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ABSTRACTS OF PAPERS PRESENTED AT THE SIXTEENTH ANNUAL MEETING OF THE SOCIETY OF NEMATOLOGISTS EAST LANSING, MICHIGAN 16-19 AUGUST 1977

AL-HAZMI, A. S. *Some biological aspects of a Meloidogyne sp. parasitic on sycamore.*

A *Meloidogyne* sp. with perineal patterns similar to but different from those of *M. arenaria* was recovered from heavily infected sycamore seedlings collected from a nursery in Franklin, Virginia. Host response of this nematode was tested in the greenhouse (22-28 C) on sycamore and on the 10 differential cultivars: *Arachis hypogaea* 'Florunner' (peanut); *Capsicum frutescens* 'California Wonder' (pepper); *Citrullus vulgaris* 'Charleston Gray' (watermelon); *Fragaria chiloensis* 'Allbritton' (strawberry); *Gossypium hirsutum* 'Delta Pine 16' (cotton); *Ipomoea batatas* 'All Gold' and 'Porto Rico' (sweet potato); *Lycopersicon esculentum* 'Rutgers' (tomato); *Nicotiana tabacum* 'N.C. 95' (tobacco); and *Zea mays* 'A-401 Minn.' (corn). Sycamore was severely galled and egg masses were abundant. Tobacco was highly galled and egg masses were moderate. Tomato and watermelon were moderately galled but had few egg masses. Pepper was slightly galled but no reproduction occurred. In life cycle studies, larvae penetrated sycamore roots within 3 days after plants were transplanted into infested soil, and swelling was evident after 7 days. The second molt and sex differentiation occurred after 17 days. After 26 days, young females were observed; the stylet reappeared, the median bulb was elongated and distinct, and the perineal pattern was formed. Females expanded in width, and the perineal pattern was completely formed after 31 days. Eggs were observed inside the roots after 35 days and on the surface of the root galls after 40 days. Behavior of the nematode on differentials and preliminary morphological studies of perineal patterns indicate that this nematode is a new species which is highly pathogenic on sycamore or a physiological race of *M. arenaria.*—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

ANDREWS, SUSAN W., L. R. KRUSBERG, and A. M. GOLDEN. *The host range of a Meloidoderita species from Maryland.*

Several smartweeds (*Polygonum hydropiperoides, P. pensylvanicum, P. lapathifolium*) were experimentally determined to be hosts for a *Meloidoderita* species originally found on *Polygonum hydropiperoides* at Beltsville, Maryland. Buckwheat (*Fagopyrum esculentum*), also a member of the Polygonaceae, was not a host. Other plants which proved not to be hosts were: *Mentha arvensis,* reported to be parasitized by *Meloidoderita kirjanovae* in the Soviet Union, and soybean, corn, tobacco, wheat, cantaloupe, tomato, cabbage, alfalfa, onions, and carrots, all plants of economic interest in Maryland. No galling was observed on the host *Polygonum* species. The host range test, 4 months in duration, included examination of roots for characteristic egg masses with cysts and examination of Baermann extracts of soil for second-stage larvae.—*Department of Botany, University of Maryland, College Park, MD 20742, and Nematology Laboratory,*

Plant Protection Institute, Agricultural Research Center, United States Department of Agriculture, Beltsville, MD 20705.

ATILANO, R. A., and S. D. VAN GUNDY. *Chemical control of Tylenchulus semipenetrans on grape.*

Three-vine plots of 'Thompson Seedless' grape (*Vitis vinifera*) were treated with oxamyl, 1,2-dibromo-3-chloropropane (DBCP), oxamyl plus DBCP, aldicarb, or phenamiphos. Soil treatments were applied at the bottom of the furrow (35-40 cm from the vine row) on each side of the vine row and followed by a 48-h irrigation. Vine spacing was 1.8 m x 2.4 m. DBCP was injected in a single line at 30-cm intervals @ 23.41 liters (a.i.)/ha. Granular formulations of aldicarb and phenamiphos were applied in a 7-cm wide drill @ 11.2 kg (a.i.)/ha. A foliar spray of oxamyl @ 4,800 mg/liter plus Triton B-1956 @ 0.3 ml/liter was applied at 14-day intervals in early and mid-season. One soil sample, consisting of six 2.5-cm diam cores, was collected from each plot at two depths (0-30 cm and 30-60 cm). Soil cores were collected from the berm between the treated furrows and around the base of the center vine only. Three months after treatment, only DBCP had significantly reduced population levels of *Tylenchulus semipenetrans* in the berm. No systemic activity was observed for the three nonfumigant nematicides.—*Department of Nematology, University of California, Riverside, CA 92521.*

BAINES, R. C., S. D. VAN GUNDY, and R. H. SMALL. *Efficacy of nonfumigant and low volatile nematicides for control of Tylenchulus semipenetrans on navel and Valencia oranges.*

Four granular, nonfumigant nematicides were spread on the open area (6.1 x 7.3 meters) around trees, and mixed 8 to 12 cm deep in the soil. DBCP (1,2-dibromo-3-chloropropane) was injected 5 to 8 cm deep into the soil at 25- to 30-cm spacings. Both soils were fine sandy loam; they were nontilled, and irrigated at 3-week intervals by sprinklers. Aldicarb, carbofuran, DBCP, ethoprop, and phenamiphos were applied at 22 or 44 kg (a.i.)/ha on 85% of the area around 12-year-old navel orange trees on 'Cleopatra' mandarin rootstock. Compounds were applied at the low rates each spring and at the high rates on alternate years. The high rates of all compounds decreased the number of larvae more than the low dose in the 0- to 90-cm depth of soil. Yields from the trees that were treated with the low dose of aldicarb were 86%, carbofuran 137%, ethoprop 124%, and phenamiphos 108% higher, and yields from those treated with the high dose, including DBCP, were 71-92% higher than those from the nontreated trees during the second and third years ($P \leq 0.01$). The average yields of 30 kg and 68 kg of navel oranges/tree over the 2-year period were low, because young fruit abscissed. Aldicarb or DBCP applied at 20 and 80 kg (ai.)/ha on 55% of the area around 15-year-old 'Valencia' orange trees on 'Troyer' citrange rootstock decreased the number of citrus nematode larvae by 50% and 80%, respectively, in the 0- to 90-cm depth of soil. Yields from the aldicarb- or DBCP-treated trees increased by 29% and 21.7% respectively (N.S. at $P=0.05$), and average size of the oranges was larger on treated trees ($P \leq 0.05$). In a third orchard of 14-year-old Valencia orange/Troyer citrange trees, 11 or 22 kg aldicarb (a.i.)/ha increased yield by 24% and 28%, or by 60 kg and 70 kg of oranges/tree, respectively, on the average for 2 years ($P \leq 0.05$).—*Department of Nematology, University of California, Riverside, CA 92521.*

BAINES, R. C., T. W. EMBLETON, H. S. BHALLA, T. A. DE WOLFE, and L. J. KLOTZ. *Effects of 1,3-dichloropropene and supplemental phosphorus on Glomus fasciculata, Thielaviopsis basicola, Tylenchulus semipenetrans, and growth of Citrus macrophylla seedlings.*

Treatments were 0, 213, 426, and 852 liters (a.i.)/ha of 1,3-dichloropropene (1,3-D) (D-D 57%, 1,3-dichloropropene and related C_3 hydrocarbons, Shell Chemical Company) on main plots and 0 or 224 kg of phosphorus/ha on sub plots in six randomized blocks on old citrus soil. Two months after treating, soil from 6- to 40-cm

depths from 4 replications of the 1,3-D plots was placed in 1-liter plastic pots and planted with a sweet orange seedling 10 to 12 cm high. Roots were examined at 90X after 4.5 months in a greenhouse. Decreasing amounts of *Glomus fasciculata* mycelium and spores occurred with increased dose of 1,3-D. Seventeen months after planting *Citrus macrophylla* seedlings in the field plots, 12.8, 10.3, 8.7, and 6.4 spores of *G. fasciculata*/gm of rhizosphere soil were obtained by the wet-sieve method from plots treated with 0, 213, 426, and 852 liters of 1,3-D/ha, and 7.5, 7.2, 7.4, and 5.4 spores/gm of soil from the 1,3-D treatments plus supplemental phosphorus, respectively. Fewest spores occurred at the highest level of 1,3-D supplemented with phosphorus. Seedling growth 0-4 months after planting was similar on all treatments. Tree dry wt. 17 months after planting was not affected by the level of *G. fasciculata* infection, the slight infection by *Thielaviopsis basicola*, or by the level of phosphorus (0.138 to 0.322%) in the leaves. Percent of phosphorus was positively related to the level of *G. fasciculata* infection. The phosphorus supplement decreased sporulation of *G. fasciculata*. The 64.5% increase ($P \leq 0.01$) in dry weight of all the 1,3-D treated trees, in comparison to those on the nontreated plots, was directly related to *T. semipenetrans* control. One or fewer adult female nematodes/m of feeder roots were on the 1,3-D plots and 730 adult females/m were on those of the nontreated plots.—*Department of Nematology, University of California, Riverside, CA 92521.*

BARKER, K. R. *Yield losses of tobacco caused by four species of Meloidogyne.*

Methyl-bromide treated microplots (80 x 100 cm or 80-cm diam) in a loamy sand (91% sand, 3.3% clay, and 5.7% silt) were infested with four initial inoculum densities (0, 750, 1,500, and 3,000 eggs and larvae/500 cm^3 of soil) of *Meloidogyne arenaria, M. hapla, M. incognita,* and *M. javanica.* Susceptible 'Coker 319' *Nicotiana tabacum* seedlings were transplanted into each of eight replicate plots/inoculum level per species. *Meloidogyne incognita*-resistant 'Speight G-28' seedlings also were established in eight plots/inoculum level of this species. On the basis of regression models, yield losses for each 10-fold increase in initial density per species were: *M. javanica* —19.9%; *M. arenaria*—16.5%; *M. incognita* —8.8%; *M. hapla*—3.7%; and 3% for *M. incognita* on resistant G-28. The lowest density of all species except *M. hapla* caused a significant yield loss on Coker 319. Only the greatest density of *M. incognita* and *M. Hapla* caused a significant yield loss on the resistant G-28 and the susceptible Coker 319, respectively. These results demonstrate the magnitude of tobacco-yield losses caused by the major *Meloidogyne* species in a sandy soil, including *M. incognita* on a resistant cultivar on which there were no obvious root galls.—*Plant Pathology Department, North Carolina State University, Raleigh, NC 27607.*

BENSON, D. M., and K. R. BARKER. *Efficacy of 1,2-dibromo-3-chloropropane and aldicarb for control of parasitic nematodes in the root zone of American boxwood, and Japanese and Chinese hollies.*

Dibromochloropropane (DBCP) at either 12.0, 28.0, or 55.6 liters (a.i.)/ha was injected with a fumigun to a depth of 15 cm in six holes equidistant between the plant crown and the edge of a 80-cm diam microplot. Aldicarb at either 8.5, 11.5, or 17.0 kg (a.i.)/ha was broadcast over the soil which was then cultivated by hand. Immediately after treatment, plots were irrigated with 3 cm of water. Plants had been grown in microplots variously infested with the plant-parasitic nematode species mentioned hereafter for 29 months prior to treatment in October. Decline of American boxwood and Japanese holly caused by *Pratylenchus vulnus* and *Meloidogyne arenaria,* respectively, was apparent. These plants and Chinese holly showed no significant response to the other species of parasitic nematodes present in some of the microplots. Nematode density was determined 2 weeks before, and 8 and 12 months after treatment. Aldicarb and DBCP gave good control of *P. vulnus* and *Helicotylenchus dihystera* on boxwood up to 1 year after treatment. Control of *M. arenaria,*

Tylenchorhynchus claytoni, Trichodorus christiei, and *H. dihystera* on Japanese and Chinese hollies was effective for 8 months, but at 12 months, nematode densities were increasing. The effect of nematicide rate was most apparent at 8 months. DBCP controlled *Macroposthonia xenoplax,* but plants treated with aldicarb had densities equal to or greater than the control. Plants with severe decline showed no significant growth response from nematicide 1 year after treatment.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

BERNARD, E. C. *Morphology and biology of Bunonematidae from Georgia.*

Two genera (*Bunonema, Rhodolaimus*) and five species of Bunonematidae (Rhabditida) have been found associated with moss and rotten wood in Georgia. Four of the species were established in xenic cultures and feed on bacteria. This nematode family is characterized by radical external asymmetry of the right side in the form of hexagonal patterns of tiny protuberances and/or rows of warts. Prominent warts are present on three of the species, whereas the other two have rudimentary warts. Several explanations have been offered for the function of asymmetry: *(i)* locomotion; *(ii)* disruption of hyphae for food; *(iii)* armor-like defense against predacious mites. The first two explanations are highly unlikely. Limited observations of a species with large warts, exposed to predation by the fungus *Arthrobotrys* sp., suggest a fourth possibility —that the warts prevent movement of the nematodes into the nonconstricting trapping rings—because nematodes were frequently seen to back out of rings after partial entry. Species of Bunonematidae are highly susceptible to endozoic parasites, especially *Harposporium* spp. Reproduction in *Bunonema* spp. is parthenogenetic, while *Rhodolaimus* spp. is amphimictic. The parthenogenetic species lay more eggs (45-70) than the amphimictic species (30-50). Although all species are didelphic, only one egg develops at a time. However, at peak egg production, 15-25 eggs may be laid in a 24-h period. Development from egg to mature adult requires about 7 days under laboratory conditions. Upon senescence, females become swollen and sluggish, and *endotokia matricida* becomes frequent.—*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, GA 30602.*

