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ABSTRACT OF PAPERS PRESENTED AT THE TWENTY-FIRST ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS HYATT REGENCY HOTEL KNOXVILLE, TENNESSEE 26-30 JULY 1982

ABU-GHARBIEH, W. I., and S. A. TAMIMI. *Reaction of wheat and triticale cultivars to the wheat nematode and covered smut in Jordan.*

Response of six durum wheat varieties (Horani Nawawi, Deir Alla 2, F-8, Safra Ma'an, Cocorit and Stork), three common bread wheat varieties (Deir Alla 4, Kalynnsona × FAO 215–2, and Sakha), and triticale variety were tested in two field experiments for their responses to the wheat gall nematode (*Anguina tritici*) and the covered smut of wheat (*Telletia caries*). The tests were made under natural rainfall conditions at the campus of the University of Jordan in the central highlands. Durum varieties were generally susceptible to both pathogens, except that Safra Ma'an exhibited slight resistance to the nematode. Horani Nawawi, which is the most popular variety, was highly susceptible to both pests. The bread cultivars Deir Alla 4 and Kalynnsona were resistant to the smut but susceptible to the nematode. The Egyptian variety Sakha, however, was moderately susceptible to smut but highly resistant to the nematode. The triticale variety showed no infection by the bunt fungus and was only mildly infected with the nematode.—*Department of Plant Protection, Faculty of Agriculture, University of Jordan, and FAO, UNDP, Amman, Jordan.*

AHMAD, A., A. D. RADICE, and P. M. HALISKY. *A convenient method for studying nematode biology in axenic culture.*

A sterile culture technique for studying parasitic nematodes on excised plant roots was developed. The nematodes were successfully cultured on 5–15 mm roots of bentgrass (*Agrostis palustris*) and Kentucky bluegrass (*Poa pratensis*). The roots were grown aseptically on modified Hoagland's and Knop's nutrient medium in 9 × 50-mm seal-tight Falcon petri dishes. The technique enabled us to trace the life history of a nematode through one generation and to observe any effects of temperature, pH, and nutrients on nematode growth, development, and reproduction. The thinness of the petri dishes permitted microscopic examination and direct photography without opening the sterile, sealed chamber. An inverted microscope was used for photography. The cultures also provided uncontaminated host tissues for histological and histochemical tests related to host-parasite interactions.—*Department of Plant Pathology, Cook College, Rutgers University, New Brunswick, NJ 08903.*

AL-HAZMI, A. S., Z. M. ABUL-HAYJA, and I. Y. TRABULSI. *Plant-parasitic nematodes in Al-Kharj region, Saudi Arabia.*

A nematode sampling program was conducted for 16 months in Al-Kharj region, a large agriculture area in the center of Saudi

Arabia. A total of 1,124 soil and plant samples were collected, of which 621 samples were infested with plant-parasitic nematodes. *Meloidogyne javanica* was recovered from 270 samples. Sixteen other plant-parasitic nematodes were identified. Stunt, lesion, and dagger nematodes were among the dominant genera. Several citrus orchards were infested with the citrus nematode. Thirty-five economically important crops, mostly vegetable and a few field and fruit crops, were the common hosts. Plant-nematode relationships ranged from neutral, ecological association to various levels of parasitism and pathogenicity. The most frequent and severe damage was caused by *M. javanica* on many vegetable crops, particularly eggplant, okra, and tomato. During the period of survey, the percentage of samples infested with nematodes, especially *M. javanica*, increased. The root-knot nematode is a serious problem on vegetable production in Saudi Arabia.—*Department of Plant Protection, King Saud University, Riyadh, Saudi Arabia.*

APPEL, J. A., and S. A. LEWIS. *Infestation levels of Meloidogyne incognita or Hoplolaimus columbus and growth and yield of Glycine max.*

Davis soybeans were planted in field microplots of Varina sandy loam previously fumigated with methyl bromide, aerated for 6 weeks and inoculated with the endomycorrhizal symbiont, *Glomus macrocarpus*. *Meloidogyne incognita* (*Mi*) or *Hoplolaimus columbus* (*Hc*) were inoculated at 0, 25, 50, 75, 100, 125, 150, 200, 300, or 600 nematodes/100 cm^3 soil. Soil preparation and inoculation procedures were the same for each of the two years of the study. Treatments were replicated five times in a randomized complete block experiment. Plots were irrigated minimally to prevent plant death in 1980 only. *Mi* and *Hc* suppressed dry weight of filled pods as much as 43% and 35%, respectively, in 1980, when drought prevailed. In 1981, precipitation was nearly optimum and *Mi* suppressed dry pod weight 42% whereas *Hc* had little or no effect. An exponential decay curve described the effect of increasing numbers of *Mi* in both years and of *Hc* in 1980 on dry pod weight. For both nematode species, shoot weight and pod weight responded similarly. Nodule number and height were suppressed by both nematodes in 1980 but not in 1981, when moisture was normal. Nematode reproduction was inversely related to P_i. *Mi* is a rapid colonizer, favored by a nonlimited resource environment, while *Hc* is a slower colonizer but one whose populations are more stable than those of *Mi*.—*Department of Plant Pathology, University of Illinois, Urbana, IL 61801; and Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*

ATU, U. G., and R. O. OGBUJI. *Effects of cover crops on root-knot nematode population.*

Fourteen cover plants commonly found in fallow lands in southern Nigeria were evaluated for resistance to root-knot nematode, *Meloidogyne incognita* race 2. In glasshouse and field experiments, *Crotolaria retusa, Arachis hypogaea, Stylosanthes gracilis,* and *Tagetes* spp. were immune; *Centrosema* sp., *Panicum maximum, Eupatorium odoratum,* and *Aspilia latifolia,* highly resistant; while *Calopogonium* sp., *Pueraria* sp., *Cajanus cajan, Vigna unguiculata,* and *Cynodon dactylon* were highly susceptible. Yam (*Dioscorea rotundata*) and tomato (*Lycopersicon esculentum*) were used as test crops in the cover plant plots. Planting cover plants that suppress root-knot nematode in fallow lands would aid in nematode pest management in fields.—*National Root Crops Research Institude, Umudike-Umuahia, Nigeria; and University of Nigeria, Nsukka, Nigeria.*

BALDWIN, J. G., and A. H. BELL. *Comparative morphology of the esophageal glands and lip region of Pratylenchoides spp.*

Pratylenchoides species vary with respect to morphology of the esophageal

gland lobe, but apparently share a unique lip pattern. Observations of 12 species, including two new species and a new combination, suggest that a morphological continuum of the gland region includes species with a basal bulb, similar to certain Merliniinae. Modifications result in displacement of the esophago-intestinal junction to a more anterior position relative to the isthmus and base of the lobe, and elongation of one or both subventral glands. Examination by scanning electron microscopy of six species of *Pratylenchoides* indicates that they share a similar lip pattern. This pattern is modified from the basic hexaradiate arrangement through fusion of the labial disc with submedial lip sectors. Unlike other Tylenchida, where similar fusion may occur, the lateral lips are not greatly reduced in size relative to medial lips, and the medial lips are not dorsoventrally elongated. Comparison of the lip pattern with four species of *Radopholus* suggests that *Radopholus* has a unique lip pattern which is distinct from *Pratylenchoides*. These morphological observations on the esophagus and lip region lend support to *Pratylenchoides* as a monophyletic group.—*Department of Nematology, University of California, Riverside, CA 92521.*

BARKER, K. R. *Influence of soil moisture, cultivar, and population density of Meloidogyne incognita on soybean yield in microplots.*

A 3 (low, medium, high moisture) × 4 (0, 750, 3,000, 12,000 *Meloidogyne incognita* [MI] eggs/500 cm^3 soil) factorial experiment involved a moderately MI-field tolerant soybean cv. Coker 156 in 1980 and a highly susceptible cv. Lee 68 in 1981. The 750 and 3,000 initial MI densities (P_i) resulted in increased yields of 4–20% over the control for Coker 156. Only the P_i of 12,000 at the low moisture had a slight negative effect (1%) on yield. In contrast, MI on Lee 68 effected yield losses of 4–23% as yield was inversely related to P_i and positively related to moisture. Compared to the low moisture regime, medium and high water regimes resulted in yield increases of 48 and 68% in the respective controls of Coker 156 and 24 and 48% on those of Lee 68. Greater water availability also enhanced nodulation by *Rhizobium japonicum*. Egg production by MI was favored slightly by low moisture. Thus, cultivar, MI density, and moisture affect soybean yield, but moisture has the greatest impact.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

BHATTI, D. S., and K. R. DABUR. *Use of wheat as a trap crop for the control of Heterodera avenae.*

Wheat cv. C 306 was sown in a field as a trap crop in the second week of October 1980. Three treatments (trap crop, aldicarb [Temik 10G]) applied at 1.5 kg a.i./ha, and untreated control) were replicated four times in 5 × 4-m plots and randomized in blocks. The initial nematode population was six eggs and larvae/g soil. The experimental area was irrigated in the second week and the trap crop plowed under in the third week of November. Aldicarb was applied by mixing with fertilizers and drilling the mixture. Then, all the experimental plots were sown with wheat cv. S 308. Final nematode population and wheat yield data were recorded at the time of harvest in April 1981. As compared to untreated control, the final nematode population in aldicarb and trap crop treatments decreased by 7.5 and 9.4%, respectively. The respective increases in wheat yield were 9.0 and 13.5%. Observations on nematode populations and wheat yields indicated wheat cv. C 306 may be used as a trap crop for the control of *H. avenae* since the yield differences were significant.—*Department of Nematology, Haryana Agricultural University, Hissar, Haryana, India.*

BHATTI, D. S., and K. R. DABUR. *Effect of summer plowings on Heterodera avenae population and wheat yield.*

In May and June, very hot (45 C) and dry conditions prevail in Haryana State,

India. The effect of summer plowing during these conditions on population of *Heterodera avenae* and the subsequent growth and yield of wheat cv. WH 157 was investigated in the Mohindergarh district. The treatments included one, two, or three plowings at 10-day intervals and no plowing (control). All the treatments were replicated four times in 5 × 4-m plots and randomized in blocks. The initial nematode infestation level was seven eggs and larvae/g soil. One hundred thirty-three days after the last plowing, soil populations of the nematode were again determined; they were five, four, and three eggs and larvae/g soil in plots plowed one, two, and three times, respectively. The plots were then planted to wheat and 140 days later, at harvest, nematode populations were again determined; they were 9.4, 9.0, 8.9, and 5.5 eggs and larvae/g soil in the control and three treatments, respectively. Compared to the control, yield increases were 2.7, 5.6, and 11.2% for the three treatments, respectively.—*Department of Nematology, Haryana Agricultural University, Hissar, Haryana, India.*

BIRCHFIELD, W., and M. M. JOSHI. *Nematode, bacteria, and nematicide effects on soybean nodulation.*

Rotylenchulus reniformis, Rhizobium japonicum, and Fensulfothion alone and in all combinations were used to determine their effects on soybean nodulation. A low level of native *Rhizobium* plus strains 6 and 10 antibiotic resistant *R. japonicum* were used. The nematicidal rate was comparable to 3.0 lbs a.i./acre of 15% granules soil mixture. Reniform nematode at known levels in naturally infested soil were used. 'Lee 74' soybeans were planted in the treatments and grown at 30 C on a greenhouse bench under Gro-Lux inflorescent and window lighting. Nodule and nematode counts were recorded from three tests after a 78-day growth period. Reniform nematodes did not adversely affect soybean nodulation, alone, or in combination with *Rhizobium* inoculum and/or the nematicide. A significant increase in the number of bacterial nodules was observed with the nematicide alone. The bacterial inoculum alone or combined with the nematicide gave significantly higher nodule counts per plant. The bacterial inoculum alone, the nematicide alone, and a combination of the inoculum and nematicide depressed the reniform nematode population.—*USDA, ARS, Department of Plant Pathology & Crop Physiology, Baton Rouge, LA 70803; and E. I. DuPont DeNemours & Co., Wilmington, DE 19898.*

BIRD, G. W., M. SARETTE, M. DOVER, D. MILLER, S. GAGE, and H. RUSSELL. *NEMALAB: An interactive on-line extension data base management system.*

NEMALAB is an interactive on-line data base management system designed to computerize the records of the Michigan State University (MSU) Extension Nematode Diagnostic Service Laboratory. It is programmed in Fortran and maintained on the MSU Cyber 750 mainframe computer. NEMALAB is accessed through PMEX (Pest Management Executive System) which is part of COMNET (College of Agriculture and Natural Resources communications computer system). The program makes a wide variety of nematode data summaries (e.g., nematode type, population density, crop, county, region, grower) available in an on-line mode to campus-based extension specialists, regional and county extension field staff, researchers, and administrators. The system is in its sixth year of operation. It has been especially helpful for documentation and accountability purposes and for use by regional agents to obtain information about nematode problems associated with specific counties and agricultural production systems. NEMALAB information can be input and accessed through a broad range of interactive micro and mini computers. In the near future it will be interfaced with the Michigan Cooperative Crop Monitoring System (CCMS/APHIS/USDA).—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

BOLLA, R. I., F. SHAHEEN, and R. E. K. WINTER. *Phytotoxin production in Bursaphelenchus xylophilus pine wilt.*

A lipid extract obtained by $CHCl_3$:base extraction of a boiled wood extract from *Bursaphelenchus xylophilus* infected Scotch pine, *Pinus sylvestris,* produced wilt symptoms in all species of pine tested except Jeffrey pine, *P. jeffreyi.* These symptoms were comparable to those induced by *B. xylophilus.* Chemical analysis of the extract indicates the presence of compounds of the general formula $C_{10}H_{12-16}O_{1-3}$, one of which is 10-hydroxyverbenone. Similar compounds cannot be isolated from uninfected Scotch pines or from Scotch pines killed by some means other than the nematode. The infected wood extract is also biologically active against the organisms of infection. Thus a suppression of the rate of growth, development, and reproduction of *B. xylophilus* has been observed in vitro in fungal mat cultures of the nematode supplemented with various concentrations of the extract. The suppression is dose dependent and long term. In addition, the rate of mycelial growth of the blue stain fungus, *Ceratocystis ips,* is significantly suppressed in cultures containing the infected wood extact. This suppression is also dose dependent. These observations suggest that (i) a phytotoxin is produced in this disease, (ii) this phytotoxin may have a functional role in the mechanism of wilting, and (iii) this material may also have phytoalexin activity.—*Departments of Biology and Chemistry, University of Missouri-St. Louis, St. Louis, MO 63121.*

BONSI, C., and M. B. HARRISON. *Effect on growth of resistant and susceptible tomato transplants of various periods of exposure to root-knot nematodes.*

Experiments were conducted to determine the effects of length of time of exposure in root-knot nematode infested soil on growth of susceptible and resistant tomato seedlings. Susceptible (Rutgers) and resistant (Nematex) tomatoes were grown in soil infested with different initial inoculum densities (0, 100, 1,000, 5,000, 10,000, and 50,000 eggs and larvae/kg of soil) of *Meloidogyne incognita* for either 2, 4, or 6 wk. Seedlings of Nematex were stunted when they were grown in soils infested with 10,000 or 50,000 eggs and larvae/kg of soil. They grew as well as the control, however, if in 2 wk they were repotted in noninfested soil. Rutgers seedlings were severely stunted when they were grown for 2, 4, or 6 wk in infested soil that contained more than 1,000 eggs and larvae/kg of soil. Although transplants recovered from the nematode attack when they were repotted in noninfested soil, they did not grow as well as the controls. By 6 wk none of the Rutgers seedlings grown in the highest inoculum level soil survived.—*Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

BONSI, C., and M. B. HARRISON. *Influence of plant resistance and chemical treatments on population dynamics of root-knot nematodes (Meloidogyne incognita) and growth of tomato.*

In growth chamber studies, 4-wk-old root-knot nematode resistant tomato cultivars (VFN and Nematex) growing in 12.5-cm-d pots were inoculated with initial *M. incognita* inoculum densities (P_i) of 0, 10^3, 5×10^3, 10^4, and 10^5 eggs/500 cm^3 soil. Six weeks after inoculation, the plant tops were removed and the nematode population per kilogram of soil was determined. Zero, 22.5, or 45 L Vorlex (DD-MENCS)/ha were then applied to seven replications of each treatment. Four weeks after fumigation, all pots were replanted with 3-wk-old seedlings of a susceptible cultivar (Rutgers) and grown for 6 wk. Nematode population was determined for each treatment, and the pots were immediately replanted with Rutgers seedlings. Three more successive plantings of Rutgers were made before terminating the experiment. Applications of 22.5 or 45 L Vorlex/ha resulted in sufficient reductions of the nematode populations that at least three successive crops of Rutgers could be grown before the population reached a damaging level. Either of the resistant cul-

tivars alone permitted one (at highest P_i's), and two to three (at lowest P_i's) susceptible crops to be grown before the nematode population reached a damaging level.—*Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

BOSTIAN, A. L., and D. P. SCHMITT. *Soybean root morphology as affected by phenamiphos and alachlor.*

Greenhouse tests were conducted to determine the effects of phenamiphos and/or alachlor on early root morphology of soybean in order to investigate previously reported enhanced resurgence of nematode populations with certain combinations of pesticides. The pesticides were added as aqueous solutions to 500 cm^3 soil in 10-cm-d clay pots in sufficient amounts to give each a final concentration of 1 μg pesticide/cm^3 soil. Four 'Ransom' soybean (*Glycine max* L.) seeds were planted in each pot; however, only the first plant emerging was allowed to grow. Eight treatment replicates in a randomized complete block design were harvested at 5 days, and 8 replicates were harvested at 10 days. No differences were present at 5 days; however, several were detected at 10 days. Primary root weights were greater ($P = 0.05$) in treatments containing alachlor, and the primary root weight accounted for a higher ($P = 0.10$) percentage of the total root weight with the phenamiphos/alachlor combination than with either pesticide alone or the untreated control. In addition, the ratio of secondary to primary root weight was less ($P = 0.10$) with the combination treatment than with phenamiphos alone or the untreated control. The root weight ratio was also less ($P = 0.05$) with the treatments containing alachlor than with phenamiphos alone. Shoot weight was greater ($P = 0.05$) with alachlor alone than with phenamiphos alone. The altered root morphology in the nematicide/herbicide treatment may enhance the susceptibility of soybean to nematodes.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

BRODIE, B. B. *Possible use of potato as a trap crop for controlling Globodera rostochiensis populations.*

Globodera rostochiensis resistant and susceptible potato cultivars were planted in 10-cm plastic pots containing a 1:1 soil-sand mixture, inoculated with *G. rostochiensis* cysts of known contents, and grown in a greenhouse (23–28 C). A portion of the infested pots were left fallow. At plant emergence and at weekly intervals for 4–7 weeks, a portion of the plants were either killed with a herbicide, removed from the pots and the pots replanted, removed from the pots and the pots left fallow, or removed from the pots and their roots stained for nematode counts. At the end of the experiments, cysts were extracted from all pots and their viable contents determined. Six weeks after plant emergence, *G. rostochiensis* densities had declined 20% in fallowed pots, 66% where a susceptible cultivar had grown, and 75% where a resistant cultivar had grown. When the effects of physical destruction of resistant plants on *G. rostochiensis* densities was compared with killing the plants with a herbicide, densities declined 92% when plants were physically destroyed and 66% when plants were killed 4 wk after emergence. Observations of stained roots indicated that most of the *G. rostochiensis* juveniles that enter potato roots do so within 3 wk after plant emergence.—*Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

BROWN, R. H. *Effect of nematicide application and time of sowing on Heterodera avenae and the subsequent yield of wheat.*

A field experiment was conducted in 1981 to evaluate the effects of five nematicides and two sowing dates on populations of *Heterodera avenae* and on the subsequent yield of wheat cv. Millewa. The experiment, at Sea Lake in the Mallee district of Victoria, Australia, was located on a site having an initial population of 7 eggs/g of soil. The nematicides were E.D.B. (Nemadi) at 3.71 kg a.i./ha, applied through a new low

volume pesticide applicator; aldicarb (Temik 15G) at 1 kg a.i./ha; terbufos (Counter 15G) at 0.6 kg a.i./ha; chloethocarb (BAS 263 5G) at 1 kg a.i./ha, and oxamyl (Vydate L) at 187.5 g a.i./ha, applied as a seed treatment. Plots were 30 m long × 1.4 m wide, and the experiment was arranged in a randomized block having four replicates. All treatments were applied at sowing. One half of the experiment was sown in May and the second half in June. Observations were made on the numbers of white cysts per plant, numbers of tillers and emerged heads per meter of row, and on grain yield. All nematicide treatments reduced the numbers of white cysts produced on plant roots and improved grain yields. Greater yield increases followed early, rather than late, applications of nematicides. The greatest yield increase (2.8 t/ha) followed the May sowing and application of E.D.B. This nematicide is registered for use on cereals in southern Australia, and with wheat currently valued at $AUS 150/t, the gross return following treatment with E.D.B. is $AUS 420/ha.—*Department of Agriculture, Plant Research Institute, Burnley, Victoria, 3121, Australia.*

BROWN, R. H. *The ecology and control of cereal cyst nematode (Heterodera avenae) in southern Australia.*

The cereal-cyst nematode *(Heterodera avenae)* infests more than 2 million/ha of Australia's southeastern wheatbelt, extending through the States of Victoria and South Australia. The wide distribution of *H. avenae* is due largely to movement of cysts by wind during dust storms. The fungus *Rhizoctonia solani* frequently is associated with the nematode in a disease complex in wheat. There is a consistent association of increased disease severity with lighter soils, or with well structured soils. A single pathotype of *H. avenae* occurs in Australia, and it is distinct from and more damaging than those recorded elsewhere. The effects of various cultural practices on *H. avenae* populations and the subsequent yield of wheat have been studied over many seasons in both Victoria and South Australia. Crop rotations which include periods of fallow, or of nonhost crops reduce population levels and improve yields. The inclusion of a legume has the aditional advantage of improving soil nitrogen levels. Early-sown crops (April/May) are less severely damaged and produce better yields than late-sown crops (June/July). The resowing of damaged wheat crops with either wheat or barley is not effective in improving yields, although cyst numbers are lower on resown crops. Nitrogenous fertilizers are not generally applied to cereals, and although small increases in yield are sometimes obtained, they are rarely economic. Sulphate of ammonia applications increase cyst numbers, especially when applied at seeding, but urea has only a marginal effect on cyst numbers. The world's first wheat variety cv. Katyil bred specifically with resistance to *H. avenae* was released recently in Victoria. Other resistant varieties including those of barley and oats are nearing commercial release. Various nematicide treatments have been evaluated, and excellent nematode control has been achieved in some seasons with yield increases of up to 600%. Four nematicides are currently registered for use on cereals in Australia, and growers now have a wide choice of products, formulations, and methods of application.—*Department of Agriculture, Plant Research Institute, Burnley, Victoria, 3121, Australia.*

