was conducted for areas of fields having high or low populations of *Pratylenchus* and *Tylenchorhynchus* species.

The nematodes found with greatest frequency were *Pratylenchus* spp., with 90% of the samples taken containing this genus. Populations as high as 1,096 *Pratylenchus* spp./g fresh root were found. *Pratylenchus penetrans* was common, followed by lesser occurrence of *P. crenatus, P. vulnus,* and *P. neglectus. Tylenchorhynchus* spp. were found in 18% of the samples taken. Population analyses were performed on the survey data. Prominence values, similarity indices, absolute frequencies, and relative densities were established for the sampled counties.—*Department of Botany and Plant Pathology, Michigan State University, East Lansing, MI 48824.*

CHITWOOD, D. J., and L. R. KRUSBERG. *Phospholipids of Turbatrix aceti.*

Lipids comprised 19.8% of the dry weight of *Turbatrix aceti* and contained 44.1% neutral lipid, 4.5% glycolipid, and 51.4% phospholipid. Phospholipids consisted of 45.1% phosphatidylcholine (PC), 40.4% phosphatidylethanolamine (PE), 5.3% sphingomyelin, 4.4% diphosphatidylglycerol, 3.4% phosphatidylserine, and 1.4% phosphatidylinositol. Octadecenoic (18:1) acid comprised 26.0% of the phospholipid fatty acid. Also abundant were 18:0 (19.0%), 18:2 (11.3%), 20:3 (9.3%), 20:4 (11.0%), and 20:5 (10.9%) acids. PE con-

tained more 18:0 acid and less 20:3, 20:4, and 20:5 acids than PC. Fatty acids esterified at the 1-position of PE or PC were generally shorter and more saturated than those esterified at the 2-position. The 1-alkyl-2-acyl and 1-alkenyl-2-acyl analogues of diacyl PE and PC comprised 10.5% and 43.2%, respectively, of the total PE but only 3.8% and 7.0%, respectively, of the total PC. These analogues have not been previously detected in free-living nematodes. The most abundant alkyl and alkenyl groups were the 18:0 compounds. Fatty acid compositions of the alklacyl and alkenylacyl analogues of diacyl PE or PC were similar to that of the 2-position of diacyl PE or PC, but a few significant differences were observed.—*Department of Botany, University of Maryland, College Park, MD 20742.*

CLARK, C. A., V. L. WRIGHT, and R. L. MILLER. *Reaction of some sweet potato selections to the reniform nematode, Rotylenchulus reniformis.*

Three sweet potato selections supported less reproduction of reniform nematode in the greenhouse than Goldrush (least suitable standard), while 26 supported greater reproduction than Centennial (highly suitable standard), and 13 were intermediate. The ratio of Pf/Pi (Pi = 600/10-cm pot) ranged from 3.3 for selection P-104 to 97.1 for W-103 after 58 d. Yield of nine selections was compared in fumigated (F) and nonfumigated (N) plots in a field with a natural infestation. In 1978 initial populations were low (500/500 cc). There were no significant differences between N and F for any selection for vine growth or total yield. Yield of U.S. #1 sweet potatoes was increased for the cultivars Jasper and Goldrush. All selections except L1-207 had a high incidence of cracking of sweet potatoes and, except for Creole, the incidence of cracking was significantly lower in fumigated plots. In 1979 initial populations were high (N = 10,000 and F = 3,000/500 cc). Vine growth, total yield, yield of U.S. #1 sweet potatoes, and number of sweet potatoes was increased by fumigation for each selection. Total yield of Goldrush was most severely (78%) and Porto Rico least severely (23%) reduced by the nematode. The incidence of cracking was high in both N and F, although it was slightly lower in F plots. Reniform nematodes were not found in fleshy roots. Although Goldrush was one of the selections least suitable for reproduction of *R. reniformis*, it was one of the most sensitive to damage by the nematode. (Supported in part by USDA agreement No. 12-14-7001-1155).—*Departments of Plant Pathology and Crop Physiology and Experimental Statistics, Louisiana Agricultural Experiment Station, Louisiana State University, Baton Rouge, LA 70803.*

EDONGALI, E. A., and H. FERRIS. *Varietal response of tomato to salinity-Meloidogyne incognita interaction.*

A 1:1 ratio of sodium chloride (NaCl) and calcium chloride ($CaCl_2$) with conductivity of 0, 1.5, 2.5, 3.5, and 5.0 mmho/cm was applied to sandy soil in insulated cups. Seedlings of four tomato cultivars were grown in the cups in a greenhouse: 'Beefmaster' and 'Atkinson' are *M. incognita* resistant; 'Hunts 2580' and 'Ronita' are *M. incognita* susceptible. Half of the plants were inoculated with 400 larvae 3 d after salinization. There were 12 replicates of each treatment. The experiment was terminated 60 d after inoculation. As salinity increased, plant growth declined. Addition of nematodes to salt-stressed plants significantly reduced plant weight and the number of flowers and fruits of all varieties. Root size decreased as salinity increased. The total number of nematodes recovered from roots in a mist chamber decreased significantly with increase in salinity; however, nematode root gall index increased. Total nematodes recovered differed significantly among varieties at low salt concentrations and in the absence of salinity.—*Department of Nematology, University of California, Riverside, CA 92521.*

EDONGALI, E. A., and H. FERRIS. *Uptake and accumulation of Na^+, K^+, and Cl^- by tomatoes in response to soil salinity and Meloidogyne incognita infection.*

Four tomato cultivars—Beefmaster, Hunts 2580, Atkinson, and Ronita—were grown in sandy soil treated with a 1:1 ratio of NaCl and $CaCl_2$ with conductivity of 0, 1.5, 2.5, 3.5, and 5.0 mmohs/cm. Half of the plants of each cultivar at each salinity level were inoculated with *M. incognita*. Samples of roots and leaves were taken from the 12 replications of each treatment after 60 d. The roots and leaves were analyzed for Na^+, Cl^-, and K^+. The uptake and accumulation of Cl^- in leaves and roots increased with an increase in salinity. Addition of nematodes doubled the concentration of chloride in the roots and leaves of 'Atkinson' and 'Hunts,' but only in roots of 'Beefmaster.' Nematode-salt interaction caused no significant change in Cl^- concentration in leaves and roots of 'Ronita.' Salt-stressed plants were higher in Na^+, but much lower in K^+, in roots as well as leaves of all varieties. However, the interaction of salinity and nematodes resulted in less Na^+ and more K^+ in leaves and roots of all cultivars. Nematode recovery from roots was low for the first 96 h, possibly because of some inhibitory effect of these ions on egg hatching.—*Department of Nematology, University of California, Riverside, CA 92521.*

EISENBACK, J. D., and H. HIRSCHMANN. *SEM comparisons of female stylets of Meloidogyne arenaria, M. hapla, M. incognita, and M. javanica.*

A technique was developed for the removal of the stylet and attached esophageal lumen lining from the body of an adult root-knot nematode female. The morphology of female stylets of one population each of *Meloidogyne arenaria, M. incognita,* and *M. javanica* and six populations of *M. hapla* was examined by scanning electron microscopy (SEM). The populations of *M. hapla* included three each of the two cytological races, A and B. Race A populations had haploid chromosome numbers of 15, 16, and 17 and reproduced by facultative parthenogenesis. The populations of race B had somatic chromosome numbers of 45, 45, and 48 and reproduced by mitotic parthenogenesis. The populations of *M. arenaria, M. incognita,* and *M. javanica* reproduced by mitotic parthenogenesis and had somatic chromosome numbers of 54, 41–43, and 44, respectively. The stylet morphology was different for each of the species. Differences occurred in cone, shaft, and knob morphology. Stylets of all six populations of *M. hapla* had similar shape. Morphological differences between the species first seen in the SEM were subsequently observed in the light microscope and are suggested as useful supplemental characters in the identification of *Meloidogyne* species.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

ELLIOTT, A. P., and G. W. BIRD. *Economic analysis of Pratylenchus penetrans control in Michigan bean production.*

The economic threshold for *Pratylenchus penetrans* associated with Michigan dry bean production was determined for the 1979 crop using aldicarb at 0.0, 0.5, 1.0, 1.5, and 2.0 lb a.i./acre for nematode control. The economic analysis involved calculation of profits, marginal revenues, and marginal costs for dry beans under current production system conditions. Sensitivity analyses were conducted to evaluate responses to changes in (i) cost of aldicarb (ii) technological and management inputs, resulting in increases and decreases in yield of dry beans, and (iii) selling price of beans. Economic analyses of three alternate future scenarios in dry beans production ("the good years," "the dreary years," and "the expected years") were examined. The relationship between profit and rate of aldicarb applied was expressed as a second-degree polynomial. Profits increased with increasing rates of aldicarb (0 through 2.5 lb aldicarb/acre) and decreased at higher rates. The economic threshold was determined as 26 *P. penetrans*/100 cm^3 soil plus 1.0 g root tissue, requiring an input of 1.25 lb aldicarb/acre. The economic threshold was dynamic and

varied with changes in production inputs and alternate futures.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

FERRIS, H., and L. DUNCAN. *Consideration of edaphic factors in quantifying nematode stress on plant growth.*

Implementation of available information on nematode damage functions involves interpolation and, where necessary, limited extrapolation to appropriate environmental conditions. By assigning numerical values to soil textural classes (1 = sand, 2 = loamy sand, 3 = sandy loam, 4 = loam, 5 = clay loam, 6 = loamy clay, 7 = clay), we were able to summarize published experimental and field observations in quantifying the textural preference of various nematode genera on a 0–1 scale. This textural preference index (TPI) is used in computer models to weight nematode counts from soil samples according to the suitability of the soil texture in the field for the individual species present. It is used in the consideration of the impact of mixed communities of several plant-parasitic species. For *Meloidogyne*, the TPI was 1.0 for textural classes less than 3, and declined to 2.7 at textural class 7. By comparison, the TIP for *Helicotylenchus* was 0.0 at textural class 1, increased to 1.0 at classes 4 and 5, and decreased to 0.43 at soil class 7. The model relating TPI to textural class is perceived as tripartite: a range of textural classes at which the TPI is 1.0, with decreasing TPI values on either side. The parts may vary in size or be absent according to the genus considered. There are four determinant parameters: the lowest soil class at which the TPI is 1.0, the highest soil class at which the TPI is 1.0, the TPI at soil class 1, and the TPI at soil class 7. The TPI at appropriate textures is determined by linear interpolation.—*Department of Nematology, University of California, Riverside, CA 92521.*

FERRIS, V. R., and J. M. FERRIS. *Numerical analyses as tools in nematode systematics.*

Phenetic classifications group organisms on the basis of overall similarity. Phyletic classifications are concerned with genealogy and are based on special similarity in derived features. We used factor analysis and quantitative phyletic techniques with data from a revisionary study of *Oxydirus* (Dorylaimida: Belondiroidea) to determine whether the analyses would confirm our observations (made by conventional methods) that three distinct species groups were present among *Oxydirus* and *Oxyiroides*. Principal component analysis was applied to a data matrix containing coded values for 14 qualitative and quantitative characters. The first five principal components of the unrotated factor matrix accounted for a cumulative 89.7% of the total variance. Plots of the factor scores (based on a rotated factor matrix) for each species showed the species evenly spread across axis I, with our species groups 1 and 2 clearly separated on this axis. Group 1 formed a discrete cluster on the plot of axis I on axis II. The other groups were not distinctly separated, owing to the underlying overall phenetic similarity. For our numerical phyletic analyses (Wagner and Wiss tree algorithms) we used coded data for homologous character states for which we could make a reasonable hypothesis concerning the order of evolutionary change. The analyses produced distinct separations of the oxydirid groups and resulted in minimum length testable phylogenetic hypotheses for the groups.—*Department of Entomology, Purdue University, West Lafayette, IN 47907.*

FRECKMAN, D. W., and W. G. WHITFORD. *Responses of desert soil arthropods and nematodes to simulated rainfall.*