BERNARD, E. C., and R. S. HUSSEY. *Toxicity zones of 1,2-dibromo-3-chloropropane under field conditions.*

Control of plant-parasitic nematodes by soil fumigation depends upon maintenance of a given concentration of toxicant for a sufficient period of time. Effective doses equivalent to 6 μg-days (1 μg/g OD soil maintained for 6 days) have been reported for control of *Meloidogyne* spp. Maintenance of effective doses of 1,2-dibromo-3-chloropropane (DBCP) in coastal plain soils is complicated by the presence of a relatively impervious sandy plow pan layer between the loamy sand topsoil and clay subsoil. The practice of subsoiling to disrupt plow pans further modifies the movement of DBCP by increasing diffusion to lower soil depths. Treatments to determine toxicity zones were: *(i)* 10 kg(a.i.)/ha DBCP injected at a depth of 18 cm, not subsoiled; *(ii)* 10 kg/ha DBCP injected at 18 cm, subsoiled; *(iii)* 10 kg/ha DBCP injected at 35 cm, subsoiled; and *(iv)* 13.5 kg/ha DBCP injected at 35 cm, subsoiled. Soil cores (2.5 cm) were taken at five depths to 50 cm and at five, 7.5-cm increments from the injection line. Hexane extraction from the soil cores and gas chromatography were used for determination of DBCP concentrations at five dates over an 11-week period. Dosages were determined by calculating the area under concentration curves for the soil plane vs. time. The experiment was performed both in 1975 and 1976. During the first 2 weeks after treatment in April 1975, more than 5 cm of rain fell at the site; during the comparable period in 1976, there was no measurable rainfall. In 1975, 4 weeks after treatment, 24% of the sampled area in treatment 1 had been covered by a 6 μg-day dosage; treatment 2, 53%; treatment 3, 58%; treatment 4, 72%. Areas covered in 1976 were: treatment 1, 9%; treatment 2, 17%; treatment 3, 26%; treatment 4, 40%.

Areas covered in the sampled soil plane by a 6 μg-day dosage or more were greater in 1975 than in 1976, probably because of the surface-sealing and percolating effects of rainfall. Within years, subsoiling accounted for the greatest increases in effective coverage.—*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, GA 30602.*

BIRD, G. W. *Population dynamics of Pratylenchus penetrans associated with three cultivars of Solanum tuberosum.*

A Michigan field of sandy loam infested with *Pratylenchus penetrans* was divided into 24 plots (15 x 3.6m) and each was planted with four rows of *Solanum tuberosum* (C.V. 'Superior', 'Onaway', or 'Russet Burbank'). One-third of the plots were planted with each cultivar and each plot was sampled every 7 days for *P. penetrans*. Numbers of *P. penetrans*/gm of root tissue increased rapidly for the first 3 weeks after planting and decreased during the fourth week. This pattern was followed by a second increase (weeks 5 to 6 or 7) and a second decrease (week 8 for Superior and week 7 for Onaway and Russet Burbank). Densities of *P. penetrans* in Superior roots reached a maximum early in August and declined with root senescence. Densities associated with Onaway and Russet Burbank increased after the second decline, had a third decline, and then increased until the final decrease with root senescence. If each peak and following decline represent a generation of *P. penetrans,* there were three with Superior and four with Onaway and Russet Burbank. Increases in root densities of *P. penetrans* were associated with decreased soil population densities, and decreases in root population densities with increased soil population densities, an indication of the existence of a specific migration pattern of *P. penetrans* from roots of *S. tuberosum* to soil and back to root tissue.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

BROWN, D. J. F., P. B. TOPHAM, and C. E. TAYLOR. *The application of computerized data processing systems to nematological surveys.*

Surveys were made to study the national distribution of various plant-parasitic nematode species in relation to their geographical location, and in relation to the effects of various biotic and abiotic factors of the edaphic environment. Data were collected as records or as soil samples from many collaborators active in nematological research or advisory extension work; other records were extracted from published research work and soil samples collected by schools. The data-management system was based upon standard data processing facilities for file creation and management. Data were interfaced to computing packages, such as SPSS (Statistical Package for the Social Sciences) and TAXIR (Taxonomic Information Retrieval), and to computer-generated map production, by a minimal use of specially written programs. Adequate computer facilities enabled the research team to systematize data recording and processing and to subordinate this aspect to map production and the assessment of ecological relationships. The data base management system took account of the volume and complexity of data and provided varied and flexible output. However, the system can adapt to, and is being used for, records from a single field, farm, or crop; records from agricultural advisory regions within the British Isles; nationally based records; and records from the European Plant Parasitic Nematode Survey. This survey is a cooperative project on a European scale which at present is concentrating on establishing the geographical distribution of nematode species at a national and finally at continent level.—*Scottish Horticultural Research Institute, Invergowrie, Dundee, Scotland, DD2 5DA.*

CALLAHAN, C. A., J. M. FERRIS, and V. R. FERRIS. *Evaluation of nematode community structure as a method for quantifying ecological change in stream environments.*

Benthic nematodes were sampled at 16 sites on two streams to investigate the relationships of nematode community structure

to various water quality factors. A prominance value for each species was calculated for use in three-dimensional community ordination. Species composition of the sites, nematode density, and species interaction with certain physico-chemical factors were significant in determining the pattern, or clustering, of the sites in the ordinations. The sites found in clusters with low densities of all species were those with the lowest level of nutrients (i.e., nitrate and nitrite nitrogen, total nutrients, and orthophosphate), and the highest level of dissolved oxygen. The density of nematodes observed at each site was inversely correlated with median size of benthic particles. If the number of species used in the analysis was decreased from 154 to the 6 predominant species, a closer relationship of nematode species with the physico-chemical factors was observed. It is assumed that these six predominant species are most influenced by the physical and chemical parameters measured and that these species are most important in determining clustering of sites. Presence-absence data for nematode species do not yield information for relating nematode species to ecological conditions at the sites.—*U.S. Environmental Protection Agency, Corvallis Environmental Research Laboratory, 200 S.W. 35th St., Corvallis, Oregon 97330; and Department of Entomology, Purdue University, Lafayette, Indiana 47907.*

CHIN, D. A. *Fine structure of the body wall of the adult Histiostrongylus coronatus.*

Electron microscopy showed that the cuticle of *Histiostrongylus coronatus* consists of five layers: a thin outer trilaminate cortex, an internal cortex, a median layer, and two thick inner layers which cannot be homologized with those of other nematodes. Cuticular pores are present but striations and fibers are lacking. The lateral and ventral hypodermal chords contain a nucleus while the dorsal chord is anucleate and contains granular endoplasmic reticulum with cisternae arranged to form concentric lamellar systems and mitochondria. The muscle field is basically meromyarian and consists of two to four muscle cells arranged in a single layer. The spindle-shaped muscle cells are platymyarian. The contractile region of each muscle cell is divided by dense Z bars into five to six sarcomeres which contain both thick and thin myofilaments approximately 28 nm and 7 nm in diameter, respectively, High magnification micrographs show the presence of a repeating sequence of I, A, and H bands arranged in parallel arrays to the Z bars. Sarcoplasmic reticula appear as small, oval-shaped vesicles in the middle of uninterrupted I bands, close to Z bars. The noncontractile, sarcoplasmic region is characterized by the presence of a large nucleus with a distinct, rounded nucleolus and dense peripheral heterochromatin, mitochondria, and granular endoplasmic reticulum.—*Department of Biology, Nassau College, State University of New York, Garden City, NY 11530.*

CROLL, N. A., J. M. SMITH, and B. M. ZUCKERMAN. *Behavioral parameters in the aging of Caenorhabditis elegans.*

Much is known of morphological changes which occur during the aging of *Caenorhabditis elegans,* and physiologic changes have been the subject of some study. Little attempt has been made to measure the changes in behavior with age, however. Wild type *C. elegans* (var. Bristol) was cultured on soy peptone, yeast, and fresh liver extract. The worms were individually observed each day for 15 min and their behavioral actions were recorded on a multichannel event recorder or on a video tape recorder of a closed circuit television. Particular attention was paid to the rate of backwardly directed somatic waves and pharyngeal bulb pulsations, and to the interval between defecations and oviposition. *Caenorhabditis elegans* lived significantly longer in axenic culture than in the presence of bacteria. A gradual linear decline occurred in the rate of backward waves between maturation (day 4) and death (day 20) for those worms in axenic culture. In striking contrast, the mean maximum rate of pharyngeal bulb pulsations maintained a plateau from days 4 to 18, while the mean interval between

defecations doubled from 60 sec (days 4 to 8) to 120 sec (days 10-20). These results will be discussed in the context of nematode coordination and the mechanisms of aging.—*Institute of Parasitology, Macdonald College of McGill University, Macdonald College Post Office, Province of Quebec, Canada, H0A 1C0, and Laboratory of Experimental Biology, University of Massachusetts, East Wareham, MA 02538.*

FERRIS, H., and H. S. DU VERNAY. *Development of models for death rate of Meloidogyne arenaria, and their inclusion in a computer simulator.*

Computer simulation studies showed that further information on the death rate and the overwintering of *Meloidogyne arenaria* eggs was required to improve the performance of predictive models. Experiments in incubators at a range of temperatures (5 C to 36 C) indicated that the death rate of eggs at high and low temperature extremes was high during the first week. During the second week of exposure, the rate was lower; it increased with time, gradually at 18-21 C, but more rapidly at extremes of the temperature range tested. Subsequent experiments indicated that early developmental stages (one-cell to gastrula) were more temperature sensitive than more developed eggs. Two regression models for the effect of egg death rate proved necessary: for the first week of exposure, one which used temperature as the independent variable, and for a further exposure period, a second which used both time and temperature as independent variables. This finding may explain the high death rate during the first week of exposure to temperature extremes. Inclusion of the egg death rate models in a computer simulation of *M. arenaria* on grapevines improved the similarity between predicted population levels and validation data and indicated need for further research on the system.—*Department of Nematology, University of California, Riverside, CA 92502.*

FERRIS, H., and L. A. FEIGEN. *Determination of economic threshold levels of Meloidogyne incognita for southern California crops.*

Studies from small field plots have produced estimates of economic threshold levels of *Meloidogyne incognita for sweetpotatoes* (C.V. 'Golden Pride') and processing tomatoes (C.V. 'Roma'). The nematode appears to have little economic importance on certain winter crops under local conditions. Crops were grown in 45 plots (13.4 m^2) of varying initial nematode density (P_i). Nematode populations (L_2 and eggs) were assessed by a 12-core sample from each plot. This approach proved inadequate at low P_i values as a high frequency of nondetection occurred. Yields were expressed relative to plots with maximum yields in various areas of the field to correct for covariance. The relationship between relative yields and log P_i was tested by linear regression. A computer program serially increased the lowest acceptable log P_i values in the regression while monitoring the correlation coefficient, maximum yield estimate (y-axis intercept), and the standard deviation from regression. This system allowed rejection of data below the tolerance limit, or level at which yield losses were not measurable, and also allowed emphasis of the linear portion of the relationship between yield and log P_i. Economic threshold estimates were based upon expected crop yield and current costs of commercial nematode control. Variations in the estimates are expected with annual economic trends and with changes in soil texture, weather conditions, and management efficiency.—*Department of Nematology, University of California, Riverside, CA 92502.*

FRANCIS, J. A., R. M. RIEDEL, and J. D. FARLEY. *Reaction of experimental greenhouse tomato hybrids to Meloidogyne hapla, M. incognita, and M. incognita acrita.*

Breeders at the Ohio Research and Development Center and Ohio State University developed experimental greenhouse tomato hybrids resistant to *Meloidogyne incognita.* The reactions of these experimental hybrids to *M. incognita, M.*

incognita acrita, and *M. hapla,* which occur in Ohio greenhouse soils, were tested. Under greenhouse conditions (24-29 C soil temperature), resistant tomatoes in 10-cm pots inoculated with 200 second stage larvae (L_2) of *M. hapla* or 2,000 L_2 *M. incognita* or *M. incognita acrita* received root-gall indices of 3.2, 1.0, or 1.0, respectively. A galling index of 0.4 was used in which 0 = no galling and 4 = heavy galling. In growth chambers at 26 C, tomatoes in 10-cm pots inoculated with 200 L_2 *M. hapla* or 1,500 L_2 *M. incognita* or *M. incognita acrita* developed root gall indices of 2.2, 0.2, or 0.5, respectively. In similar growth chamber tests at 32 C, tomato plants developed root gall indices of 1.0, 2.5, or 2.2. Larvae of *M. incognita* and *M. incognita acrita* freely invaded root tips and caused extensive necrosis at 26 C. Populations of *M. incognita* and *M. incognita acrita* capable of causing extensive galling of resistant lines at 26 C were developed from egg masses of a few females reproducing initially on resistant lines at 26 C.—*Virginia Truck and Ornamentals Research Station, Painter, VA 23402; and Plant Pathology Department, Ohio State University, Columbus, OH 43210.*

FRECKMAN, D. W., S. D. VAN GUNDY, and S. F. MAC LEAN, JR. *Nematode community structure in Alaskan soils.*