CANTO-SAENZ, M., and B. B. BRODIE. *Factors affecting host efficiency of potatoes to Meloidogyne incognita.*

The effects of temperature, plant age at inoculation, and origin of plant (cutting, tubers, or botanical seed) on host efficiency of potato to *Meloidogyne incognita* races 1 and 2 were studied. Host efficiency was based on Pf/Pi ratio and number of eggs per gram of root. For temperature studies, stem cuttings of resistant and susceptible potato clones were inoculated with *M. incognita* and grown in controlled growth chambers at 14, 23, 31, and 35 C with 14-h day length and a light intensity of 17,000 lux. All clones became efficient hosts at 31 C except two that became efficient hosts at

35 C. For plant age studies, 5-, 10-, and 15-day-old cuttings of resistant and susceptible clones were inoculated and grown in a greenhouse (23–35 C). Plant age at time of inoculation did not affect host efficiency of the resistant clones, but root weights of susceptible plants inoculated when 5 and 10 days old were significantly reduced (5%). For origin of plant studies, potato plants originating from cuttings, tubers, and botanical seed were used. Plant growth was not significantly affected by the nematodes regardless of plant origin. Also, host efficiency of resistant plants was not affected by plant origin, but with susceptible plants, nematode Pf was significantly higher in plants from cuttings and number of eggs per gram of root was higher in plants from seed.—*Department of Plant Pathology, Cornell University, Ithaca, NY 14853.*

CARPENTER, A. S., R. W. MILLER, and N. G. CONRAD. *Effects of nematicides on Xiphinema sp. and Pratylenchus sp. parasitizing apple roots.*

Of 29 apple orchards sampled during 1981 in Oconee County, South Carolina, USA, 95% had populations of *Pratylenchus penetrans* and *Xiphinema americanum,* with 21% having damaging levels of these nematodes. Two field experiments measured effects of three nematicides on these nematodes on apple, *Malus sylvestris* Mill. 'Red Delicious.' Soil types in both orchards were fine sandy loam. Nematicides were injected 5–10 cm deep at 2,758 kPa (400 lb/in^2) with a hand-held wand. Soil and root samples were collected 15–25 cm below soil surface at 3-month intervals for nematode counts. Phenamiphos was applied at 22.4 kg a.i./ha in spring and fall. Each treatment consisted of five 15-yr-old trees (MM 106 rootstock) in a randomized block design with four replications. Spring applications gave better control of *P. penetrans* than fall applications in both soil and root tissue. Differences between treatments for *X. americanum* were not significant ($P < .05$), although both treatments reduced populations. In the second experiment, oxamyl at 14.1 kg a.i./ha, phenamiphos at 22.4 kg a.i./ha, and ethylene dibromide at 37.4 kg a.i./ha in a spring application were tested for *X. americanum* control. Treatments consisted of twenty-five 10-yr-old trees (MM 111 rootstock) in a randomized block design with three replications. All nematicide treatments suppressed *X. americanum* populations when evaluated periodically for 9 months. Oxamyl was most effective in suppressing *X. americanum* populations.—*Departments of Plant Pathology & Physiology and Ag. Chemical Services, Clemson University, Clemson, SC 29631.*

CARTER, W. W. *Interaction between Rotylenchulus reniformis and Rhizoctonia solani in seedling disease of muskmelon.*

Both incidence and severity of seedling damping-off and root rot caused by *Rhizoctonia solani* (anastomosis group 4) were significantly greater when muskmelon (*Cucumis melo*) was parasitized by the reniform nematode, *Rotylenchulus reniformis.* The incidence of seedling disease increased from 43.1 to 93% when *R. solani* was combined with *R. reniformis,* compared to *R. solani* alone. Both *R. solani* and *R. reniformis* significantly reduced top growth and root fresh and dry weights compared to noninoculated plants. Seedling age at the time of inoculation with *R. solani* significantly affected the nematode-fungus interaction. No interaction was detected when nematode infected seedlings were inoculated with *R. solani* at less than 10 days after emergence; disease was equal in all treatments. *R. reniformis* increased the period of seedling susceptibility to *R. solani* from 20 to 27 days after emergence. A minimum of 5,000 *R. reniformis* larvae per seedling was necessary to elicit nematode-fungus damage significantly greater than that caused by either pathogen alone. Soil temperature had a direct effect on disease severity, growth of the muskmelon plant, fungus, and nematode. The nematode-fungus interaction, as expressed by disease severity, was greatest at 28 C; at 22 C disease was equal in all treatments. Soil temperatures of 34 C inhibited both *R. solani* and *R. reniformis,* with dis-

ease incidence less than 10% and less penetration of roots by *R. reniformis.—USDA, SEA, ARS, Crop Protection and Production Research, Weslaco, TX 78596.*

CHAPMAN, R. A., and M. J. EASON. *Estimating biomass of soybean cyst nematode, Heterodera glycines.*

Specific gravity (sp. gr.) of females and cysts (FC) of the soybean cyst nematode varied widely. White-yellow females with attached filled egg-masses had the maximum sp. gr., 1.15–1.17. Younger females and older cysts had ranges of lower sp. gr. Hence, the biomass of a collection of FC cannot be determined by multiplying its volume by a sp. gr. value. FC were obtained by Dunn's centrifugation-sugar flotation technique and most of the foreign matter was removed with forceps. Cleaned FC were weighed in a 25-ml sp. gr. pycnometer at 20 C. Volume of FC must be known in order to determine weight of water displaced by FC in the pycnometer. Settled volume (SV) of FC was measured in tapered, graduated, 12-ml centrifuge tubes. Settled FC were not packed tightly and SV overestimated their actual volume. A correction factor was obtained by centrifuging FC in perforated, plastic, tapered tubes at 1,000 × *g* for 5 min. The resultant packed volume (PV) was 60% of SV. Hence, biomass (B) of a collection of FC was calculated from B = WPfc − WP + 0.6SV, where Wpfc is weight of the pycnometer filled with FC and water and WP is weight of the pycnometer filled with water. *—Department of Plant Pathology, University of Kentucky, Lexington, KY 40546.*

CHITWOOD, D. J., and J. A. SVOBODA. *Sterols of Caenorhabditis elegans.*

Caenorhabditis elegans was propagated in a semidefined liquid medium containing sitosterol. Purified sterols from steryl ester and free sterol fractions were identified and quantified by gas-liquid chromatography (GLC) on columns coated with SE-30 and OV-17. Sterols comprised 0.11% of the dry weight of *C. elegans,* with steryl esters containing 13.3% of the total sterol and the free sterol fraction the remainder. The free sterol fraction consisted of 7-dehydrocholesterol (67.1%), sitosterol (16.4%), lathosterol (8.6%), cholesterol (7.0%), campesterol (0.7%), and stigmasterol (0.2%). Sterols from the steryl ester fraction included sitosterol (42.6%), 7-dehydrocholesterol (34.9%), cholesterol (12.2%), lathosterol (8.2%), campesterol (1.9%), and stigmasterol (0.3%). The identity of 7-dehydrocholesterol was further confirmed by GLC-mass spectrometry and UV spectroscopy. When ^{14}C-sitosterol was used as the dietary sterol, 7-dehydrocholesterol, cholesterol, lathosterol, and sitosterol isolated from *C. elegans* were present in ratios similar to those previously found and contained approximately the same specific activity as the original dietary sitosterol (2.3 × 10^6 dpm/mg). These results indicate that *C. elegans* dealkylates dietary sitosterol to form 7-dehydrocholesterol, cholesterol, and lathosterol—three sterols which may be better suited to its growth and reproduction.—*USDA, ARS, Insect Physiology Laboratory, Plant Protection Institute, Beltsville Agricultural Research Center, Beltsville, MD 20705.*

CHIZHOV, V. N., and S. B. IDEH. *Pathology of the genital system of Meloidogyne incognita infecting Vicia sativa.*

At low levels of infection, *Vicia sativa* exhibited relative resistance to *Meloidogyne incognita* and only a few larvae developed to adults. These females, however, were not capable of laying eggs due to considerable structural changes in the spermatheca and postovarian opening (oviduct). The number of the cells increased from 28–32 (normal) to more than 40 and they had thin walls and small nuclei. The differentiation between regions was abnormal, there were no mature oocytes in the ovary, and the gonad did not appear to function. At a high level of infection, *V. sativa* lost its resistance and *M. incognita* caused normal gall formation. An alteration of the structure of the spermatheca was observed in some of the

egg-laying females. Differentiation between the postovarian opening and the spermatheca and the opening itself appeared normal, and the gonad functioned normally. Thus, if only the structure of spermatheca is altered and the opening develops normally, the gonad functions. Apparently, in *M. incognita* the postovarian opening is functionally responsible for egg activation and the spermatheca functions as a shell gland.—*Department of Botany, University of Jos, Nigeria Institute of Helminthology, USSR Academy of Sciences, Moscow.*

CONRAD, N. G., A. S. CARPENTER, and R. W. MILLER. *Effect of nematicides on Criconemella xenoplax on South Carolina peach trees.*

Incidence of populations of *Criconemella xenoplax* above the damage threshold (50/100 cm^3 soil) in South Carolina peach orchards has risen from 15% in 1979 to 30% in 1980 and 50% in 1981. Methods, timing, and rates of application of phenamiphos nematicide wth dichloropropane-dichloropropene (D-D) were evaluated for reducing population levels of *C. xenoplax* associated with Peach Tree Short Life. Field experiments were carried out at three locations on 'Lovell' and 'Nemaguard' rootstock in sandy clay and sandy loam soils. Treatments were phenamiphos 3EC at 11.2 kg a.i./ha and 22.4 kg a.i./ha applied in either spring or fall, with and without a pretreatment of D-D and phenamiphos 3EC at 11.2 kg a.i./ha applied during both spring and fall. The phenamiphos was either surface sprayed or incorporated in a 1.7-m band on two sides of the tree row. The D-D was injected at 187 L a.i./ha at 7.5-cm depth. Five spring and fall applications of phenamiphos beginning April 1980 at 11.2 kg a.i./ha gave significant control ($P < .05$). This treatment reduced *C. xenoplax* populations below damage threshold levels from August through December 1981 when populations are normally increasing.—*Departments of Agricultural Chemical Services and Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*

DABAJ, K. H., E. A. EDONGALI, and M. WAJID KHAN. *Studies on root-knot nematodes in the Libyan Jamahiriya.*

Vegetables grown in the western region of the Libyan Jamahiriya were observed to be variously affected by root-knot nematodes. Crops of tomato, pepper, eggplant, and cucumber were more commonly damaged. Survey of tomato and potato crops in the region showed that tomato was more severely and widely affected than potato. *Meloidogyne incognita* and *M. javanica* were distributed in this region on these crops. *M. javanica* was dominant. Race differentiation revealed the presence of Race 1 and Race 2 of *M. incognita*. Race 2 was relatively more common. Some cultivars of potato and tomato were screened against *M. javanica*. Commonly grown cultivars of tomato were mostly highly susceptible. However, cultivars that are under experimentation for introduction showed better resistance. Most of the potato cultivars were only slightly susceptible. Some were also resistant.—*Department of Plant Protection, Faculty of Agriculture, P.O. Box 13538, Al-Fateh University, Tripoli, Libya.*

DIRKS, V. A., and P. W. JOHNSON. *Harmonic analysis of variation in numbers of Pratylenchus penetrans in peach orchard soil with sampling depth, sampling time, years, and soil cover as sources of variation.*

Replicated nematode population data were collected from peach orchard soil in regular monthly samplings at 10 successive 15-cm depths with both sod and clean cover. Preliminary analysis of variance of the data indicated that sampling month, year, and sampling depth were major sources of variation, with significant months × depths interaction. Mean numbers of *P. penetrans* decreased with increased sampling depth. Harmonic analysis, as outlined by Bliss, was used to fit the regression model $y = a_0 + a_1\cos(ct) + b_1 \sin(ct) + a_2\cos(2ct) + b_2\sin(2ct)$. . . . This model accounted for most of the variance among months in num-

bers of *P. penetrans*. Fitted coefficients (a_1, b_1,a_2,b_2) and, hence, amplitude (A) and phase angle (θ) varied with sampling depth and between years. Equations for nematode numbers at different sampling dates and depths were tested against the observed data. The extreme variation in nematode numbers near the soil surface was attributed in part to variation in soil temperature and moisture; sod cover modified this variation to some degree. The use of harmonic analysis in nematode population studies, tests of significance of the coefficients, and partitioning of the experimental variance are discussed, with examples.—*Agriculture Canada: Harrow Research Station, Harrow, Ont. NOR 1G0; and Delhi Research Station, Delhi, Ont. N4B 2W9.*

DISANZO, C. P. *Movement of carbofuran through the soil profiles.*

Laboratory and field studies were made to investigate the movement of carbofuran (Furadan 10G) through the soil profile under different water regimes. The concentration of carbofuran present at various depths in soil was determined through bioassay techniques. *Meloidogyne incognita* and tomato plants (*Lycopersicon esculentum*) were used as the pathogen and the host, respectively, for laboratory studies, whereas *Pratylenchus penetrans* and peas (*Pisum sativum*) were used to bioassay samples from field studies. The movement of carbofuran through the soil profile was directly correlated to water movement. Carbofuran, applied in a band on the soil surface, moved in a conical pattern with no apparent upward movement. Carbofuran applied on the surface of sandy loam soil in the field moved to a depth of at least 45 cm. Carbofuran used as a 43% flowable liquid in drip irrigation moved within the wet areas. Continuing drip irrigation after treatment moved carbofuran even further. The movement observed was greater in lighter then in heavier soils.—*FMC Corporation, Ag. Chem. Group, 100 Niagara Street, Middleport, NY 14105.*

DI VITO, M., N. GRECO, and A. CARELLA. *Effect of various population densities of Meloidogyne incognita on the yield of pepper.*

The root-knot nematode, *Meloidogyne incognita,* occurs in almost all vegetable growing areas of Italy. It has been shown to affect the yield of pepper (*Capsicum annuum* L.); therefore, an experiment was done in 1981, in microplots out doors, to relate population densities of the nematode to yield. Microplots were concrete tiles (30 × 30-cm cross section × 50-cm long) filled with 40 liters of sandy soil which had been treated 7 months earlier with 300 liters of ethylene dibromide/ha. *Meloidogyne incognita* race 1 was cultured on pepper and the inoculum collected from roots by the sodium hypochlorite method. Appropriate numbers of eggs and juveniles were thoroughly mixed into the soil of each microplot to give a range of initial population densities of 0, 0.25, 0.5, 1 . . . 512/ml soil. A single two-month old pepper seedling cv. Yolo Wonder was transplanted into each microplot. The fruits were harvested and weighed as they matured. The population density of the nematode was assessed at the last harvest, when the plants were removed, and at intervals thereafter throughout the fall and winter. The data fitted the equation $y = m + (1 - m)\, z^{P-T}$ which indicates a tolerance limit of 2.2 eggs and juveniles/ml soil and a minimum yield of 58%. Maximum reproduction of the nematode was 274-fold with the lowest initial population density. The population of the nematode decreased markedly after removing the plants, and only 13% of eggs and juveniles were detected one month later.—*Istituto di Nematologia Agraria, C.N.R., Via G. Amendola, 165/A, 70126 Bari, Italy.*

EDWARDS, G. J., and A. C. TARJAN. *Spectral densitometric detection of stress symptoms in pine seedlings inoculated with the pinewood nematode.*

Slash pine, *Pinus elliottii,* inoculated with *Bursaphelenchus xylophilus* has shown wilt symptoms in 24–35 days at ambient

greenhouse temperatures. It was possible to detect stress in inoculated plants by infrared photographic techniques as early as 17 days after inoculation with nematodes. A 35mm camera fitted with a Wratten 12 filter and Ektachrome infrared color film was used to photograph nematode-inoculated and uninoculated pine seedlings every 3–4 days after inoculation. The developed film was positioned over a Photovolt model 52-0 light source. A fiber optic light guide connected to a high-intensity monochromator scanned the subject area in 10-mm steps from 400 to 650 nm. Light intensity was read on an autophotometer. Wavelength and corresponding intensity values were plotted to provide the spectral curve. A computer program was devised to determine the first derivative values of the spectral curve. These values indicated the areas of greatest change on the curve, corresponding to the time seedling stress due to nematode infection was first photographically detected. Symptomatic trees can be differentiated from stressed asymptomatic trees by color differences in the film. It is conceivable that the procedure described may be used for field situations to detect asymptomatic, infected trees.—*A.R.E.C., Lake Alfred, FL 33850; and Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

ELLIOTT, A. P., and F. W. RAVLIN. *Development of a computer program for analyzing data from nematode advisory services.*

A computer program was developed to analyze data from soil samples processed for detection of nematode problems in association with 10 crops in 50 counties within five agricultural regions in the state of Virginia. The program involved entering data for the following variables: agricultural region, county, laboratory number, crop history, crop to be grown, and nematode genera density. A Statistical Analysis System program was used to sort and calculate mean values and frequency distributions for nematode densities, according to regions, crop history, crop to be grown, and by counties. Nematodes within the genera *Meloidogyne, Heterodera, Globodera, Tylenchorhynchus, Pratylenchus,* and *Hoplolaimus* were most frequently associated with field crops of corn, soybean, peanuts, and tobacco. Species of *Hoplolaimus, Xiphinema,* and *Pratylenchus* were most frequently associated with fruit production sites. Nematode problems associated with crops requiring a nematicide treatment were detected in 27%, 48%, 44%, 48%, 19%, 4%, 86%, 96%, and 70% of the corn, soybean, peanuts, tobacco, small grain, vegetables, apple, peach, and small fruit production sites, respectively.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

ELLIOTT, A. P., S. MEREDITH, and C. HARRIS. *Soil population dynamics of Heterodera glycines associated with three soybean cultivars.*

A field study was conducted to study the population dynamics of *Heterodera glycines* associated with 'Essex,' 'Lee 74,' and 'Forrest' soybean cultivars. Cyst population densities associated with all cultivars fluctuated throughout the growing season and reached one peak at 2,210 degree days, base 10 C (DD_{10}) (54 days after planting) and another at 4,169 DD_{10} (157 days after planting). Greater fluctuations in population densities of second-stage larvae were associated with Essex and Forrest cultivars compared to Lee 74. A peak in population densities of second-stage larvae of all cultivars was detected at 1,748 DD_{10} (38 days after planting); a second peak associated with Essex was observed at 2,773 DD_{10} (74 days after planting) and at 3,376 DD_{10} (100 days after planting) with Lee 74 and Forrest cultivars. Final densities of second-stage larvae associated with all cultivars increased at 4,619 DD_{10} and densities associated with Essex and Lee 74 (440 and 438/250 cm^3 soil, respectively) were higher than densities associated with Forrest (28/250 cm^3 soil). Comparison of dynamics of cyst and larvae densities indicated that maxima in densities of *H. glycines* second-stage larvae cor-

responded to minima in cyst densities. Population densities of cyst and larvae in plots to which Phenamiphos (Nemacur 15 G) was applied indicated similar dynamics as in untreated plots.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

ELSON, J. E. *Nematicide registration for minor crops.*

Interregional Research Project No. 4 titled "A National Agricultural Program; Clearances of Pesticides and Biologics for Minor or Special Uses" (IR-4) is a coordinating effort to provide research guidance in obtaining requisite data for labelling pesticides for use on "minor" crops. Crops other than soybeans, corn, small grains, and cotton may well be considered "minor." Since 1975 there have been 134 pesticide/commodity requests for nematode control submitted to IR-4. Twenty-two of these requests were withdrawn for various reasons, such as a more effective agent being available or the material withdrawn from the market. Manufacturers have declined to register 14 of these uses for reasons such as possible liability claims on high cash-value crops. Manufacturers are proceeding with research on 18 requests. IR-4 has 45 research projects which are already underway or are eligible for research. Currently nine petitions for various nematicides are under review at the Environmental Protection Agency (EPA). Twenty six of the requested uses have been registered through EPA.—*IR-4 Project, Cook College, Rutgers University, New Brunswick, NJ 08903.*

ENDO, B. Y. *Ultrastructure of the esophagus of larvae of the soybean cyst nematode, Heterodera glycines.*

Stylet shaft and protractor muscles are supported by subjacent cells of the procorpus. The cells supporting the protractor muscles are in the dorsal and subventral positions, while cells that have cytoplasmic connections to stylet shaft tissues are in the triradiate positions of the procorpus. Secondary muscle cells lie centripetal to the protractor muscle cells. The procorpus joins a narrow muscular anterior region of the metacorpus. The central metacorpus consists of a pump and a complex of muscle units with their nuclei and perikaryons. The subventral gland processes terminate as ampullae at the posterior vestibule of the triradiate pump valve. Subventral gland ampullae with open valves provide continuity between the gland processes and the lumen of the esophagus. The isthmus is muscular anteriorly and merges with the gland lobes posteriorly. The isthmus is encircled by a nerve ring that has nerve cell processes with neurosecretory granules and synaptic junctions. The dorsal gland occupies the major part of the anterior region of the gland lobe; whereas, the two subventral glands, separated by discrete membrane boundaries, occupy the posterior region. The esophageal-intestinal valve lies adjacent to the dorsal gland nucleus.—*U.S. Department of Agriculture, Plant Protection Institute, Beltsville Agricultural Research Center, Beltsville, MD 20705.*

FASSULIOTIS, G., and C. S. CREIGHTON. *Factors influencing in vitro development of the entomogenous nematode, Filipjevimermis leipsandra.*

Filipjevimermis leipsandra juveniles were cultivated in vitro for three weeks in Schneider's Drosophila (SD) medium supplemented with 20% fetal bovine (FB) serum prepared at pH ranges of 4.0 to 8.0. Culture media with a pH of 7.0 and 7.3 provided the best conditions for growth of the nematode to the preadult (post-parasitic) stage. When FB serum was increased to 35% of the total volume of the culture medium, preadults were larger than those in medium containing lower concentrations. Replenishment of this medium at 2-day intervals supported better nematode growth than did medium replenished at 4, 6, or 8-day intervals. A filtrate of reconstituted nonfat dry milk (NDMF) showed promise as a partial substitute for fetal bovine serum. A

medium supplemented with NDMF supported juvenile growth as good as or better than growth in culture medium containing equivalent concentrations of fetal bovine. Whereas in vitro cultivated preadults were 2–3 times smaller than those recovered from parasitized larvae of the banded cucumber beetle, *Diabrotica balteata,* they were twice as large as those cultivated in SD plus 20% FB serum. This indicates that with further experimentation on media constituents and other cultural factors, larger nematodes can be mass produced in vitro to supply the numbers that will be required for biocontrol of the insect.—*U. S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29407.*

FATTAH, F. A., and J. M. WEBSTER. *Fine structure of giant cells induced by Meloidogyne javanica in lima bean.*