Desert ecosystems are pulse regulated by rainfall. Behavior of soil fauna in response to simulated rainfall was examined in the New Mexico Chihuahuan desert. Twenty g of mixed litter (60% creosote, *Larrea tridentata*, + 40% annual plant parts and

rabbit feces) was placed in screen cylinders on the desert soil surfact 6 d prior to wetting. The litter and the soil below was moistened with 25.4 mm H_2O. Five litter cylinders and a 6-cm deep soil sample from below the cylinder were collected at 0400 h, 1400 h, and 2200 h at 1, 2, 4, and 8 d after the simulated rainfall. Parameters examined were microarthropod, nematode, bacterial and protozoan densities, and species diversity in litter and soil. Numbers of nematodes in the soil were not significantly different following the simulated rainfall. Nematodes responded physiologically to the drying litter and soil by becoming anhydrobiotic. Eighty-five percent of the litter nematodes were anhydrobiotic 1 d after wetting, whereas it took 4 d for the soil nematodes to become 85% anhydrobiotic. This reflects slower drying in the soil. The density and diversity of microarthropods in both litter and soil increased within 1 h after wetting. There were no significant changes in numbers of protozoans or bacteria in the litter from day 1 to day 4 after wetting. The process of nematodes grazing on bacteria and fungi in the desert surface litter may be of short duration, occurring for less than 24 h following rainfall.—*Department of Nematology, University of California, Riverside, CA 92521; Department of Biology, New Mexico State University, Los Cruces, NM 88003.*

GIBLIN, R. M., and H. K. KAYA. *The association of a nematode, Huntaphelenchoides sp. (Aphelenchoididae) with the solitary soil dwelling bee, Anthophora bomboides stanfordiana (Anthophoridaes Hymenoptera).*

The nematode, *Huntaphelenchoides* sp., was found in the reproductive tracts of adult *Anthophora bomboides* and in cells containing bee progeny (one immature bee per cell) at the Point Reyes National Seashore, Marin County, California. Dauer juveniles of *Huntaphelenchoides* sp. were recovered from 14% (n = 411) and 7% (n = 42) of adult female and male bees, respectively. In male bees, the dauer juveniles were found solely in the penis and ductus ejaculatoris; in female bees, the dauers were recovered from the lateral and median oviducts and bursa copulatrix. Twenty-one percent (n = 217) of brood cells containing eggs, larval (first-third instars), or "post-defecating" larval stages of *A. bomboides* were infested with *Huntaphelenchoides* sp. The propagative stages of the nematode were found in cells containing bee eggs or larvae, while dauer juveniles were found in cells containing "post defecating" larvae and pupae. All stages of *Huntaphelenchoides* sp. were easily cultured on a wide variety of fungi, including unidentified fungal species isolated from the bee cells. The association between *Huntaphelenchoides* sp. and *A. bomboides* appears to be one of phoresy. Vertical transmission of the nematodes from one bee generation to the next occurs when nematode infested females contaminate progeny bee cells with dauer juveniles during oviposition. Fungi growing in the pollen provisions serve as food for the nematodes. The nematodes appear to be confined to the brood cell and subsequently utilize the adult bee for transportation to newly provisioned cells. There was no apparent physical damage or behavioral modifications observed in nematode-infested bees.—*Division of Nematology, University of California, Davis, CA 95616.*

GOLDEN, A. M., J. H. O'BANNON, G. S. SANTO, and A. M. FINLEY. *Morphology of an undescribed root-knot nematode on potato in the Pacific Northwest.*

Perineal patterns of *Meloidogyne* females from potato tubers from Aberdeen, Idaho, were found to have characteristically round to oval patterns and highly distinctive broken, curled, or twisted striae around and above the anal area. The vulva is in a prominent sunken area devoid of striae. In females, stylets average 12-μm long, DGO 4.2 μm from stylet knobs, and the median bulb contains vesicles or vesicle-like structures clustered around the lumen, anterior to the valve. These vesicle-like structures, not previously reported in *Meloidogyne* females, are absent in larvae and males in this species, although in *M. naasi* they are present only in males and larvae. Larvae average 390 μm in length

and have short tails (43 μm) with a distinctive short (11 μm), blunt tail terminal with little or no taper to its rounded terminus. Males average 1,068 μm in length, and the center band of the lateral field is narrower than the outer two. SEM observations of perineal patterns and anterior portions of males and larvae confirmed and extended those made by optical microscopy, showing clearly the nature of the labial discs, the absence of head annules on males and larvae, and spicule tips being dentate ventrally. The relationship of this root-knot species to related forms is discussed. This new parasite of potato is known from certain areas of Idaho, Washington, and Oregon.—*USDA, SEA, AR, Beltsville, MD 20705; USDA, SEA, AR, Prosser, WA 99350; Dept. of Plant Pathology, Washington State University, Prosser, WA 99350; and University of Idaho, Moscow, ID 83843.*

GOODELL, P. B., and H. FERRIS. *NEMASAM—A sample simulator for five plant-parasitic nematodes.*

An interactive FORTRAN computer program was written to sample a data base from a study in which 1,936 soil cores had been systemically collected in a 7-ha alfalfa field. The data base consisted of six arrays: soil core weight, *Meloidogyne arenaria, Pratylenchus minyus, Merlinius brevidens, Helicotylenchus digonicus* and *Paratrichodurus minor.* A nematode advisory scenario is developed and the user is allowed to (i) experiment with sampling strategies by varying sampling pattern, number of samples, and number of cores composing a sample to obtain field estimates within prescribed levels of precision and variability; (ii) deal with the problem of differential precision of the estimates for the nematodes present; and (iii) balance the need for accuracy and reliability with profit maximization under the economic constraints of an advisory service. The nematodes have different field distribution patterns and population densities so that optimum strategies vary for each species. The four collection strategies are random, division of the field into strips (two directions), and division of the field into equal-sized cells. Components of cost include time required to collect, extract, and count. The economic constraints are established by the fee the grower is willing to pay for the service, overhead and travel expenses, and the hourly wage the sampler is prepared to accept. Output consists of the field estimate for all five nematodes, deviation from the true field mean, coefficient of variation between repeated estimates (based on 25 replications), the number of hours required to collect, extract, and count those samples, and the profit or loss using the selected sampling scheme. NEMASAM has proved to be an excellent teaching tool.—*Department of Nematology, University of California, Riverside, CA 92521.*

GORDON, R., J. M. SQUIRES, S. J. BABIE and I. R. BURFORD. *Effects of protein content of the host diet on the development of the mermithid nematode Romanomermis culicivorax.*

Newly hatched mosquito (*Aedes aegypti*) larvae were experimentally infected with controlled doses of the mermithid nematode *Romanomermis culicivorax,* then reared (27 C) in groups on one of four types of diets: 1) high protein (55%), *ad libitum* (HP); 2) high protein, restricted quantity (HPR); 3) low protein (3.5%), *ad libitum* (LP); 4) low protein, restricted quantity (LPR). The four groups were compared with respect to the development of the nematode's parasitic phase and postparasites which emerged. The numbers of postparasites which emerged from the mosquitoes were significantly decreased as a consequence of reducing (a) the protein content of the host's diet and (b) the amount of diet available to the hosts. These two effects were not interrelated, and total numbers of postparasites decreased between the groups in the order HP-HPR-LP-LPR. Host mortality was greatest in the LPR group (15.4%), less in the HPR (8.2%) and LP (10.0%) groups, and least in the HP group (4.6%). Such differences in host mortality rate were insufficient to fully account for the observed decreases in numbers of postparasites that emerged from hosts fed on protein deficient or restricted diets. Host dissec-

tions and nematode examination, done at daily intervals throughout the infection, determined that the incidence of infection, rate of multiple infection, and level of parasitism were not significantly different between the four groups of insects. In hosts fed on a protein deficient (LP) or restricted diet (HPR, LPR), however, the parasites developed less rapidly than in insects fed on the unrestricted, high protein diet. Moreover, the development of the nematodes was asynchronous in nutritionally disadvantaged hosts (especially LP, LPR), so that multiple infections frequently consisted of two or more parasites at varying stages of development. In such infections, one nematode would complete parasitic development and emerge from the host, a process which killed the rest that were underdeveloped and led to an overall reduction in postparasite numbers. Postparasites emerged from the HP insects between days 6–11 of infection, from the HPR group between days 7–15 of infection, and from the LP group between days 8–20 of infection. Postparasites began to emerge from LPR hosts on day 10 of infection; some had still not emerged from these hosts after day 30. The development of the host was retarded by feeding protein deficient or restricted diets, so that while pupation of noninfected HP hosts occurred at times corresponding to days 8–14 infection, it took place 10–21 days, 14–22 days, and 20–30-plus days in the groups HPR, LP, and LPR respectively. Thus, while postparasites invariably emerged from fourth instar mosquito larvae in group HP, they began emerging from third instar hosts in group HPR and from second instar hosts in groups LP and LPR. Accordingly, postparasites recovered from LPR hosts were smallest in size and contained the least amount of storage material. The average size of the postparasites increased according to the series LPR-LP-HPR-HP. Reduction in food intake of the host caused a greater proportion of the mermithids to develop into males, but the protein content of the host diet did not affect the sex ratios of the developing nematodes.—*Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.*

GRANEY, L. S., and L. I. MILLER. *Differentiation of five isolates of Heterodera schachtii as races of the sugarbeet cyst nematode.*

Five isolates of *Heterodera schachtii* (C1 from tomato and C2 from sugarbeet in California, M1 from sugarbeet in Michigan, N1 from cabbage in New York, and F1 from cabbage in Florida) proved to be distinct races, differentiated by their ability to develop egg-bearing females on the following plants: *Cleome spinosa* ('Ruby Queen' cleome), *Lespedeza striata* ('Kobe' common lespedeza), *Lycopersicon esculentum* (Pearson A-1' tomato), *Phytolacca decandra* (pokeweed), *Portulaca oleracea* (common purslane), *Glycine max* ('Lee' soybean), and *Beta vulgaris* ('US 75' sugarbeet). Tomato was an efficient host for C1 and a poor host for the other isolates, except for F1 for which tomato was not a host. Lespedeza was an efficient host for C1, C2, and M1 and a poor host for N1 and F1. Pokeweed was an efficient host for C1 and M1 and a poor host for the other isolates. Purslane was a poor host for C1, C2, and M1, a very poor host for F1, and it was not a host for N1. Soybean was not a host for N1, and it was a very poor host for all the other isolates. Even though cleome and sugarbeet were efficient hosts for all the isolates, N1 and F1 could be differentiated by their levels of reproduction on these plants. Twice as many females developed on roots of cleome with F1 than with N1, but 20 times more females developed on sugarbeet with N1 than with F1.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

GRIFFIN, G. D. *The pathogenecity of a combination of Meloidogyne hapla and Heterodera schachtii on tomato.*

Fourteen-day-old 'Stone Improved' tomato seedlings were inoculated with larvae of *Meloidogyne hapla* and *Heterodera schachtii* (a population that reproduces on tomato), singly and in combination, or were left uninoculated. After 80 d at 22 ± 4 C the combination of *M. hapla* and *H.*

schachtii was found to have significantly ($P = 0.05$) reduced tomato root weights below that of single inoculations of *M. hapla*, *H. schachtii*, and uninoculated control plants. A combination of *M. hapla* and *H. schachtii* significantly ($P = 0.05$) reduced top growth below that of the other treatments, and top growth of plants inoculated with *M. hapla* was significantly ($P = 0.05$) less than that of plants in *H. schachtii* and uninoculated control treatments. A combination of *M. hapla* and *H. schachtii* had no more effect on reproduction and galling of *M. hapla* or the reproduction of *H. schachtii* than did single species inoculations. Sequential inoculations of tomato plants with either *M. hapla* or *H. schachtii* larvae 30 d after inoculations with the other nematode species did not significantly reduce tomato root or top growth below that occurring with a single inoculation of *M. hapla.—USDA, SEA, AR, Crops Research Laboratory, Utah State University, Logan, UT 84322.*