Nematodes were collected from two tundra sites, Meade River and Barrow, and from a taiga forest site at Washington Creek Alaska in August and September 1976. The taiga forest differs from tundra by having a great diversity of vegetation types, temperatures, invertebrates, and decomposer organisms. Soil samples were separated into two fractions for nematode extraction. Nematodes were collected from the surface horizons (which were composed of mosses, lichens, and other organic debris) with a mist chamber, and from the soil-organic horizons with Baermann funnels. All nematodes were counted, preserved in 5% formalin for taxonomic identification, and placed in one of four trophic groups: *(i)* fungivores (F), *(ii)* microbivores (M), *(iii)* plant parasites (PP), and *(iv)* omnivore-predators (OM). Although the feeding habits of some of these nematodes are unknown, they were placed in a particular group because of taxonomic relationships to known trophic groups. A total of 22 genera were represented in the three sites. Microbial feeders predominated in all habitats. *Plectus* spp., *Aphelenchoides* spp., *Eudorylaimus* spp., and *Merlinius* spp. were the most abundant microbivore, fungivore, predator, and plant-parasitic nematodes, respectively. Species diversity was greatest at the Meade River site. Trophic structure varied at each site as follows: Meade River—M>O/P>PP>F; Barrow—M>PP>O/P>F; Washington Creek—M>F>PP>O/P. The numbers of nematodes varied from a low of 342 x 10^3 m^{-2} at the Barrow site to a high of 8900 x 10^3 m^{-2} at Washington Creek.—*Department of Nematology, University of California, Riverside, CA 92521 and Department of Biological Sciences, University of Alaska, Fairbanks, AK 99701.*

GOLDEN, A. MORGAN. *Subspecific forms of the Meloidogyne incognita complex.*

The *Meloidogyne incognita* species group in the United States contains four morphologically distinct forms. The subspecies *incognita* and *acrita* and two races are described as new subspecies on the basis of recent study. Though closely related, each subspecies has characters which should permit identification above the 75% accuracy common for a subspecific taxon. The nature of the perineal pattern is important in separating *incognita,* with its fine, wavy, rather continuous lines, from *acrita,* which has coarse, rather straight, but broken lines. One of the races is identifiable because the female excretory pore is about 45 μm from the anterior end, and the perineal pattern is generally high with a square arch. This form, received in 1970 from W. Birchfield, attacks Bragg and other resistant soybean varieties in Louisiana and is known as the "Wartelle race" of *incognita.* The second race was sent in 1968 from South Carolina by T. W. Graham and reported by him in 1969 as a "new pathogenic race" of *incognita* which attacked 'NC-95' tobacco previously resistant to that species. This race has a rather

distinctive perineal pattern with a rounded arch and several broken, irregular lines above the anus. Also, the female dorsal gland orifice is further from the base of the stylet (5 μm or more), and larval length is greater (405 μm) than in other forms of this species group. Identification of these forms as four subspecies will contribute to the control of the *incognita* complex, especially in the development of resistant varieties of the many economic crops attacked.—*Nematology Laboratory, Plant Protection Institute, Agricultural Research Center, USDA, Beltsville, MD 20705.*

GORDON, R., and W. J. CONDON. *Effects of mermithid nematode parasitism on the hemolymph composition of blackflies.*

Larval stages of the blackflies *Prosimulium mixtum/fuscum* (a winter developing species) and *Simulium venustum* (summer developing) were collected from local streams. In both *P. mixtum/fuscum* and *S. venustum,* the hemolymph composition of noninfected (control), terminal-instar larvae with dark histoblasts was compared with mermithid (*Neomesomermis flumenalis*)-infected insects. Parasitized insects usually harbored one nematode per host. By using polyacrylamide disc electrophoresis, five protein fractions were separated from the hemolymph of the two blackfly species. Mermithid parasitism caused a nonselective depletion of all protein fractions in both hosts with the exception of one fraction of low relative mobility in *S. venustum* which was unaltered by parasitism. The nematode affected the concentrations of blood amino acids in a more selective fashion. In *P. mixtum/fuscum,* the levels of most amino compounds were reduced by mermithid parasitism, whereas in *S. venustum* such blood metabolites were approximately evenly divided into three categories (reduced, increased, unaffected by parasitism). Phosphoethanolamine, methionine sulfoxide, citrulline, tyrosine, and histidine were severely depleted in the blood of both host species. The depletive effect of the parasite on the blood proteins of larval simuliids results from utilization by the nematode of host amino acids and causes severe exhaustion of hemoloym amino acids in *P. mixtum/fuscum.* Pronounced increases in the levels of many blood amino compounds in *S. venustum* could result from differences in nutrition, the primary structure of proteins, and/or rates of protein catabolism between the two parasitized host species. Effects of parasitism on the hemoloymph carbohydrate levels of the hosts were noted.—*Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.*

GRIFFIN, G. D. *Influence of nonhost cultivars on the population dynamics of Heterodera schachtii and growth of sugarbeets.*

Redwood containers (42 x 30 x 14 cm) infested with *Heterodera schachtii* at the rate of 21 larvae/gm of soil were sown with seeds of alfalfa, bean, onion, potato, barley, wheat, and sugarbeets, or left fallow. Treatments were replicated and randomized on a greenhouse bench. After 160 days, nematode populations in soil planted to onion, bean, potato, alfalfa, wheat, barley, and sugarbeet were 19, 24, 33, 43, 43, 52, and 119% of the initial population, respectively. These compared to 38% in the fallowed soil. Nematode populations in sugarbeet plantings were 55, 27, and 18% of the initial population after 40, 80, and 120 days. Numbers of *H. schachtii* larvae in sugarbeet seedling transplants, grown for 14 days in soil previously planted to onion, bean, potato, alfalfa, wheat, barley, and sugarbeet, were 8, 9, 12, 13, 17, 19, and 28, respectively; there were 14 larvae/seedling from fallow soil (LSD @ 0.05 = 3.2). Sugarbeet growth measured after 70 days paralleled seedling infections; the poorest growth (33.2 gm/plant) occurred in soil previously planted to sugarbeets, and the best growth (75.7 and 75.8 gm/plant) occurred in soil previously planted to onions and beans. Results of microplot studies paralleled most greenhouse findings. The greatest reduction in the initial nematode population and subsequent greatest sugarbeet growth occurred in soil planted to onions and beans.—*Agricultural Research Service, U. S. Department of Agriculture;*

and Utah State Experiment Station, Crops Research Laboratory, Utah State University, Logan, Utah 84322.

HIRSCHMANN, H., and A. C. TRIANTAPHYLLOU. *Cytogenetic and morphologic comparison of members of the Heterodera trifolii species complex.*

Cytogenetic studies were undertaken with 19 populations of *Heterodera trifolii,* 1 population of *H. lespedezae,* 2 populations of *H. galeopsidis,* and 2 populations of an undescribed *Heterodera* species from *Rumex crispus.* All populations were monosexual and reproduced by mitotic (apomictic) parthenogenesis. The chromosome number was stable for each population but varied among the populations from 2n = 24 to 35. Considering that the basic chromosomal complement of the genus *Heterodera* is n = 9, these chromosomal forms probably represent triploids and tetraploids or derivatives of such polyploid forms. In search of morphological manifestations of the cytological differences, we examined five populations (two of *H. trifolii* and one each of the other species) for morphological differences by using light and scanning electron microscopy. A number of quantitative and qualitative characters of second-stage larvae, females, and cysts proved to be useful in distinguishing the chromosomal populations on a morphological basis. With the exception of one population of *H. trifolii* with 26 chromosomes, triploids differed from tetraploids by smaller measurements in body length, stylet, tail, and tail terminal length of second-stage larvae; stylet length of females; and fenestral and vulval-slit length of cyst cones. No correlation with ploidy was found in vulval-anus distance of cysts. The scanning electron microscope was helpful in revealing additional external structural differences in cyst cones of the various populations examined.—*Department of Plant Pathology and Department of Genetics, North Carolina State University, Raleigh, NC 27607.*

HOGGER, C. H., and R. H. ESTEY. *Survival of Xiphinema americanum in frozen soil.*

Throughout the winter, third- and fourth-stage juveniles and adult nongravid females of *Xiphinema americanum* were extracted from frozen soil at depths of 0-15 cm or 15-30 cm around Norway maple (*Acer platanoides*) or raspberries (*Rubus idaeus* var. *strigosus*) by either centrifugal flotation (CF) or modified Baermann pan (2 days). Almost equal numbers were extracted by both methods and from both depths. After extraction, at least 90% of the nematodes moved spontaneously or upon mechanical stimulation. Surviving *X. americanum* contained large lipid droplets. Of the *X. americanum* collected from frozen soil during the winter, 80, 40, and 0% survived a further 10 days of freezing at −5, −14, and −25 C, respectively, in 700 gm soil samples (with 35% moisture content) contained in polyethylene bags. When soil samples were allowed to thaw before refreezing at −5 and −14 C, 25 and 10%, respectively of the nematodes survived. No nematodes collected during the summer survived freezing at −5 C in field soil with 17% moisture content. However, during storage at 4 C for 3 weeks, some *X. americanum* developed large lipid droplets in the intestine which were similar to those found in individuals collected during the winter. Twenty percent of these nematodes survived at −14 C. This result suggests the occurrence of a hardening process associated with the formation of lipid droplets. The mechanism appears to be suited for survival through gradually decreasing soil temperatures in the field, but less suitable for survival of artificial, more rapid freezing.—*Department of Plant Science, Macdonald College of McGill University, St. Anne de Bellevue, Quebec, Canada, H0A 1C0.*

HUSSEY, R. S., and R. W. RONCADORI. *Interaction of Pratylenchus brachyurus and an endomycorrhizal fungus on cotton.*

Little is known about the interaction of plant-parasitic nematodes and endomycorrhizal root symbionts even though they

commonly occur together in the roots or rhizosphere of the same plant. We investigated the interaction of a migratory endoparasitic nematode, *Pratylenchus brachyurus* (PB), with a vesicular-arbuscular endomycorrhizal fungus, *Gigaspora margarita* (GM), on cotton (*Gossypium hirsutum* 'Coker 201') at two different fertility levels (equivalent to 560 and 1,120 kg/ha of 10-10-10 N-P-K) in the greenhouse. Treatments consisted of single inoculations with PB (5,000 nematodes per plant) or GM (250 azygospores/plant), joint inoculations, and appropriate controls. The effect of fertility level was evaluated for each of the treatments. Although the high fertility level increased cotton growth and reproduction when they were measured 77 days after transplanting, the greatest stimulation in plant development occurred when plants were inoculated with GM at each fertility level. At the low fertility, GM increased shoot height, fresh shoot weight, root weight, and square production by 96%, 553%, 358%, and 760%, respectively, over that of nonmycorrhizal controls. Plant development was also stimulated by GM at the high fertility level, but the magnitude of the increase was not as great as at the low fertility rate. Even though cotton was a good host for PB, plant development was not retarded by the nematode at either fertility level. In concomitant culture, mycorrhizal-induced plant growth and reproduction and sporulation of the fungus were not affected by the parasitic activities of PB on the cotton roots. Mycorrhizal synthesis in the cotton roots, however, suppressed the number of PB in root tissue. —*Department of Plant Pathology and Plant Genetics, University of Georgia, Athens, GA 30602.*

IBRAHIM, I. K. A. *Effects of plant-growth substances on pathogenicity of Meloidogyne javanica on horse bean and soybean.*

The effects of foliar applications of indole-3-acetic acid (IAA) on the pathogenicity of *Meloidogyne javanica* (MJ) to the horse bean cultivar 'Giza 1' were investigated in two greenhouse tests. Depending on the concentrations applied, and the time of application, treatments with IAA increased or decreased MJ galls and growth of bean plants. Spraying with either 50 or 100 μg/ml IAA solution at the time of nematode inoculation resulted in fewer MJ galls and an increase in the root and shoot dry weights, whereas treatment with 10 μg/ml IAA stimulated galling and suppressed growth of infected plants. In a second test, treatments with 50 μg/ml IAA 24 h prior to, or at the time of, nematode inoculation decreased the disease severity, whereas the application of IAA 24 h following MJ inoculation stimulated root galling and suppressed plant growth (dry wt). In a third test, two foliar applications of either IAA, indole butyric acid, or gibberelic acid, at the rate of 50 μg/m, 24 h prior to and at the time of nematode inoculation, suppressed MJ gall development by more than 50% and increased the root and top growth of treated plants.—*Faculty of Agriculture, Alexandria University, Alexandria, Egypt.*

ICHINOHE, M., M. HAMADA, and T. YOSHIDA. *Nonhost plants of Meloidogyne incognita on black peppers in the Amazonian region.*