Lima bean (*Phaseolus lunatus L.*) cv. L-136 seedlings were inoculated with second-stage larvae of *Meloidogyne javanica* and maintained in the green house. This variety of lima bean supported a large population of *M. javanica* without significant root galling and hence, is very useful for experimental and stock culture purposes. The ultrastructure of giant cells associated with egg laying females was examined by transmission electron microscopy. Giant cells in the lima bean roots showed the usual characteristics but in contrast to the giant cells of tomato these contained a very large number of plastids and crystalline protein bodies. These giant cells appeared to be in a senescent stage as manifest by the presence of osmiophilic granules within the plastids, loss of starch grains, degenerating mitochondria and spiny vesicles associated with the breakdown of crystalline protein bodies. The complete loss of starch from plastids and the association of a large number of spiny vesicles with protein bodies suggest that these giant cells have transferred most of the cell's accummulated nutrients to the female during the process of egg laying.—*Department of Biological Sciences, Simon Fraser University, Burnaby, Vancouver, Canada.*

FERRIS, H., and M. C. STUTH. *Egg production by Meloidogyne arenaria in grape cultivars.*

To determine productivity and longevity of *Meloidogyne arenaria* females in grape cultivars, young rootings were exposed to a low number of second-stage juveniles (J_2) in sand for 3 days, then transplanted into nematode-free sand. After 18 days, each root system was washed from the soil and suspended in a light-proof cylinder with a funnel fused to the base. Roots were sprayed with water at a rate of 0.63 gph through a 90° solid-cone nozzle for 8 sec every 10 min. Excess water that gathered in the funnel was collected in 1-liter flasks. Water overflowed from the flasks after passing through a 900-mesh sieve to retain nematodes. The system functioned as a mist chamber extraction apparatus. Rootings were suspended in dilute nutrient solution for 30 min each week. The cylinders were incubated in a growth chamber at constant temperatures of 25 C and 30 C in separate experiments. Rationale of the experimental design was that hatch rate and recovery of *M. arenaria* J_2 in collection flasks reflected egg production rate under the constant conditions. J_2 were harvested and counted daily. At the termination of the experiment, plant roots were stained and the number of females responsible for the production was ascertained. Cumulative egg production per female was linearly related to degree days at base 10 C (DD_{10}) (r^2 = 0.60–0.88) until maximum egg production was reached. The physiological time span of egg production was 560–990 DD_{10}, maximum production per female was 498–1,184 eggs, and rate of production per DD_{10} was 0.51–1.2 eggs/female in different cultivars.—*Department of Nematology, University of California, Riverside, CA 92521.*

GARABEDIAN, S., and S. D. VAN GUNDY. *Growth enhancement and inhibitiing effect of insecticides/nematicides on the growth of plants in the absence of nematodes.*

The effect of the insecticides/nematicides oxamyl, aldicarb, and orthene on

plant growth were compared to no treatment, Agroplus, and Vitamin B_1 Plus. Oxamyl applied as a spray and drench at 1 and 10 ppm, and Agroplus and Vitamin B_1 Plus were applied as drench at 10 ppm; all treatments were applied biweekly. Aldicarb 20 G was applied only once at the beginning of the experiment at 0.153 gm/15-cm pot. The test plants included two citrus varieties, tomato and cucumber varieties, and four greenhouse ornamentals—dieffenbachia, schefflera, ivy, and pthos. The citrus and ornamental seedlings and cuttings were 2 months old; the tomato and cucumber seedlings were 2 weeks old. The leaf area and fresh and dry weight of shoots and roots were recorded at the end of the three-month study. Oxamyl and aldicarb increased leaf area and fresh and dry weights of shoots and roots. Agroplus and Vitamin B_1 Plus drenches were only slightly stimulatory to the ornamentals and orthene induced growth retardation.—*Department of Nematology, University of California, Riverside, CA 92521.*

GARBER, S., A. M. GOLDEN, and A. P. ELLIOTT. *Fixation techniques and taxonomic studies on nematode species in Virginia.*

Two methods of nematode fixation were compared: (1) a slow fixing method of slow infiltration with glycerin over a 4-wk period, and (2) a more rapid method of infiltration with glycerin over a 1-wk period. The slow method was more effective for producing specimens without distortion. Considerable distortion of *Hoplolaimus* species occurred with both methods; however, less distortion was obtained with the slow method. Species identified included *Xiphinema americanum, Hoplolaimus galeatus, Pratylenchus penetrans, Pratylenchus crenatus,* and *Criconemella xenoplax.* Considerable variation in tail shape of *P. penetrans* was detected, and the presence and shape of the spermathecea was the most significant morphometric character for taxonomic purposes.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

GARCIA-M., R. *Plant parasitic nematodes of the U.S. Virgin Islands.*

The U.S. Virgin Islands consist of three land masses: St. Croix, St. Thomas, and St. John, with areas of 207,199, 77,699, and 51,799 square kilometers, respectively. In 1978 a survey of St. Croix and St. Thomas was conducted to determine the genera of plant parasitic nematodes present, their relative abundance and geographical distribution, and the crops with which they were associated. St. John was not included because most of the island is a national park with very little agriculture on the remainder. Soil samples were collected from agricultural fields, home gardens, golf courses, nurseries, lawns, and noncultivated areas with potential for agricultural development. A total of 80 composite soil samples were taken from the root zone of 30 different plants on St. Croix and 26 samples from the root zone of 16 different plants on St. Thomas. All samples were processed on St. Croix using a modification of a centrifugation-sugar-flotation technique. Nematodes recovered were preserved and transported to the nematology lab of the University of Florida, Gainesville, for identification. Eleven species in nine genera of plant parasitic nematodes were recovered: *Rotylenchulus reniformis, R. parvus, Helicotylenchus dihystera, H. multicinctus, Tylenchorhynchus mashhoodi, Xiphinema americanum, Pratylenchus pratensis, Criconemoides citri, Meloidogyne cruciani,* and *Hemicriconemoides cocophillus* on both islands, and *Hoplolaimus columbus* only on St. Croix. The most prevalent genera were *Rotylenchulus, Helicotylenchus,* and *Tylenchorhynchus.*—*University of Florida, Agricultural Research Center, P.O. Box 1210, Live Oak, FL 32060.*

GODOY, G., R. RODRIGUEZ-KABANA, and G. MORGAN-JONES. *Chitinolytic activity of fungi isolated from cysts and eggs of Heterodera glycines from Alabama, Arkansas, Florida, Mississippi, and Missouri soils.*

Chitinolytic activity (CA) of 13 fungal species isolated from cysts and eggs of

Heterodera glycines in Alabama, Arkansas, Florida, Mississippi, and Missouri soils was studied using an agar medium with 0.2% (w/v) chitin. The fungi were *Neocosmospora vasinfecta, Codinea heteroderae, Stagonospora* sp., *Thielavia terricola, Exophiala jeanselmi, Gliocladium roseum, G. catenulatum, Verticillium leptobactrum, V. lamellicola, Chaetominum indicum, Phoma multirostrata, P. macrostoma, Fusarium oxysporum,* and *F. solani.* Plates with medium were inoculated and incubated at 29 C for 5 days. A clear zone underneath or at the periphery of the colonies of some fungi 72 hrs after inoculation was considered evidence of CA. *V. leptobactrum, V. lamellicola,* and *C. heteroderae* colonies showed peripheral clearing and *T. terricola, C. indicum, G. roseum,* and *Stagonospora* sp. showed clearing underneath the colonies; the remaining species did not show clearing. The fungi were also tested for pathogenicity against eggs of *H. glycines* and *Meloidogyne arenaria.* Seven of the species parasitized eggs of both nematodes, but only *V. leptobactrum* and *P. multirostrata* infected more than 80% of the eggs.—*Department of Botany, Plant Pathology and Microbiology, Agricultural Experiment Station, Auburn University, Auburn, AL 36849.*

GOEL, A. K., S. KUMAR, and M. S. TAYAL. *Morphophysiological and biochemical alterations induced in Carica papaya by Meloidogyne javanica.*

Meloidogyne javanica stunted growth of *Carica papaya* and significantly reduced height, leaf area, length of internodes, chlorophyll content, number of leaves and flowers per plant, fresh and dry weights, size and quality of fruit, and, finally, yield. The infected roots showed enhanced activities of amylase, invertase, peroxidase, polyphenol oxidase, protease, and acid phosphatase and decreased IAA-oxidase activity. The corollary of infection was reduction in the quantity of starch, nonreducing sugars, and total sugars and enhancement in the contents of amino acids, proteins, reducing sugars, o-dihydric phenols, total phenols, and IAA in infected plants. The use of two systemic nematicides—carbofuran and aldicarb—proved promising in controlling nematode infection and considerably restoring the production loss.—*Laboratory of Plant Physiology and Nematology, Department of Botany, D.A.V. (P.G.) College, Muzaffarnagar-251001, India 3048.*

GOLDEN, A. M., and R. H. MULVEY. *Morphological and diagnostic features of Heterodera zeae, the corn cyst nematode.*

Heterodera zeae was described from corn in India in 1971. It was later found in Egypt and Pakistan on this host and is now recognized to be of economic importance. Following its discovery in the USA (Maryland) early in 1981, *H. zeae* was studied critically, using material from Maryland, India, and Pakistan, to develop a detailed morphometric profile of its major stages. Cysts are lemon shaped, usually light brown in color, ambifenestrate, with bullae and underbridge, and a zig zag pattern on cyst wall. *Heterodera zeae,* therefore, belongs in the *H. schachtii* group. Bullae are prominent with an arrangement unique for this species, having four finger-like bullae just below the underbridge followed by random bullae. The anus is very small and indistinct. New diagnostic data on larvae include a revised stylet length average of 20 μm (vs. 23 μm in the original description); caudal ratio A = 3 and B = 12.9, indicating a thin, finely pointed tail and a low head, only 3.9 μm high, but 9.1 μm in width. New details on females include the DGO averaging 4.8 μm and vulva slit of about 33 μm. Egg shells were clear, with no visible markings (LM and SEM observations). Males have not been found. These features are useful in differentiating *H. zeae* from closely related species, including particularly *H. glycines* and *H. schachtii.*—*USDA, ARS, Nematology Laboratory, Beltsville, MD 20705; and formerly, Nematology Section, Biosystematics Research Institute, Agriculture Canada, Ottawa.*

GOLDEN, J. W., and D. L. RIDDLE. *Caenorhabditis elegans dauer larva pheromone.*

A *Caenorhabditis*-specific pheromone, constitutively secreted throughout the life cycle, stimulates dauer larva formation and inhibits recovery. It is a fatty acid-like substance and can be purified from crowded liquid cultures by organic extraction followed by column and thin-layer chromatography. The pheromone and the food supply provide competitive environmental cues. A "food-signal" has been partially purified from yeast extract. It is small, neutral, heat-stable, and hydrophilic. In the presence of added pheromone, the frequency of dauer larva formation is greater at higher temperature than at lower temperature. The pheromone extends the duration of the second larval stage, but has no effect on the development of post-dauer stages or on two adult behaviors tested (chemotaxis and egg laying). A mutant strain which fails to secrete the pheromone does not form dauer larvae unless pheromone is added to the culture medium.—*Division of Biological Sciences, University of Missouri, Columbia, MO 65211.*

GRANT, C. E., J. J. REILLY, and A. P. ELLIOTT. *Reproduction of Globodera solanacearum and its effect on growth and development of three flue-cured tobacco cultivars under greenhouse conditions.*

Six populations (0, 1, 5, 10, 20, and 40 cysts per 400 cm^3 soil) of a tobacco cyst nematode *Globodera solanacearum* were used to inoculate 6-wk-old seedlings of tobacco cvs. McNair 944, Coker 319, and VA 81. At 1 month the mean plant height of cvs. VA 81 and Coker 319 were significantly ($P = .05$) higher than that of McNair 944, mean shoot dry weight of VA 81 was significantly higher than McNair 944 and Coker 319, and the mean numbers of cysts, males, and larvae on McNair 944 and Coker 319 were significantly higher than those on VA 81. Linear increases in nematode populations on McNair 944 and Coker 319 were observed at 1 and 2 months. At 2 months after inoculation the mean plant height, leaf number, and shoot and root dry weight of VA 81 were significantly higher than those of McNair 944 and Coker 319. The nematode densities associated with McNair 944 were significantly higher than densities associated with Coker 319 and VA 81. There was a linear decrease in shoot dry weight of the cvs. McNair 944 and Coker 319 in response to the initial populations. These effects were greater on McNair 944. Nematode populations did not increase on VA 81.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

GRECO, N., M. DI VITO, and A. BRANDONISIO. *Effect of temperature and plant age on the hatching of Heterodera carotae and H. fici.*

The emergence of juveniles from cysts of *Heterodera carotae* and *H. fici* was investigated in a range of temperatures in growing cabinets. Cysts were collected from soil using a Fenwick can, and batches of 200 each of both species were incubated respectively in leachates from pot soil in which carrot or fig had been grown. Distilled water and cysts in leachate from soil without plants were controls for *H. fici*. The test temperatures were 5, 10, 15, 20, and 25 C for *H. carotae* and 10, 15, 20, 25, and 30 C for *H. fici*. Most juveniles emerged from cysts of *H. carotae* at 15 and 20 C (38 and 40%), compared with 10 C (31%) and 5 C (28%); few juveniles emerged at 25 C (6%). Root diffusates from carrot plants 3 days and 1, 2, 3, 5, and 7 wk of age were tested for their effect on emergence of juveniles from cysts of *H. carotae* incubated at 15 C; emergence was 7.5, 48, 56, 55, 67, and 80%, respectively. More *H. fici* eggs hatched at 20–25 C (86 and 85%) than at 15 and 30 C (60 and 52%); no juveniles emerged at 10 C and in the controls. Juveniles emerged more quickly at 20 and 25 C than at 15 or 30 C.—*Instituto di Nematologia Agraria, C.N.R., Via G. Amendola, 165/A, 70126 Bari, Italy.*

GRIFFIN, G. D. *Concomitant relationships of Meloidogyne hapla and Heterodera schachtii on tomato.*

Combined inoculations of tomato (*Lycopersicon esculentum* Mill.) cv. Stone Improved by *Meloidogyne hapla* and one of three populations of *Heterodera schachtii* (UT1A, UT1B, and UT1C) had an inhibitory effect on the development and reproduction of both nematode species. Compared to development (females/plant) on plants inoculated only with *M. hapla,* simultaneous inoculations of plants with *M. hapla* and UT1A, UT1B, or UT1C reduced *M. hapla* development, respectively, by 3, 32, and 34% at 18 C; 10, 28, and 39% at 22 C; 4, 28, and 35% at 26 C; and 9, 34, and 40% at 30 C. Comparable reductions of UT1A, UT1B, and UT1C development were, respectively, 10, 15, and 11% at 18 C; 11, 8, and 5% at 22 C; 9, 19, and 8% at 26 C; and 8, 10, and 14% at 30 C. Inhibition of development of *M. hapla* was even more severe when inoculation of tomato plants by *H. schachtii* preceeded *M. hapla* by 20 days; similar results, although less pronounced, were also observed for *H. schachtii* development when inoculation of tomato plants by *M. hapla* preceeded inoculation of *H. schachtii* by 20 days. Nematode reproduction exhibited the same trend as nematode development, and *M. hapla* was more effected than *H. schachtii.* Similar results on nematode development and reproduction were also obtained by varying the inoculum densities; the higher the density the greater the nematode effect, especially on *M. hapla.*—*USDA, ARS, Corps Research Laboratory, Utah State University, Logan, UT 84322.*

HAROON, S. A., J. L. NATION, and G. C. SMART, JR. *Isolation of a natural nematicide from Pangola digitgrass, Digitaria decumbens, that affects egg hatch and larval survival of Meloidogyne incognita.*

An aqueous extract of Pangola digitgrass roots (20 wk old) killed many larvae of *Meloidogyne incognita* prior to hatching and reduced survival of those that did hatch in a laboratory bioassay. The extract did not move on silica gel thin layer chromatography developed with chloroform: ethyl acetate:formic acid (75:60:15 V/V); when developed with isopropanol:water (10:3), the active material was located about 1 cm from the origin as measured by biological activity assays. The active material is stable after heating for 48 h at 90 C but not after heating for 20 min at 121 C. It is not soluble in nonpolar solvents. Active material was precipitated from concentrated aqueous extracts by adjusting to pH 10 with dilute NaOH. The dried precipitate produced about 50% mortality of *M. incognita* larvae in a laboratory bioassay at a dose of 1.0 mg precipitate/ml water. The active material migrates as one spot in several paper chromatographic systems and is detectable with a spray of 1% diphenylcarbazone reagent. The identity of the precipitated material is not yet known.—*Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611 .*

HAROON, S. A., and G. C. SMART, JR. *An evaluation of two cultivars of Digitaria decumbens as biological control agents of some endo- and ecto-parasitic nematodes.*

Pangola and Transvala digitgrasses are cultivars of *Digitaria decumbens* Stent. They originated in Africa and were released in Florida in 1954. When inoculated with *Trichodorus christiei, Xiphinema americanum, Hoplolaimus galeatus,* and *Tylenchorhynchus martini,* both grasses were hosts of, and were damaged by, each nematode. Transvala digitgrass was antagonistic to *Belonolaimus longicaudatus* and was a poor host for *Hemicyliophora* sp., *Helicotylenchus* sp., and *Pratylenchus brachyurus;* Pangola digitgrass was an excellent host for all four nematodes. Pangola digitgrass was antagonistic to *Meloidogyne incognita, M. javanica, M. hapla,* and *M. arenaria;* some larvae entered the roots, but none developed beyond the late second stage. The roots of Transvala digitgrass were entered by larvae of the four *Meloido-*

gyne spp. and some developed to maturity and produced eggs; root galls were small. When pots were inoculated with both *B. longicaudatus* and *M. incognita* and interplanted with Pangola and Transvala digitgrasses, populations of both nematodes declined. Since Pangola and Transvala digitgrasses are used as pasture grasses in Florida, we suggest that the two be interplanted to provide mutal protection against *B. longicaudatus* and *Meloidogyne* spp.—*Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

HARRIS, A. R. *Nonvolatile nematicide applications in Sultana vineyards at Mildura, Australia.*

Meloidogyne javanica and *Tylenchulus semipenetrans* are the most serious nematode parasites of grapevines in the irrigated horticultural districts around Mildura, in northwestern Victoria. Since DBCP (1,2-dibromo-3-chloropropane) became unavailable, no registered nematicides have been available in Australia to control these pests. In 1978 two exeperiments were established in commercial Sultana (syn. Thompson Seedless) vineyards in sandy loam soils to screen five nonvolatile nematicides. All nematicides were broadcast or watered onto the total soil surface and incorporated by rotary hoe and flood irrigation in spring 1979 and 1980. Nematodes were extracted from soil by elutriation. At one site, ethoprop (granules at 10 kg ai/ha), fenamiphos (emulsifiable concentrate at 12 kg ai/ha), and aldicarb (8 kg ai/ha) did not significantly ($P = 0.05$) reduce numbers of *T. semipenetrans,* the predominant nematode. At the other site, fenamiphos (emulsifiable concentrate at 12 kg ai/ha, or granules at 20 kg ai/ha), aldicarb (8 kg ai/ha), and oxamyl (granules incorporated into soil at 5 kg ai/ha, followed by five foliar sprays at 2 kg ai/ha every 3 wk) significantly ($P = 0.01$) reduced populations of *M. javanica,* the major parasite, 28 wk after the 1979 applications. Eight weeks after the 1980 nematicide applications, there were no significant ($P = 0.05$) differences between treatments in numbers of *M. javanica, T. semipenetrans,* or *Criconemella xenoplax.* The mean bunch weight was lower for the oxamyl treatment than for the control in 1980, but no other parameters of yield or cane growth showed any significant ($P = 0.05$) differences at either site over 2 yr. Further research is examining the effects of higher nematicide rates and different application times.—*Sunraysia Horticultural Research Institute, Department of Agriculture, P.O. Box 460, Irymple, Victoria, 3498, Australia.*

HUANG, J. S., and K. R. BARKER. *Leghemoglobins of soybean nodules as influenced by Heterodera glycines.*

Four-day old soybean seedlings 'Ransom' were dipped in a suspension of *Rhizobium japonicum* (strain 61A76) at the concentration of 10^9 colony forming units/ml and transplanted, seven per pot, to 20-cm pots containing soil-sand (1:1, v/v) mixture. Three days after transplanting, each plant received either 0 or 2,500 juveniles of race 1 of *Heterodera glycines* (HG). Plants were harvested 4 wk after inoculation with the nematode. Nodules were removed from roots and their fresh weight and acetylene reduction capacity were determined. Results indicate that HG infection suppresses nodule development and acetylene reduction capacity. Leghemoglobins (Lb) were extracted from soybean nodules by homogenization in 0.1 M phosphate buffer, pH 8.6 in the presence of polyvinylpyrrolidone, and then precipited with 55–80% saturation of ammonium sulfate. Leghemoglobins were then purified in a Sephadex G-15 column and separated into four components, Lb*a*, Lb*b*, Lb*c*, and Lb*d*, by DEAE-cellulose column chromatography. Results indicate that Lb content in the nodules of HG-inoculated soybean is lower than the Lb content in the nodules of control plants on the basis of per gram nodule weight. The ratio of Lb*a*/Lb*c* from HG-inoculated soybean is also lower than the ratio from control plants.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

HUETTEL, R. N., D. W. DICKSON, D. T. KAPLAN, and W. J. APT. *Identification of the citrus and banan races of Radopholus similis from Hawaii.*

Karyology, host preference, and mating behavior of one Hawaiian population of *Radopholus similis* infecting *Anthurium* sp. and another infecting *Musa* sp. were compared with the citrus and banana races of *R. similis* from Florida. The population from *Anthurium* and the citrus race had a chromosome number of n = 5, whereas the populations from *Musa* sp. had a chromosome number of n = 4. The *Anthurium* population infected *Citrus aurantium* growing in Astatula fine sand. High population levels (200 nematodes/g root) have been maintained on citrus in a greenhouse for 9 months. The Hawaiian population from *Musa* sp. did not reproduce on *C. aurantium*. Two species of *Anthurium* were heavily infected by the citrus race of *R. similis* from Florida, whereas the banana race from Florida did poorly. The mating behavior of the population from *Anthurium* showed a close relationship with the Florida citrus race, but not with the Florida banana race. No mating was observed between the Hawaiian population from *Musa* sp. and the Florida citrus population. This is the first report of a *R. similis* population which appears to be identical to the Florida citrus race occurring outside of Florida. We conclude that both the banana and citrus races of *R. similis* occur in Hawaii.—*Department of Entomology & Nematology, University of Florida, Gainesville, FL 32611; USDA-ARS Horticulture Research Laboratory, Orlando, FL 32803; and Department of Plant Pathology, University of Hawaii, Honolulu, HA 96822.*