GRIFFIN, G. D. *The effect of genetic variability on the susceptibility of certain weed hosts to Heterodera schachtii.*

Seeds of *Heterodera schachtii* weed host plants—black nightshade (*Solanum nigrum* L.), common lambsquarter (*Chenopodium album* L.), purslane (*Portulaca oleracea* L.), redroot pigweed (*Amaranthus retroflexus* L.), shephardspurse (*Capsella bursa-pastoris* [L] Medic), and wild mustard (*Brassica kaber* [DC] L. C. Wheeler)—were collected from sugarbeet field in Colorado, Idaho, Oregon, and Utah. Seeds were stored at 5 C for 6 months, germinated, and planted into *H. schachtii* infested soil from sugarbeet fields in Colorado, Idaho, Oregon, and Utah and grown at a greenhouse temperature of 22 ± 4 C. Redroot pigweed seedlings were also inoculated with 4.0 and 6.0 larvae/g soil and grown at 16, 20, 24, and 28 C. All plants were grown for 100 d, and the host status of each plant determined. There were great variabilities in the degree of susceptibility of weeds to *H. schachtii*. This was not only observed between geographical areas, but within seed collected from the same plant. Weeds from all plant species were both susceptible and resistant to one or more *H. schachtii* populations. Physiological differences between *H. schachtii* populations in relation to reproducing on weed hosts were also evident, but these were not as variable as were differences in resistance and susceptibility of the weed populations. The greatest variability in the susceptibility of weed hosts to *H. schachtii* was observed in redroot pigweed. Temperature also affected the host status of redroot pigweed; *H. schachtii* reproduction was greater at 28 C than at any other soil temperature. *—USDA, SEA, AR, Crops Research, Laboratory, Utah State University, Logan, UT 84322.*

HAFEZ, S., and D. J. RASKI. *Nonfumigant nematicides tested against plant-parasitic nematodes in established vineyards.*

Nematodes have been found in the soil of all the major grape-producing areas of California. The experiments reported here were carried out at several locations in California over a 4-yr period to obtain information regarding control of nematode parasites of grapes with nonfumigant nematicides, emphasizing rates, time and methods of application, and combinations of chemicals. Nematode counts generally reflect differences in chemical types and amounts, and percentage of total area treated. Carbofuran had more effect on *Xiphenema index* than on *Meloidogyne* spp. Control of *X. index* and *Meloidogyne* spp. with aldicarb and phenamiphos was better at higher rates than lower rates. When chemicals were applied over 100% of the area, nematode control was greater and lasted longer than when 50% of the area was treated. Combinations of the fumigant (DBCP) and the nonfumigants (aldicarb or phenamiphos) were more effective at reducing nematode populations than using either fumigants or nonfumigants separately. Although control varied among chemicals and location, early control was obtained from most of the chemicals used. Control could not be correlated precisely with yield. The yield data indicate that in most treatments yields increased slightly the first harvest after application. However, yield differences between

treatments were not statistically significant. For some of the treatments the yield increases were statistically significant in the second and third harvest after application with or without repeating the same treatment every year or every other year.—*Division of Nematology, University of California, Davis, CA 95616.*

HAROON, S. A., and G. C. SMART, JR. *Effect of pangolagrass on the root-knot nematode, Meloidogyne incognita.*

Pangolagrass, *Digitaria decumbens* Stent., was more effective in reducing populations of *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 than was fallow. Roots of tomato seedlings interplanted with pangolagrass were less galled than were roots of tomato seedlings planted alone. Few second-stage larvae entered the roots of pangolagrass, and those that entered did not develop beyond the second stage. Pangolagrass cuttings were rooted each week until plants aged 3–14 wk were available. Root extracts were prepared from these roots. Two hundred-fifty *M. incognita* eggs were placed in root extract from each age plant and the percent hatch determined every 24 h for 10 d. During the first 5 d only 0.3% hatch was observed in the root extracts from 11–14-wk-old plants, while 29% hatched in the root extracts from 3–10-wk-old plants; 35% hatched in the water control. During the second 5 d, 87% hatched in the extract from 11–14-wk-old plants for a total hatch of 87%; 63% hatched in the extract from 3–10-wk-old plants for a total hatch of 91%; 90% was the total hatch in the control. Larvae that hatched in the root extract from 3–10-wk-old plants lived longer than those that hatched in the root extract from 11–14-wk-old plants. In another test 92% of the larvae transferred into extract from 14-wk-old plants were dead within 24 h and all were dead within 48 h; only 4% of the larvae transferred into extract from 4-wk-old plants were dead within 10 d, and all lived at least 4 d.—*Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

HEALD, C. M., and W. H. THAMES. *Vertical distribution and dissemination of Rotylenchulus reniformis in field soils.*

The vertical distribution of *Rotylenchulus reniformis* was determined in cotton fields at regular intervals over a 3 year period. Soil cores collected at 25 cm intervals to a depth of 1.75 m showed *R. reniformis* was distributed throughout the soil profile. Populations were highest in the top 1 m of soil and significantly lower at 1.5 and 1.75 m depths. The transition zone between high and low numbers of nematodes was at 1.25 m. Analyses for roots from soil cores showed a significant decrease in roots at 1.5 and 1.75 m depths. Dissemination of *R. reniformis* was determined by placing infested soil in a 6.5 m circle in the middle of a .5 ha field. Crops were planted in the field and minimum tillage was practiced to determine the movement of *R. reniformis* by furrow irrigation. After one year, nematode movement was determined to be minimal and then the field was disked in all directions by crossing over the infested area. Five months after disking, *R. reniformis* was detected in all areas of the field in the top 10 cm of soil. After 4 years, *R. reniformis* was detected in a depth of 1.25 m in all sampling sites and at 1.5 and 1.75 m in half of the sampling sites.—*USDA, SEA, AR, Subtropical Fruit and Vegetable Research Unit, Weslaco, TX 78596.*

IBRAHIM, I. K. A., M. A. REZK, and S.I. ATA-ALLAH. *Reaction of certain bean and cowpea cultivars to root-knot nematodes.*

The reaction of certain cultivars of asparagus bean (*Vigna sesquipedalis*), cowpea (*V. sinensis*), kidney bean (*Phaseolus vulgaris*), lima bean (*P. limensis*), and sieva bean (*P. lunatus*) to *Meloidogyne javanica, M. arenaria* (Race 1), and *M. incognita* (Race 2, Race 3, Race 4) was studied in the greenhouse. Seeds of the tested cultivars were sown in 15-cm pots containing steam sterilized sandy clay soil. After emergence, seedlings were thinned to two/pot and soil was infested with 3,000 nematode larvae/

pot. Each of the applied treatments was replicated four times. Plants were harvested 60 d after sowing. Roots were rated for galling and number of egg masses according to the scale: 0 = 0, 1 = 1–2, 2 = 3–10, 3 = 11–30, 4 = 31–100, and 5 = > 100 galls or egg masses. Plants with average ratings of 2 or under were considered resistant; those with ratings greater than 2 were considered susceptible. Kidney bean cv. Berbouni, Contender, Menganot, and Swez Blane gave a susceptible reaction to the tested nematodes, except Menganot which was resistant to *M. javanica, M. arenaria,* and *M. incognita* (Race 3). Cowpea cv. Azmerli and Fetryat were susceptible to the tested nematodes, except Azmerli which showed a resistant reaction to *M. incognita* (Race 3). Asparagus bean cv. Metrawi appeared resistant to *M. arenaria* and *M. incognita* (Race 3 and Race 4). Lima bean cv. Burpees Bush and sieva bean cv. Hendersons Bush were resistant to the tested nematodes with exception of *M. incognita* Race 4.— *Department of Plant Pathology, College of Agriculture, Alexandria University, Alexandria, Egypt.*

IMBRIANI, J. L., and E. G. PLATZER. *Gaseous requirements for the development of postparasitic mermithids.*

The development of postparasitic stages of *Romanomermis culicivorax* was studied under various O_2, CO_2, and N_2 tensions at 27 C. Freshly emerged larvae were placed on agar and exposed continuously to the gas mixtures. Postparasites developed poorly in the presence of N_2 alone; only 33% molted and the nematodes died within 30 d. Development was normal in the presence of 5% CO_2–95% N_2; 50% of the postparasites molted by 20 d and egg laying commenced after 45 d. Addition of oxygen (0.5%) stimulated the developmental rate of the postparasites; 50% of the nematodes molted by day 10 and egg production was initiated at 28 d. Higher oxygen tensions further stimulated the rate of egg production which commenced at day 18 in the presence of 21% O_2. Carbon dioxide did not influence molting in the presence of oxygen but was essential for egg production at very low oxygen tensions. The natural environment of the postparasitic stages is relatively anoxic; our findings suggest that *R. culicivorax* copes with this milieu through facultative anaerobiosis.—*Department of Nematology, University of California, Riverside, CA 92521.*

JATALA, P., R. KALTENBACH, M. BOCANGEL, A. J. DEVAUX, and R. CAMPOS. *Field application of Paecilomyces lilacinus for controlling Meloidogyne incognita on potatoes.*

Discovery of *Paecilomyces lilacinus* as a biological control agent for controlling *Meloidogyne incognita* was reported in 1979. To determine the efficiency of *P. lilacinus* as a biological control agent under field conditions as compared to chemical control, a randomized block field experiment was conducted in a field heavily infested with *M. incognita*. Treatments were as follows: fungus alone, Temik 10% G at 25 Kg/ha, Nemacur 5% G at 50 Kg/ha, Furadan 5% G at 50 Kg/ha, organic matter 10 ton/ha, and nontreated control plots. Each plot was 60 m^2; each treatment was replicated four times. *P. lilacinus* was cultured on 500 petri plates containing PDA. After 14 d contents of plates were macerated and the suspension was directly applied to the fungus treatment plots at planting. Nematicides and the organic matter were also applied at planting. Tubers of a local Peruvian cv. Cuzco were planted and normal field care was taken throughout the growing season. Upon harvest, roots and tubers were examined for infection by *M. incognita*. Data indicated that plants grown in plots inoculated with the fungus had significantly lower root galling index than those grown in plots applied with organic matter and nematicides. Root galling index of plants grown in plots treated with Temik was significantly lower than those grown in other nematicide treated plots. There were no differences of root galling index of the plants grown in plots treated with Furadan or organic matter and those of the control plots. Eighty-six percent of the egg masses collected from the plants grown in the fungus treated plots were infected with *P.*

lilacinus, and 54.7% of the eggs were destroyed. Similar results were obtained in other field plot studies. This is the first report of a successful application and biocontrol of *M. incognita* under field conditions.—*Department of Nematology and Entomology, International Potato Center, Apartado 5969, Lima, Peru.*

JOHNSON, A. W., and J. R. YOUNG. *Effect of nematicides applied through a sprinkler irrigation system on control of root-knot nematodes on squash, southern pea, and field corn.*

Applications of phenamiphos and ethoprop (6.7 kg a.i./ha) through a sprinkler irrigation system (injected) were compared with a conventional method of application (granules spread on the soil surface and incorporated into the top 15-cm soil layer with a tractor-powered rototiller) for nematode control on squash, southern pea, and field corn. Treatments were (i) phenamiphos, injected; (ii) phenamiphos, rototilled; (iii) ethoprop, injected; (iv) ethoprop, rototilled; (v) carbofuran, injected; and (vi) untreated control. Treatments were arranged in a randomized complete block design with four replications. Comparisons were made one month after planting and at harvest.