To test the reaction of more than 100 plant species or varieties to *Meloidogyne incognita* from black pepper roots in the Amazonian region, seeds or seedlings were planted in 20-cm diam pots in a glasshouse and grown 30 days at 21-33 (av 26.5) C after inoculation with two nematode egg masses. Roots from the three replicates of each plant were washed and examined to determine degree of completion of nematode development. Acid fuchsin lactophenol was used where necessary. On the basis of this degree of completion, test plants were classified into four groups. The first of these contained plants on which no galls or egg masses formed, and included *Anacardium occidentale, Arachis hypogaea, A. prostrata, Brachiaria decumbens, Cajanus cajan, Ceiba pentandra, Centrosema pubescens, Clitoria laurifolia, C. ternatea, Crotalaria anagyroides, C. lanceolata, C. mucronata, C. paulina, C. retusa, C. spectabilis, C. striata, Derris elliptica, Erythrina indica, E. poeppigiana, Glycine wightii, Gossypium*

barbadense, Leucaena glauca, Manihot utilissima Iracema, *Medicago sativa* Intro. 309, *Phaseolus atropurpureus, P. vulgaris, Pueraria phaseoloides, Stizolobium deeringianum, Tagetes erecta, T. minuta, T. patula,* and *Tephrosia toxicaria.* A second group, on which few galls and no egg masses formed, included *Abrus precatorius, Bixa orellana, Cassia occidentalis, C. patellaria, C. Tora, Eupatorium odoratum,* and *Tephrosia purpurea.* A third group, on which a few galls, few egg masses, and a reduced number of eggs formed, included *Andoropogon nardus, Cassia leschenaultiana, Crotalaria juncea, Crybadeum surinamence, Indigofera hirsuta, Passiflora edulis,* and *Vigna catjang* (only one var. out of four tested). The fourth group contained a large number of species on which galls and egg masses were fully formed; it included *Capsicum annuum* California Wonder, *Erythrina glauca, Flemingia congesta, Hordeum vulgare, Inga edulis, Quamoclit pennata, Rauwolfia serpentina, Triticum aestivum, Zea mays,* and others. *—Instituto Experimental Agricola Tropical da Amazonia. c/o JAMIC, Caixa Postal 421, Belem, Para, Brazil.*

INGRAM, EDWIN G., R. RODRIGUEZ-KABANA, and PEGGY S. KING. *Comparison of the efficacy of ethoprop and fensulfothion in control of parasitic nematodes.*

Technical ethoprop and fensulfothion were applied to pots containing a sandy loam soil infested with *Meloidogyne arenaria;* rates were 0, 0.20, 0.50, 1.00, 2.00, 4.00, and 8.00 mg/kg soil. Pots were planted with summer squash and allowed to grow for 6 weeks, at which time the roots were examined. Number of galls/gm fresh root wt declined proportionately to nematicide concentration; however, the decline was sharper for ethoprop than for fensulfothion. Gall density at 1.00 mg/kg ethoprop was 82% below that for the control and a 42% suppression for fensulfothion. At the 4 mg/kg rate, gall development was suppressed 100% by ethoprop and 92% by fensulfothion. In a similar experiment with cotton 'Rowden' in a sandy loam soil infested with *M. incognita* and *Tylenchorhynchus claytoni,* numbers of galls per gm fresh root wt were inversely related to nematicide concentration. Suppression of gall development was sharper in roots from ethoprop-treated soil than in roots from fensulfothion-treated soil. Gall density at the 0.50 mg/kg rate was 85.9% below that of the control for ethoprop and a 49% inhibition for fensulfothion. At the 2 mg/kg rate, *M. incognita* was eradicated in the ethoprop-treated soil but not in pots containing fensulfothion. Numbers of *T. claytoni* in soil declined sharply in response to nematicide concentrations in the range of 0-1.00 mg/kg with little additional control resulting from higher concentrations. Ethoprop was more effective than fensulfothion in reducing populations of *T. claytoni.* At the 1 mg/kg rate, numbers in soil with ethoprop were 97.5% below those of the control compared to a 73% suppression for fensulfothion. These results show that ethoprop is a more effective nematicide than fensulfothion for parasitic nematodes. *—Department of Botany and Microbiology, Auburn University, Auburn, AL 36830.*

JATALA, P., and L. J. TURKENSTEEN. *Interrelationships of Globodera pallida with some Phoma spp. and Colletotrichum coccodes on potatoes.*

Tubers of *Solanum tuberosum* subsp. *andigena* cultivar 'Renacimiento' were planted in 2,000-cm^3 clay pots placed in a screenhouse. Plants approximately 20 cm tall were inoculated with: *(i) Globodera pallida* alone (3,000 freshly hatched larvae in 20 ml water/pot); *(ii) Phoma exigua* var. *exigua, P. exigua* var. *nonoxydabilis, P. andinum* sp. nov, and *Colletotrichum coccodes* each alone (20 ml. suspension); *(iii) G. pallida* and each of the previously listed fungi simultaneously. Control plants received neither organism. Each fungus was cultured in petri plates containing 20 ml of Potato Dextrose Agar for 3 weeks at 20 C. The contents of 5 petri plates of each fungus were macerated separately in 250 ml water in a Waring blender and diluted to 1,000 ml. Inocula were introduced through 12 x 1-cm glass tubes which were placed around the seed piece at planting and

which protruded 3 cm above the soil line. Screenhouse minimum-maximum temperature was 14-20 C during this experiment. Two months after inoculation, plant roots were carefully removed from the pots, washed, examined, and fresh root and top weights recorded. Three 100-cm^3 soil samples from each pot were processed for extraction, except for treatments involving *P. andinum* in which many plants failed to emerge. There were no significant differences in fresh top or root weights among treatments. Roots of the plants inoculated simultaneously with *C. coccodes* and *G. pallida* exhibited a greater rate of black dot symptom than those inoculated with *C. coccodes* alone. Of the fungi used, only *C. coccodes* is a root pathogen; however, roots of the plants inoculated simultaneously with *G. pallida* and either of the other fungi were unhealthy and somewhat stunted. Cyst development of *G. pallida* on plants inoculated simultaneously with either fungus was depressed. No cyst infection by the fungi was noted in cysts examined. It appears that fungi used in this experiment infect roots in the presence of *G. pallida,* a factor which retards nematode development.—*The International Potato Center, Apartado 5969, Lima, Peru.*

JATALA, P., MARIA L. ARENS, and J. CHRISTIANSEN. *Effects of bitter potato root exudates on hatching of Globodera pallida and G. rostochiensis.*

Tubers of bitter potatoes *Solanum juzepczukii,* Peruvian cultivars 'Parina', 'Piñaza', and 'Ruckii' and table potatoes *S. tuberosum* subsp. *andigena* cultivar 'Renacimiento' were planted in 2,000-cm^3 pots containing sterilized soil and allowed to grow in a screenhouse. Similarly well-sprouted tubers of the same cultivars were placed on wire mesh (0.5-cm opening) screens on top of 600-ml beakers containing sterilized water to the level just touching the screens. Beakers were covered with aluminum foil and held at room temperature so that the roots were allowed to grow into the water. Water level was maintained periodically. After 1 month, root exudates were collected from the pot-grown potatoes as well as from those grown in beakers. Thirty fresh, full, and evenly sized cysts of each *Globodera pallida* and *G. rostochiensis* were held in special baskets placed in counting dishes containing root exudates of each cultivar. Dishes containing only water served as controls. All the containers were kept in a 20 C chamber and, every 4 days, the number of hatched larvae was counted. There were 10 replications/treatment, and the experiment was repeated twice. There were no statistical differences in the hatching of the nematodes in the root exudates of pot grown and beaker grown potatoes. *Globodera pallida* eggs hatched at a greater rate than those of *G. rostochiensis* in 'Renacimiento' cultivar exudates. Hatching of the eggs of both species was supressed in the root exudates of the bitter potato cultivars. However, more *G. rostochiensis* hatched in the root exudates of the bitter potatoes than in *G. pallida.* Bitter potatoes have been predominantly cultivated for centuries in the highlands of the Lake Titicaca region of Peru and Bolivia where *G. rostochiensis* is the dominant of these nematode species. The root exudates of the local native cultivars may have an influence on the hatching of these nematodes and the more that hatch, the greater the increase on susceptible cultivars, an occurrence which probably accounts for the dominance of *G. rostochiensis* over *G. pallida* around the Lake Titicaca, in comparison to its lack of dominance in other parts of the Andes.—*The International Potato Center, Apartado 5969, Lima, Peru.*

JOHNSON, A. W., and G. M. CAMPBELL. *Influence of cropping systems and a nematicide on Meloidogyne species in tomato transplant production.*

Crops were grown from 1971 to 1976 in field plots of Tifton sandy loam naturally infested with *Meloidogyne incognita* and *M. javanica.* The 31 cropping systems included pearl millet, milo, soybean, crotalaria, pigeon pea, and clean fallow preceeding and following tomato transplants in all possible combinations. Each system was replicated 6 times in a randomized, complete block design. All matured forage debris on each plot was cut and incorporated into the soil with a disk

harrow. In the spring of 1974 and each year thereafter, all plots were divided; one-half of each plot was treated with fensulfothion (11.2 kg active/ha) and the remaining one-half was not treated. All plots were seeded (28-32 seeds/0.91 m in five rows per plot 30 cm apart) to tomato cv. 'Campbell 28' in April each year. After the first and second crop of tomatoes in 1972 and 1973, roots of transplants were free of galls in 13 and 11 of the total cropping systems, respectively. In 1974, gall-free transplants were produced only in cropping systems following pigeon pea. In 1975 and 1976, no transplants that were free of root galls were produced in any cropping sequence with or without the nematicide. The most effective treatment combination for suppression of root-knot nematode populations was clean fallow plus fensulfothion. The next most effective treatments were pigeon pea and fallow. Soybean, crotalaria, and millet were less effective than the preceding, and milo was the least effective.—*Agricultural Research Service, U.S. Department of Agriculture, Coastal Plain Experiment Station, Tifton, Georgia 31794, and Campbell Institute for Agricultural Research, Cairo, GA 31728.*

KAPLAN, D. T., and N. T. KEEN. *De novo synthesis of an isoflavanoid compound by soybeans in response to Meloidogyne incognita infection.*

The soybean variety 'Centennial' does not support reproduction of *Melodogyne incognita* and may be considered a poor host for this nematode species. In contrast, the closely related variety 'Pickett 71' is a good host. Ethanol extracts of Centennial root tissue infected with *M. incognita* contain an isoflavanoid-type compound which is not detectable in noninfected tissue of this variety or in infected or noninfected root tissue of Pickett 71. The purified compound has been tentatively identified as glyceollin on the basis of analysis by thin-layer chromatography (TLC) and ultraviolet (UV) methods. Future investigations will be directed toward determining whether glyceollin confers soybean resistance to *M. incognita,* and thereby acts as a phytoalexin.—*Department of Nematology, University of California, Riverside, CA 92502.*

KAYA, H. K. *Effects of temperature on the growth and reproduction of the DD-136 strain of Neoaplectana carpocapsae.*

Neoaplectana carpocapsae, along with its associated bacterium, *Achrombacter nematophilus,* is a promising biological control agent of insect pests. The importance of moisture for survival of *N. carpocapse* has been well documented, but the effects of temperature have not been studied in detail. *Neoaplectana carpocapsae,* in association with *A. nematophilus,* was placed at different temperature regimes on 3 food sources for 14 days. At temperatures above 35 C, *N. carpocapsae* did not develop and live nematodes were not recovered. At 33 C, no live nematodes were observed in the dog food medium or in *Galleria* larvae. On the pork kidney-peptone agar medium, a few live dauer stages were found. They developed to adults at 30 C but no reproduction occurred. Between 15 and 27 C, they developed and reproduced, with highest densities obtained at 25 C. No development occurred at 10 C. These results indicate that *N. carpocapsae* will not develop in homoiothermous animals, but its development in poikilothermal vertebrates is not precluded. However, before *N. carpocapsae* can be used in biological control programs against noxious insects, it, along with its associated bacterium, has to be directly challenged against vertebrates and other nontarget invertebrates to ensure its safety.—*Division of Nematology, University of California, Davis, CA 95616.*

KING, PEGGY S., R. RODRIGUEZ-KABANA, and EDWIN G. INGRAM. *Effects of two thiocarbamate herbicides on severity of disease caused by Meloidogyne arenaria.*

Technical EPTC (S-ethyl dipropylthiocarbamate) and vernolate (S-propyl dipropylthiocarbamate) were applied at rates of 0, 1, 2, 4, 8, 12, 16, and 20 mg/kg to pots with a sandy loam soil infested with *Meloidogyne arenaria.* Pots of treated soil

were placed in the greenhouse, maintained moist (1/3 bar), and after 1 month planted with 'Florunner' peanuts. Soil samples were taken 6 weeks after planting. The roots were carefully washed and weighed, and the numbers of galls counted. The herbicides had no effect on plant growth. Vernolate did not affect gall density (no. galls/gm fresh weight roots); however, gall density was increased 16-22% (over that in the control) in pots treated with 1-8 mg EPTC per kg soil, and was suppressed 17-25% (below that in the control) in response to the three highest rates. Changes in soil larval populations paralleled changes in gall density. A similar experiment was conducted with 'Rutgers' tomatoes in a sandy loam infested with an isolate of *M. arenaria* nonpathogenic to peanuts. EPTC was phytotoxic to tomatoes at rates above 2 mg/kg, but vernolate was phytotoxic only at the two highest rates. Gall density was increased 47 and 88% in pots with 1 and 2 mg EPTC/kg soil respectively; little or no change was observed in soil larval populations. Gall density was increased 11 and 34% in response to 1 and 2 mg vernolate per kg soil respectively; rates higher than 2 mg/kg resulted in a decline in gall density proportional to vernolate concentration so that, at the 12 mg/kg rate, the galling was 51% below that in the control. Vernolate caused no significant changes in soil larval populations. These results indicate that thiocarbamate herbicides could significantly alter host-parasite relationships with *M. arenaria*.—*Botany and Microbiology Department, Auburn University, Auburn, AL 36830.*