HUETTEL, R. N., D. W. DICKSON, and D. T. KAPLAN. *Utility of starch gel electrophoresis in race identification in Radopholus similis.*

Analysis by starch gel electrophoresis of genetic variation in two morphologically indistinguishable races of *Radopholus similis* indicated that 7 of 15 enzyme-encoding loci could be used for their diagnostic separation. Five citrus race and ten banana race populations of *R. similis* from worldwide locations were reared on mung bean, alfalfa, okra callus tissue, or carrot disc culture. No mobility differences in electromorphs were detected on gels from nematode populations reared on these different host tissues. Therefore, these enzymes are considered as diagnostic markers because of their consistency and can be used in the identification of the races of *R. similis*. The lack of common electromorphs at seven loci indicates that the two races are isolated genetically. This simple, inexpensive technique provides diagnostic markers that may be useful in the identification of other closely related nematode species and races.—*Department of Entomology & Nematology, University of Florida, Gainesville, FL 32611; and USDA-ARS Horticulture Research Laboratory, Orlando, FL 32803.*

HUFF, D., and R. F. MYERS. *Longidorus breviannulatus in New Jersey field corn.*

In 1981, *Longidorus breviannulatus* was found in association with stunted corn in Colts Neck, New Jersey. A field experiment was conducted first to determine whether *Longidorus* had any significant effect on growth and yield of corn and second to investigate the effects of soil environment on the size of *Longidorus* population. Fifty microplots were established within the corn field. Soil samples were taken from each plot to determine the nematode species present and their population sizes. A second soil sample was taken from each plot for soil texture determination, sand fraction analysis, pH determination, and nutrient analyses. Finally, measurements were taken on 12 plants in each plot for height, stem circumference, ear diameter, and ear length. Five genera of plant parasitic nematodes were found in the field. These were *Longidorus, Xiphinema, Pratylenchus, Helicotylenchus,* and *Hoplolaimus.* Statistical analysis of the data indicated that *Longidorus* had a significant negative effect on both corn height and stem circumference but no direct effect on either ear diameter

or ear length. Five soil factors were found to influence the size of the *Longidorus* population. These were phosphorus and the very coarse sand fraction (both positively correlated with *Longidorus*) and potassium, silt, and soil pH (negatively correlated with *Longidorus*).—*Department of Plant Pathology, P.O. Box 231, Cook College, and N. J. Agriculture Experiment Station, New Brunswick, NJ 08903.*

HUSSEY, R. S., and H. R. BOERMA. *Influence of planting date on Heterodera glycines damage to soybean.*

High soil temperature (> 34 C) retards development of *Heterodera glycines* in roots of susceptible soybean (*Glycine max*). Forty to sixty percent of soybeans grown in Georgia are planted after small grains from late June to mid July when the soil temperature is high. Bragg soybeans were planted in fumigated and nontreated plots on 15 May, 15 June, 1 July, and 15 July for 2 yr to determine the influence of planting date on damage caused by *H. glycines*. Soil temperature was recorded continuously at 10- and 20-cm depths during the test. Planting in July did not reduce the effect of *H. glycines* on soybean. Yields from plots treated with 1, 2-dibromo-3-chloropropane (28 l/ha) were 48, 118, 395, and 403% higher than yields from nontreated plots with planting dates of 15 May, 15 June, 1 July, and 15 July, respectively. Increase in both seed size and number accounted for the yield increases in treated plots. Soil temperatures were highest during July of 1980, but even then averaged only 9 and 7 h/day above 34 C at 10- and 20-cm depths, respectively. Numbers of *H. glycines* juveniles were reduced by the nematicide but not by late planting. These results indicate that late planting of soybeans does not reduce *H. glycines* damage, and nematicides may actually be more beneficial when soybeans are planted late.—*Departments of Plant Pathology and Agronomy, University of Georgia, Athens, GA 30602.*

IBRAHIM, I. K. A., and M. A. EL-SAEDY. *Resistance of 20 soybean cultivars to root-knot nematodes in Egypt.*

The reactions of 20 soybean cultivars to five populations of *Meloidogyne* spp. were studied in the greenhouse. The nematode populations were identified with Sasser's differentials as *M. arenaria* (Race 1), *M. incognita* (Race 2, Race 3, Race 4), and *M. javanica*. Seeds of the tested cultivars were sown in 15-cm clay pots containing autoclaved sandy clay soil. Seven days after emergence, seedlings were thinned to two/pot and the soil was infested with 5,000 nematode eggs/pot. Each of the applied treatments was replicated four times. Plants were harvested 65 days after nematode inoculation. Gall and egg mass ratings were made on a 0–5 scale. Plants with average ratings of 0–2 were considered resistant; those with ratings greater than 2 were considered susceptible. Results show that cv. Hutton exhibited resistance to the tested nematodes except *M. javanica*. Bragg was resistant to *M. incognita* (Race 3, Race 4) and *M. javanica*. Cobb appeared resistant to *M. arenaria* and *M. incognita* (Race 3, Race 4). Forrest was resistant to *M. incognita* (Race 3, Race 4). Cultivars Clark, Clark 63, Columbus, Davis, Harosoy, Ransom, and Williams were resistant to *M. javanica*, while Coker 488 was resistant to *M. incognita* (Race 4). In contrast, cvs. Bossier, Calland, Coker 136, Essex, Lee, Mitchell, Rillito, and Woodworth were susceptible to the tested nematode populations.—*College of Agriculture, Alexandria University, Egypt.*

IDEH, S. B., and V. N. CHIZHOV. *Features of the structure of the genital system in nematodes of the family Heteroderidae.*

The genital tracts of *Bidera avenae*, *Heterodera glycines*, and *Globodera rostochiensis* were isolated for observation from white females. Clear morphological differences in the gonad were observed in the structure of the upper portion of the preuterine gland (quadricolumella). In *B. avenae* it consists of rectangular cells dis-

tributed in three rows with 30–35 cells per row; in *H. glycines* the cells are elongated to oval in shape and distributed in four rows with 35–55 cells in each row; in *G. rostochiensis* there are six to eight rows and the cells are almost square in shape and smaller than those of the other two species. The low portion of the pre-uterine gland of all three species consists of large, oval cells distributed spirally in three rows. In egg-laying individuals it opens out into the body cavity. Differences in the structure of the pre-uterine gland as expressed by an increase in the number of cells with a simultaneous decrease in their size, in species situated at phylogenetically differing levels, is apparently connected with increasing egg productivity of the genital tract.—*Department of Botany, University of Jos, Nigeria Institute of Helminthology, USSR Academy of Sciences, Moscow.*

INSERRA, R. N., and G. D. GRIFFIN. *The importance of temperature on hatching of Meloidogyne chitwoodi and M. hapla in different root diffusates.*

The effect of distilled water and the root diffusates of potato (*Solanum tuberosum*) cv. Russet Burbank, tomato (*Lycopersicon esculentum*) cv. Columbia, and wheat (*Triticum aestivum*) cv. Hyslop on the hatching of *Meloidogyne chitwoodi* and *M. hapla* eggs was investigated at 4, 7, 10, 15, 20, and 25 C (± 1 C). No consistency in the influence of root diffusates on the percentage of the cumulative hatch of the two nematodes was observed. However, temperatures strongly affected the juveniles emergence of both nematode species. Less than 1% of both nematode eggs hatched at 4 C, and the percentage of the cumulative hatch at 10 C was significantly ($P = 0.05$) less than that at the higher temperatures for both nematode species; however, a significantly ($P = 0.05$) greater number of *M. chitwoodi* eggs than *M. hapla* eggs hatched. The percentage of cumulative hatch of both nematodes at 15 C were similar to those at 20 C, but were significantly ($P = 0.05$) less than those at 25 C. The percentage of cumulative hatch of the two nematodes differed at 20 C, but not at 25 C. There was a fivefold emergence increase ($P = 0.01$) of *M. chitwoodi* juveniles over that of *M. hapla* in distilled water over a 30-day period at 7 C, indicating a greater adaptation of *M. chitwoodi* to cooler temperatures. The length of embryogenic development was 82–84 days for *M. chitwoodi* and 95–97 days for *M. hapla* at 10 C, but was similar (21 days) for both nematode species at 20 C.—*Istituto Nematologia Agraria, C.N.R. 70126. Bari, Italy; and USDA, SEA, AR, Crops Research Laboratory, Utah State University, Logan, UT 84322.*

JAFFEE, B. A., and E. I. ZEHR. *Parasitism of Criconemella xenoplax by the fungus Hirsutella rhossiliensis.*

Criconemella xenoplax (= *Macroposthonia xenoplax*) is an important component of peach tree short life, a complex disease of peach trees. Because there are few effective controls for this nematode, biological control agents were considered. *Hirsutella rhossiliensis* was isolated from dead, surface-disinfested nematodes extracted from 10 of 23 peach orchard soils. This fungus produces sticky spores which adhere to the nematode's cuticle. In the laboratory, juvenile *C. xenoplax* were touched to 10 *H. rhossiliensis* spores, incubated in sterile distilled water, and periodically examined for parasitism. Penetration of living nematodes was observed 3 days after inoculation. The fungus always penetrated the cuticle directly beneath the spore. Then a bulbous infection hypha formed from which secondary hyphae developed. Nematode death was associated with extension of the secondary hyphae. After colonization, hyphae emerged from the nematode, usually at the head or tail. If the nematode was not submerged in water, the fungus sporulated soon after emergence from the nematode. Infection of adults was also observed. *C. xenoplax* eggs were not parasitized by *H. rhossiliensis.*—*Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*

JOHNSON, A. W., and J. R. YOUNG. *Effect of phenamiphos applied through an irrigation simulator with various amounts of water to control root-knot nematodes.*

Applications of phenamiphos (6.7 kg a.i./ha) through an irrigation simulator with 0.63, 1.57, and 4.71 ha cm of water were compared with a conventional method of application for control of *Meloidogyne incognita* on squash and field corn. Treatments were applied to one series of plots immediately after planting (IAP) both crops, and similar treatments were applied to another series of plots 14 days and 7 days after planting squash and field corn, respectively. Treatments were arranged in a split-plot design with time of application as whole-plots and treatments as subplots with four replications. Generally, root-gall indices (RGI) of squash were lower ($P = 0.05$) in plots treated IAP, but not in plots treated 14 days after planting, than those in nontreated plots. A similar trend occurred in RGI's of field corn, except those in plots treated 7 days after planting were lower than those in nontreated plots. Plots treated IAP and 14 days after planting produced marketable yields of squash ranging from 248% to 492% and 432% to 597%, respectively, greater than yield from nontreated plots. Similarly, yields of field corn from plots treated IAP and 7 days after planting were from 123% to 171% and 111% to 179%, respectively, greater than yield from nontreated plots. RGI's and yield of squash were not influenced ($P = 0.05$) by methods of applying phenamiphos. —*Science and Education, Agricultural Research, United States Department of Agriculture, and University of Georgia College of Agriculture Experiment Stations, Coastal Plain Experiment Station, Tifton, GA 31793.*

KAPLAN, D. T. *Influence of Ridomil (metalaxyl) on Pratylenchus coffeae, Radopholus similis, and Tylenchulus semipenetrans in citrus.*

Results of greenhouse studies indicated that application of 200 ml of 112 ppm Ridomil (metalaxyl) adversely affected the development of *Tylenchulus semipenetrans* and *Pratylenchus coffeae* in roots of sour orange seedlings (*Citrus aurantium* L.) grown in 20.3-cm-d pots. Ridomil did not appear to reduce *R. similis* population development but did prevent destruction of feeder roots. However, Ridomil significantly reduced nematode infection of feeder roots by *R. similis* and *T. semipenetrans*. Technical metalaxyl in 2.2% acetone had only a slight adverse effect on the three nematode species under in vitro conditions. However, under in vitro test conditions, the commercial carrier for metalaxyl was nematocidal to *P. coffeae* and *T. semipenetrans* (ED_{50} = 12 and 17 ppm, respectively), while *R. similis* was not adversely affected. These findings suggest that i) Ridomil alters the host-parasite interactions of citrus roots with *R. similis, T. semipenetrans,* and *P. coffeae;* ii) the commercial carrier of Ridomil adversely affects the biology of *P. coffeae* and *T. semipenetrans;* and iii) Ridomil may provide prophylactic protection against spreading decline, slow decline, and citrus slump.—*USDA, ARS, Horticultural Research Laboratory, Orlando, FL 32803.*

KAPLAN, D. T. *Histological characterization of citrus rootstock response to infection by Radopholus similis.*

Population development and cellular responses to *Radopholus similis* infection in fibrous roots of Albritton orange (*Citrus sinensis*), Carrizo citrange S-10 (*C. sinensis* × *Poncirus trifoliata*), Milam lemon (*C. limon*), and sour orange (*C. aurantium*) were compared. Albritton, Carrizo, and Milam significantly reduced *R. similis* development. Sour orange was *R. similis* susceptible. In a histological study, *R. similis* infected feeder roots of all four citrus rootstocks. Infection of susceptible sour orange roots resulted in the formation of cavities and ultimately in cortical destruction. Neither cell wall thickening nor differential staining of cell cytoplasm occurred in response to *R. similis*. In contrast, *R. similis* typically penetrated the epidermis,

hypodermis, and 3–4 cortical cells of Albritton roots. Differentially stained walls of cells devoid of cytoplasm typically lined these infection sites, and deeper penetration occurred only where lateral root meristems arose. Nematodes penetrated deeper into the cortex of Milam roots but were surrounded by a limited number of safranin-stained cells with thick walls and granular cytoplasm. Greater numbers of cortical cells became stained with safranin in Carrizo roots infected by *R. similis*. The granular cytoplasm in these cells was not stained as intensely as those in Milam roots. Cell wall thickening was greatest in peripheral cells. Eggs were observed in the cortex of sour orange roots but not in roots of the three *R. similis*-incompatible rootstocks studied.—*USDA, ARS, Horticultural Research Laboratory, Orlando, FL 32803.*

KHAN, H. A. *Morphology of an undescribed genus of marine nematode from Somiani Beach, Karachi, Pakistan.*

An undescribed nematode genus has been collected from marine habitats. Its cuticle is smooth, and cephalic setae are prominent. The lip region is smooth and the stoma is large and funnel shaped with sclerotized walls containing forwardly directed teeth. The subventral tooth is larger than the subdorsal which is placed a little farther back. The undescribed nematode closely resembles *Oncholaimus* Dujardin, 1845 in the shape of the cuticle, cephalic setae, and stoma. However, it is more variable in body shape and arrangement of teeth. In *Oncholaimus* the subventral tooth is larger and two subdorsal teeth are smaller and located farther back. The esophagus of the undescribed nematode is cylindrical, but not swollen at the base as in *Oncholaimus*. The undescribed nematode contains caudal glands with fine tubes, but tubiform organs are missing whereas caudal glands and tubiform organs are present in *Oncholaimus*. The undescribed nematode is also similar to *Onchulus* Cobb, 1920 in shape of cephalic setae and cuticle. It differs, however, in the size of the dorsal tooth; in *Onchulus* it is large and traversed by the duct. This condition is not present in the undescribed nematode. In the undescribed nematode the vulva is postequatorial, while it is preequational in *Onchulus* Cobb, 1920.—*Nematology Laboratory, Applied Biology Research Division, P.C.S.I.R., Karachi-39 460101/15.*

KING, P. S., R. H. SHELBY, M. H. POPE, and R. RODRIGUEZ-KABANA. *Combinations of anhydrous ammonia and 1,3-D for control of root-knot nematodes on soybeans.*

The efficacy of combination at plant treatments of anhydrous ammonia and 1,3-D against *Meloidogyne* spp. was studied in two field experiments. One experiment was in a field infested with *M. arenaria* and the other in a field with *M. incognita*. Ammonia was applied at 0, 56, and 112 kg N/ha alone and in combination with 1,3-D (Telone II for *M. incognita* or DD for *M. arenaria)* at rates of 0, 18.7, 37.4, and 56.1 L/ha. Applications of NH_3 alone failed to reduce soil larval populations of the two nematodes. Factorial analysis of the larval data indicated no significant interaction between NH_3 and 1,3-D treatments. A significant reduction in larval numbers in response to Telone II was detected when the data were considered independently of the effect of NH_3 applications. Applications of DD did not reduce the number of *M. arenaria* larvae. The use of NH_3 alone did not result in increased yields in either test; however, all combination treatments with Telone II (except NH_3 at 56 kg N/ha + Telone II at 18.7 L/ha) and treatments with Telone II alone at rates above 18.7 L/ha increased yields. The only DD treatments that resulted in increased yields were those at rates of 56.1 L/ha alone or in combination with NH_3 at 112 kg N/ha. Analysis of the yield data indicated that the effects of NH_3 and 1,3-D were synergistic.—*Department of Botany, Plant Pathology and Microbiology, Agricultural Experiment Station, Auburn University, Auburn, AL 36849.*

KINLOCH, R. A., C. K. HIEBSCH, and K. HINSON. *Combined resistance in soybean breeding lines to Meloidogyne arenaria, M. incognita, and Heterodera glycines (Race 3).*

Fourteen soybean cultivars with varied nematode resistance and breeding lines F77-1790, F77-1797, and F77-1840 were evaluated for yield in sites separately infested with three nematodes. In the *Meloidogyne arenaria* site, nematode counts per plot at harvest averaged 68 juveniles/10 cm^3 soil. F77-1797 yielded significantly ($P < 0.05$) more than 'Braxton,' the most resistant and highest yielding cultivar (2,899 vs. 2,260 kg/ha). Yields of F77-1790 and F77-1840 (2,670 and 1,964 kg/ha) did not differ significantly from Braxton. Other entries yielded less, ranging down to 94 kg/ha ('Brysoy 9'). In the *M. incognita* site, nematode counts averaged 82 juveniles/10 cm^3 soil per plot at harvest. The lines yielded 2,933, 2,684, and 2,502 kg/ha. These yields were not significantly different from yields from resistant cultivars Braxton, 'Foster,' 'RA800,' 'Hutton,' 'Centennial,' 'Bragg,' and 'RA701,' which ranged from 3,000 to 2,704 kg/ha. Susceptible cultivars ranged down to 760 kg/ha ('Wilstar 790'). In the *H. glycines* site, the lines yielded 3,161, 3,154, and 2,761 kg/ha. These yields were not significantly different from yields from Foster, Centennial, 'Bedford,' RA701, and RA800 (3,296 to 2,726 kg/ha). Susceptible cultivars ranged down to 1,790 kg/ha ('Cobb'). At harvest, cysts per 100 cm^3 soil ranged from 0 to 3 for resistant cultivars and lines and averaged 26 for Cobb. These data demonstrate that high yielding breeding lines with combined resistance to these nematode species have been developed.—*University of Florida, Agricultural Research Center, Jay, FL 32565; and Agronomy Department, Gainesville, FL 32611.*

KO, M. P., K. R. BARKER, and J. S. HUANG. *Influences of the soybean cyst nematode, Heterodera glycines, on nodulation of soybean roots.*

Greenhouse experiments were conducted to determine if the inhibition of nodulation on soybean roots by *Heterodera glycines,* race 1, is systemic or localized. One-week-old soybean seedlings with split-root systems were transplanted at the time of inoculation into paired 10-cm-d clay pots. Both pots of each split-root system were infested with *Rhizobium japonicum* at 10^8 colony forming units per pot, but only one pot of each system was infested with 0, 500, 2,500, or 12,500 nematode eggs. Five weeks after inoculation, shoot weight, fresh root weight, fresh nodule weight, nodule number, and rate of acetylene reduction for each half-root system were determined. Shoot growth was unaffected with 500 eggs as inoculum, but was suppressed by 65% with 12,500 eggs. In the infected half-root systems, there was a linear decrease in fresh root weights, fresh nodule weights per gram of fresh roots, or in rate of acetylene reduction with the presence of increasing nematode densities; in the uninfected half-root systems of the same plants, such decreases were observed only with their other half-root systems being subjected to high nematode densities. Thus the influences of *H. glycines,* race 1, on the nodulation of soybean roots was localized at low nematode numbers and became systemic at high nematode numbers. The systemic influence on nodulation may be due to nutrient deficiencies or to some translocatable chemical factors secreted or initiated by the nematodes.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

KOENNING, S. R., and D. P. SCHMITT. *Effects of location and planting date on the population dynamics of Pratylenchus brachyurus on soybean.*

The effects of planting date and management practices on the population dynamics of *Pratylenchus brachyurus* were studied in microplots at the Borderbelt Tobacco Research Station (BTRS), Whiteville, N. C., and the Central Crops Research Station (CCRS), Clayton, N. C. Plots at both locations were arranged in a split-plot design with planting dates (four at BTRS and three at CCRS) as whole plots and inoculum density (0 or 275 *P. brachyurus*

juveniles and adults/500 cm^3 soil) as subplots. Plots were planted with soybean cv. Forrest, and paired subplots were divided into winter wheat or fallow. Microplots were sampled 5–6 times prior to harvest (October 1981) and at 4–7-week intervals after harvest. At BTRS, yields were less ($P = 0.10$) in the nematode-infested plots, whereas yields were not suppressed at CCRS. More nematodes were recovered from early planting dates at both locations at most sampling times, and this trend continued through March 1982. The nematode population density peaked at BTRS between August and October, depending on planting date, and generally began to decrease prior to harvest. The nematode population density peaked at CCRS at harvest in October. The nematode population decline was greater at CCRS after harvest than at BTRS. At BTRS the nematode population decline was greater in treatments with winter wheat than with fallow.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

KRAUS, R., G. R. NOEL, and D. I. EDWARDS. *Effect of preemergence herbicides and aldicarb on Heterodera glycines population dynamics and yield of soybean.*

The herbicides vernolate, trifluralin, and metribuzin applied at recommended rates stimulated the population development of *H. glycines* in field experiments at two locations. Hatched larvae per 250 cm^3 of soil 14 days after planting increased by 43 to 82% (lowest to highest, respectively), white females 5 wk after planting by 133 to 251%, and eggs and larvae from planting to harvest by 37 to 134%, when compared to the untreated control. Population dynamics were not altered by alachlor. Application of vernolate, trifluralin, or metribuzin with aldicarb (208 g/100 m of row) improved the nematicide effectiveness. Compared to aldicarb alone, cyst production was reduced with these combinations. Also when compared to aldicarb alone, the rate of increase of egg and larval numbers was reduced following application vernolate plus aldicarb. Trifluralin or metribuzin with aldicarb were effective in reducing nematode fecundity in one experiment. Alachlor plus aldicarb did not affect nematode populations when compared to aldicarb alone. At one location there was an increase ($P < 0.05$) in yield when aldicarb was applied with either vernolate, metribuzin, trifluralin, or metribuzin plus trifluralin, but not with alachlor. The control did not differ from aldicarb without herbicide application. The same trend was observed at the second location, but the only yield increase ($0.10 > P > 0.05$) occurred when aldicarb was applied with vernolate or trifluralin when compared to herbicide application alone.—*USDA, ARS, Department of Plant Pathology, University of Illinois, Urbana, IL 61801.*