One month after planting, root-gall indices of all crops were significantly ($P = 0.05$) lower in all treated plots than in untreated plots. At harvest, root-gall indices of squash and field corn were lower ($P = 0.05$) in plots treated with phenamiphos than in other treated plots. Root-gall indices recorded at harvest of southern pea were not reduced by nematicide treatments. Yield of squash in treated plots ranged from 2.4-fold to 3.5-fold increase over untreated controls. The greatest yield came from plots treated with phenamiphos. Yield of field corn was greater ($P = 0.05$) from all treated plots than from control, but was not different among nematicide treatments. Yield of southern pea was not affected by nematicide treatments. In most comparisons, root-gall indices and yield were not significantly ($P = 0.05$) influenced by methods of applying phenamiphos and ethoprop, indicating that nonvolatile nematicides can be applied through sprinkler irrigation systems for control of nematodes.—*USDA, SEA, AR; and the University of Georgia College of Agriculture Experiment Stations, Coastal Plain Experiment Station, Tifton, GA 31794.*

KAPLAN, D. T. *Histological characterization of citrus rootstock responses to Tylenchulus semipenetrans infection.*

The genomes of future citrus rootstocks should include genes conferring several incompatibility mechanisms which collectively may limit citrus nematode development. To determine the range and source of incompatible responses which might be incorporated into such varieties, the interactions of California (CA_3) and Florida (FL) populations of the citrus nematodes, *Tylenchulus semipenetrans*, with *Severenia buxifolia*, *Citrus limon* cv. Milam, *C. grandis*, *C. reticulata* cv. Cleopatra, *Fortunella, margarita* cv. Nagami, *Poncirus trifoliata* cv. Flying Dragon, and a hybrid, Swingle (*C. paradisi* x *P. trifoliata*), were characterized with light microscope and greenhouse pot studies. 'Nagami' was CA_3- and FL-compatible. *S. buxifolia* and 'Swingle' were CA_3- and FL-incompatible. 'Flying Dragon' was FL-incompatible but only moderately CA_3-incompatible, whereas 'Cleopatra' and *C. grandis* were CA_3-incompatible but only moderately FL-incompatible. Successful citrus nematode development was predicated upon unimpared penetration of the cortex and the establishment of a feeding site composed of nurse cells containing dense granular cytoplasm. Incompatibility was correlated with hypersensitive-type responses to infection in the hypodermis and outer cortex, cavity formation within the cortex, cell wall thickening of invaded cells, and the timely vacuolation of nurse cell cytoplasm. Wound periderm formation was also observed in some cultivars. The four responses did not occur cumulatively in any of the rootstocks, and individual nematodes circumvented each of the responses.—*USDA, SEA, AR, Horticultural Research Laboratory, Orlando, FL 32803.*

KEYSERLING, M. L., and E. C. BERNARD. *Suitability of sunflower for reproduction of selected plant-parasitic nematodes.*

A study was initiated to investigate the reproductive ability of selected plant-parasitic nematodes on sunflower. Ten thousand eggs of either *Meloidogyne incognita* or *M. javanica,* increased on tomato, were added to the rhizospheres of 10-d-old sunflower seedlings (10 oil cultivars and 1 ornamental cultivar) and to 1-month-old reference tomato plants. Root systems of all plants were harvested 58–60 d after inoculation and weighed. Eggs were collected by a sodium hypochlorite method and counted. *Helicotylenchus dihystera,* increased on soybean, were collected by sieving and 750 adults and larvae were added to 24-d-old sunflower seedlings (6 oil cultivars and 1 ornamental cultivar) and to 6-d-old reference soybean seedlings. All pots received new seedlings 87 d after inoculation and these grew an additional 56 days. The soil of each pot was mixed and the nematodes in a 100-cm^3 soil sample were extracted by a centrifugal-flotation method. Total eggs/plant and eggs/g root for both *M. incognita* and *M. javanica* did not differ among the sunflower cultivars, but reproduction of *M. incognita* on tomato, measured as eggs/g root, was significantly greater than on any sunflower cultivar. *H. dihystera* increased greatly on most tested sunflower cultivars, but one cv. (241A) was significantly more suitable for nematode reproduction. All sunflower cultivars were better hosts for *H. dihystera* than was soybean. The results suggest that nematodes may be a significant factor in the use of sunflower for rotation with other field crops.—*Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37916.*

KING, P. S., R. RODRIGUEZ-KABANA, P. G. MAWHINNEY, and H. W. IVEY. *Efficacy of planting time injections to soil of liquid formulations of three systemic nematicides against root-knot nematodes in peanuts.*

Liquid formulations of the systemic nematicides carbofuran (Furadan 4F), oxamyl (Vydate 2L), and phenamiphos (Nemacur 3SC) were applied to peanuts (*Arachis hypogaea*) at planting time for control of *Meloidogyne arenaria* during the 1978 and 1979 seasons in South Alabama. The formulations were diluted in water to make emulsions containing 60 gm of active ingredients (a.i.) per litre (0.5 lbs a.i./gal) and were injected into soil at rates of 1.1–4.5 kg a.i./ha. The injection was effected using either three chisels (1978) or two chisels (1979) per row to deliver the nematicides to a depth of 7.6–10 cm on the seed furrow and on each side of it (1978) or on either side of the furrow only (1979). Applications of oxamyl improved the general appearances of plots and increased yields to levels comparable to those obtained with the fumigant EDB (Soilbrom 90 EC). Phenamiphos was as effective as oxamyl in the 1979 experiment, but not in 1978. Significant reductions in larvae of *M. arenaria* in soil at the end of the season were obtained only with oxamyl and only in 1979. Applications of carbofuran did not reduce larval numbers in soil and failed to improve the general appearance of plots. Injections of carbofuran significantly increased yields only when applied at rates higher than 2.2 kg a.i./ha. Results indicate that injection of liquid formulations of systemic nematicides is a practical and economical method for nematode control in peanuts.—*Department of Botany, Plant Pathology, and Microbiology, Auburn University, Auburn, AL 36830.*

KINLOCH, R. A. *Correlations between yield reduction of soybean and preseason soil infestation levels of Meloidogyne incognita infective juveniles.*

Soil population levels of *Meloidogyne incognita* infective juveniles were monitored every 2 wk in 12 field plots from December through to the planting of the plots to a root-knot susceptible soybean in the following May. Yields of the plots, which varied from 0 to 2,686 kg/ha, were negatively correlated ($P < 0.05$) with the number of juveniles/10 cm^3 soil at all preplanting sampling dates. In the linear regression

equations derived between yield and juvenile density, there was a progressive increase in slope as the sampling date approached the time of planting. The slope of the regression line is a measure of the predicted yield reduction due to each juvenile recovered in the sample. A significant negative correlation was found between the various slopes and days remaining before planting ($r = -0.93$, reg. $r = -0.68$, $P < 0.01$). The relationship is described by the exponential equation $Y = 50.12/(1.01)^x$ where Y is the predicted yield loss due to each juvenile recovered in a sample taken X days before planting. Thus, for each juvenile recovered in the sample there would be a predicted yield loss of 6.3, 12.6, 25.1, and 35.5 kg/ha when sampled at 150, 100, 50, and 25 d before planting, respectively.—*University of Florida, Agricultural Research Center, Jay, FL 32565.*

LEHMAN, P. S., D. E. STOKES, and A. DONNAN. *Effects of three species of Meloidogyne on the growth of schefflera.*

Three root-knot nematode species, *Meloidogyne incognita, M. javanica,* and two races of *M. arenaria* were compared for their effect on the growth of schfflera, *Brassaia actinophylla,* in the greenhouse. At the stage of the initiation of the first true leaves, three seedlings were transplanted in each 10-cm-d pot and inoculated. Inoculum levels were 10,000 and 100,000 eggs/pot, and each treatment was replicated four times. At 2, 4, 6, 8, 10, and 12 wk following inoculation, the number of leaves/plant, plant height, and plant width were recorded. At 12 wk after inoculation, roots were rated for galls and egg masses and the fresh and dry weights of roots and tops were determined. All species of root-knot nematodes tested caused galls, produced egg masses, and reduced plant growth; however, *M. incognita* and race 1 of *M. arenaria* caused greater reduction of growth than *M. javanica* and race 2 of *M. arenaria.* At 12 wk, plants inoculated with 10,000 eggs/pot of *M. incognita,* race 1 of *M. arenaria, M. javanica,* and race 2 of *M. arenaria* had top weights which were 54, 31, 25, and 22% lower, respectively, than noninoculated check plants. At the higher inoculum level of 100,000 eggs/pot, greater stunting occurred. Compared to noninoculated plants, top weights were reduced 68, 69, 37, and 25% for plants inoculated with *M. incognita,* race 1 of *M. arenaria, M. javanica,* and race 2 of *M. arenaria,* respectively.—*Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Box 1269, Gainesville, FL 32602; and Oakdell Inc., Apopka, FL 32703.*

LEWIS, S. A. *Morphology of a new species of Dolichodorus from Zoysia and observations on the identity of D. heterocephalus.*

An undescribed species of *Dolichodorus* was obtained by A. M. Golden in 1971 from *Zoysia japonica* in College Park, Maryland. Specimens have also been collected from a perennial bluegrass (*Poa pratensis*) pasture. The species is closely related to *D. heterocephalus* Cobb, *D. similis* Golden, and *D. aestuarius* Chow & Taylor. Females have a longer stylet (88.8 μm) than *D. aestuarius,* but the stylet is shorter than that of *D. heterocephalus* (99 μm). The body length (2.12 mm) is shorter than *D. aestuarius.* The tail is abruptly reduced in diameter, often with an acuminate terminus, while the tails of *D. similis* and *D. heterocephalus* taper conically to a median point. The excretory pore is opposite or slightly posterior to the isthmus, while that of *D. similis* is opposite the middle of the basal bulb. Cobb's published description and drawings indicate that he used a *Dolichodorus* male from Douglas Lake, Michigan, but examination of his notes and drawings at Beltsville showed that both the male and female pictured in his 1914 article establishing the genus were from Silver Springs, Florida. Stylet lengths of *D. heterocephalus* collections are compatible with Cobb's drawings but differ from measurements given by Thorne in his book, *Principles of Nematology.*—*Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631; temporarily at Nematology Laboratory, Plant Protection Institute, USDA, Beltsville Agricultural Research Center, Beltsville, MD 20705.*

LOPEZ-CHAVES, R. *Spatial distribution of rice nematodes after harvest in southwestern Costa Rica.*

Preliminary observations on the horizontal and vertical distribution of rice nematodes were made immediately after harvest in the alluvial valleys of La Cuesta and Rio Claro, Puntarenas province, in southwestern Costa Rica. In both localities compound soil samples were taken at 15-cm intervals from the soil surface up to 45 cm from each of six adjacent one-square-meter plots. At both sites the horizontal distribution of plant-parasitic nematodes between plots was heterogeneous. Population densities of all nematodes showed a sharp decrease as sampling depth increased; most nematodes were located in the upper 15-cm soil layer. Nematodes present at La Cuesta were *Tylenchorhynchus annulatus, Macroposthonia* sp., and an undescribed species of *Meloidogyne,* whereas *T. annulatus, Macroposthonia* sp., and *Helicotylenchus* sp. were the nematodes associated with rice at Rio Claro. Plowing and disking of the upper soil layer during the dry season could reduce nematode densities to a large degree.—*Laboratorio de Nematologia, Escuela de Fitotecnia, Universidad de Costa Rica, San José, Costa Rica.*

MANKAU, R. *Biological control of Meloidogyne populations by Bacillus penetrans in West Africa.*

The nematode pathogen *Bacillus penetrans* occurred in *Meloidogyne* populations throughout Senegl but was especially abundant in vegetable market garden soils on the Cape Ver Peninsula adjacent to metropolitan Dakar. Despite ideal conditions for the development of severe root-knot nematode problems, local growers market good quality produce from susceptible crops apparently because of a high level of biological control in some areas. *Meloidogyne* larvae recovered from some soils were 80–98% infected and had large numbers of *B. penetrans* spores attached to their cuticles. A field population which was 33.5% infected with a light spore burden was inoculated into potted tomato seedlings at a rate of approximately 10,000 larvae per seedling. After 60 d the seedlings were allowed to die, and the recovered larvae were approximately 60% infected with a generally heavy spore burden. This infection level persisted through an additional replanting. A third replanting of tomato seedlings was examined after 30 d; the roots contained relatively few galls and few larvae were in the soil. An average of 191 females were dissected from stained galls in each plant; only 3.2% had egg masses. Of the females without egg masses, an average of 78.2% contained colonies of the parasite, while 18.6% appeared diseased but the presence of the parasite could not be verified, and 3.2% contained healthy ovaries with developing eggs. The infected *Meloidogyne* population approached extinction in 4–5 generations in pot culture.— *Department of Nematology, University of California, Riverside, CA 92521.*

McCANN, J., V. H. DROPKIN, and V. D. LUEDDERS. *The reproduction of differentially selected populations of Heterodera glycines on different r-lines of soybean (Glycines max).*

Six populations of *H. glycines* were selected from field soil from Missouri by monoculture on six r-lines of soybean during a 2-yr period. A seventh similarly selected population was obtained from North Carolina. The reproductive abilities of these populations were tested in a standard inoculation of each population on each r-line (49 combinations). The results of three independent trials were comparable. The standard technique involved the addition of germinated seedlings (radicle 1–3 cm long) to plastic pipes containing fine sand which had been infested with 500 freshly hatched larvae. The pipes were maintained at 27 C. The cyst and egg populations on each root system were assessed after 25 d.