LEWIS, S. A., H. D. SKIPPER, and H. L. MUSEN. *Nematode and nodulation studies in coastal plain soybean fields of South Carolina.*

Soil-biology parameters were evaluated in 36 soybean fields in 20 South Carolina counties during 1975 and 1976. Eighteen fields with histories of high or low yields were sampled four times each season. In 1975, yields were positively correlated with pink nodule color, proximity of clay horizon to Ap layer, pH, and subsoiling, and negatively correlated with numbers of *Pratylenchus brachyurus*. In 1976, yields were positively correlated with numbers of nitrogen-fixing nodules, numbers of free-living nematodes, and $N_2(C_2H_2)$ fixation. Yields were inversely correlated with *Criconemoides curvatum* but positively correlated with several other genera. The number of factors and their relationships in the model accounting for yield varied with sampling time. The highest populations of *P. brachyurus* at three locations were 350, 440, and 650/gm dry roots in 1975, and 350, 925, and 1,100/gm dry roots in 1976. Soil populations for both years at R5 (pod stage) were <40/100 cm^3. Inverse correlations existed between *P. brachyurus* and pink color of nodules. Populations of *Helicotylenchus dihystera* and *H. erythrinae* were >500/100 cm^3 soil in 5 of the 18 fields at R1-R2 (bloom) and R5 in 1975; in 1976, they were 270-600/100 cm^3. Root populations of *Helicotylenchus* spp. were 260-320/gm in 1975 and 300-450/gm dry root weight in 1976. We concluded that: *(i)* experiments on pathogenicity of *P. brachyurus* and *Helicotylenchus* spp. are needed, *(ii)* soil profile may influence yield in a dry season, *(iii)* subsoiling was beneficial in different soils, *(iv) P. brachyurus* may influence nitrogen-fixation, and *(v)* the effects of components on yield vary by site and time.—*Departments of Plant Pathology and Physiology, and Agronomy and Soils, Clemson University, Clemson, SC 29631; and Edisto Experiment Station, Blackville, SC 29817, respectively.*

LOWNSBERY, B. F., E. H. MOODY, and G. R. NOEL. *Macroposthonia xenoplax associated with disease of walnut.*

Orchard samplings indicate that ring nematodes are present in at least 30% of California walnut orchards. The species found most often is *Macroposthonia xenoplax*. Elimination of this nematode from soil by treatment with 1,2-dibromoethane at the rate of 100 liters/ha (11 gal/a) improved growth of *Juglans hindsii* seedlings in comparison with the growth of those grown in nontreated soil. *Juglans hindsii* is used commonly as a rootstock for commercial walnuts (*Juglans regia*). After 1 year's growth, *J. hindsii* seedlings inoculated

with 5,000 *M. xenoplax* were smaller than noninoculated controls. When the experiment was terminated, root lesions were present on the roots of nematode-infected seedlings, but not on roots of noninfected controls. These lesions were much smaller initially than those caused by the root-lesion nematode, *Pratylenchus vulnus,* but they coalesced with time.—*Division of Nematology, University of California, Davis, CA 95616.*

MANKAU, R. *Comparisons of nematode populations in U. S. desert soils.*

Nematode populations from soil taken in a standardized random sampling pattern around roots of dominant plants in five desert sites in California, Nevada, Arizona, Utah, and New Mexico were compared and studied with regard to biomass, spatial distribution, and trophic groups. The sampling program included three depths (10, 20, & 30 cm) at the plant bases, at the edge of the plant canopy, and at three times the mean radius of the shrub canopy where applicable. Horizontal positioning of depth samples was altered for dominant grasses and when dictated by plant spacing. Nematodes were recovered by a modified sugar-flotation method, counted, and the data corrected to nematodes/1,000 gm soil. They were identified as: microbivores, fungivores, predator/omnivores, and plant-parasites/miscellaneous tylenchida; then they were fixed and stored for taxonomic study. An examination of the effects of four levels of simulated rainfall applied in two different time sequences was made at the Mojave desert site in Nevada. Greatest numbers of all nematode groups occurred in the top 10 cm of soil near the plant bases and generally decreased significantly with depth and horizontal distance from the plants, but the rate of decrease varied between different deserts and appeared to be related to average annual rainfall and general plant biomass. Microbivores at all locations were composed almost entirely of Cephalobidae. Percentages of different trophic groups in populations varied considerably between sites, as did species composition of groups. Added moisture had only very short term effects on the population tested.—*Department of Nematology, University of California, Riverside, CA 92521.*

MC KENRY, M. V., and P. NAYLOR. *Determination of 1,2-dibromo-3-chloropropane concentrations in soil atmosphere.*

By using a Varian Aerograph model 600-D with flame ionization detector, it is possible to detect concentrations of 2 μg per liter 1,2-dibromo-3-chloropropane (DBCP) in soil air spaces. A 150-cm stainless steel column containing 2% OV-101 on Chromosorb G is used at flow rates of 20 cm^3/min hydrogen and 30 cm^3/min nitrogen. With the column oven operating at 110 C, the DBCP peak emerges at 1.5 min. A gas sampling valve maintained at 120 C with a 3.5-cm^3 loop permits consistent laboratory sampling within 2% error. Small-diameter, stainless-steel tubing is introduced into field soils for subsequent removal of soil atmosphere at various depths. Following fumigation, soil air spaces are periodically sampled by using 30-cm^3 glass syringes lubricated with a water film. Soil atmosphere is drawn into the syringe, contained for 1 min, and discarded. Then the tube is re-sampled. Following the third sampling, the needle tip is sealed with polyurethane. Samples can be stored for a maximum of 3 h at field temperature. Accuracy of field sampling is within 15% error limits. Sampling the soil atmosphere provides quick, direct analysis, and it enables repeated samples to be taken from the same position in the soil profile. It also provides a technique for avoiding the harsh extraction procedures which detect DBCP whether it is in the soil solution or present in a bound form. The most serious disadvantage of the technique is the temperature-dependent error associated with sampling the vapor phase of a chemical with such a hydrophilic nature.—*San Joaquin Valley Research and Extension Center, Parlier, CA 93648.*

MC SORLEY, R., J. M. FERRIS, and V. R. FERRIS. *A predictive simulation model of corn-nematode interactions.*

A model was constructed from field and greenhouse data to simulate population levels of *Pratylenchus hexincisus* in corn roots during the growing season. Major components of the model, which has been translated into the GASP IV simulation language, are nematode, data, weather data, and agronomic data. Output consists of data on centigrade degree-day accumulation, plant ht, root wt, total numbers of *Pratylenchus* present in the root system, and numbers of *Pratylenchus*/gm of root tissue. This last quantity is particularly suitable for field assay, and its seasonal cycle exhibits the characteristic shape of an initial peak, a mid-season valley, and a late-season peak as maximum levels are approached. Simulated levels of *P. hexincisus* per gm of root fell in the 95% confidence intervals around the means of actual samples collected in a given field for 17 of 21 collection dates. A comparison of simulated levels of *Pratylenchus*/gm of root for three different field sites having widely differing initial nematode populations in the soil indicated that higher soil counts increased the size of the initial peak and caused the late-season maximum to be achieved earlier than in fields with lower initial counts. The model allows one to compare counts from a specific sampling date with the expected level, as well as to extrapolate values between sampling dates. This information can be integrated readily into a corn pest management scheme.—*Department of Entomology, Purdue University, West Lafayette, IN 47907.*

MINTON, N. A., M. B. PARKER, and B. G. MULLINIX. *Immediate and residual effects of cultivars, subsoiling, and fumigation on soybean yields and Meloidogyne incognita populations.*

After subsoiling, application of 1,2-dibromo-3-chloropropane (DBCP) under the row in Tifton sandy loam heavily infested with *Meloidogyne incognita* increased average yields of four soybean cultivars. The different resistance levels of these cultivars to *M. incognita* are as follows: 'Hutton', high; 'Essex', intermediate; and 'Davis' and 'Ransom', low. After subsoiling, applying DBCP, and growing the four cultivars for 2 years in the same plots, the residual effects of these practices on yield of the Davis cultivar and the *M. incognita* populations were studied. Differences ($P=0.05$) in yield occurred among plots previously planted to the different cultivars. The 1975 yields of Davis soybeans from plots treated with DBCP and planted to the four cultivars in 1973 and 1974 were: after Essex, 2,171 kg/ha; after Hutton, 1,902 kg/ha; after Davis, 1,404 kg/ha; and after Ransom, 1,055 kg/ha. The DBCP treatment at planting in 1973 and 1974 resulted in a 1975 yield of Davis soybeans of 1,576 kg/ha which was higher ($P=0.05$) than the 1,126 kg/ha from nontreated controls. No statistically significant differences could be attributed to subsoiling. Assays of nematode populations indicated that some residual effects might be attributed to cultivars and nematicides. However, root galling was significantly ($P=0.05$) suppressed by only DBCP. Although beneficial effects occurred, neither practice provided adequate residual control of nematodes for economical soybean production.—*Agricultural Research Service, United States Department of Agriculture; and the University of Georgia College of Agriculture Experiment Station, Coastal Plain Station, Tifton, GA 31794.*

MJUGE, S. G. *The possible role of bioelectrical potential in the manifestations of meloidogynosis.*

It has been shown that *Meloidogyne hapla* and *M. javanica* cause various bioelectrial potentials (BEP) in roots of infected plants. The appearance of BEP accompanies all plant growth processes. There are no precise data in the literature as to the exact mechanism of growth hormone (GH) action on physiological processes using nematodes, and in particular the role of BEP. It has been shown that, under the influence of GH, BEP are formed as a result of changes in cell membrane permeability to K and Na ions. Change of electrical charge of cell structures influences

the adsorption-elution of enzymes. Because most enzymes are in an adsorbed state and are not active, the degree of adsorption-elution of any one of them can influence the whole range of physiological processes of the plant. Applying precise amounts of external electrical stimuli to plant cells leads to processes that are similar to those brought about by the action of corresponding concentrations of GH.—*Institute of Parasitology, Macdonald Campus of McGill University, P.Q., H0A 1C0.*

MOTSINGER, R. E., E. H. MOODY, and C. M. GAY. *Reaction of certain french marigold (Tagetes patula) cultivars to three Meloidogyne spp.*

French marigold (*Tagetes patula*) cultivars, 'Tangerine', 'Petite Harmony', 'Petite Gold', and 'Goldie', differed in respective reactions to *Meloidogyne incognita, M. arenaria,* and *M. hapla* in greenhouse studies. Gall and egg-mass formation varied with the respective marigold cultivar and *Meloidogyne* spp. The only cultivar in which no galls or egg masses were observed, regardless of the nematode species, was Tangerine. Fewer mature *Meloidogyne* females resulted from interplantings of 'Rutgers' tomato with the Tangerine cultivar than with tomato plantings alone. This difference was probably due to random penetration of the larvae into both the marigold and tomato roots. Essentially, this interaction reduced the number of nematodes available for penetration into the tomato roots. No differences in root gall size of tomato were observed between the two treatments. Field studies revealed that soil nematode populations from tomato alone or tomato interplanted with marigold were not different. The nematode populations in the marigold alone treatment were near zero. This 2-year study indicates that certain French marigold cultivars serve as a trap crop rather than as a producer of nematicidal materials for their roots.—*Extension Plant Pathology Department, University of Georgia, Athens, GA 30602.*

NOEL, G. R., and B. F. LOWNSBERY. *The pathogenicity of Tylenchorhynchus clarus to alfalfa.*

Tylenchrohynchus clarus is widely distributed in California and is frequently associated with alfalfa. A two-factorial experiment was used to test the effect of two levels of *T. clarus* (0 and 1,800) and three levels of temperature (21, 24, and 27 C) on growth of 'Moapa 69' alfalfa. Alfalfa seeds were planted in 1.2-liter pots containing a heat-treated sandy loam. Seedlings were thinned to 4/pot and when they were 1 month old, the soil was infested with 1,800 axenized *T. clarus*/pot with noninfested pots in controls. There were 6 replicates of the nematode-infected plants and 6 noninfected plants at each temperature. During the 4.5-month experimental period, three cuttings were harvested. Suppression of alfalfa growth by *T. clarus* was reflected by reduction in top, root, and total plant weights. Top weights and total plant weights increased with temperature ($P < 0.01$ and $P < 0.05$, respectively) but root weight was unaffected. The effect of *T. clarus* on the plants was similar at all temperatures; (the nematode x temperature interaction was not significant). Nematodes were killed *in situ* on seedlings, and some were observed in the roots. Those nematodes which had penetrated the roots did so primarily in the zone of differentiation. Nematodes increased up to ninefold with the greatest reproduction occurring at 24 and 27 C.—*Department of Nematology, University of California, Davis, CA 95616.*

NOEL, G. R., R. D. MEYER, and B. F. LOWNSBERY. *Effect of Macroposthonia curvata on the nutrition of alfalfa.*

Tops of noninfected 'Moapa 69' alfalfa plants and those infected by *Macroposthonia curvata* were analyzed for PO_4-P, K, P, N, crude protein, and Zn. The midstems were used for the PO_4-P and K analyses, whereas the top 15 cm of growth were used for the analyses of P, N, crude protein, and Zn. The nematodes caused a highly significant reduction in PO_4-P and Zn. No effect on the levels of P, N, crude protein, or K

were observed.—*Department of Nematology and Department of Land, Air and Water Resources, University of California, Davis, CA 95616.*