KRAUTHAUSEN, H. J., and U. WYSS. *Influence of the cyst nematode Heterodera schachtii on the composition of free amino acids at feeding sites.*

A microanalytical method was used to study the influence of *Heterodera schachtii* on the composition of free amino acids at feeding sites on *Raphanus sativus* var. *oleiformis* host roots grown in aseptic agar culture. Main emphasis was placed on changes at six different stages of the female's development from the L_3 onwards until death. Syncytia-containing root segments, 0.5 cm long, were compared to adjacent segments and to comparable segments and active root tips of noninoculated roots. The effect of leaving the nematode in the tissue during the amino acid determination was examined. The following results were obtained. During the female's development the relative amounts of some amino acids changed significantly. This was especially true for the amides glutamine and asparagine which progressively decreased from the L_3 stage onwards and remained at a low level until females were about two weeks old. Other significant changes were restricted to certain developmental stages only. It is imperative to remove nematodes (uninjured) from host tissue before any re-

liable statement can be made.—*Institut für Pflanzenkrankheiten und Pflanzenschutz der Universität Hannover, W. Germany.*

KRUSBERG, L. R., and S. SARDANELLI. *Corn cyst nematode.*

The corn cyst nematode, *Heterodera zeae,* was identified for the first time in the Western Hemisphere from material collected from four corn fields on one farm in Kent County, Maryland, in February 1981. In March 1981 a survey of all corn fields within a one-mile radius of the original detection revealed this nematode on 8 of 14 farms, infesting about 760 acres. A more extensive survey in fall 1981 involved about 25,000 acres of corn with 745 soil samples collected, the majority from Kent County, but some from southern Cecil and northern Queen Annes Counties. Corn cyst nematode was detected in very low populations on an additional six farms in Kent County and two farms in Cecil County. All detections were within a diameter of 12 miles. At present 1,146 acres of farmland are known to be infested with this nematode. A large field experiment was conducted in summer 1981 in naturally infested soil. Part of the test involved screening 25 corn cultivars to evaluate their response to this nematode, and part the application of eight different nematicides in 25 treatments to evaluate their efficacy in controlling the nematode.—*Department of Botany, University of Maryland, College Park, MD 20742.*

LAWRENCE, G. W., and C. A. CLARK. *Reaction of resistant and susceptible sweet potato cultivars to population densities of Meloidogyne incognita.*

Field plots were artificially infested with initial levels (Pi) of 0, 10, 100, 1,000, 5,000, and 10,000 *Meloidogyne incognita* (MI) eggs and larvae/500 cm^3 soil in 1980 and 0, 100, 1,000, 2,000, 3,000, 4,000, and 5,000 eggs and larvae/500 cm^3 soil in 1981. The cultivars Centennial (susceptible) and Jasper (intermediate-resistant) were evaluated. Population development trends, studied at monthly intervals, were similar for both cultivars. Nematode reproduction (egg and larvae counts) was not as high on Jasper as on Centennial. The higher Pi levels did not yield the highest midseason populations. Initial population densities of 10–100 MI severely affected both the yield and quality of Centennial sweet potatoes. Regression analysis of yield vs. soil infestation levels for Centennial gave an R^2 of −0.49 and −0.31 for 1980 and 1981, respectively. Low initial population densities (10–100) affected the quality of Jasper, but reductions in yield did not occur at a Pi below 1,000 (1980) or 2,000 (1981). R^2 was −0.06 and −0.51 for 1980 and 1981, respectively. Incidence of cracking of the fleshy root was apparent on both cultivars at low Pi in 1980. In the 1981 test, cracking was exiguous for both cultivars. Data on cracking suggests that *M. incognita* predisposes sweet potatoes to a higher incidence of growth cracking.—*Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Experiment Station, Baton Rouge, LA 70803.*

LUCAS, L. T. *Effects of numbers of Belonolamius longicaudatus and nitrogen levels of leaf and root growth of bentgrass.*

Bentgrass, *Agrostis palustris,* cv. Penncross seedlings were inoculated with 0, 25, 50, 100, 200, or 400 *Belonolamius longicaudatus*/500 cm^3 soil and grown at three nitrogen levels for 3.5 months. The soil was a mixture (1:1) of Norfolk sandy loam and 65-mesh (230 μm) sand. Seedlings were inoculated by pouring 40 ml of water with the desired number of nematodes in holes that were punched with a template. Nitrogen solutions were applied once every 2 wk at rates that totaled 454, 908, or 1,816 g N/93 m^2 at the end of the experiment. The leaves were cut once a month and weighed; the roots were collected and weighed at the end of the experiment. At the low N rate, total leaf weights were not affected by the different number of nematodes, but leaf weights of plants inoculated with up to 200

nematodes/500 cm^3 increased at the higher rates of N. Leaf weights did not increase with more N when plants were inoculated with 400 nematodes. Root weights were lower with all nematode levels. Leaf-to-root ratios of plants inoculated with up to 200 nematodes/500 cm^3 soil were 1.5 and 2.7 times as great with 908 and 1,816 g of N, respectively, than with 454 g of N. Nematodes per gram of root were greatest with 25 and 50 nematodes/500 cm^3 soil and the high N rate. The higher N rates increased the stress potential of bentgrass by increasing the leaf-to-root ratios.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

LUZZI, M. A., and A. C. TARJAN. *Vector and transmission studies on the pinewood nematode in Florida.*

Eighteen-month-old seedlings of two varieties of slash pine (*Pinus elliottii*), sand pine (*P. clausa*), and loblolly pine (*P. taeda*) were each inoculated with 500 and 1,000 adults and juveniles of *Bursaphelenchus xylophilus* (Steiner and Buhrer). All inoculated seedlings showed wilt symptoms and succumbed within 40 days. Branches of 10-year-old slash pine were inoculated in October 1981 with 5,000, 10,000, and 25,000 *B. xylophilus*. None of the trees became infected. A male and female longhorn beetle (*Monochamus titilator*), heavily infested with dauerlarvae of *B. xylophilus*, were introduced into a sleeve cage on a side branch of each of seven replicate 10-yr-old slash pines. Cages were kept in place 1 wk to ensure maturation feeding by the beetles. All seven trees showed evidence of feeding; nematodes were present in wood taken from feeding sites. Four out of seven inoculated trees showed wilt symptoms 6 wk after infested beetles were placed within sleeve cages and died 3 wk afterwards. Seven replicate bolts of freshly-cut slash pine, 8 × 25 cm, were enclosed in jars with the same beetles used to infect the trees previously described. After 1 wk, oviposition sites were observed in all cases with underlying wood infested with nematodes. *Hylobius pales* weevils which feed on slash pine roots were trapped in the same area from which the infested longhorn beetles originated. No *B. xylophilus* were found on 81 male and 42 female weevils examined.—*Department of Entomology and Nematology, University of Florida, Gainesville, FL 32611.*

MacGUIDWIN, A. E., and G. W. BIRD. *Influence of Glomus fasiculatus on the ontogeny of Meloidogyne hapla infecting Allium cepa.*

Root penetration and development of *Meloidogyne hapla* were inhibited on *Allium cepa* colonized by the vesicular-arbuscular mycorrhizal fungus, *Glomus fasiculatus,* in greenhouse studies. On both an absolute and per unit root weight, root length, and root tip basis, fewer second-stage juveniles penetrated one-month-old *A. cepa* inoculaed at seeding with G. *fasiculatus* spores, as compared to nonmycorrhizal plants with or without supplemental phosphorus. Root penetration by *M. hapla* occurred prior to the establishment of mycorrhizae when *A. cepa* was inoculated at seeding with nematode eggs and fungal spores. Similar numbers of *M. hapla* per root system were associated with mycorrhizal and nonmycorrhizal plants until the appearance of second-generation (F_2) nematodes. Final root populations of *M. hapla* were twofold greater in nonmycorrhizal than in mycorrhizal plants, possibly due to decreased penetration of roots by F_2 juveniles or the production of fewer progeny in the presence of VA mycorrhizae. Sixty percent fewer nematodes reached the adult stage in mycorrhizal than in nonmycorrhizal plants on the sampling date preceding the first observation of F_2 juveniles. A series of developmental tests indicated that *M. hapla* required ca 2,000 more degree hourse (base = 9 C) to progress from root penetration to oviposition on mycorrhizal *A. cepa* than on nonmycorrhizal plants. These findings were incorporated into a computer model simulating the seasonal dynamics of *M. hapla* associated with *A. cepa.*—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

MAQBOOL, M. A. *Occurrence of some members of Tylenchorhynchinae and Merliniinae in Pakistan.*

Soil samples (1,640) were collected from around the roots of important crops in 36 regions of Pakistan. Parasitic nematodes in the groups Tylenchorhynchinae and Merliniinae were detected as follows: *Tylenchorhynchus brassicae* and *T. mashhoodi* on *Avena sativa, Hordeum vulgare, Oryza sativa, Sorghum vulgare, Triticum aestivum, Zea mays, Musa paradisiaca, Pennisetum typhoides, Grewia asiatica, Prunus persica, Puncia granatum,* and *Pyrus communis; Tylenchorhynchus clarus* on *Zea mays, Citrus sinensis,* and *Oryza sativa; Tylenchorhynchus nudus on Sorghum vulgare; Tylenchorhynchus clavicaudatus* on *Musa paradisiaca; Tylenchorhynchus parvus* on *Solanum tuberosum; Quinisulcius acutus* on *Sorghum vulgare, Prunus persica,* and *Pyrus communis; Quinisulcius capitatus* on *Avena sativa, Hordeum vulgare, Zea mays, Citrus sinensis, Ficus carica, Prunus domestica,* and *Pyrus communis; Quinisulcius solani* on *Citrus sinensis* and *Solanum tuberosum; Merlinius brevidens* on *Avena sativa, Hordeum vulgare, Oryza sativa, Sorghum vulgare, Triticum aestivum, Zea mays, Citrus sinensis, Citrus medica, Ficus carica, Prunus persica, Prunus domestica, Pyrus communis,* and *Vitis venifera; Merlinius nanus* on *Zea mays* and *Pyrus communis; Merlinius microdorus* on *Prunus domestica; Scutylenchus koreanus* on *Triticum aestivum.* With the exception of *Quinisulcius solani* and *Scutylenchus koreanus,* all these species are recorded for the first time from Pakistan.—*Nematological Research Centre, University of Karachi, Karachi-32, Pakistan.*

MAQBOOL, M. A. *Morphology and relationship of a new genus and species in the subfamily Tylenchinae (Nematoda: Tylenchida) from Pakistan.*

During studies of the nematodes belonging to the genera of subfamily Tylenchinae from Pakistan, an undescribed species was found representing a new genus combining certain characters which relate it to four genera in the subfamily. This new species bears distinct longitudinal striae, as in the genera *Coslenchus* Siddiqi, 1978, *Pleurotylenchus* Szczygiel, 1969, and *Campbellenchus* Wouts, 1968, but differs in other respects from these genera. It has a vagina oblique to the body axis, as in *Agelenchus* Andrássy, 1954 which bears no longitudinal striae. Since this new species does not completely fit the characters of any of the genera of the subfamily Tylenchinae, a new genus in Tylenchinae is proposed to accommodate this species. The main characters for the new genus are the longitudinal striae, oblique vagina, and absence of males. This new species was found associated with potato *Solanum tuberosum.*—*Nematological Research Centre, University of Karachi, Karachi-32, Pakistan.*

MAQBOOL, M. A., and S. HASHMI. *Nematodes associated with Oryza sativa in Pakistan.*

In a comprehensive survey during 1979–80, 1,100 soil and root samples were collected from rice in the main rice growing areas of Pakistan. The samples were processed by usual methods, and the following plant nematodes were found in high frequency: *Aphelenchus avenae, Aphelenchoides besseyi, Basiria graminopilla, Boleodorus acutus, Criconemella xenoplax, Ditylenchus clarus, D. angustus, Helicotylenchus dihystera, H. pseudorobustus, H. multicinctus, Hirschmanniella caudacrena, H. gracilis, H. mucronata, H. oryzae, H. spinicaudata, Hoplolaimus indicus, H. galeatus, Merlinius brevidens, Meloidogyne* sop., *Paralongidorus breyllus, Paratylenchus hamatus, Paratylenchus brachyurus, P. thornei, P. pratensis, P. coffeae, P. sefaensis, Psilenchus hilarulus, Tylenchorhynchus clarus, T. brassicae, T. mashhoodi, T. annulatus, Xiphinema americanum* and *Xiphinema indicum.* Except for the three underlined species, all are recorded for the first time associated with *Oryza sativa* in Pakistan.—*Nematological Research Centre, University of Karachi, Karachi-32, Pakistan.*

MARTIN, M. J., M. ALVES DE LIMA, and R. M. RIEDEL. *Reproduction of four species of Pratylenchus in monoxenic culture.*

Reproduction of *Pratylenchus brachyurus, P. crenatus, P. penetrans,* and *P. scribneri* on alfalfa callus at 25 C was measured at 40, 60, 80, 100, and 120 days after inoculation. French square bottles (30 ml) containing three alfalfa seedlings callused on a simplified medium (10 g agar, 20 g sucrose, 1 g yeast extract, and 2 mg 2, 4-D/L) were inoculated with nematodes in a 0.2-ml aliquot. For each 20-day interval, 10 cultures of each species were extracted for 24 h in water in modified Baermann funnels. The experiment was repeated three times with similar results. Results from the third replicate showed that *P. scribneri* reproduced most rapidly, reaching peak population at 80 days, having increased 100-fold over initial populations of 53/bottle. *P. penetrans* populations peaked at 80 days, having increased 18-fold over initial populations of 84/bottle. *P. brachyurus* populations peaked at 80 days, having increased 8-fold over initial populations of 102/bottle. *P. crenatus* reproduced most slowly, reaching peak populations at 120 days, having increased 6-fold over initial populations of 81/bottle. In *P. scribneri* and *P. brachyurus,* peak populations were maintained through 100 days but dropped at 120 days. *P. penetrans* maintained peak population through 120 days.—*Department of Plant Pathology, Ohio State University, Columbus, OH 43210.*

MARTIN, M. J., R. M. RIEDEL, and R. C. ROWE. *Effects of Pratylenchus crenatus and P. scribneri on growth and yield of cv. Superior potato in microplots in Ohio.*

In 1980 and 1981, effects of *Pratylenchus crenatus* or *P. scribneri* on growth and yield of *Solanum tuberosum* cv. Superior were tested in microplots on organic, sandy loam, and silt loam soils. The 1980 high, medium, and low initial numbers of *P. crenatus*/100 cm^3 soil were, respectively, 195, 79, and 28 in sandy loam and 70, 16, and 12 in silt loam. The 1981 initial numbers were 119, 66, and 24 in organic soil and 44, 12, and 17 in silt loam. Initial high, medium, and low numbers of *P. scribneri* in organic soil were, respectively, 282, 141, and 54. In 1980, *P. crenatus* reproduced poorly in potato roots in sandy loam and silt loam soil and did not reduce final shoot, root, or tuber weight of potatoes in silt loam. In sandy loam, shoot, root, and tuber weight were reduced 22, 36, and 34%, respectively. Seasonal rainfall in silt loam and sandy loam was 217 and 77 mm, respectively, above average. In 1981, *P. crenatus* reproduced poorly in silt loam and reduced shoot, root, and tuber weight 33, 41, and 28% respectively. In organic soil, final *P. crenatus* and *P. scribneri* soil populations had increased 4- and 16-fold by harvest, and both reduced final root weight ca. 35%. Neither species reduced shoot or tuber weight in organic soil. Gray-brown sunken cracked lesions were observed on potatoes from infested microplots in 1981. *P. scribneri* was associated with lesions from *P. scribneri* microplots. *P. crenatus* was not detected in lesions from *P. crenatus* microplots. Seasonal rainfall in 1981 in silt loam and organic soil was, respectively, 24.5 mm below average and 122.7 mm above average. —*Department of Plant Pathology, Ohio State University, and the Ohio Agricultural Research and Development Center, Columbus, OH 43210 and Wooster OH 44691.*

McGAWLEY, E. C., and K. L. WINCHELL. *Nematodes parasitic on soybean in Louisiana.*

During the 1980 and 1981 soybean seasons, a total of 92 soybean fields in four of the major soybean producing parishes in Louisiana were sampled. Plant parasitic nematodes in the genera *Meloidogyne, Heterodera, Helicotylenchus,* and *Tylenchorhynchus* were recovered from 50% or more of the samples and those in the genera *Criconemoides, Rotylenchulus, Pratylenchus,* and *Xiphinema* from 10% of the samples. The genera *Hemicycliophora,*

Paratylenchus, and *Hoplolaimus* were found in fewer than 10% of the samples. Monoxenic pot cultures maintained under greenhouse conditions have been used to identify species and races of the various genera and to test the host suitability of common Louisiana soybean cultivars. The following nematodes were identified: *Helicotylenchus dihystera, H. erythrinae,* and *H. pseudorobustus; Tylenchorhynchus claytoni,* and *T. cylindricus; Criconemoides mutabilis, C. macrodorus,* and *C. ornatus; Hoplolaimus galeatus; Paratylenchus projectus,* and *P. hamatus; Xiphinema americanum.* Subsequent studies using these nematodes indicate that all 15 of the currently recommended soybean cultivars are hosts of the three species of *Helicotylenchus,* 11 are hosts of *Criconemoides mutabilis,* 8 are hosts of *C. macrodorus,* and 5 are hosts of *C. ornatus.* Soybean cyst nematode (SCN) race determination tests have been conducted on 12 of the 27 field-collected isolates of the SCN; four of the isolates are race 4, five are race 3, one is race 2, and two are questionable.—*Department of Plant Pathology, Louisiana State University Agricultural Experiment Station, Baton Rouge, LA 70803.*

McKENRY, M. V., and C. KEARNEY. *Soil fumigants as replacements for DBCP in vineyards.*

Nematicidal efficacy of soil fumigants was tested in four nematode-infested vineyards during a 2-yr period. Ethylene dibromide (EDB) as Soilbrom 90 EC or 1,3-dichloropropene (1,3-D) as Telone II EC were chiseled into the vineyard berm within 60 cm of the vine trunk. These two fumigants were applied in various proportions as tank mixes with water or in one treatment with additions of water and mineral oil to reduce toxicant vaporization. Nematode populations were monitored semiannually and when control of *Meloidogyne* spp. did not exceed 50% after 6 months, a retreatment was made. The objective of each treatment was to deliver between 30 and 150 μg of toxicant · ml^{-1} · day^{-1}. EDB provided the most consistant positive yield response. With five replications, the vine yield over the 2-yr period was 103, 103, 111, and 116% of the untreated vines across each of the four vineyards. Tank mixes of 1,3-D yielded 75, 86, 87, and 99% of the untreated, whereas 1,3-D plus oil and water yielded 85, 85, 90, and 100% of the untreated. There appears to be little practical value to the tank mixing of 1,3-D with water or oil. Although we were able to deliver reduced concentrations of the toxicant to the vine roots, there was a negative plant response associated with repeated applications of 1,3-D. This effect was not associated with visible root damage. These data suggest that a vigor and yield reducing factor may be associated with the use of 1,3-D when applied to growing plants. This negative effect may be the result of a 1,3-D degradation product.—*Department of Nematology, University of California, Riverside, CA 92521.*

McSORLEY, R. *Sampling plans for nematodes distributed by negative binomial models.*

Spatial distributions of *Meloidogyne incognita, Rotylenchulus reniformis, Quinisulcius acutus, Helicotylenchus dihystera,* and *Criconemella* sp. were determined in three fallow vegetable fields in south Florida and in smaller subunits of those fields. Goodness of fit to the Poisson, negative binomial, and Neyman Type A distributions were tested by means of X^2 tests. Distributions of most species showed good agreement with negative binomial models, except for *Criconemella* sp., which showed better agreement with a Neyman Type A distribution. For the other nematode species, the k values for the fitted negative binomial distributions increased as field size decreased. Appropriate mean and k values were used to estimate the number of soil cores (n) to be included in a single composite soil sample to achive a predetermined standard error to mean ratio (E). Relationships between n and E were determined for the various nematode and field combinations involved. A single sample of 22 cores was sufficient to estimate soil populations of

M. incognita, Q. acutus, R. reniformis, and *H. dihystera* within a standard error to mean ratio of 25% for fields 0.25–0.45 ha in size.—*University of Florida, Agricultural Research and Education Center, Homestead, FL 33031.*

MINTON, E. B. *Effects of reniform nematodes on cotton in Mississippi.*

Aldicarb 15G, PCNB-ETMT X-aldicarb 10–2.5–5G, and phenamiphos 15G (0.84, 1.12–0.28–0.56, and 0.84 kg a.i./ha, respectively) were applied in the seed furrow with seed of *Gossypium hirsutum* L. in 1981 at Rolling Fork, Mississippi, to determine the effects of these chemicals on control of nematodes (*Rotylenchulus reniformis*) and seed cotton yields. An untreated control was also used. The cotton cultivars evaluated included DES 56, Stoneville 825, and the Deltapine cottons (DPL) 41 and 62. During June, August, and October, nematode numbers were lower in all chemical treated plots than in the untreated plots. In October, nematode numbers were significantly lower in soil samples collected from the Stoneville 825, DPL 41, and DES 56 plots than from the DPL 62 plots. The average percentages of surviving seedlings were lower in the plots treated with aldicarb than in those treated with phenamiphos and in the untreated plots. During June, the cotton plants were significantly taller (10%) in the chemical treated plots than in the controls. Seed cotton yields were not affected significantly by the nematicides but were 5, 11, and 13% higher in PCNB-ETMT X-aldicarb, aldicarb, and phenamiphos treated plots, respectively, than the yields in untreated plots. Significantly higher seed cotton yields were obtained with Stoneville 825 and DPL 62 than with DES 56 and DPL 41.—*Cotton Physiology and Genetics Research Unit, P. O. Box 225, Stoneville, MS 38776.*

MUELLER, J. D., G. R. NOEL, and J. B. SINCLAIR. *Effect of aldicarb on yield components, population dynamics of Heterodera glycines, and fungi on soybean cyst nematode susceptible and resistant soybeans.*