All nematode populations reproduced on 'Pickett 71' and on r-lines from which they were selected. However, three classes of selected nematode populations were distinguished. Class 1 consisted of nematode populations which reproduced on soybeans 209332, 87631-1, 88788, 90763-R, 'Cloud,'

and 'Pickett 71'; class 2 reproduced on 89772 and 'Pickett 71'; and class 3 reproduced only on 'Pickett 71.' The results suggest that the technique was successful for producing nematode populations to screen r-lines and that the populations may be useful for the genetical analysis of resistance. It seems likely that more than one gene is involved in the inheritance of resistance to *H. glycines* populations.—*Department Plant Pathology, University of Missouri, Columbia, MO 65211.*

McGAWLEY, E. C., J. P. JONES, and W. BIRCHFIELD. *Reproduction of* Bursaphelenchus lignicolus *on fungi isolated from* B. lignicolus*-infected pine trees.*

Twenty-three genera of fungi were isolated from root and stem samples of pine trees (*Pinus elliotii* L.) naturally infested with *Bursaphelenchus lignicolus* (BL). Many of the samples contained *Fusarium* sp., *Gliocladium* sp., *Pestalotia* sp., *Trichoderma hamatum, T. harzianum, T. koningii, Verticillium* sp., and *Zygorhynchus* sp. The suitability of these fungi as hosts for BL was tested at 16, 20, and 24 C. Single 10-mm-d plugs from 5-d-old cultures were placed in the center of 90-mm-d plates of potato dextrose agar. One hundred twenty-one individuals of BL, previously surface sterilized with 0.1% $HgCl_2$ and washed three times with distilled water, were added to each plate with syringe. Nine days after infestation, both fungus growth and nematode reproduction were best at 24 C. *Gliocladium* sp. was a significantly better host for BL than the other fungi. At higher levels of infestation (5,000–9,000 BL/plate), populations increased to levels as high as 1.0×10^5 individuals/plate and caused a disease of *Gliocladium* sp. characterized by inhibited mycelial growth and sporulation. —*Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Experiment Station, Baton Rouge, LA 70803.*

McKENRY, M. V. *Delivery of nematoxic, nonphytotoxic concentrations of alkyl halide fumigants into the soil solution.*

Chisel spacings, application rates, soil temperature, and follow-up irrigation procedures are important factors influencing the concentration at which soil fumigants are delivered to the site of the nematode or plant root or both. DBCP (1,2-dibromo-3-chloropropane), because of its physicochemical nature, was delivered to the target at relatively low concentrations, usually below root-toxic concentrations. With proper selection of application parameters and the use of fumigant solutions, it was hypothesized that other high vapor pressure fumigants may also be delivered to the target with minimal root damage. A fumigant monitoring site was established in barren soil to determine the procedures necessary to deliver 1,3-dichloropropene (1,3-D) or ethylene dibromide (EDB) nematicides at nematoxic, but nonphytotoxic, levels at the target site. Formulations included the following: 1) 1:9 mix of Telone II EC (1,3-D) and water; 2) 1:1:8 mix of Telone II EC, oil, and water; and 3) 1:9 mix of EDB EC and water. Toxicants were delivered throughout the surface 60 cm of soil and deeper at concentrations below 10 $\mu g\ ml^{-1}$ in the soil solution. These experiments indicate that with proper application methods 1,3-D and EDB may be delivered to established plants at concentrations below root toxic levels. Field testing is underway.—*Department of Nematology, University of California, Riverside, CA 92521.*

McSORLEY, R., and C. W. CAMPBELL. *Relationship between nematode and weed densities in avocado groves.*

The relationship between densities of plant parasitic nematodes and weeds was examined in three Florida groves planted to avocado (*Persea americana*). Soil and root samples were collected from 24 trees in each of two groves and from 80 trees in a third grove and assayed for plant parasitic nematodes. A rating of the percent of ground beneath each tree covered by in-

dividual weed species and by all weed species together was obtained, and correlation coefficients between each nematode density and each corresponding weed density were computed. Numbers of *Rotylenchulus reniformis* per 100 cm^3 of soil were correlated with total weed density at two of the three sites, with r = 0.233* (78 d.f.) and r = 0.602** (22 d.f.). Density of *R. reniformis* also showed a significant (P = 0.05) correlation with densities of several individual weed species, including a weed host, *Bidens pilosa*, at these two sites. While *R. reniformis* density was not significantly correlated with total weed density at the third site (r = 0.249, 22 d.f.), it nevertheless did exhibit significant correlations with density of either *Sida acuta* (r = 0.442,* 22 d.f.) or *Blechum brownei* (r = 0.475,* 22 d.f.). Neither soil nor root densities of *Pratylenchus brachyurus* were correlated with total weed density or with densities of individual weed species, but this nematode was common in avocado roots at all sites. It is evident that information on the identity and distribution of weed species present is necessary in making diagnosis of *R. reniformis* in avocado groves. *—University of Florida, Agricultural Research and Education Center, Homestead, FL 33031.*

NICKLE, W. R., and A. M. GOLDEN. *Another look at the timber nematode, Bursaphelenchus xylophilus Steiner & Buhrer, 1934.*

During the past 2 yr nematologists in the United States have found a *Bursaphelenchus* sp. in dead and dying pine trees. This nematode-host interaction resembles reports from Japan of pine trees damaged by the pine wood nematode, *Bursaphelenchus lignicolus* Mamiya & Kiyohara, 1972. At present the infestation in the United States is apparently not as severe as in Japan, but dead pine trees containing *B. xylophilus* or *B. lignicolus*-type nematodes have been found in many states in the central and eastern United States. This type of tree damage was probably attributed to insects and fungi.

Recently, original specimens of the timber nematode, *B. xylophilus* Steiner & Buhrer, 1934 were found in the USDA Nematode Collection. They were collected from blue-stained logs of *Pinus palustris* at a sawmill in Bogalusa, Louisiana, on 24 Nov. 1931. Though the original description mentioned specimens from five separate collections of pine wood, these specimens of *B. xylophilus* are of the type drawn by Steiner and Buhrer. These nematodes have typical large aphelenchoid spicules, expanded spicule tips, and short postanal caudal alae. An important taxonomic character on this newly reported *B. xylophilus* material is the presence of a prominent flap on the vulva of the females. Lectotype specimens will be designated from this excellent material. Though *B. xylophilus* is similar to *B. lignicolus*, their taxonomic relationship has not been determined.*—USDA, SEA, AR, Beltsville, MD 20705.*

NOEL, G. R., P. V. BLOOR, R. F. POZDOL, and D. I. EDWARDS. *Influence of Heterodera glycines on soybean yield components and observations on economic injury levels.*

Field studies were conducted in order to determine the effects of *Heterodera glycines* on yield components of 'Clark 63' soybean and the life stages of the nematode which provide the best estimate of yield reductions. Regression of yield on numbers of nematodes indicated a highly significant coefficient of determination (r^2). An r^2 of 0.87 was obtained when yield was regressed on the total eggs and larvae/250 cm^3 soil sample taken at planting. The r^2 for gravid cysts (cysts containing progeny) was 0.74, and for total cysts (empty cysts plus gravid cysts) r^2 was 0.67. The quadratic model gave higher r^2 values than did the linear model. The regression of pod counts on nematode numbers was significant for total eggs and larvae and gravid cysts, but not for total cysts. The effect of *H. glycines* on 300 seed weight was not significant. The damage threshold was 60–100 eggs and larvae/250 cm^3 soil sample taken at planting while the economic injury level was 300–500 eggs and

larvae/250 cm³ of soil.—*USDA, SEA, AR, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.*

NOLING, J. W., and G. W. BIRD. *Joint impact of Pratylenchus penetrans and Leptinotarsa decemlineata (Insecta) on the growth of Solanum tuberosum.*

The joint role of *Pratylenchus penetrans* (root-lesion nematode) and *Leptinotarsa decemlineata* (Colorado potato beetle) on the growth and development of *Solanum tuberosum* was studied under field conditions in Michigan during 1978 and 1979 growing seasons. Insect cages (1.83 x 1.83 x 1.83 m) were used in a completely randomized design, with three replicates for each of nine treatments. The treatments included three initial population densities of *P. penetrans* (0, 150, and 500/100 cm³ soil) superimposed on three population levels of *L. decemlineata* (0, 10, and 20 beetles/plant). *S. tuberosum* growth and the population dynamics of *P. penetrans* were monitored throughout the growing season. Path coefficient analysis was used as the conceptual framework for data collection and interpretation of the results. Plant and nematode data analysis showed that various levels of defoliation by *L. decemlineata* directly influence the population dynamics of *P. penetrans* as well as the growth and development of the potato plant. Increasing densities of *L. decemlineata* significantly ($P = 0.05$) reduced leaf weight, leaf area, root weight, and tuber yield. Increasing densities of *P. penetrans* also had a detrimental influence on tuber yield. The joint impact of *P. penetrans* and *L. decemlineata* on *S. tuberosum* plants defoliated by *L. decemlineata* were significantly lower than those associated with nondefoliated plants. Path coefficient analysis provided a quantitative estimate of the functional relationships among the three components of the pest-crop ecosystem evaluated in these studies.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

NORTON, D. C., and M. PLOUFFE. *Occurrence and diversity of members of the Criconematidae and Paratylenchidae in the Adirondack Mountains of New York State.*

Two-hundred-forty-two soil samples from the forests of the Adirondack Mountains of New York State were examined for the presence of members of the Criconematidae and Paratylenchidae, the most numerous parasitic forms encountered. Soils around *Abies balsamea, Acer saccharum, Betula cordifolia, B. lutea, B. papyrifera, Fagus grandifolia,* and *Tsuga canadensis* were sampled most frequently. Soils were highly organic with a mean pH 4.1 (range 2.8–6.8). Species identified, followed by their maximum numbers/cm³ soil and percentage frequencies in parentheses, were *Bakernema inaequale* (680/10.3), *Criconema octangulare* (258/17.4), *C. proclivis* (180/2.9), *Crossonema cobbi* (20/0.8), *C. fimbriatum* (171/5.8), *C. menzeli* (720/26.9), *C. seymouri* (7/1.2), *Macroposthonia axesta* (4/0.4), *M. rustica* (100/0.4), *M. xenoplax* (60/1.7), *Nothocriconema jaejuense* (57/1.2), *N. longula* (220/0.8), *N. petasum* (211/7.4), *N. permistum* (60/0.4) *N. sphagni* (1,030/35.5), *Xenocriconemella macrodora* (90/0.4), *Hemicycliophora ferrisae* (120/5.0), *H. uniformis* (60/2.5), and *Gracilacus straelani* (203/1.2). *C. menzeli* and *N. sphagni* were common at all altitudes (293–1329 m). *B. inaequale* and *C. octangulare* were not found above 634 and 988 m, respectively. There was a significant ($P = 0.01$) negative correlation between nematode diversity, as measured by the Shannon-Weiner index, and altitude for all samples. When conifers and nonconifers were analyzed separately, the slope of the regression coefficient for diversity with altitude was not significant for conifers but was negative and highly significant for nonconifers. This agrees with the hypothesis that the presence of conifers decreases both faunal and floral diversity.—*Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.*