O'BANNON, J. H., and A. T. TOMERLIN. *Population dynamics of Radopholus similis on citrus growing in topsoil and subsoil.*

The spreading decline disease, caused by *Radopholus similis,* occurs on citrus principally in the deep, well-drained sandy soils of the Florida "Ridge" section. The zone of greatest root destruction is below 50 cm in the soil. Certain environmental conditions, including unfavorable temperature and insufficient moisture, are limiting factors which restrict the reproduction and survival of *R. similis.* Other factors which adversely affect *R. similis* may occur in the topsoil. Two greenhouse experiments were conducted to study *R. similis* populations on infected, rough lemon seedlings grown in 20-cm pots in Astatula fine sand topsoil (0-20 cm, 1.5% organic matter) and subsoil (35-55 cm, 0.24% organic matter). All seedlings were uniformly infected in growth bins and then transplanted into their respective soils. In the first experiment, seedlings were maintained at 25 C. Root samples for nematode extraction were taken 19, 32, 44, and 56 weeks after planting. Numbers of *R. similis*/gm of root in topsoil and subsoil (in parentheses) were respectively: 51 (145), 149 (333), 7 (43), and 2 (49). In the second experiment, seedlings were maintained at ambient greenhouse temperature. Root samples were taken 13, 33, 55, 68, 82, and 96 weeks after planting. Numbers of *R. similis*/gm of root were respectively: 259 (238), 126 (204), 102 (397), 103 (487), 40 (420), 22 (23). The final population density in the subsoil reflects limited available food supply because of weakened roots and competition with other microorganisms for the same feeding sites. This study also suggests that *R. similis* was inhibited in the topsoil because of some unknown factor.—*Agricultural Research Service, United States Department of Agriculture, Orlando, FL 32803.*

ORR, C. C. *Biology of Nothanguina phyllobia.*

Nothanguina phyllobia parasitizes leaves and fruiting structure of silverleaf nightshade (Solanum elaeagnifolium), an important weed species of west Texas. Nematode larvae attack the silverleaf nightshade, from the time of its emergence through the growing season, whenever environmental conditions are favorable. Summer infection occurs following rain and several days of humid weather. Nematode larvae ascend the stem from soil or ascend from galled leaves on the plant. Larvae seek young, growing tissue where penetration is more easily accomplished. Larvae move up stems at the rate of 25 cm/h. In laboratory experiments, *N. phyllobia* larvae migrate to leaves of silverleaf nightshade in preference to silverleaf nightshade stems; silverleaf nightshade roots, or tomato leaves, stems, or roots. *Nothanguina phyllobia* larvae are dispersed by wind-movement of infected leaves, in blowing dust, and by soil moved by water.—*Texas Agricultural Experiment Station, Route 3, Lubbock, TX 79401.*

OVERMAN, A. J., and JOHN PAUL JONES. *Effects of Belonolaimus longicaudatus, Criconemoides sp., and Meloidogyne incognita on Verticillium wilt of tomato.*

Two-week-old 'Walter' tomato seedlings (susceptible to *Verticillium* wilt but resistant to Fusarium wilt) were transplanted to plastic trays (6 x 16.5 x 20 cm) filled with Myakka fine sand which was infested with *Belonolaimus longicaudatus* (BL), *Criconemoides* sp. (CRIC), or *Meloidogyne incognita* (MI). A hole then was formed with a sterile glass rod beside each plant and 55,000,000 spores of *Verticillium albo-atrum* were pipetted into each hole. After 2 weeks, half of the plants then were moved to a growth room at 28 C, and half remained in a 21-C growth room. Five weeks after inoculation with *Verticillium,* the plants were excised at the soil line and fresh weights were determined. At 28 C, BL + *Verticillium,* CRIC + *Verticillium,* and MI + *Verticillium* suppressed plant growth (fresh weights) by 90, 79, and 64%,

respectively, in comparison with a 40% suppression by *Verticillium* alone. At 21 C, BL + *Verticillium*, CRIC + *Verticillium*, and MI + *Verticillium* suppressed plant growth by 69, 43, and 31%, respectively, compared to a 29% suppression by *Verticillium* alone. In contrast to the general belief that *Verticillium* wilt is a cool-weather disease, wilt symptoms were much more pronounced at 28 than 21 C.—*Agricultural Research and Education Center, 5007 60th Street East, Bradenton, FL 33508.*

PINOCHET, J. *Distribution of Radopholus similis on bananas in Belize.*

A total of 6,520 banana rhizomes from 5 plantations in Big Creek and South Stann Creek, Belize (British Honduras) were examined for *Radopholus similis* lesions. These plantations account for 98% of the commercial bananas grown in this country. The procedure used to determine the nematode infestation and spread within the fields consisted of digging, at random, 12 rhizomes/ha, peeling them superficially, and checking for *R. similis* lesions. The lesions are characterized by the formation of dark, necrotic tissue with reddish borders. Although all these plantations are less than 4 years old, and were established by using heat-treated "seed pieces," 33-35% of the rhizomes were infected with *R. similis*. Possible sources of nematode inoculum are: bananas and plantains growing on peasant farms before these plantations were established, ineffective heat treatment of rhizomes, or use of nematode-infected rhizomes in replanting. In the search for potential lands for banana culture, *R. similis* was not found in wild *Musa* spp. or other indigenous hosts in areas adjacent to existing banana plantations, an indication that this nematode was probably introduced. Other nematodes, such as *Meloidogyne* spp. and *Helicotylenchus* spp., were found frequently throughout the survey.—*Division of Tropical Research, United Fruit Company, La Lima, Honduras, Central America.*

PLATZER, E. G., J. E. EBY, and P. A. FRIEDMAN. *Growth inhibition of Caenorhabditis elegans with benzimidazoles.*

The nematostatic properties of nine benzimidazoles were evaluated on *Caenorhabditis elegans*. The nematodes were grown axenically at 20 C in thin films of a medium used to maintain *Caenorhabditis briggsae*. This medium was supplemented with β-sitosterol, cytochrome *c*, and lactalbumin hydrolysate. After the median growth inhibition for each compound was determined, it was possible to establish a group order for in vitro potency. The activity of the benzimidazoles in order of decreasing effectiveness was: oxibendazole, cambendazole, parbendazole, mebendazole (0.2-0.7 μM); benomyl, fenbendazole, methyl 2-benzimidazolecarbamate (2-8 μM); thiabendazole (31 μM); and benzimidazole (2.7 mM). Benzimidazoles with carbamates at position 2 and substitutions at position 5 were the most active compounds, although cambendazole and fenbendazole were exceptions. The parent compound, benzimidazole, and its riboside were relatively inactive. These results are similar to those reported for animal-parasitic nematodes. This fact suggests that *C. elegans* could be used both as a test organism for development of nematicides and anthelminthics, and in a model system for determining the molecular modes of action of benzimidazoles in nematodes.—*Department of Nematology, University of California, Riverside, CA 92521.*

REBOIS, R. V., ARNOLD E. STEELE, A. K. STONER, and B. J. ELDRIDGE. *A gene for resistance to Rotylenchulus reniformis in tomato, and a possible correlation with resistance to Heterodera schachtii.*

Tomato seedlings from F_3 seed of a *Lycopersicon pimpinellifolium* (P1375937) x *L. esculentum* 'Red Rock' cross were tested for resistance to *Rotylenchulus reniformis*. F_3 seedlings derived from four of seven F_2 plants were all resistant, whereas those from another F_2 plant were susceptible. Progeny from two F_2 plants produced seedlings that segregated in a

ratio of three resistant to one susceptible, an indication of at least one dominant gene (Re_1) for resistance to *R. reniformis* in P1375937. In addition, 22 other cultivars of different origin, from five different countries, were tested for resistance to *Heterodera schachtii* and *R. reniformis* at Salinas, California and Beltsville, Maryland, respectively. All cultivars responded similarly to both species of nematodes, an indication that the gene or genes which impart resistance to the reniform nematode may be identical, or closely linked, to those that cause resistance to *H. schachtii*. Additional seedlings of these segregating cultivars will have to be tested to determine whether a single gene is dominant or several genes are involved in resistance to *H. schachtii* in tomatoes.—*Nematology Laboratory, Plant Protection Institute, Agricultural Research Center, Beltsville, MD 20705; U. S. Agricultural Research Station, Alisal Branch, Salinas, CA 93901; and Vegetable Laboratory, Plant Genetics and Germplasm Institute, Agricultural Research Center, Beltsville, MD 20705.*

RICKARD, D. A., K. R. BARKER, and J. C. WELLS. *Effects of Macroposthonia ornata and Meloidogyne hapla on yield and value of peanut.*

A mixed population of *Macroposthonia ornata* and *Meloidogyne hapla* in a Craven fine sandy loam field was assayed in treated and nontreated plots planted to peanut (*Arachis hypogaea* L., 'Avoca 11'). The field had been in peanut for 5 years previously, and population densities of both nematodes were high. Soil samples were assayed for nematodes at 0 (P_i), 36 (P_{ie}), 71 (P_m), and 145 days (P_f) after planting. Compared to the nontreated control, the treatment which resulted in the lowest P_{ie}, P_m, and P_f of *M. ornata* also gave the highest yield and value of peanut. The second best crop response was in plots treated with the material providing the lowest P_{ie} and P_m of *M. hapla*. In addition to the nematicide test, relationships of population densities of *M. ornata* and *M. hapla* with yield of 'Florigiant' peanut were determined in microplot tests using each nematode species alone. Low, medium, and high initial populations were established in 80- x 100-cm microplots of loamy sand. On the basis of linear regression models, yield losses for each 10-fold increase in P_i were *M. ornata* — 18.7% ($r = -0.76^{**}$), and *M. hapla* — 8.6% ($r = -0.84^{**}$).—*North Carolina Department of Agriculture, Agronomic Division, Raleigh, NC 27611; and Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

RIEDEL, R. M., and C. C. POWELL. *Chemical control of Pratylenchus penetrans and cultural control of Xiphinema americanum in Rhamnus frangula.*

Surveys of *Rhamnus frangula* ('Tallhedge') in Ohio nurseries associated *Pratylenchus penetrans* and *Xiphinema americanum* with plants of poor vigor. *Pratylenchus penetrans* in roots of *R. frangula* was controlled by dipping dormant, bare root stocks in 2,400 μg (a.i.)/ml oxamyl or 1,2-dibromo-3-chloropropane (DBCP) for 30 min before potting. Oxamyl dip caused cupping and marginal burn on leaves of treated stock in containers. DBCP caused no damage under these conditions, nor was field survival of *R. frangula* altered by root dips of DBCP before or after winter storage. Preplant incorporation of phenamiphos at rates of 6.7 and 13.4 kg(a.i.)/ha significantly lowered nematode populations to 220 and 0 *Pratylenchus*/10 gm roots, respectively, in comparison with 4,720 nematodes/10 gm in controls. Oxamyl [13.4 and 26.8 kg (a.i.)/ha], and ethoprop [6.7 and 13.4 kg (a.i.)/ha] did not reduce numbers of *Pratylenchus* significantly. Three foliar sprays of oxamyl at 11.6 and 46.5 gm (a.i.)/liter applied to drip-off at 30-day intervals on 3-year-old established stock did not reduce numbers of *Pratylenchus* in roots. Two crops of sudan grass (*Sorghum bicolor* X *S. sudanense* 'Magic Vigor') and winter rye (*Secale cereale*) decreased X. americanum from 5,000/500 cm^3 soil to undetectable levels. *Rhamnus frangula* grown 2 years in the same field following the sudan grass-winter rye rotation increased populations to 1,250/500 cm^3 of soil —*Plant Pathology Department, Ohio State University, Columbus, OH 43210.*

ROBERTSON, W. M. *Possible receptor regions within the esophagus of Longidorus leptocephalus.*

Electron microscopy of the esophagus of *Longidorus leptocephalus* has revealed a number of distinct regions where there are groups of nerve processes closely associated with the wall of the food canal. There are innervated regions in the ventral and subdorsal sinuses of the odontophore and in the anterior slender esophagus. Within the basal bulb, there are innervated regions associated with the openings of the anterior and posterior salivary gland ducts into the food canal. It is thought that all these innervated regions are chemoreceptors which monitor ingested food and salivary secretions. Three possible proprioreceptor regions have also been found. The first is at the base of the odontophore where three sets of nerve processes pass between the three groups of radial muscles which transfer the pull of the main protractor muscles to the odontophore. The second is at the isthmus of the slender esophagus where the peripheral muscles of the basal bulb surround the esophagus; and the third is at the esophageal-intestinal valve around which three sets of nerve processes form an annulus.—*Zoology Section, Scottish Horticultural Research Institute, Invergowrie, Dundee, Scotland, DD2 5DA, UK.*

RODRIGUEZ-KABANA, R., PEGGY S. KING, and EDWIN G. INGRAM. *Activity of the systemic insecticide disulfoton against plant-parasitic nematodes.*