Soybean cvs. Williams 79, susceptible to the soybean cyst nematode (SCN), and L77-994, a resistant near-isogenic line, were planted 29 June 1981 in a field infested with an average of 16 cysts of SCN-race 3/250 cm^3 of soil; no other plant-parasitic nematodes were present. Plots were nontreated or aldicarb was banded at 208 g/100 m of row establishing four treatments: L77-994 without (994$^-$) or with (994$^+$) aldicarb and Williams 79 without (W79$^-$) or with (W79$^+$) aldicarb. Plant height and recovery of fungi from roots and stems was recorded at 2-wk intervals after planting. Nematode samples were taken 5, 8, 10, and 12 (harvest) wk after planting. At harvest, 78, 12, 6, and 3 cysts and 424, 44, 21, and 23 larvae/250 cm^3 of soil were recovered from the W79$^-$, W79$^+$, 994$^-$, and 994$^+$ treatments, respectively. At each date, SCN infestations were higher in W79$^-$ than in the other three treatments, which did not differ among themselves. All aldicarb-treated plants had greater height and yield than did nontreated plants. Yield and height responses to aldicarb did not differ between the two soybean lines. Recovery of *Macrophomina phaseolina* from epicotyls over all sampling dates was higher from aldicarb-treated than from nontreated plots. Recovery of *Phomopsis* spp. from hypocotyls and epicotyls was lower from aldicarb treated than from nontreated plots. Recovery of fungi from roots was unaffected by aldicarb application.—*Department of Plant Pathology, University of Illinois at Urbana-Champaign, Urbana, IL 61801.*

MYERS, R. F. *Histology of pines infected with Bursaphelenchus xylophilus, the pinewood nematode.*

Pinewood nematode (PWN) isolated in New Jersey was inoculated into several species of pine. Tissues were embedded in parafin, cut on a rotary microtome, stained with safranin-fast green, and examined for PWN. Intercellular spaces in the cortical

tissues of primary stems are large enough to permit passage to axial resin canals through radial rays. No nematodes were found in cortical tissues of Japanese black and Scots pine. No PWN were found in any tissue of pitch pine. In the primary stem, radial rays funnel downward from 50 μm wide through the phloem and cambial tissues to 20 μm before passing through the xylem to the pith. This should be sufficient to permit passage of larval PWN into the axial resin canal. Multiseriate or fusiform rays develop radial resin ducts up to 50 μm in diameter, although most ducts were 25–30 μm. The PWN has been found in the axial resin canals of Japanese black, Scots, and southwestern white pines. Males, females, larvae, and eggs were found together. The PWN causes gaps in the cambial layer in Japanese black pine, and traumatic resin ducts were created. These areas produced during secondary growth apparently served as nursery chambers for nematodes. Epithelial and other parenchyma cells were killed where nematodes were found. The cambial layer and rays also died. No trachial blockage was noted to explain the dehydration of chlorenchymous tissues.—*Department of Plant Pathology, Cook College, and N. J. Agriculture Experiment Station, Rutgers University, New Brunswick, NJ 08903.*

NELSON, F. K., P. S. ALBERT, and D. L. RIDDLE. *Caenorhabditis elegans secretory-excretory system.*

The secretory-excretory system of *Caenorhabditis elegans* has been reconstructed from electron micrographs of serial sections. The system consists of four cells. 1) The terminal half of the cuticle-lined excretory duct is enclosed by a specialized hypodermal cell, the pore cell. 2) The duct cell surrounds the duct from the origin of the duct to the pore cell boundary. The duct cell contains a lamellar system which increases the cell surface area at the duct, possibly for the purpose of resorption. 3) The large, H-shaped excretory cell extends bilateral canals anteriorly and posteriorly nearly the entire length of the worm. The cell body contains an excertory sinus which joins the canals with the origin of the duct. 4) A binucleate, A-shaped gland cell extends bilateral processes from cell bodies behind the pharynx anteriorly to the nerve ring where the processes join and apparently receive synaptic input. The processes are also joined at the anterior edge of the excretory cell body, where the gland cell, duct cell, and excretory cell are joined by a tight junction. A specialized secretory membrane connects the gland cell to the origin of the duct directly adjacent to the excretory sinus. Secretory granules are concentrated in the gland cell around this junction. Dauer larvae are uniquely deficient in secretory granules. Paraldehyde-fuchsin (PAF) staining appears to be correlated with a high concentration of secretory granules. Laser microsurgery experiments, in progress, may yield insights into cellular functions.—*Division of Biological Sciences, University of Missouri, Columbia, MO 65211.*

NIBLACK, T. L., and E. C. BERNARD. *Nematode community structure in dogwood, maple, and peach nurseries in Tennessee.*

Tennessee nurseries are major suppliers of ornamental and fruit trees, but the potential for nematode-induced losses is poorly known. This study was undertaken to i) study numerical relationships among nematode trophic groups in dogwood, maple, and peach nurseries; ii) determine the diversity of plant-parasitic nematodes in these areas; iii) determine the relative importance of tree species and age class, weed cover, and edaphic factors in the distribution of plant-parasitic species. Ninety-two nursery blocks were sampled for nematodes in March, July, and October 1981. Each soil sample was analyzed for pH, bulk density, texture, and organic matter content. Nematodes were extracted from a 200-cm^3 aliquant of each sample and counted. Microbivores, fungivores, predators, and "omnivores" (trophism unknown) were counted as such, but plant parasites were identified to species. Microbivores occurred in the highest numbers for all sampling dates, followed by plant parasites, fungivores, "omnivores,"

and predators. Fifty-eight plant-parasitic species in 25 genera were identified, with 2–16 species occurring in each site. Diversity was higher in March and October than in July, higher in maple than in dogwood and peach blocks, and positively correlated with percent weed ground cover and number of weed species. *Paratylenchus projectus* and *Xiphinema americanum* were the two most common species, occurring in 88% and 77% of the sites, respectively. A community ordination technique was employed to explore nematofaunal relationships among sites.—*Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37996-4500.*

NICKLE, W. R. *Status of the pinewood nematode in the United States, Europe, and Japan.*

Since the pinewood nematode, *Bursaphelenchus xylophilus* (Steiner & Buhrer, 1934) Nickle, 1970, was found to cause damage to pine trees in the United States in 1979, nematologists have found it in 32 states on larch, spruce, deodora cedar, and 20 species of pine. Taxonomic research has shown that this nematode has been in the USA for more than 50 years and probably was not introduced from Japan as suspected earlier. Damage in the USA occurs mainly on individual trees or plantations of introduced ornamental Scots pines and in Japanese black pines grown on the Atlantic coast. In a 7-acre tract of red pine and 5 acres of Scots pine at Loch Raven Reservoir near Baltimore, Maryland, more than half of the trees were dead and many other trees were in various stages of decline because of the nematode infestation. Three native species of long-horned borers, genus *Monochamus*, are vectors of the pinewood nematode in the USA. Thus far, the nematode is not found extensively in the native pine forests of the USA. However, in Japan up to 100% of the Japanese red pine stands were killed in areas where the nematode and the vector, *M. alternatus*, occurred together for 10 yr. Recent studies of suspected nematode specimens from France were shown to be *B. mucronatus*, which does not cause extensive damage; *B. xylophilus* has not been reported on the European continent.—*Nematology Laboratory, PPI, ARC-W, ARS, USDA, Beltsville, MD 20705.*

NILES, R. K., A. P. ELLIOTT, and K. S. YODER. *Comunity structure and population dynamics of phytonematodes in an apple orchard.*

A study of the community structure and population dynamics of phytonematodes associated with five scion varieties on one of two rootstocks was conducted in an apple orchard. Over a 211-day period of study, *Hoplolaimus galeatus* composed 58–62% of the total population of phytonematodes associated with all varieties; *Xiphinema americanum* composed 10–17%; and *Macroposthonia curvatus* 7–10%. Other phytonematodes present were *Helicotylenchus, Hemicyliophora, Heterodera, Paratylenchus, Pratylenchus,* and *Trichodorus.* The percentage frequency composition of the community varied through the season. Population density of *H. galeatus* fluctuated throughout the season but reached its maximum in mid-October. Population density of *X. americanum* also reached its maximum in mid-October. Population dynamics of the community structure were similar in control plots and nematicide plots.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

NOE, J. P., and K. R. BARKER. *Plant row effects on the distribution of plant-parasitic nematodes.*

Seven tobacco fields were systematically sampled for *Meloidogyne* spp. and *Tylenchorhynchus claytoni* with either an 8 × 8 or a 10 × 10 grid design. Samples were taken within plant rows and across rows. The distance between samples was the same as the distance between rows (ca. 1 m). Three of the fields were sampled in midsummer and four in the fall after discing.

The same grids in these four fields were sampled again in the spring. The mean population estimates were different ($P < .05$) among the plant rows for both plant parasitic nematodes in all seven fields. However, the mean population estimates were not significantly different across the ranks within plant rows in any of the samples. This plant-row effect was maintained after discing and throughout the winter until the next spring. Since there was no significant difference in the means of individual ranks going across rows, any sample taken in a straight line going across rows provided an accurate estimate of the overall grid mean. Analysis of plant rows in two of the midsummer samplings indicated that the location of population peaks along a row was closely related to the location of peaks along an adjacent row.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

NOEL, G. R., and B. A. STANGER. *Estimation of Heterodera glycines populations and yield reduction of soybean.*

Economic injury level studies using aldicarb at the rate of 208 g/100 m of row were conducted in producers' fields at two locations during 1979 and 1980. Yields were regressed on numbers of eggs and larvae, total cysts, and gravid cysts/250 cm^3 of soil sampled at planting. In 1979, eggs and larvae were counted for each individual cyst; during 1980, numbers were determined from an aliquant of cyst contents from each sample. During both years, lower coefficients of determination (r^2) were usually obtained when aldicarb was applied. In 1979, regardless of the method of population determination, quadratic regression (QR) resulted in higher r^2's when compared to linear regression (LR), and determination of eggs and larvae provided substantially higher r^2's than did cyst counts. In 1980, QR using total cysts or gravid cysts was not substantially better than LR, but the r^2 for QR of yield on egg and larval numbers was substantially higher than the r^2 for LR. The r^2 for QR of yield on egg and larval counts was not higher than for cyst counts, thus reflecting the greater inherent error when egg and larval numbers were obtained from an aliquant. Nematode levels of 12 total cysts, 10 gravid cysts, or 600 eggs and larvae/250 cm^3 of soil resulted in a 32% yield loss in 1979 when aldicarb was not applied; in 1980, the losses were 33, 35, and 25%, respectively. When aldicarb was applied, the 1979 yield reductions were 8, 17, 20% and the 1980 losses were 18, 21, and 12% for total cysts, gravid cysts, and eggs and larvae, respectively.—*USDA, ARS, Department of Plant Pathology, University of Illinois, Urbana IL 61801.*

NORTON, D. C. *Densities of Pratylenchus hexincisus in maize and species related to maize.*

Population increases of *Pratylenchus hexincisus* on 25 accessions of different maize types and species related to maize were measured in five replications in greenhouse tests. Four-day-old seedlings were inoculated with 1,300 or 1,500 nematodes per plant with one plant per 15-cm pot. *Zea diploperennis* (PI 441931, PI 441932) from Mexico generally had 1/2 to 1/4 the number of nematodes per gram of dry root after 95 days as DeKalb XL-25 or A619Ht × A632Ht dent maize, which were used as checks. In one test, *Z. diploperennis* had 1/3 to 1/10 the number of *P. hexincisus* as *Z. mexicana* (PI 206617, PI 206615). Populations of *P. hexincisus* in isotypes of *Z. mays parviglumis* were the same as the two PI *Z. mexicana,* but significantly fewer than an unnumbered accession of *Z. mexicana.* The sweet types (PI 253730, PI 318728) from Brazil generally supported more *P. hexincisus* than did the dent, pod, pop, and flint types tested. The greatest *P. hexincisus* specific growth rate, expressed as a percentage of the check, was 214% in sweet maize PI 318728 from Brazil. The lowest specific growth rates were 16% in dent maize PI 201543 from Yugoslavia and 16 and 19% in the two *Z. diploperennis* accessions. The dent maize from Yugoslavia had a poor root system which possibly retarded nematode development.—*Depart-*

ment of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.

NORTON, D. C. *Nematode problems on corn.*

Corn is an excellent host for many nematodes. More than 70 species of bona fide plant parasites are associated with corn in the United States. Parasitism on corn has been demonstrated with 41 species and pathogenicity with 17 species, either by controlled tests or by field tests strongly implicating parasitism or pathogenicity. The species most commonly reported parasitizing corn are *Helicotylenchus pseudorobustus, Hoplolaimus galeatus, Meloidogyne incognita, Paratrichodorus minor, Pratylenchus brachyurus, P. hexincisus, P. penetrans, P. scribneri, P. zeae,* and *Xiphinema americanum.* Other species, such as *Longidorus breviannulatus* and *Belonolaimus longicaudatus,* although reported less frequently, can be extremely damaging locally. Because of environmental constraints only 3–6 species of plant-parasitic nematodes are usually found in a field at one time. Losses range from minor to near total. The ubiquitousness of nematodes and the insidious nature of parasitism allow many losses to go undetected. Although corn is a good host for many species of nematodes, many cultivars appear tolerant. Nematode increase of a given species can vary markedly among cultivars. Crop rotation and use of nematicides have proved effective in controlling nematodes and increasing corn yields in many instances.—*Department of Plant Pathology, Seed and Weed Sciences, Iowa State University, Ames, IA 50011.*

NYCZEPIR, A. P., E. I. ZEHR, and S. A. LEWIS. *Predisposition of Nemaguard peach trees to cold injury by Criconemella xenoplax.*

Criconemella xenoplax has been implicated as a predisposing factor of peach to cold injury in the peach tree short-life syndrome (PTSL). Field microplots were established with Nemaguard peach trees in the presence or absence of *C. xenoplax* to determine if the nematode predisposed peach to PTSL. Twenty cuttings were established in 25-cm-d biodegradeable pots containing methyl bromide fumigated Lakeland fine sand and grown in the greenhouse from September 1977 to April 1978. In April the soil around 10 cuttings was infested with 5,800 ± 100 *C. xenoplax* per pot. The inoculum was extracted from infested soil and contained low levels of *Tylenchorhynchus* sp. A comparable extract from nematode free soil was portioned to 10 other pots which served as controls. In May 1978, pots containing seedlings were transplanted into the microplots containing methyl bromide fumigated Lakeland fine sand. In October 1979, tree trunk diameters were smaller and leaf senescence less on trees growing in the nematode infested soil, compared to trees in the control plots. In 1980–81, nine of ten trees growing in nematode infested soil died of cold injury. None of the control trees was affected from cold injury. Results of this study provide further evidence that *C. xenoplax* is a predisposing factor of peach trees to cold injury and the PTSL syndrome.—*Irrigated Agriculture Research and Extension Center, Washington State University, Prosser, WA 99350; and Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*

O'BANNON, J. H., and R. N. PEADEN. *Host suitability and reproductive potential of Meloidogyne chitwoodi to Medicago sativa.*

Meloidogyne chitwoodi is a major pest of potato in the Pacific Northwest. Principle crops grown in rotation with potato are alfalfa, a host of *M. hapla,* and cereals. The reproductive potential of *M. chitwoodi* was compared to *M. hapla* on *M. hapla* susceptible *Medicago sativa* cv. Ranger and resistant cv. Nevada Syn XX; in addition, host suitability of *M. chitwoodi* to several commercial

alfalfa cultivars was evaluated. Flats were inoculated with 6.0 eggs/cm^3 soil of either *M. chitwoodi* or *M. hapla,* planted with pregerminated Ranger or Nevada Syn XX seeds, and grown 45 days in a greenhouse at 20–25 C. Plants were washed free of soil and roots stained with hot acid-fuchsin in lactophenol. Index of reproduction (IR) and egg mass index (EI) of *M. hapla* were significantly correlated (r = 0.98). IR and EI values for *M. hapla* on susceptible Ranger were 100 and 3.1, respectively; on resistant Nev Syn XX they were 0.2 and 0.0, respectively. Values for *M. chitwoodi* on Ranger and Nev Syn XX were 0. *M. chitwoodi* females were rarely observed on Ranger and Nev Syn XX (mean = 3.1 and 0.7). Ten cultivars—African, DuPuits, Gladiator, Lahanton, Moapa, Ranger, Saranac, Thor, Vernal, and Washoe—were grown in flats infested with *M. chitwoodi* (9 eggs/cm^3 soil) for 56 days. Mean EI for each of the 10 cultivars was 0–1 (1 = 1–2 egg masses/plant), indicating slight reproduction may occur following a longer incubation period. These data show that alfalfa is not a suitable host for *M. chitwoodi.*—*USDA, ARS, Irrigated Agriculture Research and Extension Center, Prosser, Washington 99350.*

OLEXA, M. T., and G. C. SMART, JR. *Agricultural scientist as witness in administrative hearings.*

This report is part of a larger effort to investigate current issues in agricultural law and to present extension information on legal topics of importance to farmers, agricultural scientists, and other persons in farm-related professions. This specific educational material is intended to aid the agricultural scientist (especially one who serves as a witness in formal administrative hearings concerning registration of pesticides) to prepare both written and oral testimony and to anticipate tactics common to legal adversary proceedings. Direct and cross-examination are emphasized. During the hearing, any matter to which a witness testifies on direct examination can be the subject of cross-examination. Cross-examination allows an opposing attorney to question the qualifications of the witness and to determine the reliability (credibility) of that witness's testimony. The scope of allowable cross-examination is partly determined by the witness's oral and/or written direct testimony. If under cross-examination a witness appears confused or unsure of his testimony, such testimony may be accorded little evidentiary weight by the administrative law judge. Therefore, to present the testimony (data) most effectively, agricultural scientists involved in such cases must understand the tactics of opposing attorneys and the legal significance of their testimony. —*Department of Food and Resource Economics and Department of Entomology and Nematology, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.*

OLSEN, H. C., and G. W. BIRD. *Joint influence of nematicides, nitrogen, and crop rotation on Pratylenchus penetrans and potato production.*

The influence of two levels of nitrogen (84 and 252 kg/ha), two rotation crops (alfalfa and corn), and treatments (control, aldicarb, DD mixture plus methyl isothiocyanate [Vorlex], and aldicarb-Vorlex) on *Pratylenchus penetrans* and *Solanum tuberosum* cv. Superior were evaluated under commercial production conditions in a factorial randomized block design with five replicates. Soil and leaf tissue nutrient levels, *P. penetrans* population densities, and marketable tuber yields (MTY) were monitored. Following alfalfa, aldicarb or aldicarb-Vorlex resulted in increased (P = 0.05) MTY at 84 and 252 kg N/ha, compared with the controls. Following corn, nematicide applications at 84 kg N/ha did not increase MTY, and Aldicarb-Vorlex at 252 kg N/ha increased MTY above all treatments except aldicarb. Petiole nitrate after the alfalfa rotation was greater in the control and aldicarb-Vorlex at the high N level, compared with the low N treatment. After corn, petiole nitrate was significantly increased by the high N, compared to the low N treatment. Specific gravities of tubers following alfalfa were not influenced by N

level or nematicides. After corn, specific gravities were significantly reduced at the high N, compared to low N, except with Vorlex. Aldicarb and aldicarb-Vorlex reduced root and soil population densities of *P. penetrans*. The population differences were most pronounced at 1,063 degree days (base = 10 C). Vorlex reduced population densities of *P. penetrans* following the corn rotation, but not after alfalfa.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

ORR, C. C., A. F. ROBINSON, and J. A. VEECH. *Cotton losses to nematodes on the Texas High Plains.*

Two kinds of information are essential in assessing crop loss to pathogens: 1) yield comparisons of healthy and infected crops, and 2) knowledge of the pathogen's distribution. In 1981, we established nine 1-ha experiments to evaluate loss to root-knot nematodes in a 500,000-ha region of the Southern High Plains of Texas. Ethylene dibromide was used to simulate the root-knot nematode free condition. Soil samples taken from 330 farms indicate that approximately 50% of the survey region is infested with root-knot nematodes at a level comparable to population densities at the test sites. At these sites, cotton lint yields were increased 30% by fumigation, indicating that more than 15% of the cotton crop in the survey area, and probably more than 10% of the crop on the Southern High Plains, was lost to root-knot nematodes.—*USDA SEA AR, Lubbock, TX 79401, and College Station, TX 77840.*

OWNLEY GINTIS, B., G. MORGAN-JONES, and R. RODRIGUEZ-KABANA. *Fungal colonization of young cysts of Heterodera glycines in soybean field soils.*

An analysis of the mycoflora associated with young cysts of *Heterodera glycines* in two North Carolina coastal plain soybean field soils showed the predominating fungi within cysts to be *Acremonium strictum, Exophiala pisciphila, Fusarium oxysporum, Neocosmospora vasinfecta, Phoma leveillei, Phoma macrostoma, Septobasidium terreum, Thielavia terricola* and one organism referred to as "black yeast." Some, including *F. oxysporum* which occurs with considerable frequency, are considered to be opportunistic saprophytes of cyst mucilage. Others, particularly *E. pisciphila*, are implicated as pathogens of eggs. The fungi were shown to enter through native openings rather than by prior degradation of the cyst wall.—*Department of Botany, Plant Pathology and Microbiology, Agricultural Experiment Station, Auburn University, Auburn, AL 36849.*

PARK, R. H. N., D. BURGOYNE, and D. A. ALLISON. *Oxamyl (Vydate): different application techniques for nematode control.*

Oxamyl (Vydate Insecticide/Nematicide) is being marketed in the U.S. for control of insects and nematodes in potatoes, vegetables, pome fruits, cotton, tobacco, citrus, ornamentals and pineapples. Recent development work has demonstrated that careful placement of the chemical can provide nematode control at economic use rates with valuable yield increases. Successful treatment depends on applying sufficient active ingredient to the target area of soil in which the roots are growing. A single application may be sufficient in annual crops, but sequential treatments are usually necessary in perennial and irrigated crops. In nonirrigated field crops, such as soybeans, application of granules in the seed furrow at rates of 0.6–1.2 kg a.i./ha provides good nematode control. In drip irrigated tree and vine crops, such as citrus or grapes, 1.2 kg a.i./ha per month show economic yield responses. Work is currently in progress to time oxamyl applications according to periods of root growth when protection from nematode attack is most needed. A registration already exists in California for use through drip irrigation in tomatoes and citrus. Techniques for application in other forms of irrigation in a wide range of crops

are being investigated. Spot treatment in bananas has been found useful to control *Rhadopholus similis*. Up to four applications of 1.2–2.4 g a.i./banana mat are applied to the base of the daughter plants at the commencement of the rains (root growth) and repeated four weeks later. Successful use of oxamyl depends as much on application technique and reaching the target area as on rate of application. Availability of liquid and granules allows soil placement, foliar or spot applications, and use through irrigation systems.—*E. I. Dupont, Wilmington, DE 19898.*

QUALLS, M. G. *Application of metham (Vapam) through center pivot sprinklers for the control of nematodes in potatoes.*