NYCZEPIR, A. P., and S. A. LEWIS. *The influence of Macroposthonia xenoplax Raski on indole-3-acetic acid (IAA) and abscisic acid (ABA) in peach.*

The concentration of indole-acetic acid (IAA) and abscisic acid (ABA) was monitored in roots and shoots of 'Nemaguard' peach cuttings inoculated with 5,000 ± 100 *Macroposthonia xenoplax* per 15-cm-d pot. Cuttings were arranged in randomized blocks in a lathhouse. Four plants from each of two treatments were sampled twice each month for 6 months beginning in October 1978. No plant was sampled more than once. Parasitism by *M. xenoplax* suppressed concentrations of IAA in root tissue and caused aberrant fluctuations of ABA and IAA in shoot tissue. Rapid increases in numbers of *M. xenoplax* produced higher concentrations of IAA in shoots in the following sampling period. In February and March, the IAA concentration in shoots fluctuated inversely between treatments. During this time, canker-like symptoms, similar to those caused by *Pseudomonas syringae*, developed on twigs and a discoloration of pith tissue occurred at the base of cuttings growing in nematode-infested soil. *Macroposthonia xenoplax* altered the physiological rhythm of IAA and ABA in peach cuttings which suggests an alteration in the dormancy and cold-hardiness mechanisms of peach trees.—*Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*

O'BRIEN, P. C. *Studies on parasitism of Meloidogyne javanica by Bacillus penetrans.*

Bacillus penetrans attaches to the nematode cuticle before it parasitizes the nematode, but attachment does not necessarily mean the nematode is a host. However, attachment can indicate differences in host specificity between some populations of *B. penetrans*. To determine the nature of attachment, spores, suspended in water, were prepared from infected females of *Meloidogyne arenaria* on *Ligustrum japonicum* and then added to second-stage larvae of *M. javanica* in water. None of these spores attached to the cuticle within the next 4 h. When these spores were either air dried over 24 h and then resuspended in water or left in water for 24 h before inoculation, attachment occurred within 1 h. In a further test, the air dried spores began attaching within 5 min. Attachment was not affected between pH 4.5 and 8.5. Lectins were considered a possible factor in the rapid adherance of the preconditioned spores to the nematode cuticle. Twenty-five carbohydrates related to known lectins of microorganisms were tested; none prevented the attachment of spores to *M. javanica*. Additional lectin tests and studies on the germination of spores on the cuticle of *M. javanica* are continuing prior to attempts to culture *B. penetrans in vitro.*—*Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

PLATZER, E. G., and J. E. EBY. *Purines and pyrimidines in the growth of Caenorhabditis elegans.*

Caenorhabditis elegans was grown axenically at 20 C in thin films of *Caenorhabditis briggsae* Maintenance Medium (CbMM). The medium was supplemented with β-sitosterol and cytochrome *c*. Growth of *C. elegans* was reduced significantly when purines and pyrimidines were removed from CbMM. Although the growth rate of *C. elegans* was reduced by the absence of exogenous purines and pyrimidines, *C. elegans* grew continuously in axenic cultures for more than 100 generations. The growth rate was restored only by the replacement of adenosylic acid (AMP). The optimum concentration of AMP was 0.05–1 μM, whereas 5 μM inhibited the growth of *C. elegans*. Adenosine and adenine were equivalent to AMP in restoring the growth of *C. elegans*. Other purines (guanosine monophosphate, guanosine, guanine, inosine monophosphate, inosine, or hypoxanthine) and pyrimidines, (cytidylic acid, uridylic acid and thymine) were ineffective in restoration of the growth. These findings suggest that *C. elegans* has adequate endogenous biosynthesis of pyrimidines but the purine biosynthesis is inadequate to

achieve maximal growth of the nematode in CbMM. The lack of effect by exogenous purines other than the adenine group suggests that hypoxanthine (guanosine) phosphoribosyltransferease is absent in *C. elegans*.—*Department of Nematology, University of California, Riverside, CA 92521.*

RAMMAH, A., and S. D. VAN GUNDY. *Fungal parasites of citrus nematode eggs.*

In a search for citrus nematode egg parasites, 12 different fungi were isolated from egg masses collected from six California citrus orchards. Only two fungi, a *Fusarium* sp. and a *Pyrenochaeta* sp., exhibited a high level of parasitism both in the field and in the laboratory. The *Fusarium* sp. appeared to be the most pathogenic of the two. In laboratory studies it invaded 50% of the embryonated eggs. It did not attack eggs containing 1st or 2nd stage larvae. The optimum temperature for parasitism was 24 C. Both fungi parasitized embryonated eggs of *Meloidogyne incognita* but not of *Heterodera schachtii*.—*Department of Nematology, University of California, Riverside, CA 92521.*

ROBBINS, R. T. *Spiked tails found on the first stage juveniles of Californidorus pinguicaudatus.*

In the fall of 1979 an undescribed *Californidorus* sp. was found in Johnson County, Arkansas. First stage juveniles were found to have spiked tails. This discovery prompted the examination of a mass collection of *C. pinguicaudatus* from the type locality in California for first stage juveniles. The collection was made in July 1978 from soil in the rhizosphere of giant reed, *Donax arundo*. Numerous first stage juveniles were found, all having spiked tails. The biometrics for the first stage juveniles of *C. pinguicaudatus* are as follows: (n = 12) length = 798 μm (742–883); a = 38 (35–40); b = 3.1 (3.0–3.2); c = 12.2 (10.6–13.8); tail length = 66 μm (61–77); length of tail spike = 39 μm (37–42); Odontostyle = 38 μm (36–40); Odontophore = 49 μm (48–50); Replacement odontostyle = 47 μm (43–49). The width of the tail spike at its base is about 1/3 of the anal body width. The spike's diameter 2 μm from the tip is about 1/2 its basal diameter. The tip of the spike is bluntly rounded.—*Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.*

ROBERTS, P. A., I. J. THOMASON, and H. E. McKINNEY. *Decline of Heterodera schachtii under nonhost crops in California.*

Three to five years of nonhost crops and/or fallow between beet crops is widely used in California to control *H. schachtii*. Decisions on the nonhost interval to reduce nematode density below the action threshold are based on the initial nematode density (Pi) at rotation commencement, rate of population decline, and the damage threshold level ($\sim$ 1.5 eggs/g soil for Imperial Valley). Population decline was followed in three fields (clay loams) in the Imperial Valley cropped to nonhosts after beets. Fields were sampled by Oakfield soil tube at depths of 0–30 and 30–60 cm every 3–4 months for up to 4 yr. Egg numbers were determined in 600 g air dried soil, subsampled from eight bulked cores/4.6 m^2 site. Pi (eggs/g soil) at different sites ranged from 1.3–34.0 (0–30 cm) and from 3.7–99.3 (30–60 cm). In 2 yr viable eggs were below the damage threshold at both depths on land cropped to annual nonhosts and fallow (two sites, Pi = 1.3–14.5). Four years were required on land cropped to seed alfalfa (two sites, Pi = 31.4–99.3). In a third field cropped to hay alfalfa (10 sites, Pi = 12.2–60.9) decline to 1.5 eggs or less occurred in 4 yr on six sites at 0–30 cm and on four sites at 30–60 cm. An interval of 5 yr between beets appears necessary to reduce nema population below the damage threshold at all sites in in this field. Parasitism of eggs by *Fusarium oxysporum* and/or *Acremonium strictum* was observed in 1977 at levels of 98, 21, and 1 percent, respectively, for the three fields, and may influence the rate of decline in viable egg numbers. Rates of decline are being generated to improve the management decision.—*Depart-*

ment of Nematology, University of California, Riverside, CA 92521.

ROBERTS, P. A., and S. D. VAN GUNDY. *Development and influence of Meloidogyne incognita on winter wheat.*

The effects of temperature (T) and inoculum level (Pi) of *Meloidogyne incognita* on growth of bread wheat (*Triticum aestivum* L. em Thell cv. Anza) and nematode reproduction were investigated in greenhouse temperature baths. Seven-day-old plants in 7.5-cm-d plastic pots containing 280 cm^3 of steam sterilized loamy sand were inoculated with 0, 3,000, 9,000, or 30,000 eggs/pot, maintained at 26 C for 8 d and then at 14, 18, 22, 26, or 30 C for 70 d. There were eight replicates. Top and root growth and head numbers were inversely related to T ($P = 0.01$). However, no significant differences in these plant growth characters were found due to Pi alone or to the interaction of Pi and T. Nematode reproduction was directly related to T ($P = 0.01$). P_f/P_i (final egg numbers/initial egg numbers) was greatest at all temperatures when Pi = 3,000; it ranged from 0.03 at 14 C to 51.12 at 30 C. Pf was greatest from 18 to 30 C when Pi = 30,000 and peaked at 26 C (Pf = 276,862). Therefore, 7-day-old 'Anza' plants at warm temperatures allow good nematode reproduction but appear tolerant to *M. incognita* attack. Roots of 'Anza' planted mid-October on a sandy loam field in Southern California infested with *M. incognita* contained 427 second-stage juveniles/g fresh root 7 d after emergence (soil temperature [ST] at 23 cm = 20 C) and 2 egg-producing females/g by mid-February (ST = 15 C). Roots of a mid-November planting (ST = 15 C) were not invaded. Lowest minimum winter ST = 11 C, on 22 January. Early sown winter wheat in mild winter regions may help maintain overwintering *M. incognita* populations.—*Department of Nematology, University of California, Riverside, CA 92521.*

ROSE, LINDY. *Comparative morphology of an undescribed species of the Meloidogyninae from Vitis, L. in Michigan.*

Females of *Meloidogyne* from grape roots in Michigan were found to be about 1 mm in length, have exceptionally long necks, a massive stylet averaging 23 μm, and the excretory pore adjacent to or near the base of the head. Perineal patterns have widely spaced striae and appear semicircular ventrally and oval to broadly arched dorsally, often with a lateral ridge or a small band of broken striae on each side. Phasmids are exceptionally large, prominent, and widely separated (about 60–100 μm). Larvae are around 600 μm in length, have a heavy stylet of about 22 μm, and an excretory pore near or anterior to the center of the median bulb. Tails are short (28 μm) and have conoid hyaline tail terminals of only about 10 μm long. Males are near 1.5 mm in length and possess huge stylets (29 μm) and six separate lips appearing as a rosette beneath the large labial disc. SEM observations confirmed and extended the details seen by optical microscopy, showing the nature of the perineal patterns, amphidial apertures, labial discs and lips, and absence of head annules on males and larvae. Females cause no detectable swellings on grape roots, protrude from the root surface, and are surrounded posteriorly by an exceptionally large gelatinous sac in which 50–400 eggs are deposited. The relationship of this unique nematode to related forms in the subfamily Meloidogyninae is discussed.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

SANTO, G. S., J. H. O'BANNON, and A. M. FINLEY. *A new root-knot nematode parasitizing potatoes in the Pacific Northwest.*