Technical disulfoton was applied at rates of 0, 0.5, 1.0, 2.0, 3.0, 4.0, 8.0, 12.0, 16.0, 20.0, and 30.0 mg/kg soil to pots of nematode-infested sandy loam soil. In pots planted with 'Rowden' cotton, the number of *Meloidogyne incognita* galls/gm fresh root wt increased significantly above the controls in response to the 3 lowest rates; concentrations of 4-12 mg/kg soil did not affect galling, and rates higher than 12 mg/kg soil resulted in 80-100% suppressions of gall development. Numbers of *Tylenchorhynchus claytoni* and *Helicotylenchus dihystera,* in unplanted pots and in pots with cotton, declined in proportion to the disulfoton concentration over the range of 0.5-12.0 mg/kg soil; nematode numbers in pots containing concentrations higher than 12 mg/kg soil were reduced by 80% compared to numbers in nontreated controls. The effect of disulfoton on *Meloidogyne arenaria* was also studied in a sandy loam from an infested peanut field. The insecticide was added at rates of 0-8 mg/kg soil and the treated soil was planted with summer squash. Disulfoton had no appreciable effect on the number of galls per gm fresh root wt of squash 6 weeks after planting. In a field test with 'Florunner' peanuts in an area infested with *M. arenaria,* disulfoton applied in a 46-cm band at rates of 2.2, 4.5, and 6.7 kg/ha resulted in 15, 12, and 31% increases in yield, respectively; the nematicides ethoprop and carbofuran applied similarly at the rate of 4.5 kg/ha produced 50 and 67% increments in yield, respectively. Results suggest that disulfoton may be valuable for the control of *M. incognita* and other plant-parasitic nematodes on cotton, but that it is only marginally effective against *M. arenaria.*—*Department of Botany and Microbiology, Auburn University, Auburn, AL 36830.*

SANTO, G. S., and W. J. BOLANDER. *Separate and concomitant effects of Macroposthonia xenoplax and Meloidogyne hapla on Concord grapes.*

In central Washington, *Macroposthonia xenoplax* and *Meloidogyne hapla* are commonly associated with Concord grape vineyards exhibiting poor growth. Studies were undertaken to determine the interrelationship between these two nematode species and their effect on the growth of Concord grape plants. Eight-week-old, three-node Concord grape plants were planted to sandy loam soil in 15-cm clay pots. These plants were given nine treatments: 500 or 5,000 *M. xenoplax,* 500 or 5,000 *M. hapla,* the four possible combinations of low and high inoculum levels of the two nematode species, and an untreated control. The 10 replications of these treatments were arranged in randomized blocks in a greenhouse. Soil temperature in the pots during the experiment ranged from 18 to 24 C. Plant dry weights were

inversely proportional to the initial numbers of *M. xenoplax* or *M. hapla* added. In the combination treatments (*M. xenoplax* plus *M. hapla*), plants inoculated with 5,000 *M. xenoplax* plus either 500 or 5,000 *M. hapla* weighed less than the controls. No difference was observed between the 500 *M. xenoplax* plus 5,000 *M. hapla* treatment and the controls. In general, the presence of *M. xenoplax* tended to suppress *M. hapla* reproduction and *M. hapla* tended to increase *M. xenoplax* reproduction.—*Department of Plant Pathology, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, WA 99350.*

SASSER, J. N., and A. C. TRIANTAPHYLLOU. *Identification of Meloidogyne species and races.*

Populations of *Meloidogyne* received from cooperators participating in the International *Meloidogyne* Project have been characterized on the basis of host response, morphology, and cytogenetics. Differential hosts included tobacco, 'NC 95'; cotton, 'Deltapine 16'; pepper, 'California Wonder'; watermelon, 'Charleston Gray'; peanut, 'Florunner'; and tomato, 'Rutgers'. The principal morphological character used was the perineal pattern of females. Cytogenetic characters studied included mode of reproduction, chromosome numbers, and chromosome behavior during maturation of oocytes. In general, identification was possible through the use of differential hosts alone, since most populations comprised a single species and the various species conformed to their "usual" response on the differentials used. However, for more accurate identification of species and for characterization of mixed populations comprising more than one species, examination of perineal patterns and cytogenetic information was essential. Variation in chromosome numbers for each species rarely exceeded the variation already reported in the literature, and there were no deviations with regard to mode of reproduction. Of the 180 populations studied thus far, most belonged to the so-called "common" species, namely, *M. incognita*, 56%; *M. javanica*, 24%; *M. hapla*, 12%; and *M. arenaria*, 5%. Other species accounted for 3%. Four parasitic races of *M. incognita* have been designated according to their parasitism on N.C. 95 tobacco and Deltapine cotton. These races do not correspond to the two chromosomal forms detected in the same species.—*Departments of Plant Pathology and Genetics, respectively, North Carolina State University, Raleigh, NC 27607.*

SAYRE, RICHARD M., and W. P. WERGIN. *Morphological comparison of the bacterial spore parasite of Meloidogyne sp. to Pasteuria ramosa, a bacterial parasite in water fleas.*

A spore parasite of nematodes (SPN) was originally described by Thorne as a protozoan, and subsequently reclassified by Mankau as a bacterium. If this bacterium could be cultured, its potential value as a biocontrol agent against *Meloidogyne* spp. would be considerable. Consequently, an investigation was undertaken to examine the life cycle and to grow the organism in vitro. Examination of the literature revealed that a description of a bacterium, *Pasteuria ramosa,* Metchnikoff, 1888, and a drawing of its life cycle were strikingly similar to those for SPN. These morphological similarities suggested that a close taxonomic affinity might exist between the two organisms. To test this hypothesis, *P. ramosa* was searched for, and found, in the water flea, *Monia rectirostris.* Several striking similarities were discovered between the cladoceran parasite and the SPN: *(i)* the diseased, mature cladocerans and the diseased, mature female nematodes were both "milky" in appearance; *(ii)* even though the coeloms of cladocerans and pseudocoeloms of nematodes carry many developing parasites, the hosts continue to grow and to molt; *(iii)* in both diseases, a synchronous development occurs between the host and the parasite. The stages of the life cycle, as illustrated by Metchnikoff, parallel the sequence found for SPN. The mature spores of both parasites were highly refractile when examined in the thick-walled spore. The scanning electron microscope revealed a collapsed parasporal structure around the endospore of SPN,

but the mature spore of *P. ramosa* was stalked and possessed a middle vesicle bearing an intact anterior endospore. The similarities in morphological features between SPN and *P. ramosa* indicate that the bacteria are closely related.—*Nematology Laboratory, Plant Protection Institute, Agricultural Research Center, USDA, Beltsville, MD 20705.*

SCHMITT, D. P. *Suitability of soybean cultivars to Xiphinema americanum and Macroposthonia ornata.*

The host suitability of 19 soybean cultivars was evaluated in a deep sandy soil infested with *Macroposthonia ornata* and *Xiphinema americanum.* Experimental design was a split plot with 4 replications; each sub-plot was 4 rows wide by 9 m long. One sub-plot was treated with 1,2-dibromo-3-chloropropane at 7 liters/ha and bedded; the other was only bedded. Yields of 'McNair 600', 'FFR 666', 'Hutton', 'York', 'Tracy', 'SRF 450', and 'Mack' differed by less than 70 kg/ha between fumigated and nonfumigated plots. Yields of 'Coker 136', 'Forrest', 'Davis', 'Bragg', 'Coker 338', 'Lee 74', 'Ransom', 'Cobb', 'Pickett 71', 'Essex', 'Dare', and 'McNair 800' were 101, 141, 148, 175, 182, 215, 282, 296, 417, 451, 454, and 511 kg/ha higher in the fumigated soil than in the nonfumigated soil. Numbers of *M. ornata* increased only on McNair 800, Cobb, Ransom, and Essex. *Xiphinema americanum* increased on all 19 cultivars. For cultivars, except Ransom and Coker 338, that yielded more than 100 kg/ha in the fumigated than in the nonfumigated soil, the population density of *X. americanum* at harvest was 10 times the density at planting. Ransom appeared to be susceptible to *M. ornata;* Pickett 71, Dare, Coker 338, and Lee 74 to *X. americanum;* and McNair 800, Cobb, and Essex to one or both of the nematode species.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

SLINGER, L. A., and G. W. BIRD. *Growth and development of carrot in the presence of Meloidogyne hapla.*

Plant surface area, dry weight, fresh weight, net assimulation rate, relative growth rate and leaf area ratio of *Daucus carota* C.V. 'Spartan Premium' grown in *Meloidogyne hapla*-infested and noninfested soil were measured every 96 h during a 100-day growth period. Detrimental nematode effects were observed as early as 4 days after germination. Growth and development of the shoot system (height, surface area, dry weight and fresh weight) were significantly retarded in the presence of *M. hapla* as early as 12 days after seeding. During the first 12 days after seeding, there was an increase in root dry weight in the presence of *M. hapla.* Root growth and development (surface area, dry weight and fresh weight) associated with the nematode, however, were retarded as early as 16 days after seeding. In the presence of *M. hapla,* there was a delay in the occurrence of sixth order roots; there were 44% fewer roots (primary through sixth order) and 50% less total root length. Only 57% of the carrots grown in the presence of *M. hapla* were suitable for fresh market use whereas, 97% of the carrots grown in noninfested soil were satisfactory for fresh market. Data from this study were used to construct a pest-crop ecosystem model for the growth and development of Spartan Premium carrots.—*Department of Entomology, Michigan State University, East Lansing, MI 48824.*

STARR, J. L. *A micro-polyacrylamide gel electrophoresis system for analysis of nematode enzymes.*

A major obstacle in the study of plant-parasitic nematode enzyme systems is the difficulty of obtaining nematodes of suitable quality for analysis in sufficient quantities. To help overcome this difficulty, a cylindrical, micro-polyacrylamide gel electroporesis system has been adapted for the study of nematode enzymes. Electrophoresis is conducted in 50-μl capillary pipets containing 35 μl of a 7% polyacrylamide separating gel and 6 μl of a 2% polyacrylamide stacking gel. Separation of anionic

proteins occurs when gel columns are subjected to 140 volts in Tris-glycine running buffer (pH 8.3) for 30-45 minutes, depending on the migration distance desired. The micro-gel system is capable of separating a 0.1-μg sample of partially purified commercial bovine serum albumin into four discrete bands. Crude homogenates from four *Meloidogyne* spp. females (or 5 to 10 μg of total protein from a larger sample) yield sufficient activity for the separation and detection of peroxidase isozymes, nonspecific esterase isozymes, and RNase isozymes. The micro-gel system increases our ability to study plant-parasitic nematode enzyme systems by eliminating the need for a large quantity of nematodes.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

STARR, J. L. *Peroxidase activity in different developmental stages of Meloidogyne spp.*

Peroxidase activity in eggs, freshly hatched larvae, males, and females of *Meloidogyne arenaria, M. hapla, M. javanica,* and *M. incognita* was measured qualitatively by a "micro" polyacrylamide gel electrophoresis system and quantitatively by a colorimetric assay. Electrophoretic analysis of crude nematode homogenates revealed that females from each of the four species had identical peroxidase isozyme profiles; two isozymes with Ef of 0.43 and 0.53 were detected. No peroxidase activity was detected in homogenates from eggs, larvae, or males from any of the four species by means of electrophoretic techniques. Total peroxidase activity was measured, by using o-diansidine and H_2O_2 as substrates, and expressed as the change in absorbance at 460 nm/min/mg protein ($\triangle A_{460}$). Crude homogenates from eggs of *M. arenaria, M. hapla,* and *M. javanica* had total peroxidase activity of $\triangle A_{460} = 3.3 \times 10^{-3}$, 1.4×10^{-3}, and 1.4×10^{-2}, respectively. Homogenates from freshly hatched larvae of *M. arenaria* and *M. incognita* had activities of $\triangle A_{460} = 4.1 \times 10^{-3}$ and 2.4×10^{-2}, respectively. Peroxidase activity in homogenates of females of the four species ranged from $\triangle A_{460} = 1.04$ to 1.54. The observed differences in peroxidase activity among the different developmental stages of *Meloidogyne* are apparently not caused by differences in enzyme pH optimum or substrate affinity but appear to be related to feeding activity.—*Department of Plant Pathology, North Carolina State University, Raleigh, NC 27607.*

STEELE, A. E. 1977. *Inheritance of resistance to Heterodera schachtii in Lycopersicon spp.*

Twenty-eight cultivars or advanced breeding lines of *Lycopersicon esculentum,* 22 accessions of *L. pimpinellifolium,* 4 accessions of *L. peruvianum,* and 12 hybrids of *L. esculentum* X *L. pimpinellifolium* were evaluated for resistance to *H. schachtii.* Data established that resistance was variable within each of the three *Lycopersicon* spp. *L. pimpinellifolium* exhibited the greatest degree of resistance. Evaluation of F-1 and F-2 progenies indicated that resistance is conferred by a single dominant gene, or that susceptibility is inherited as an epistatic combination of single recessive and single dominant genes. —*Agricultural Research Service, United States Department of Agriculture, P. O. Box 5098, Salinas, CA 93901.*