Metham has been used successfully as a nematicide in many countries for the past 25 yr. Recently metham has been developed for application in sprinkler irrigation water prior to planting potatoes; 467 liters/ha is injected continuously into the mainline while the moving center pivot sprinkler is set to apply 2.54 cm of irrigation water in one revolution. Solid set sprinklers are also being used; however, the uniformity of application is not as great. Two species of root knot nematodes (*Meloidogyne hapla* and *Meloidogyne chitwoodi*) and one species of root lesion nematode (*Pratylenchus penetrans*) have been successfully controlled by this method of application. Depth of penetration and subsequent control has been studied using caged wireworms buried at various depths in the soil profile prior to application. Side benefits of weed seed control, disease control, and soil insect control have lead to yield increases which make this method of application economical to the producer. Applying metham through the sprinklers allows the grower the opportunity to leave wheat, corn, or alfalfa stubble on the soil surface to prevent wind and water erosion. The crop residue is used as a surface covering for holding in the fumes.—*Stauffer Chemical Co., 374 Dodson Road, Ephrata, WA 98823.*

RADICE, A. D., and P. M. HALISKY. *Interaction of concomitant populations of Macroposthonia curvatum and Tylenchorhynchus claytoni on creeping bentgrass.*

The interaction between two ectoparasites, *Macroposthonia curvatum* and *Tylenchorhynchus claytoni,* was studied in a greenhouse experiment on Penncross creeping bentgrass (*Agrostis palustris*). In one experiment, five single stolon sections were placed in 10-cm pots for 54 days. Dry weights and total biomass of bentgrass were reduced by both species alone and in combination. Significant reductions of root weight occurred only when *T. claytoni* was inoculated alone. Nematode population levels when inoculated alone and in combination were compared. The amphimitic, *T. claytoni,* produced more offspring when it was inoculated alone. In contrast, *M. curvatum* which is parthenogenic, failed to increase when inoculated alone. The combination of both species reduced total dry weights, but not significantly more than either species alone. When in combination with *M. curvatum,* the number of *T. claytoni* was reduced by 26%, while the number of *M. curvatum* was reduced by approximately 45%.—*Department of Plant Pathology, Cook College, New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, NJ 08903.*

RICHARDSON, L., and N. S. PRICE. *Host-parasite relationships of Meloidogyne incognita and the diageotropica tomato mutant.*

The diageotropica mutant (dgt) of tomato is characterized by horizontal shoot growth and a root system essentially devoid of lateral roots. Plants of normal tomato cv. Ailsa Craig and its dgt mutant were grown in pots in the glasshouse and hatched juveniles of *Meloidogyne incognita* added. Nematode invasion (second-stage juveniles per gram fresh weight of root) was much lower (12%) in dgt plants, and nematode development also proceeded more slowly than in normal Ailsa Craig. Foliage growth

was reduced by nematode infection in normal Ailsa Craig, but growth of dgt plants was unaffected. Galls on dgt tomato appeared later, were fewer in number, and much smaller in size than on normal Ailsa Craig.—*Department of Zoology, University of Reading, Whiteknights, Reading RG6 2AJ, United Kingdom; and Department of Plant Pathology, University of Georgia, Athens, GA 30602.*

RIGGS, R. D., and L. R. OLIVER. *Effect of trifluralin (Treflan) on soybean cyst nematode.*

Silt-loam soil infested with *Heterodera glycines* (SCN) was collected from the Cotton Branch Experiment Station (CBES), Marianna, Arkansas, in the winter of 1981. Trifluralin (Treflan) at a 0.84 kg/ha (3/4 lb/A) rate was mixed with sufficient soil to fill eight 15.4-cm-d clay pots. Five days after treatment, three pots were processed by the roiling and sieving-Baermann funnel method for the recovery of SCN larvae (L2), and after 35 days five pots were sieved for the recovery of mature SCN. The number of L2 recovered from the Treflan treated soil was five times as many as from the untreated check. The number of mature SCN recovered from Treflan treated soil was not different from the number from the check, but the root system was much more deteriorated. The test was repeated in 1982 with infested field soil from two locations. The results from the CBES silt loam soil were similar to 1981; compared to the untreated check the L2 count was 3.6 times greater at 0.42 kg Treflan/ha and 4.1 times greater at 0.84 kg Treflan/ha. Treatment of a fine sandy loam soil did not produce the same response. Field response was tested on the CBES silt loam soil in 1981. Two weeks after treatment more than twice as many L2 were recovered from the Treflan treated (0.8 kg/ha) plots. At 6 weeks more than six times as many L2 were recovered from the Treflan treated plots compared to the untreated check. On plots treated with metalachlor (Dual, 4.2 L/ha) the difference was not as great after 2 weeks, but greater after 6 weeks.—*Department of Plant Pathology, University of Arkansas, PS 217, Fayetteville, AR 72701.*

ROBBINS, R. T. *Phytoparasitic nematodes associated with soybean in Arkansas.*

Nematode specimens were obtained from the following sources: 1) Arkansas Nematode Assay and Diagnostic Service samples, 2) survey samples from the Arkansas Crop Reporting Service (1979-1981), and 3) a special survey of Mississippi County, Arkansas (1981). Samples were taken from fields planted to soybean or planted to soybean the previous season. The samples were extracted by the sieving-Baermann funnel technique. Tentative nematode identifications are in brackets. The distribution of species is rated as very common (C), frequent (F), infrequent (I), or rare (R). The following phytoparasitic nematodes were identified: *Belonolaimus nortoni* (R), *Criconemoides* (*Macroposthonia*) spp. (I), *Gracilacus* spp. (F), *Helicotylenchus dihystera* (I), *H. pseudorobustus* (F), *Hemicycliophora* spp. [*H. triangulum*] (I), *Heterodera glycines* (C), *Hoplolaimus galeatus* (I), *H.* sp. (description in press) (I), *Longidorus* sp. (undescribed) (R), *Meiodorus hollisi* (R), *Meloidogyne hapla* (F), *M. incognita* (F), *Paratrichodorus christiei* (C), *Paratylenchus projectus* (I), *P.* spp. [*P. tenuicaudatus*] (F), *Pratylenchus alleni* (C), *P. brachyurus* (F), *P. hexincisus* (R), *P. neglectus* (I), *P. scribneri* (C), *P. vulnus* (R), *P. zeae* (F), *Quinsulcius acutus* (C), *Rotylenchulus reniformis* (R), *Scutellonema bradys* (I), *Tylenchorhynchus ewingi* (C), *T.* [*goffarti*] (R), *T. martini* (I), *T.* spp., *Xiphinema americanum* (C), *X. chambersi* (R), *X. rivesi* (R).—*Department of Plant Pathology, University of Arkansas, PS 217, Fayetteville, AR 72701.*

ROBBINS, R. T. *Phytoparasitic nematodes of noncultivated habitats in Arkansas.*

Nematode specimens were obtained from samples sent to the Arkansas Nema-

tode Assay and Diagnostic Service or from survey samples. Nematodes were extracted for identification by sieving with Baermann funnel or sugar centrifugation. The following nematodes were identified (tentative identifications in parentheses): *Aorolaimus helicus, A.* sp., *Belonolaimus nortoni, Bursaphelenchus xylophilus, Cactodera (cacti), Californidorus* spp., (*Criconema* spp.), *Criconemoides* (*Macroposthonia, Xenocriconemella*) spp., *Dolichodorus* sp., *Gracilacus* spp., *G. (acicula), G. (aculenta), G. (latescens), Helicotylenchus dihystera, H. pseudorobustus, H.* spp., *Hemicriconemoides* sp., *Hemicycliophora* spp., *Heterodera butulae, H. glycines, H. schachtii, H. trifolii, H. weissi, H.* spp., *Hirschmanniella* sp., *Hoplolaimus galeatus, H.* spp., *Longidorus* spp., *Loofia (gigas), Meloidogyne arenaria, M. graminis, M. hapla, M. incognita, M. javanica, M.* spp., *Merlinius brevidens, M.* sp., *Nacobbus aberrans, Nothocriconema* spp., *Paratrichodrus christiei, P. porosus, Paratylenchus projectus, P. (tenuicaudatus), P.* spp., *Peltamigratus* sp., *Pratylenchus alleni, P. brachyurus, P. hexincisus, P. neglectus, P. penetrans, P. scribneri, P. vulnus, P. zeae, Punctodera (punctata), Quinsulcius acti, Q. acutus, Rotylenchus* spp., *Scutellonema brachyurum, S. bradys,* (*Sphaeronema* sp.), *Trichodorus obscurus, Tylenchorhynchus claytoni, T. ewingi, T. (goffarti), T. martini, T. (maximus), Xiphinema americanum, X. bakeri, X. chambersi, X. rivesi, X.* sp.—*Department of Plant Pathology, University of Arkansas, PS 217, Fayetteville, AR 72701.*

ROBERTS, P. A., A. G. GEORGE, and W. C. MATTHEWS. *Effects of root knot nematode field populations on cotton growth and yield.*

Cotton cv. Acala SJ5 growth and yield were compared in a *Meloidogyne incognita* infested sandy loam field near Tulare, California, in replicated, paired, 1,3-Dichloropropene fumigate (Telone, 84 L/Ha), and nontreated 3.9-m × 7.6-m plots. Preplant *M. incognita* juveniles averaged 11 and 293 per 250 cm^3 soil, respectively. Low numbers of stubby root nematode were also present. Weekly plant growth was related to accumulated day-degrees (D°) > 11.9 C, starting at 672 D° from planting. Rate of plant height increase was 36.7% lower ($P = 0.01$) on heavily infected plants before boll maturation. Flower bud, flower, and boll production rates by heavily infected plants were lower ($P = 0.05$ or 0.01) than by lightly infected plants in treated soil, especially as production neared maximum. However, onset of flowering, maximum numbers of flower buds and flowers per plant, onset of boll production, and maximum bolls per plant on heavily infected plants occurred at the same accumulated D° (790, 885, 1,090, 885, and 1,289, respectively) as on lightly infected plants. Seed lint yield was reduced 51.7% ($P = 0.01$) in untreated plots. Data indicate nematode stress reduces cotton plant growth rates but does not alter the timing of physiological events. Seed lint yield as a function of preplant *M. incognita* juveniles (1–568/250 cc soil on 30 field plots) conformed to Seinhorst's model $y = m + (1\text{-}m)\, z^{(P-T)}$, ($r^2 = 0.624$, $P = 0.01$), indicating the potential of predictive management using preplant sampling.—*Nematology Department and Co-operative Extension, University of California, Riverside, CA 92521.*

ROBINSON, A. F., C. C. ORR, and C. E. HEINTZ. *Effects of NaCl, sucrose, and artificial soil solutions on the survival of Orrina phyllobia.*

Infective L4 juveniles of *Orrina phyllobia* were maintained at various water potentials between –2.5 and –200 bars in sucrose, NaCl, and an artificial soil solution containing Na^+, K^+, Ca^{++}, Mg^{++}, Cl^-, and NO_3^-. Juveniles always survived instantaneous transfer from distilled water to sucrose solutions but were killed by both instantaneous and gradual (9 h, linear) transfer to NaCl at concentrations greater than 360 mmol/L (–15 bars). Toxic effects of the artificial soil solution were observed only at lower water potential (–60 bars). After transfer from distilled water to artificial soil and sucrose solutions in the range of –2.5 to –15 bars, nematode activity immedi-

ately decreased and then partially or completely recovered during the next 24 h. At water potentials exceeding –30 bars, movement ceased within 2 h and nematodes became partially dehydrated. Activity returned 2–4 h after the resuspension of nematodes in distilled water. Continuous suspension in concentrated sucrose (–60 bars) prolonged life by 3 wk. Preliminary results of ongoing experiments testing a wide array of ratios among eight common soil ions suggest that variable effects on survival occur within the ranges of concentrations which exist in situ. Sodium ion, Ca^{++}, or Mg^{++} in particular may be toxic when present at relatively high concentrations.—*USDA, SE, ARS, Southern Plains Cotton Research Laboratory, Route 3, Lubbock, TX 79401.*

RUSSELL, C. C. *Interaction of soil moisture, fungi, and nematodes on wheat.*

The plant parasitic nematodes most consistently associated with debilitated wheat in Oklahoma are the root lesion, stunt, and pin nematodes. Dagger, spiral, lance, and stubby root nematodes are less commonly encountered in the wheat rhizosphere and infrequently cause measureable yield reductions under field conditions. Root lesion, stunt, lance, and stubby root nematodes have been demonstrated to have sufficient pathogenic potential to cause economic yield reductions. Root lesion nematodes and several pathogenic fungi have been shown to be components of a variously constituted disease complex on wheat. The fungal components of the disease complex may vary from year to year in the same area of a field. The fungal component of the complex, as well as the degree of yield reduction, appears to be influenced to a major extent by abiotic factors. Chemical applications at several locations per year over the past 10 yr have usually produced significant and economic increases in forage and grain production. Economic yield increases were not obtained in some trials despite excellent nematicidal and fungicidal efficacy, due to the predominating influence of abiotic conditions, especially soil moisture. —*Department of Plant Pathology, Oklahoma State University, Stillwater, OK 74078.*

SANTO, G. S., and R. P. PONTI. *Control of nematodes on Concord grapes with nonfumigant nematicides.*

Two nematicide trials were conducted near Pasco, Washington, in a sandy loam soil for control of *Meloidogyne hapla* and *Xiphinema pachtaicum* on Concord grapes. In Trial I aldicarb, carbofuran, and phenamiphos were applied in 1978, 1979, and 1980; in Trial II Standak (2-Methyl-2-[methyl sulfonyl] propionaldehyde 0-[methyl carbamoyl] oxime) was applied in 1978 and 1979. No yield differences were observed in the first year after treatments in either trial. In 1979 significant (P = 0.05) yield increases were observed in the aldicarb 15G at 8.6 kg a.i./ha, carbofuran 10G at 10.8 kg a.i./ha, and Standak at 4.3 and 8.6 kg a.i./ha treatments. In 1980 aldicarb 15G at 4.3 kg a.i./ha and phenamiphos 3SC at 21.6 kg a.i./ha also increased (P = 0.05) yields. Carbofuran 4F at 10.8 kg a.i./ha did not result in yield increases in any year. Although no nematicide treatments were made in 1981, aldicrab and carbofuran 10G plots continued to show significant yield increases. In 1980 Trials III and IV were conducted near Prosser, Washington, in a sandy loam and loam soil, respectively, for control of *M. hapla* (Trial III) and mixed populations of *M. hapla* and *X. pachtaicum* (Trial IV). No yield differences were observed the first year after treatment. In 1981 significant (P = 0.05) yield differences occurred in Trial III, but not in IV. Treatments showing yield increases were aldicarb 15G at 4.3, 6.5, and 3.2 kg a.i./ha applied in the spring plus 3.2 kg a.i./ha in the fall; aldicarb 20 G at 4.3 kg a.i./ha and carbofuran 4F at 10.8 kg a.i./ha. No differences in nematode counts were observed among the treatments in Trials I, III, and IV. In Trial II, Standak reduced *X. pachtaicum* populations the first year, but not the second. Trials I-III were sprinkler irrigated and Trial IV was furrow irrigated. —*Department of Plant Pathology, Washing-*

ton State University, and Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.

SAUNDERS, M. C., and J. N. ALL. *Population regulation of the grape root borer, Vitacea polistiformis, by entomophilic Rhabditoid nematodes.*

Two bioassays were conducted in which newly eclosed, first-instar larvae of the grape root borer (GRB), *Vitacea polistiformis*, were shown to be susceptible to the entomophilic Rhabditoid nematode (ERN), *Neoaplectana carpocapsae*. Inverse correlation was demonstrated between ERN activity in vineyard soils and associated GRB density. The negative impact of ERN activity on first instar GRB survivorship was suggested as one method by which GRB populations are regulated.—*Department of Entomology, University of Georgia, Athens, GA 30602.*

SCHMITT, D. P., and F. T. CORBIN. *Population dynamics of Heterodera glycines and soybean response in soils treated with phenamiphos and preemergence herbicides.*

Two factorial experiments were conducted in 1978 and 1979 to determine the interactive effects of phenamiphos and herbicides (alachlor, fluchloralin, metolachlor, linuron, metribuzin) on the population dynamics of *Heterodera glycines* and related effects on soybean yields. In 1978, the numbers of juveniles and eggs were generally greater in alachlor treated plots. At harvest, numbers of juveniles were greater in the phenamiphos + alachlor treatment than with phenamiphos alone. In 1979, the numbers of juveniles ($P = 0.05$) and eggs ($P = 0.06$) were greater in the phenamiphos + alachlor treatments than with phenamiphos alone or with phenamiphos in combination with other herbicides. Soybean seed yields were less ($P = 0.05$) with the combination of phenamiphos and linuron than with the nematicide alone in 1978. Although phenamiphos + alachlor enhanced population buildup of *H. glycines*, this interaction had no effect on yield. This enhanced population buildup, however, may be important for the subsequent crop. It is of practical importance to understand the biology and population dynamics of the soybean cyst nematode's relationship to pesticide inputs for optimal nematode management.—*Department of Plant Pathology and Crop Science, North Carolina State University, Raleigh, NC 27650.*

SCHUERGER, A. C., and M. A. McCLURE. *Ultrastructural changes induced by Scutellonema brachyurum in roots of potato, Solanum tuberosum.*

Scutellonema brachyurum initiated dark brown lesions on potato roots within 12 h after feeding began. Lesions eventually extended several hundred micrometers axially in the root and involved cells not directly penetrated by the nematode. However, ultrastructural modifications occurred only in cells penetrated by the nematode's stylet. Insertion of the stylet resulted in an invagination of the plasmalemma and a proliferation of the invaginated membrane to form a membranous network around the stylet. A feeding plug, which appeared to emanate from the buccal cavity surrounded the stylet where it breached the cell wall. Other modifications to the parasitized cell included longitudinally arranged "macrotubules" (20–40 nm) and dense spherical inclusions associated with the membranous network. Bacteria were found only in cells disrupted by the nematode.—*Walt Disney World, EPCOT Center Land Pavillion, Lake Buena Vista, FL 32830; and Department of Plant Pathology, University of Arizona, Tucson, AZ 85721.*

SHELBY, R., P. KING, M. POPE, and R. RODRIGUEZ-KABANA. *Reaction of corn (Zea mays L.) inbred lines to Meloidogyne incognita and other nematode species.*

Reaction of selected yellow dent corn lines to a mixed population of *Meloidogyne incognita, Paratrichodorus christiei,* and *Helicotylenchus dihystera* was studied in a greenhouse experiment with infested and steamed field soil. Inbred corn lines A635Ht, B68, B73, H100, H60, Mo17, Oh7BHt, Sc213, and Va35 were planted in 1-L pots and allowed to grow until day 30 when the degree of root galling, nematode numbers, and the effect on plant growth were determined. All lines but Sc213 supported larval populations of *M. incognita;* Mo17 had the highest number of galls per gram of root and supported the highest larval population. Pots with H60 contained the highest numbers of *Paratrichodorus christiei* and *Helicotylenchus dihystera.* All other lines sustained populations of the two species to varying degrees. All inbreds showed greater shoot height, shoot weight, and root weight when grown in steamed soil rather than infested soil.—*Department of Botany, Plant Pathology, and Microbiology, Agricultural Experiment Station, Auburn University, Auburn, AL 36849.*

SCHILLING, KURT. *Life cycle studies of variants of the soybean-cyst nematode, Heterodera glycines Ichinohe.*

Isolates of representative populations of *Heterodera glycines* Ichinohe from various states were used in life cycle studies. Three studies were conducted under greenhouse conditions in 100-mesh white quartz sand in an electrically heated bed. Water and nutritional requirements were provided by twice daily watering and the application of a dilute aqueous fertilizer solution. The life cycle was defined as the time required from inoculation until second-stage larvae were recovered from the soil. Host plants were inoculated with eggs and larvae, then transplanted 2–3 days later into fresh sterile sand. Plants were screened starting 10 days after inoculation. In one study, all 14 populations completed their life cycles within 17–25 days. This was shorter than had been reported previously. In a second study the life cycle on susceptible and resistant soybean cultivars was compared. The results were inconclusive. In a third study the life cycle of selected populations on 'Kobe' lespedeza (*Lespedeza striata*) was investigated; a life cycle of 12–14 days was common for the six populations used in the study. These studies demonstrate that the life cycle of *H. glycines* is variable and host dependant.—*Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.*

SLANA, L. J., R. S. YOUNG, and J. G. BARRAT. *The relationship between nematode density and the presence of weeds within a herbicide-apple orchard field test.*

Density of phytoparasitic nematode populations in relation to weed occurrence was examined in an 18-yr-old apple orchard test plot near Charles Town, West Virginia. In the field trial 54 soil and root samples were collected from between 36 trees. Weed presence was recorded at each sample site. Within the simazine-treated (4 lb/ac) plots, 64% of the samples were taken in barren soil; remaining samples were taken in the presence of *Rhus radicans* (poison ivy) 12%, *Aster* sp. 8%, *Oxalis* sp. 4%, *Parthenocissus quinquefolia* (Virginia creeper) 4%, *Solanum carolinense* (horse nettle) 4%, and *Solidago* sp. (goldenrod) 4%. Nontreated control plot samples were taken in the presence of *Ambrosia artemisiifolia* (ragweed) 34%, *Solidago* sp. 17%, *Oxalis* sp. 17%, *Dactylis glomerata* (orchard grass) 12%, and 5% each of barren soil, *Asclepias* sp. (milkweed), *Cichorium intybus* (chickory), and *R. radicans.* Nematode mean densities in treated plots were 2.9, 1.5, and 3.6 times greater than control plots for *Pratylenchus* sp., *Tylenchorhynchus* sp., and *Xiphinema* sp., respectively, and 0.4, 0.6, and 0.1 times smaller for *Helicotylenchus* sp., *Hoplolaimus* sp., and *Paratylenchus* sp., respectively. *Pratylenchus* sp. were present at all sample sites, and highest soil counts

were found in the presence of *Aster* sp., *Ambrosia* sp., *P. quinquefolia*, and *Oxalis* sp. The herbicide test modified weed distribution which seemed to alter phytoparasitic nematode densities within the orchard.—*Appalachian Fruit Research Station, USDA, ARS, Kearneysville, WV 25430; and West Virginia University Experiment Station, Kearneysville, WV 25430.*

SLANA, L. J., and R. M. SAYRE. *Some physical factors influencing spore attachment of Bacillus penetrans to larvae of Meloidogyne incognita.*