Root-knot nematodes are serious pests on irrigated crops in the Pacific Northwest. Recently a new root-knot species has been found attacking potato (*Solanum tuberosum* L.) in areas of Idaho and Washington; it has also been found associated with wheat (*Triticum aestivum* L.) and

corn (*Zea mays* L.) from eastern Oregon. The new species can be separated from other root-knot species based on morphology and host differentiation. It reproduces well on potato, tomato (*Lycopersicon esculentum* L.), sugarbeet (*Beta vulgaris* L.), wheat, corn, oat (*Avena sativa* L.), and barley (*Hordeum vulgare* L.), but not on pepper (*Capsicum frutescens* L.) and poorly on alfalfa (*Medicago sativa* L.). *M. hapla* reproduces well on potato, tomato, pepper, and alfalfa, but not on wheat, corn, oat, and barley. Wheat and corn are commonly grown in rotation with potatoes to reduce *M. hapla* Chitwood populations. Experiments indicate that this nematode infects potato tubers more rapidly than does *M. hapla*. Symptoms produced on potato tubers are similar to those produced by *M. hapla* and *M. incognita* (Kofoid and White) Chitwood. However, the new species causes almost no galling on tomato cv. Rutger roots, whereas *M. hapla* forms small but distinct galls and *M. incognita* forms large galls. These preliminary studies indicate that this new root-knot nematode, together with *M. hapla*, poses a very serious problem for several commodities, especially potato, in the Pacific Northwest.—*Dept. of Plant Pathology, Washington State University, Prosser, WA 99350; USDA, SEA, AR, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350; and Dept. of Plant Pathology, University of Idaho, Moscow, ID 83843.*

SASSER, J. N., A. L. TAYLOR, and L. A. NELSON. *Ecological factors influencing survival and pathogenicity of Meloidogyne species.*

Survival and pathogenicity of *Meloidogyne* species on suitable hosts appear to be affected primarily by temperature, precipitation and soil texture. This is based on ecological data recorded for 346 populations of *Meloidogyne* spp. collected from 52 countries. Average annual temperatures for *M. hapla*, 3–5 C (this range included 87% of all *M. hapla* samples); *M. arenaria*, 15–27 C (90%); *M. javanica*, 18–30 C (97%). Minimum temperature, calculated as the average temperature for the coldest month of the year, also affected distribution. Of the 23 *M. hapla* populations, 20 came from localities where the average temperature for the coldest month was 0 C or less. None of the other species were from areas where the low temperature was less than 3 C, suggesting that these species are limited in distribution by minimum temperatures above 0 C. Optimum warm month temperatures: *M. hapla*, 24 C; *M. arenaria*, 21 C; *M. incognita* and *M. javanica*, 27 C. Average annual precipitation where the 346 populations were collected ranged up to 6500 mm, but nearly 94% were from areas in the range of 0–2500 mm, with the maximum number (33%) of all populations occurring in the range of 1000–1500 mm. Eighteen percent of the *M. incognita* and 39% *M. javanica* populations came from areas with less than 500 mm annual precipitation. One-hundred samples came from dry climates (3 or more months with less than 10 mm precipitation/month). Of these, 68 were identified as *M. javanica* and 32 as either *M. incognita* or *M. arenaria*. This suggests that *M. javanica* is better adapted to survive under dry conditions than other species, especially *M. incognita*. Among the 346 samples, 240 had gall indices of 3 or more on a scale of 0 to 5. Of these, 54% came from soils with more than 55% sand and 17% came from soils containing less than 35% sand. A significant correlation was found between reported gall index and crop loss, but not between gall index and numbers of years the land had been farmed, the number of months the land had been in susceptible crops during the 2 years prior to sampling, or the number of months of growth of the crop at time of sampling. These data from farms where little attempt has been made to control nematodes suggest that climate and soil influence *Meloidogyne* survival and pathogenicity more than management practices.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

SCHMITT, D. P. *Damage thresholds for Pratylenchus brachyurus on soybean as affected by soil type and cultivar.*

The relationship between initial popula-

tion density (P_i) of *Pratylenchus brachyurus*, soil type, cultivar, and soybean response was investigated in fumigated microplots established in Lakeland sand, Norfolk loamy sand, muck, and Appling clay loam soils. A randomized-block, split-plot design was used, with cultivars 'Essex' and 'Forrest' being whole plots and inoculum (0, 113, 339, 1,017, and 3,051 *P. brachyurus* adults and juveniles/500-cm^3 soil) being sub-plots. The soil was also infested with *Glomus macrocarpus*. Seeds were inoculated with *Rhizobium japonicum*. 'Forrest' was a more efficient and susceptible host of *P. brachyurus* than 'Essex.' 'Essex' exhibited high tolerance to *P. brachyurus*, especially in the Lakeland and Appling soils. 'Forrest' was moderately tolerant in the Appling and muck soils. Based on regression models, the predicted yield suppressions for P_i of 113 nematodes/500-cm^3 soil was 10.2 and 7.2% for 'Essex' in the muck and Norfolk soil, respectively; and 11.5, 19.5, 16.4, and 7.2% for 'Forrest' in the muck, Lakeland, Norfolk, and Appling soils, respectively. There is an additional predicted loss in yield of 'Forrest' per threefold increase in P_i for the respective soils of 2.6, 4.4, 3.8, and 1.6%. Although 'Forrest' soybean has good resistance to *Heterodera glycines* races 1 and 3 and *Meloidogyne incognita*, it is highly susceptible to *P. brachyurus*, particularly in sand and loamy sand soils.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

SLANA, L. J., and J. R. STAVELY. *Reaction of Nicotiana species to Meloidogyne arenaria.*

The reactions to *Meloidogyne arenaria* of 61 *Nicotiana* species and 2 *N. tabacum* cultivars were determined 6 wk after uniform inoculation of greenhouse-grown plants with approximately 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. Results show that *N. repanda* and *N. arentsii* with root galling indices of 0.49 and 0.57, respectively, are significantly more resistant than the remaining 59 species and cultivars which had root-galling indices ranging from 3.70 to 5.00. This is the first report of the highly resistant reactions of *N. arentsii* and *N. repanda* to *M. arenaria.*—*USDA, SEA, AR, Appalachian Fruit Research Station, Kearneysville, WV 25430; and USDA, Tobacco Laboratory, Plant Genetics and Germplasm Institute, Beltsville Agricultural Research Center, Beltsville, MD 20705.*

STYNES, B. A. *Epidemiology and control of annual ryegrass toxicity in Australia.*

Anguina agrostis induces galls in the seed heads of annual ryegrass (*Lolium rigidum*) in southern Australia. *Corynebacterium rathayi*, adhering to the cuticle of *A. agrostis*, is introduced and frequently colonizes some of the developing galls, preventing the nematodes from reproducing. A neurotoxin which causes ataxia, convulsions, and a high incidence of mortalities in grazing animals is produced in the galls colonized by *C. rathayi*. During the growing season the disease develops synchronously with the reproductive development of healthy plants, with galls being induced as the floral tissue differentiates and completing their development as the uninfected grass seeds mature. The development of toxin is rapid and occurs late in the season as the galls mature. The incidence of the disease between seasons is strongly influenced by cereal cropping practices with up to 95% of all mortalities occurring on fields grazed within 12 months of being cropped. The risk of losses falls considerably in the second year and is negligible after 3 or more years of continuous pasture. These features of the disease cycle form the basis of control strategies.

Control of ryegrass with selective herbicides during a cropping year is the main strategy used to break the nematode life-cycle in fields with a known history of toxicity. In addition, these fields are often burned in autumn to further minimize the risk of toxicity in the following spring. When these early measures are not taken, potentially toxic fields can be recognized

soon after heading by the presence of a high number of developing galls. Typically these pastures do not become toxic for another 4–6 weeks, allowing time for the application of low rates of herbicides to kill the young inflorescences and prevent the subsequent development of toxin.—*Plant Pathology Branch, Western Australian Department of Agriculture, Jarrah Road, South Perth, 6151, Australia.*

THOMAS, S. H. *Response of plant-parasitic nematodes to corn hybrids and edaphic factors.*

Numbers of plant-parasitic nematodes associated with five corn hybrids were monitored in seven different soil types during 1977 and 1978. Differences in nematode densities among hybrids were greatest for endoparasitic genera. Nematode populations differed quantitatively but not qualitatively among soil types and hybrids. In an expanded test containing seven additional commercial hybrids and increased replication within a single soil type at Chariton, Iowa, the five originally tested hybrids supported nematode densities similar to those observed in the less expansive test of 1977 and 1978. Sixty times more *Pratylenchus* spp. were recovered per gram dry root from the most susceptible hybrid than from the least susceptible hybrid in the Chariton test. The relative susceptibility among hybrids to colonization by endoparasites was not affected by soil type, although the total number of endoparasites recovered differed among locations. Numbers of ectoparasites also differed among soil types but were not affected by hybrids. Nematode populations correlated with soil particle size and moisture holding capacity during drought conditions in 1977 and with soil chemical properties in 1978 when rainfall was ideal. Nematode abundance correlated with differences in edaphic factors among sites for members of the Dorylaimida, *Hopolaimus galeatus*, members of the Monochidae, *Paratylenchus projectus, Pratylenchus* spp., members of the Tylenchinae, and *Xiphinema americanum*. Medium textured soils were most favorable for nematode populations in this study.—*Department Entomology and Plant Pathology, New Mexico State University, Las Cruces, NM 88003.*

THOMAS, R. J., and C. A. CLARK. *Interactions between Meloidogyne incognita and Rotylenchulus reniformis on sweetpotato.*

Nematode population data from a sweetpotato rotation experiment suggested that *Rotylenchulus reniformis* (RR) became the predominant nematode in the field while *Meloidogyne incognita* (MI) declined. In a greenhouse test, using 'Centennial' sweetpotato cuttings inoculated simultaneously with 2,000 or 10,000 RR or MI eggs/15-cm pot and harvested at 46 and 78 d, MI reproduced as well in combination with RR as it did when alone. *Rotylenchulus reniformis* reproduction was significantly reduced in the presence of MI. In a flat test where equivalent numbers of MI eggs were added to soil naturally infested with RR (3,000 larvae/500 ml soil) and both species allowed to reproduce for 4 months, RR reproduction in combination with MI was reduced from 1.6×10^5 RR/500 ml for RR alone to 9.7×10^4. At the same time the MI population was increased from 5.6×10^4 eggs + larvae/500 ml for MI alone to 1.1×10^5 in mixed populations. Root weights per flat of MI + RR were higher than for MI alone. In the pot test above, plant roots inoculated with MI + RR weighed significantly more at 46 d than those inoculated with MI alone. At 78 d, root systems with all nematode treatments weighed significantly less than the noninoculated control, but were not significantly different from each other. A field study of population dynamics with six sweetpotato cultivars showed RR to be the predominant species in most of the test area, with MI detected only late in the season. In some plots, where MI was detected early in the season, RR populations were lower at the end of the season.—*Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Experiment Station, Baton Rouge, LA 70803.*

VRAIN, T. C. *Fatty acids and their derivatives for nematode control.*

Butyric acid and other short chain saturated fatty acids were shown to be nematicidal. Nematode sensitivity to 12 fatty acids (C_3 to C_{18}) and some of their derivatives (seven potassium salts, seven methyl esters, and four primary alcohols) was investigated in vitro. The toxicity of the acid solution and their salts was inversely related with pH between 4 and 8, directly related with the carbon number from propionic acid (C_3) to undecanoic acid (C_{11}), and inversely related with higher carbon number. Oleic acid (C_{18}) or potassium oleate were relatively nontoxic. Decanoic acid (C_{10}) or undecanoic acid (C_{11}) killed all second stage juveniles of *Meloidogyne hapla* in 24 h, at a concentration of 50 ppm at pH 4. The toxicity of methyl esters and primary alcohols was not pH dependent. There was an increase in toxicity with increasing carbon chain length up to methyl decanoate and 1-decanol. In greenhouse experiments, soil was inoculated with *M. hapla* larvae or eggs and drenched with potassium caprate, methyl decanoate, 1-decanol, or formaldehyde. The number of eggs produced by the nematodes on tomato roots were counted after 60 d. A drench with 2,000 ppm of potassium caprate gave only 25% control, while 1,000 ppm of formaldehyde, methyl decanoate, or 1-decanol gave 93.3%, 90.4%, and 83.2% control, respectively. Other fatty acids derivatives are being tested in an effort to find materials acceptable for use by homeowners.—*Agriculture Canada Research Station, Vancouver, British Columbia V6T 1X2.*