STIRLING, G. R., and R. MANKAU. *New fungal parasites of Meloidogyne spp.*

Relatively low populations of *Meloidogyne* spp. occur in many peach orchards on 'Lovell' rootstock in the San Joaquin Valley of California. Because the soils and climate are suited to the nematode and a susceptible rootstock is being used, it is suspected that natural antagonists to *Meloidogyne* may be present. Egg masses from these orchards often contain relatively few eggs, and are frequently parasitized by fungi. Three different fungal isolates have been recovered from infected egg masses. All isolates grow poorly on corn meal and potato dextrose, but they survive better on media such as glucose-peptone and YPSS (yeast-phosphate-soluble starch). One isolate sporulates prolifically on a relatively rich medium containing yeast, starch, V8 juice,

and peptone and produces fusiform multiseptate conidia approximately 45 x 3 μm. The other isolates have not been induced to sporulate. All isolates parasitize egg masses on agar. Egg masses added to autoclaved or field soil in which macerated mycelium has been incorporated also become infected. Most of the eggs in an egg mass become parasitized in less than 3 weeks. The three isolates grow best at 24-30 C, and in the field, high levels of parasitism occur in late summer and fall when temperatures are in this range. Egg masses added to field soil during this period are usually heavily parasitized when removed 1 month later. Although the study is incomplete, there are indications that these fungi considerably reduce the number of *Meloidogyne* eggs in Lovell peach orchards and contribute to the low nematode populations observed.—*Nematology Department, University of California, Riverside, CA 92521.*

SVOBODA, J. A., and R. V. REBOIS. *Sterol composition of Rotylenchulus reniformis and its host plant, cotton.*

Extracts from soil stages of *Rotylenchulus reniformis* and roots from infected and noninfected seedlings of *Gossypium hirsutum* C.V. 'Auburn 56' were separated into polar and nonpolar fractions. Polar fractions from *R. reniformis* were bioassayed for ecdysteroids by means of the housefly assay, but no molting hormone activity was detected. Neutral sterols were isolated, purified, and acetylated, and the sterol acetates were separated into saturated and unsaturated fractions. The sterols were identified by gas-liquid chromatography (GLC) and GLC-mass spectrometry and quantitated by GLC. Of the 40.5 μg total sterols obtained per gm fresh wt of nematodes, 95.1% were unsaturated and found in the following relative percentages: cholesterol, 23.8; campesterol, 4.4; stigmasterol, 15.3; sitosterol, 51.6; and an unknown, 4.9%. The relative percentages of saturated sterols (4.9% of total) were as follows: cholestanol, 13.8; campestanol, 14.7; stigmastanol, 55.0, and an unknown, 16.5%. Roots of nematode-infected cotton seedlings contained essentially the same sterol percentages as noninfected roots. These were: cholesterol, 0.6; campesterol, 5.1; stigmasterol, 43.4; sitosterol, 48.5; unknown steroidal compound, 2.6%; and a trace of saturated sterols. The relative difference between the cholesterol content of *R. reniformis* and the cotton seedlings indicates that this nematode most likely derives its cholesterol by dealkylation of C_{28} or C_{29} plant sterols.—*Insect Physiology Laboratory and Nematology Laboratory, Plant Protection Institute, Beltsville Agricultural Research Center, USDA, Beltsville, MD 20705.*

SWANSON, T. A., and F. D. McELROY. *Pathogenicity of three nematode species to field rhubarb.*

Greenhouse studies were conducted to determine the role of three nematode species associated with a decline of field rhubarb (*Rheum rhaponticum* L.) in southwestern British Columbia, Canada. Three-week-old seedlings of 'Ruby Red' rhubarb growing in methyl-bromide treated field soil in 13-cm pots were inoculated with *Pratylenchus penetrans, Xiphinema bakeri,* and *Paratylenchus projectus* at the following levels respectively: 0, 100, 1,000, and 10,000; 0, 100, 500, and 1,000; 0, 100, 1,000, 10,000, and 100,000. Stalk number, stalk length, and leaf area were measured bi-weekly over 12 weeks. At 12 weeks, fresh and dry weights of the leaves, stalks, and roots were measured and nematodes extracted. Low (100/pot) numbers of *P. penetrans* stimulated plant growth as reflected by leaf area (30%), stalk length (7%), and dry top weight (30%), but root growth was suppressed (dry weight 13% less than that of control). High (10,000 per pot) populations suppressed growth [leaf area (11%), and dry weights of stalks (31%), roots (41%), and tops (19%)]. *Xiphinema bakeri* at 100/pot stimulated growth [stalk length (22%) and stalk number (26%)]. High (1,000/pot) populations suppressed growth [leaf area (37%), and dry weights of leaves (41%), stalks (44%), and roots (39%)]. At 100/pot, *P. projectus* also stimulated growth [leaf area (14%), stalk length (9%), and dry weights of stalks (29%) and roots (22%)]. High

(100,000/pot) numbers suppressed growth [leaf area (70%), stalk length (50%), stalk number (25%), and dry weights of leaves (67%), stalks (68%) and roots (61%)]. These results indicate that these nematode species are a major cause of yield decline in B.C. rhubarb.—*Department of Plant Science, University of British Columbia, and Agriculture Canada, Vancouver, B.C. V6T 1X2.*

TARJAN, A. C. *Kelp derivatives for nematode-infected citrus trees.*

Kelp (*Ascophyllum nodosum*) meal and kelp extract were applied during the past 7 years to citrus seedlings and mature trees infected with nematodes. Kelp meal was added at the rate of 448 kg/ha to soil in which rough lemon seedlings were growing. Significant increases in plant weight and decreases in *Pratylenchus coffeae* population ($P = 0.05$) were noted after 17 weeks. Kelp meal was applied at 672 kg/ha to 25-year-old Valencia orange/sour orange trees infected with *Tylenchulus semipenetrans*. After 2 years, trees which had been treated with kelp meal alone or kelp meal and 1,2-dibromo-3-chloropropane at 41.1 kg/ha did not produce more, or larger fruit or lower populations of *P. coffeae* than nontreated controls ($P = 0.05$). A water-soluble, powdered kelp extract was applied at 2.24 kg/ha in 379 liters of water as a foliar spray to potted 18-month-old lemon plants infected with *Radopholus similis*. After 6 months, plants receiving the material, either as a foliar spray or soil amendment, weighed more and had fewer nematodes ($P = 0.05$) than nontreated controls. A field test using kelp solution at 2.24 kg/ha was applied as a foliar spray to 27-year-old 'Ruby red' grapefruit/sour orange trees infected with *T. semipenetrans*. Data obtained during the next 2 years did not indicate beneficial effects from use of kelp. From these results, I conclude that kelp meal and kelp extract at the tested rates are beneficial, and even mildly nematicidal, to young plants under controlled greenhouse conditions but not to older established trees in the field.—*University of Florida, AREC, P. O. Box 1088, Lake Alfred, FL 33850.*

TRUDGILL, D. L., and D. J. F. BROWN. *A comparison of the efficiency with which Longidorus macrosoma vectors two strains of raspberry ringspot virus.*

The frequency of transmission by *Longidorus macrosoma* of two strains of raspberry ringspot virus (RRV) was examined in the laboratory. A strain from Scotland (RRV-S), which is normally associated with *L. elongatus*, was transmitted only rarely by *L. macrosoma* but was transmitted readily by small numbers of *L. elongatus*. A strain from England (RRV-E), which had been associated with *L. macrosoma* in the field, was transmitted only infrequently by small numbers of *L. macrosoma* or *L. elongatus*. When the reason for the low frequency of transmission of RRV-E and RRV-S by small numbers of *L. macrosoma* was sought, it was found that most nematodes had ample opportunity to transmit virus. Most of the nematodes tested had fed on the infector plants and had ingested virus. Most nematodes exposed to either RRV-E or RRV-S had particles (thought to be those of the virus) retained in the region of the anterior odontostyle, and had fed on the roots of the bait plants. The low frequency of transmission obtained may be caused by strong retention of virus particles within the feeding apparatus so that they are not released when the nematodes feed, or by a lack of infectivity of the virus when *L. macrosoma* is the vector and *Petunia hybrida* is the host.—*Scottish Horticultural Research Institute, Invergowrie, Dundee, Scotland, DD2 5DA.*

VEECH, J. A. *The relationship between terpenoid aldehydes and the resistance of cotton to Meloidogyne incognita.*

Five cotton (*Gossypium hirsutum*) cultivars were rated for their resistance to *Meloidogyne incognita* on the basis of root-knot index, number of nematode egg masses/gm root, and number of nematode eggs/gm root. 'Auburn 623 RNR' was, by far, the most resistant cultivar; the next most resistant were 'N6072' and 'Clevewilt'. 'Deltapine 16' was considered susceptible and 'M8' very susceptible. The terpenoid aldehydes (hemigossypol, methoxyhemi-

gossypol, gossypol, methoxygossypol, and dimethoxygossypol) were extracted from noninoculated and *M. incognita*-inoculated roots of the five cultivars. Individual terpenoid aldehydes were separated by thin-layer chromatography (TLC) and their concentrations determined colorimetrically. Coefficients of correlation between the concentrations of the individual terpenoid aldehydes and the host-resistance ratings were determined. No significant correlations were apparent between pre- or postinfection concentrations of the individual terpenoid aldehydes and host resistance. However, significant correlations were found between the changes in the concentration of methoxy-substituted terpenoid aldehydes that occur as a result of infection, and host resistance. The data indicate that infection-induced synthesis of methoxy-substituted terpenoid aldehydes are involved in the resistance of cotton to *M. incognita*.—*National Cotton Pathology Research Laboratory, P. O. Drawer JF, College Station, TX 77840.*

WANG, E. L. H. *Electron microscopy of wall ingrowths of giant cells of Lycopersicon esculentum induced by Meloidogyne incognita.*

A labyrinth of wall ingrowths in giant cells of *Lycopersicon* esculentum induced by *Meloidogyne incognita* was observed by using an electron microscope. The wall ingrowths were branched and interconnected; they produced a labyrinth that was distributed peripherally around giant cell walls. The plasma membrane was involuted around the wall ingrowths. Cytoplasmic inclusions (pinwheels), resembling those reported in literature in association with a number of plant virus diseases, were found adjacent to the wall labyrinths of giant cells. The intact pinwheel inclusions comprised 11 arms with a circumference of approximately 195 nm. There was no evidence of virus-like particles in association with giant cells, nor did the pinwheel inclusions appear in other than giant cells. It is believed that this is the first record of the appearance of pinwheel inclusions associated with a labyrinth of wall ingrowths of giant cells.—*Department of Agriculture and Fisheries, P.O. Box 834, Hamilton 5, Bermuda.*

WERGIN, WILLIAM P., BURTON Y. ENDO, and RICHARD M. SAYRE. *Three-dimensional SEM and freeze fracture for examination of the anatomy and morphology of nematode larvae and infection sites.*

Second-stage larvae of *Aphelenchoides rutgersi, Heterodera glycines, Meloidogyne incognita,* and *Panagrellus redivivus* and infected root tissues from soybean and tomato plants were chemically fixed in 3% glutaraldehyde, dehydrated in a graduated ethanol series, critical-point dried with CO_2, and sputter-coated with gold-palladium for observations of external surface structures with the scanning electron microscope. To observe the internal morphology of nematode larvae and infected roots, dehydrated tissues were frozen with liquid nitrogen prior to critical-point drying, fractured with a razor blade, and processed as previously described. Stereomicrographs, at 50 x 20,000 x, were obtained by photographing the tissue, tilting specimens 4° to 6°, and rephotographing at the new angle. Projecting these pairs of stereomicrographs onto a lenticular screen allows three-dimensional observation of the tissues by viewers wearing polaroid glasses. Three-dimensional scanning electron microscopy can be used to illustrate the details of taxonomically important surface structures in nematodes and to examine the penetration and feeding sites of larvae in host tissues. Freeze-fracturing nematode larvae and infected roots allows investigators to compare the internal morphology of tissues, as revealed with the scanning electron microscope, to morphology observed with the transmission electron microscope. These comparisons increase our understanding of the fundamental structure of nematodes and help elucidate their interactions with host plants. —*Nematology Laboratory, Plant Protection Institute, Agricultural Research Center, USDA, Beltsville, MD 20705.*

WYSS, U. *Response of root cells to feeding by Xiphinema index.*

The feeding behavior of *Xiphinema index* and cellular responses to feeding were studied on roots of *Ficus carica* seedlings in aseptic agar culture. Nematodes were surface-sterilized by a 90-min exposure to a 0.03% NaN_3 solution. In most cases, feeding was initially confined to the zone of root elongation. Attacked root tips usually stopped growing and swelled to form galls, even when they were fed upon by a single female. Under attack by several nematodes, swollen root tips became deformed by cracks. However, in many severely damaged tips, meristematic activity was not irreversibly blocked, as lateral root initials frequently emerged from the proliferated root tip tissue. A strong correlation between egg production capacity and feeding intensity on cells of root-tip galls became evident. Ultra-thin sections of tip galls always revealed hypertrophied and multi-nucleate cells with an orientation to the feeding site. In the young stage, these cells were densely filled with cytoplasm and usually contained a cluster of nuclei with extremely lobed contours and enlarged nucleoli. Signs of cell-wall dissolution were common near parasitized cells with thickened cell walls and cytoplasmic and nuclear disintegration. In spite of signs of enzymatic cell-wall breakdown near the actual infection site, it is not yet clear how the multi-nucleate condition (up to 25 enlarged nuclei per modified cell) arises. There is evidence that multi-nucleate cells are directly parasitized by *X. index,* and it appears that a successful host-parasite relationship requires the induction of modified cells. Root-tip cells of tomato seedlings, which did not support nematode reproduction, responded only with a necrotic reaction.—*Institut für Pflanzenkrankheiten und Pflanzenschutz der Technischen Universität, D-3000 Hannover 21, F. R. Germany.*