Some possible physical factors influencing spore attachment of *Bacillus penetrans* (Mankau 1975) to the cuticle of *M. incognita* second-stage larvae were examined. Aqueous nematode spore suspensions were subjected to constant aeration, continual shaking, or no agitation and compared to the soil slurry method of bringing spores and nematodes into intimate contact. The aqueous nematode spore suspensions were composed of 1-g samples of dried, finely ground pepper roots; infested with bacterially parasitized nematodes sieved through 25-μm screens; diluted to 4,000 2,000, 1,000, 500, 250, 125 mg/L; and replicated six times. Fifty milliliters of each concentration was mixed with 3,000 root-knot larvae and either not agitated or agitated by bubbled air (4 ml/sec) or wrist-action shaker. In the final group, 50 ml of soil was added to each spore and nematode concentration, shaken for 30 min, and excess water in the soil slurry drawn off using a filter and Buchner funnel. All samples were microscopically examined after 24 and 48 h to determine the number of spores adhering to the nematode cuticle. The average percent of spore laden nematodes varied with the treatments: constant aeration 52%, continual shaking 38%, no agitation 54%, and only 2% from the soil treatment. Results suggest spore attachment occurs readily in aqueous nematode suspensions and points to some physical conditions necessary for a reliable bioassay method to determine presence of *B. penetrans.*—*Appalachian Fruit Research Station, USDA, ARS, Kearneysville, WV 25430; and Nematology Laboratory, USDA, ARS, Beltsville, MD 20705.*

SORTLAND, M. E., and D. H. MacDONALD. *Development of a Minnesota population of Heterodera glycines Race 5 at four soil temperatures.*

Root systems of 14-day-old soybean (*Glycines max* 'Hodgson 78') seedlings were each placed in contact with 58 cm^3 of field soil infested with approximately 600 larvae of *Heterodera glycines* Race 5. Seedlings were grown in the greenhouse at 23 C for 5 days before being transplanted into sand-filled containers placed in temperature tanks maintained at 15, 20, 25, or 30 C. Five plants were harvested from each temperature tank every 2 days for 2 weeks, beginning 7 days after transplanting plants to the 25 and 30 C tanks and 13 days after transplanting plants to the 15 and 20 C tanks. Nematodes were collected on a sieve with 74-μm openings, categorized as to developmental stage, and counted. Mature female nematodes with eggs were present after 15 days in the 30 C temperature tank, 17–19 days at 25 C, and 23–25 days at 20 C. At 15 C, one mature white female was recovered at 28 days, but the others were still in an immature stage at 30 days. Based on these data, this nematode should have a life cycle of approximately 25 days in southern Minnesota where the June through August soil temperatures range between 20 and 26 C at 10 cm. Three or possibly four generations per growing season should occur if eggs hatch immediately.—*Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.*

STARR, J. L., D. P. SCHMITT, and A. W. DUPREE, JR. *Parasitism of soybean cv. Bedford by Heterodera glycines Race 1.*

During the 1980 growing season two fields of soybean cv. Bedford in Beaufort County, North Carolina, exhibited symptoms of severe cyst-nematode (*Heterodera glycines* Inchinohe, 1952) damage. The

nematode populations were identified as Race 1, and the indices of parasitism were 100% on 'Lee 68,' 86.1% on PI88788, 0.3% on 'Pickett 71,' and 0% on PI90763. Although 'Bedford' is reported to have resistance to Race 1 populations, an isolate from these Beaufort County populations reproduced as well on Bedford as it did on the susceptible Lee 74. In greenhouse tests on Bedford the index of parasitism was 112%. The same cyst isolate had indices of parasitism of less than 10% on the Race 1 resistant cultivars Pickett 71, 'Centennial,' and 'Forrest.' In microplot tests Bedford supported a significantly ($P = 0.01$) higher final population density of Race 1 than it did of Race 3 or Race 4. In field plots located in Lenoir County, North Carolina, a Race 1 population suppressed yields of Bedford by 38.7% as compared to yields in phenamiphos treated plots. The same population had no effect on yields of 'Centennial.' Based on these data, Bedford is no longer recommended as a *H. glycines* Race 1 resistant cultivar in North Carolina.—*Agronomic Division, North Carolina Department of Agriculture and Department of Plant Pathology, North Carolina State University, Raleigh, NC 27650.*

THIES, J. A., and D. H. MacDONALD. *Relationship of Meloidogyne hapla and Verticillium albo-atrum in Verticillium wilt of potato.*

Ten egg masses of *Meloidogyne hapla* containing approximately 2,000 eggs were placed under 100 of 200 29-mm-d seed pieces of virus-free, *Verticillium albo-atrum*-free potato tubers (*Solanum tuberosum* 'Norland') planted in pasteurized silt loam soil in 13-cm clay pots. Two or four weeks after planting, 0, 10^7, or 10^8 conidia of *V. albo-atrum*/10 ml sterile distilled water were introduced into the root zone of each plant through a previously placed section of glass tubing. Plants were maintained as single stems on glasshouse benches for 74 days at 21–28 C air temperatures. The infection of Norland potato plants by *V. albo-atrum* was independent of *M. hapla*. When treatment means were averaged over *V. albo-atrum* levels and inoculation times, plants grew significantly ($.025 < P < .05$) taller in the presence than in the absence of *M. hapla*. Also, when treatment means were averaged over nematode levels, fungal inoculum levels and inoculation times, plants grew significantly ($.005 < P < 0.25$) shorter in the presence than in the absence of *V. albo-atrum*. Neither organism had any significant effect on plant fresh weight or wilt symptoms; nor were there any significant interactions between the two in their effects on plant height, weight, wilt symptoms, or Verticillium infection.—*Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108.*

THOMAS, R. J., and C. A. CLARK. *Concomitant reproduction and population dynamics of Meloidogyne incognita and Rotylenchulus reniformis on sweet potato.*

In sweet potato field plots with a high natural population of *Rotylenchulus reniformis* (Rr) (2,700/250 cm^3 soil 8 April), artificial infestation with high levels of *Meloidogyne incognita* (Mi) (4,000/250 cm^3 soil in upper 30 cm) in both fumigated and nonfumigated treatments inhibited Rr, while the final Mi population was not affected. In various greenhouse tests using inoculum levels of 500–10,000 Mi eggs and/or Rr eggs or larvae + young adults per 15-cm pot, and times from 45 to 95 days, Rr was inhibited by Mi while Mi was not affected by Rr. In field plots fumigated with methyl bromide and then infested with low levels of Rr, Mi, and Rr + Mi (100/250 cm^3 soil), final populations of Mi were inhibited by Rr but Rr was not affected by Mi. In greenhouse tests, fibrous root weights of plants inoculated with Rr + Mi frequently were higher than those inoculated with Mi alone, indicating an early suppression of Mi by Rr. Rr + Mi failed to affect each other when they were inoculated simultaneously onto root systems developed in separate pots from different nodes of the same plant. After shoot excision, Rr increased in the soil but Mi decreased. Results from field studies indicate that a competi-

tive interaction exists, with each species capable of inhibiting the other. In natural infestations, Rr predominance may be favored by a much higher survival rate between crops.—*Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Experiment Station, Baton Rouge, LA 70803.*

THOMAS, S. H., and J. A. RYDER-WHITE. *Effect of low inoculum levels of Meloidogyne incognita on three chile cultivars.*

Meloidogyne incognita (Kofoid & White, 1919) (MI) is the principle nematode pest of chile peppers (*Capsicum annuum*) in southern New Mexico. A factorial microplot experiment with five inoculum densities (P_i) of MI and three chile cultivars was designed to determine the effects of initial nematode populations on chile growth in a sandy loam soil. Five fumigated microplots of each cultivar were infested with each MI level (P_i): 0, 50, 100, 200, and 500 eggs and juveniles/500 cm^3 of soil. Cultivar selection was based on regional commercial importance and included Jalapeno, New Mexico No. 6, and Sandia. Plants were harvested 150 days after inoculation. Growth parameters measured for each of the five plants per microplot included shoot height and weight and pod length, weight, and number. MI populations greater than $P_i = 50$ reduced all growth parameters except pod length for all cultivars, with pod weight and number and shoot weight most significantly affected. Greatest injury occurred to NM No. 6. Inoculum level $P_i = 50$ mildly increased growth of Jalapeno and Sandia. The reproduction factor ($RF = P_f/P_i$) for Jalapeno at $P_i = 50$ was 28 compared to 61 and 63 for NM No. 6 and Sandia, respectively. RF values were similar among cultivars for other inoculum levels. Low levels of MI (above $P_i = 50$) significantly reduced growth of chile cultivars in sandy loam soil.—*Department of Entomology and Plant Pathology, New Mexico State University, Las Cruces, NM 88003.*

THOMPSON, J., and A. P. ELLIOTT. *Economics of control of Meloidogyne sp.*

A field study was conducted to determine the optimum rate of phenamiphos (Nemacur 15 G) for control of *Meloidogyne* sp. on 'Essex' soybean variety. Results indicated that effective control of *Meloidogyne* sp. was not obtained with the lowest concentration of phenamiphos (0.75 lb a.i./acre). After 971 degree days, base 10 C (DD_{10}) effective control was obtained with higher rates ranging from 1.5 lb a.i. to 6.0 lb a.i. phenamiphos/acre. Population densities fluctuated throughout the growing season with one peak population at 1,541 DD_{10} and another at 2,316 DD_{10}. The regression analysis of soybean yield and phenamiphos concentration was expressed as a positive linear relationship described by the equation $Y = 18.35 + 0.56X$. Results indicate that 2.25 lb a.i./acre was the optimum economic rate of control.—*Department of Plant Pathology and Physiology, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.*

TOWSON, A. J., and W. J. APT. *Effect of soil water potential on survival of Meloidogyne javanica in fallow soil.*

A natural infestion of *Meloidogyne javanica* in an aggregated Oxisol declined at an exponential rate when aliquots of the soil were stored for 72 days in polyethylene bags at various soil water potentials (ψ). Time periods required for reduction in soil infestation by 50% were 2.7, 4.9, 110, 10, and 2.6 days at ψ of –0.16, –0.30, –1.1, –15, and –92 bars, respectively. In the wetter soils, at ψ of –0.16, –0.30, and –1.1 bars, the predominant stage recovered was the second-stage larva. In the drier soils, at ψ of –15 and –92 bars, both eggs and larvae were recovered with neither stage predominating. Incidence of coiled larvae was inversely related to the ψ value of the soil, a greater incidence occurring in the drier soils. After 15–32 days, percentages of coiled larvae were 13, 27, 55, 65, and 88% in soil at ψ of –0.17, –0.60, –1.9, –15, and –82 bars, respec-

tively.—*Department of Plant Pathology, University of California at Davis, Davis, CA 95616; and Department of Plant Pathology, University of Hawaii at Manoa, Honolulu, HI 96822.*

TOWSON, A. J., and B. LEAR. *Eradication of nematodes in rose by hot-water treatment modified by heat-hardening.*

Thermal injury to hot-water-treated roses was reduced by pretreating the plants at 37.8 C for 24 h to induce heat-hardening, and by hot-water treating only the roots and crowns. After hot-water treatment at 48.3 C, heat-hardened plants produced more total stem growth and more uniform growth than plants that were not heat-hardened. Both *Pratylenchus vulnus* and *Meloidogyne hapla* were killed at an exponential rate by the pretreatment, although nematodes that survived the pretreatment were heat-hardened. Rose plants infected with *P. vulnus* were held at 2.2 C for 3 wk to induce cold-hardening, held at 37.8 C for 24 h to induce heat-hardening, and treated at 48.3 C by partial immersion (roots and crowns) for up to 35 min. No thermal injury to the plants was observed over a 6-wk period. While specimens of *P. vulnus* were recovered from all nontreated plants, none was recovered from plants treated for 30 and 35 min. A test of the effect of lifting time on dormancy and heat tolerance showed that the level of dormancy was greater in plants that were lifted in October than in plants lifted later. Contrary to expectations, dormancy was not correlated with heat tolerance. Plants lifted in October were most sensitive to hot-water treatment.—*Department of Plant Pathology, University of California at Davis, Davis, CA 95616.*

VAN ARKEL, R. G., G. W. BIRD, and T. C. EDENS. *Economics of multi-year control of Meloidogyne hapla in carrot production.*

DD mixture plus methylisothiocyanate (Vorlex) was used to evaluate the multiple-year economics of *Meloidogyne hapla* control in Michigan carrot production. Four rates of Vorlex (0, 173, 345, and 518 L/ha) were injected into organic soil the fall before planting *Daucus carota* (cv. Gold Pac). After harvest, four additional treatments of Vorlex (0, 173, 318, and 462 L/ha) were superimposed to provide 16 treatments, each replicated four times in a randomized block design. *Meloidogyne hapla* population densities and carrot yields were monitored. A simplified dynamic programming approach was used to rank the marginal net benefits (1–16) and indicate their periodicity interdependence. All rates of Vorlex reduced final population densities of *M. hapla* the year after application. The 345 and 518 L/ha rates provided 2-yr nematode population suppression. The marginal net benefits for the first year were $711, $366, and –$350 for the 173, 345, and 518 L Vorlex/ha treatments, respectively. For the two years analyzed interdependently, the marginal net benefits ranged from $669 for the 173–318 L/ha treatment to –$56 for the 345–318 L/ha treatment. The interdependent benefits from the 173–0, 518–0, and 173–173 L Vorlex/ha treatments ranked 2, 3, and 4, respectively. The 0–462, 0–0, and 518–462 kg Vorlex/ha treatments ranked 13, 14, and 15, respectively. Treatment the first year was an important factor for economic optimization and reduced the pest risk associated with the second year crop.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

VAN GUNDY, S. D., and S. GARABEDIAN. *A pest management approach to citrus nematode control on citrus. citrus.*

A pest management approach to the control of the citrus nematode (*Tylenchulus semipenetrans*) has been developed that links soil temperature, root growth, and nematode activity to the timed application of aldicarb and oxamyl. This management practice slowly decreases the number of females on the roots and increases root biomass, fruit yield, and fruit size. Modifications have been adopted for varying cul-

tural practices and irrigation systems. These principles may have application to the development of alternatives to DBCP on other perennial trees and vines.—*Department of Nematology, University of California, Riverside, CA 92521.*

WANG, K. C., and T. A. CHEN. *Electron-microscopy of the posterior body of Scutellonema sp.*

The ultrastructure of the posterior body region of *Scutellonema* sp. was studied in longitudinal and cross-section using transmission electron microscopy. The cuticle consisted of seven layers. Two of the inner layers exhibited a thin electron-dense globular mass and a thick wavy net-like layer which were different from the basal layers found in the cuticles of other plant-parasitic nematodes. Each of the large paired phasmids was a single-ciliated glandular sensory organ. The opening of the organ formed a cup-shaped cavity filled with a plug of electron-dense material which was secreted by the neuro-glands just inside it. Two spicules, each with a central cord of nervous tissues, were separated by a cuticular guiding bar. Their anterior regions were held by a U-shaped gubernaculum. The distal end of the gubernaculum connected to an accessory cuticular piece which was equipped on both sides with a pair of tubes filled with nerve process and extended posteriorly to the outside of the nematode body.—*Department of Plant Pathology, P.O. Box 231, Cook College, New Brunswick, NJ 08903.*

WARTMAN, F. S., V. D. LUDDERS, and V. H. DROPKIN. *Repeated single cyst passage of selected populations of Heterodera glycines.*

Two populations (P1 and P4) selected from a gene pool on soybean PI's 209332 and 89772, respectively, were propagated by single cyst passage for nine generations to improve genetic uniformity of selected populations. Plants of each PI were grown in a gene pool of 20 different soybean cyst nematode (SCN) sources. After 30 days, 95 large females were recovered from plants of each PI and transferred singly to soil in PVC tubes (2.5 × 15 cm) in crocks in a water bath at 27 C. One 2-day-old seedling of the selecting PI was put in each tube. There were duplicates of each line to minimize the loss of lines. After one generation (30 days), one large female was removed from each plant and transferred to a new pipe. Care was taken to change the position of each line in the greenhouse at every transfer. Number and size of cysts at each transfer were recorded in 20 randomly chosen lines of P1 and 20 of P4. Ratios of small to large cysts declined for both sets of lines, indicating some selection against small cysts. Cyst counts were variable, some lines remaining uniform while others showed more fluctuation. The highest number of cysts recorded was 132; the lowest was zero. Ten lines including duplicate transfers were lost in P1 and one in P4. Data from P1 lines appeared more variable than data from P4 lines. The mean number of cysts began to increase in the selfed lines of P1 at the second generation, but not until the third generation in P4. After increasing, host-selected selfed SCN lines should be useful for investigating some aspects of the genetics of resistance in SCN-resistant soybeans.—*Department of Plant Pathology; USDA, ARS, Department of Agronomy; and Department of Plant Pathology, University of Missouri, Columbia, MO 65211.*

WILLUT, J. M., and R. B. MALEK. *Effect of date of planting and carbofuran treatment on nematode population development and yield of dent corn.*

The influence of date of planting and nematicide treatment on population development of *Hoplolaimus galeatus* and *Pratylenchus scribneri* and nematode damage to corn on irrigated sand was investigated in 1980 and 1981. There were four biweekly dates of planting from late April to early June, with and without a carbofuran band treatment (33 g a.i./100-m row). A hot growing season in 1980 stimulated

rapid nematode population development, whereas a cold, wet 1981 season inhibited development. In untreated soil, root and soil populations of *H. galeatus* at midseason appeared unaffected by planting date in both years. Root populations of *P. scribneri* generally developed to higher levels by midseason the earlier the crop was planted in 1980, but were depressed only by the last planting date in 1981. Highest yields were obtained in May plantings. Carbofuran suppressed early season population development of both species in 1980, but was more effective against *P. scribneri*. The degree of suppression was more pronounced the later the planting date. Suppression was generally poor in 1981. Treatment improved seedling growth and color in both years. Carbofuran significantly increased yields with the first three dates in 1980 and the middle two in 1981. Yield response from treatment in 1980 was greater the earlier the planting. Effects of nematicide treatment on growth and yield were more pronounced in that year.—*Department of Plant Pathology, University of Illinois, Urbana, IL 61801.*

WYSS, U., and J. MÜLLER. *Life cycle and growth of Heterodera schachtii on excised roots of Brassica napus under gnotobiotic conditions.*

In co-operation with the Institut für den Wissenschaftlichen Film in Göttingen, BRD, a teaching film (16 mm, color, 138 m, 13 min, with English commentary) was made on the life cycle of *Heterodera schachtii*. Invasion and migration of infective larvae through cortical cells were filmed at normal speed or slightly accelerated. As soon as the nematodes settled at future feeding sites, their development was filmed by time-lapse cinematography. The film shows in detail the characteristic growth pattern of all developmental stages (particularly rhythmical swellings and collapses of the body) as well as the moulting processes. When females and males had reached their adult stage, emphasis was given to close-ups of feeding sites, orientation of males towards females, and copulation. The film terminates with root attack by larvae of the second generation.—*Institut für Pflanzenkrankheiten und Pflanzenschutz der Universität Hannover; and Institut für Nematologie der Biologischen Bundesanstalt, Münster, W. Germany.*

YOUNG, L. D. *Effects of continuous culture of resistant soybeans on soybean cyst nematode development.*

The ability of soybean cyst nematode (SCN), *Heterodera glycines,* populations from five west Tennessee fields to develop on 10 soybean lines was determined in the greenhouse in 1980 and 1981. The five SCN infested fields had been planted for 4 or 5 years to the cultivars Bedford or Nathan, both resistant to SCN races 3 and 4. For all five SCN field populations the number of cysts developing on roots of Bedford was equal to that on Forrest and Essex. All five SCN populations reproduced very little on the soybean lines PI 89,772, PI 90,763, and J74-88, but reproduction on lines PI 88,788, PI 209,332, D72-8927, and Peking varied among field populations. When these lines were tested in soil collected from the fields before Bedford was grown there, nematode reproduction was very limited on Bedford, PI 88,788, PI 89,772, PI 90,763, PI 209,332, and J74-88 compared to reproduction on Essex and Forrest. The ability of these field populations to reproduce on the 10 soybean lines was similar to the recently reported TN-79 SCN population which reproduces equally well on Bedford and SCN-susceptible cultivars. The number of cysts recovered from these fields in September 1981 ranged from 55 to 120 per 500 cm^3 of soil. Seed yield of Bedford has not decreased from expected yields for these fields.—*USDA-ARS-Nematology Research, West Tennessee Experiment Station, 605 Airways Blvd., Jackson, TN 38301.*

ZAVALETA-MEJIA, E., and S. D. VAN GUNDY. *Effects of rhizobacteria on Meloidogyne infection.*

Two hundred and forty-four isolates of rhizobacteria were inoculated on roots of

tomato (var. Tropic tomato purch) and cucumber (var. Spacemater bush) seedlings in order to study their effects on root-knot infection. The roots of seedlings 10–11 days old were dipped in the bacterial suspension and then planted in cups containing soil naturally infested with *M. incognita* and other nematodes. After 4 wk, the dry weight of the shoot and the gall index of the roots were determined. The effects of bacterization upon the plant and root-knot infection were categorized by four general reactions. Some isolates had a negative effect and suppressed plant growth and root galling when compared with the control. In a few cases, the effect was positive: plants grew more and the degree of root galling was greater than that of the control. Most of the isolates had a negative effect on the plant and positive effect on the nematode; i.e., less plant growth and more root galling. Only 12% of the bacterial isolates tested gave a positive effect on tomato or cucumber, and rarely on both, and negative on the nematode. An increase from 6 to 48% in the dry weight of the shoot and a decrease from 8 to 49% in root galling were observed in greenhouse tests.—*Department of Nematology, University of California, Riverside, CA 92521.*

ZEHR, E. I., S. A. LEWIS, and B. A. JAFFEE. *Nematicides for control of Criconemella xenoplax in established peach orchards.*

The effectiveness of certain nematicides as postplanting treatments for peach trees to control *Criconemella xenoplax* was studied over a 4-yr period in the field and greenhouse. In the field, liquid materials were applied 10 cm deep in bands 2 m wide on either side of the row, using chisels at 25-cm spacing. Granular nematicides were spread on the surface and worked in 3–5 cm deep with a tree hoe. In the greenhouse, nematicides were incorporated into the soil mix at 0, 0.5, 1, 2, and 4 mg a.i./liter soil. Results from field tests showed that 1,3-dichloropropene at 272 liter/ha and ethylene dibromide at 109 liter/ha suppressed *C. xenoplax* populations for up to 1 yr, while DBCP 12.1EC at 47 liter/ha was effective for 2 yr. Fenamiphos at 10.9 or 21.8 g a.i./ha was partially suppressive for up to 1 yr, while aldicarb, aldoxycarb, ethoprop, oxamyl, and dichloro-diisopropyl ether were ineffective. In the greenhouse, avermectin B_1 at 1, 2, and 4 mg/liter soil reduced nematode populations, but the degree of suppression appeared to be inadequate for field control. 1,3-Dichloropropene, ethylene dibromide, or fenamiphos may be effective postplant treatments for controlling *C. xenoplax* on peach trees, but when compared with DBCP, more frequent applications, higher rates, or both are required.—*Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.*