WARTMAN, F. S. *Relative suitability of selected soybean cultivars for reproduction of Pratylenchus alleni and P. brachyurus.*

Twelve soybean cultivars recommended for cultivation in Tennessee were tested for reproductive suitability to *Pratylenchus alleni (Pa),* common in Tennessee soybean fields, and *P. brachyurus (Pb)* in greenhouse tests. For *Pa,* one seed per pot was planted in clay pots filled with steam-sterilized soil, and the soil around the seed was inoculated with 1,000 larvae and adults. For *Pb,* 7-d-old seedlings were inoculated with 1,000 larvae and adults. Identical experiments with uninoculated controls were also set up for each test, and both experiments had five replicates. After 10 wk, plant roots were harvested, blotted dry, and weighed. Nematodes were extracted from inoculated roots in a mist chamber for 2 wk. Numbers of *Pa*/g fresh root of 'Pickett-71' were significantly greater than the other cultivars, and 'Lee-74' was more suitable than 'Coker 136,' 'Dare,' 'Essex,' or 'McNair 500.' Numbers of *Pa*/g root were greater than 300 on 'Centennial,' 'Lee-74,' and 'Pickett-71'; about 250 for 'Bedford,' 'Bragg,' and 'FFR-666'; and 100–150 for 'Coker 136,' 'Dare,' 'Essex,' 'Forrest,' 'McNair 500,' and 'York.' No significant differences in reproduction were found for *Pb,* but this nematode reproduced consistently well on Bedford. Weights of infected and noninfected root systems did not differ. This study indicates that some soybean cultivars may have resistance or tolerance to *Pa,* useful in potential pest management programs.—*Department of Entomology and Plant Pathology, University of Tennessee, Knoxville TN 37916.*

WEHUNT, E. J., and D. J. WEAVER. *Effect of high rates of calcium and magnesium soil amendments on Macroposthonia xenoplax and bacterial canker of peach seedlings.*

Calcium and magnesium soil amendments were tested in soils of two peach tree short-life sites for effects on *Macroposthonia xenoplax* and bacterial canker. Hydrated lime at 5.5 kg, dolomite at 9.1 kg, calcite at 9.1 kg, and gypsum at 13.2 kg was mixed with the top 15 cm of 1.2- x 1.6-m plots on site 1. The same treatments and an additional treatment, magnesium carbonate at 10.2 kg, were mixed with soil of a 1.2- x 1.2- x 0.9-m planting hole on site 2. 'Elberta' peach seedlings were potted in soil from each plot, maintained in the greenhouse for 9 months, and then moved to a lathhouse for dormancy. In December the seedlings were inoculated with *Pseudomonas syringae.* Nematode assays of the soil were made at 6, 12,

and 15 months. Treatment effects in soil from site 1 were as follows: hydrated lime treatments had fewer *M. xenoplax* than gypsum and calcite treatments at 6 months; at 12 months control soil was lower; and at 15 months there were no differences among treatments. Treatment effects in soil from site 2 were as follows: hydrated lime and magnesium carbonate treatments had fewer nematodes than calcite treatment at 6 months; at 12 months hydrated lime treatments were lower than in gypsum or control treatments, and those in magnesium carbonate treatments were lower than in control, hydrated lime, or gypsum treatments; at 15 months gypsum and control treatments had higher nematode counts. Three months after inoculation, plants in hydrated lime treatments had less canker development than those in other treatments, but differences were not significant.—*USDA, SEA, AR, Southeastern Fruit and Tree Nut Research Laboratory, Byron, GA 31008; and USDA, SEA, AR, Appalachian Fruit Research Station, Kearneysville, WV 25430.*

WEINGARTNER, D. P., G. C. SMART, JR., and J. R. SHUMAKER. *Population dynamics of trichodorid nematodes in Florida Irish potato soils following soil fumigation.*

Soil fumigants, although effective in other potato production systems, fail to control corky ringspot disease (CRS) in northeast Florida (NEF). Severity of CRS is significantly reduced in NEF, however, following use of the nonvolatile nematicide aldicarb. Available evidence suggested that ineffectiveness of fumigants was due to viruliferous trichodorids (TC) moving from deeper soil into the tubersphere after dissipation of the fumigants. In 1979, 10- x 70-cm plastic tubes containing nematode-free soil were placed vertically in plots treated in-the-row with either 1,3D or aldicarb at 56 litre and 22.4 kg/ha, respectively. The bottom ends of the tubes were capped and openings cut into the tubes at different depths below the soil surface. Other tubes were cut into different lengths and placed uncapped in 1,3D treated soil. Openings were at 40, 50, 60, or 70 cm below the soil surface. A third set of tubes, with several openings, were placed in 1,3D treated soil and were removed at 28, 35, 48, 58, or 70 d after placement. A single Sebago cv. plant was grown in each tube. At harvest, 0–80 TC/100 cm^3 soil were found in the tubes, the density depending upon the nematicide treatment and depth. Density of TC in tubes from aldicarb and 1,3D treated soil ranged from 0–18 ($\bar{x}$ = 0.8) and from 0–80 ($\bar{x}$ = 7.0)/100 cm, respectively. Greatest densities of TC were found in tubes with openings at 40 cm below the soil surface. No TC were found when openings were below the water table. TC were first observed at 35 d after placement and near maximum densities by 48 d. These data provide additional proof that soil fumigants fail to control CRS in NEF because of movement of TC from deeper soil during the production season.—*First and third authors, Agricultural Research Center, Hastings, FL 32045; second author, Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

WERGIN, W. P., and D. ORION. *Penetration, feeding, and development of the root-knot nematode as revealed by the scanning electron microscope.*

Excised roots of tomato, *Lycopersicon esculentum*, were aseptically cultured on an artificial medium and inoculated with egg masses obtained from monoxenic cultures of the root-knot nematode, *Meloidogyne incognita*. At 24 h, and 1, 2, 3, and 4 wk after inoculation, the roots were chemically fixed, cryofractured, and prepared for examination with the scanning electron microscope (SEM). By 24 h after inoculation, infective larvae had entered the roots. They generally penetrated between adjacent epidermal cells, causing no apparent damage to surrounding tissues. However, considerable disruption of the epidermis and underlying cortical tissue occasionally occurred before final penetration. After 1 wk, the fractured root galls exhibited well-formed syncytia consisting of 6–10 cells. By 2 wk, the inner walls of the syncytium developed invaginations while the outer walls were closely opposed by the secondary

thickenings of the xylem vessels that completely surrounded the feeding site. At 3 wk, the anterior ends of the fourth-stage larvae were tightly embedded in the pericycle; however, the parenchyma cells near their posterior regions began to enlarge and dissociate. These cells became displaced toward the outer surface of the root by the gelatinous matrix that was secreted by the adult female. At 4 wk, the egg mass could be fractured to expose the developing eggs. This study illustrates and discusses the types of information pertaining to nematode development and host-parasite interaction that can be revealed by the SEM.—*Nematology Laboratory, Plant Protection Institute, USDA, SEA, AR, Beltsville, MD 20705; and Division of Nematology, Institute of Plant Protection, Agricultural Research Organization, Volcani Center, Bet-Dagan, Israel.*

WILLUT, J. M., and R. B. MALEK. *Distribution patterns of plant-parasitic nematodes in an Illinois cornfield.*

Horizontal distribution patterns of *Helicotylenchus pseudorobustus, Pratylenchus* spp., *Xiphinema americanum, Hoplolaimus galeatus* and 2nd-stage *Heterodera glycines* larvae were investigated in a square 2.25-ha section of a 16-ha cornfield of Drummer silty clay loam that had been in a corn-soybean rotation for 10 yr. A composite soil sample was taken systematically from each of 225 10- x 10-m quadrats in September and analyzed for nematode content. Five quadrats also were sampled intensively to determine distribution within quadrats. The indices of dispersion indicated that the field-wide distributions of all species were clumped. The distribution of *H. pseudorobustus* was the least clumped and that of *H. galeatus* was the most clumped. The distribution of the recently introduced *H. glycines* was even more clumped than those of the corn parasites. The distributions of *Pratylenchus* spp. (*P. hexincisus* and *P. scribneri*) and *H. galeatus* fit the negative binomial distribution, while those of *X. americanum* and *H. glycines* did not. The goodness of fit of the *H. pseudorobustus* population to the negative binomial could not be tested. Nematode distributions within quadrats also were clumped, but the degree of clumping varied greatly among quadrats and species. Only the distributions of *H. galeatus* and *H. glycines* fit the negative binomial in all quadrats where they were present.—*Department of Plant Pathology, University of Illinois, Urbana, IL 61801.*

YEATES, G. W. *Influence of earthworms on soil nematode populations.*

European lumbricid earthworms contribute to organic matter breakdown in New Zealand pastures. In areas where these worms have not established themselves, they are often introduced to improve pasture production. Samples were collected from two no worm-worm situations in the field and from a glasshouse pot trial. In every case herbage production was greater and total nematode count lower in the presence of earthworms. Changes in the contribution of various nematode genera to the fauna also occurred.—*Soil Bureau, D.S.I.R., Private Bag, Lower Hutt, New Zealand.*

YEATES, G. W. *Relation of generic nematode populations to soil and plant parameters.*

Agricultural nematologists clearly relate activity of certain nematodes to plant growth (e.g. *Globodera rostochiensis* on potato). However, in many ecological studies nematode populations have been correlated with soil factors such as temperature, moisture, and pH. Nematode populations have been estimated under grazed pasture, on Kokotau silt loam near Masterton, New Zealand, for 36 consecutive months, and parallel data collected on above-ground pasture production. Preliminary regression analysis showed that most variance in the total nematode population could be accounted for by production of white clover (*Trifolium repens*) (–2.4), ryegrass (*Lolium perenne*) (+1.5), and standing dead matter (–3.6). Moisture and temperature were not

included in the regression as such, but they are factors influencing the three variables used. The nematode fauna is dominated by *Pungentus* (30%), *Aporcelaimus* (12%), *Tylenchus* (12%), *Panagrolaimus* (6%), and *Heterocephalobus* (6%). Further analyses will be used to demonstrate the value of such long-term data from a site characterised in terms of various components of primary production.—*Soil Bureau, D.S.I.R., Private Bag, Lower Hutt, New Zealand.*

YIK, CHOI-PHENG, and W. BIRCHFIELD. *SEM morphology of the pinewood nematode, Bursaphelenchus lignicolus.*

The pinewood nematode, *Bursaphelenchus lignicolus,* was found in 40% of dead and or dying slash pine, *Pinus elliottii,* in Louisiana. Specimens from infested slash pine chips were fixed in FAA, dehydrated in an acetone series, and critical point dried. The specimens were sputter coated with 200 Å gold-palladium and viewed with the scanning (25 kv) electron microscope (SEM). In situ scans of infested pine chips showed coiled aggregates of 5–10 nemas in the radial resin canals and 1–2 nemas folded in the axial resin canals. SEM micrographs showed a six-lobed, offset head and a smaller circle of six inner lobes around the stoma. A single labial papilla was observed on each of four main lobes. Each of the two opposite lobes, without papillae, bears a pore-like amphid. The female vulva flap was observed to be a pouch. A pair of copulatory papillae were seen external to the pouch. Besides the two pairs of copulatory papillae described for the male, we observed three additional papillae—an additional postanal pair and a single papilla anterior to the cloaca. Spicules are fused ventrally. Distal spicule ends terminate in two fused half discs. Bursa alae are angular at the tail terminus but curl inwards at the corners to appear oval. Lateral fields have four lateral striations.—*Department of Plant Pathology & Crop Physiology and USDA, SEA, AR, Louisiana State University, Baton Rouge, LA 70803.*