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ABSTRACTS

ABAWI, G.S. and W.F. MAI. Cost-benefit analysis of controlling Heterodera schachtii on table beets with fenamiphos

Fiberglass field microplots (30 cm deep and 120 cm in diam) were fumigated with methylbromide (454 gm/9 m^2) in 1982. Some were infested with 15 eggs of H. schachtii (Hs)/cc soil. Fenamiphos was applied as a spray and incorporated into the top 8-12 cm soil at 2.2, 4.4 and 6.7 kg a.i./ha. A 3.3 m of rows were planted per microplot with seedballs (67/1 m) of cv. Ruby Queen. Yield was reduced 25% by Hs for a loss value of $588/ha. Fenamiphos at 6.7 kg a.i./ha (valued at $222/ha) completely eliminated this yield loss, but it was ineffective at lower rates. The test was repeated in 1983 and 1984 after plots were retreated with fenamiphos. Initial density of Hs was 237, 154, 219 and 210 in 1983; and 244, 175, 206 and 182 eggs/cc soil in 1984 in fenamiphos-treated plots at 0, 2.2, 4.4 and 6.7 kg a.i./ha, respectively. Yield loss in the nontreated and fenamiphos-treated (6.7 kg a.i./ha) plots was 93 and 82% in 1983; and 83 and 44% in 1984, respectively. There was a 22% yield loss even at 20.2 kg a.i. fenamiphos/ha. Data suggest that the efficacy and economics of fenamiphos use is Hs density-dependent. Department of Plant Pathology, Cornell University, Geneva (14456) and Ithaca (14853), NY.

ABAWI, G.S. and W.F. MAI. Effect of soil type and fumigation on the population of Heterodera schachtii and its damage to cabbage

In 1983, 4 initial population densities (P_i) of H. schachtii (0, 10, 20 and 40 eggs/cc soil) were established in field microplots filled with nontreated or methylbromide-treated (MB) loam or loamy coarse sand soils. Each microplot consisted of a nonglazed clay tile (25-cm in diam and 30-cm deep) and was planted with a 2-wk-old 'Roundup' seedling. Yields of cabbage at all P_i densities were higher in the loam than in the loamy coarse sand. In both soils, cabbage yield was significantly greater in the fumigated, noninfested treatment. Analysis of variance of the yields showed that interactions among soil type x P_i, MB x P_i, soil type x MB x P_i were significant at P=0.01, but not among soil type x MB. Final densities (P_f) were highest in the loam soil. Analysis of variance of the P_f densities as eggs or cysts showed that all interactions (soil type x P_i, soil type x MB, P_i x MB, and soil type x MB x P_i) were significant at P=0.01. Similar results were obtained when the experiment was repeated in 1984. Department of Plant Pathology, Cornell University, Geneva (14456) and Ithaca (14853), NY.

ABDEL-RAHMAN, F. H., S. I. MASSOUD. SEM Observation and morphological studies on Hetrodera daverti on the Egyptian clover Trifolium alexandrinum.

Trifolium alexandrinum was found to be heavily infected with a cyst nematode Heterodera daverti. This is the first recored for this nematode in Egypt, in addition it is also a new host plant recored. H. daverti is only known to infect its type host plant Trifolium repens. Acomparative morphological studies on H. daverti, H. trifolii, and H. cajani is presented. H. daverti and H. trifoolii can not be distinguished by using the vulval cone charecteristics, but they varies in the juvenile morphology. In a host range study it has been found that H.daverti infects and reporduces at least on 10 leguminous crops. Agricultural Research center, Plant Pathology Institute, Nematology Department. Giza,Egypt: and Suez Canal University Faculty of Agriculture. Plant Pathology division. Ismailia. Egypt.

ABDEL-RAHMAN, F. H., S. I. MASSOUD, And G. S. SHOHLA. Ecological and biological studies on plant-parasitic nematodes found associated with common flax Linum usitatissimum L.

Many plant-parasitic nematode genera were found associated with flax plants in Egypt. Soil and root Samples were collected from different flax fields. Nematode genera recovered were, Pratylenchus, Heterodera, Tylenchorhynchus, Meloidogyne, Helicotylenchus, Hoplolaimus, Paratylenchus, and Trichodorus. The most common genera found were Pratylenchus, and Tylenchorhynchus. The population dynamics of the most important nematode species were studied throughout the agriculture season since one week after planting until harvest time. Further studies were conducted to test the susceptibility of five flax cultivars to the root-knot nematode. Agricultural Research Center, Plant Pathology Institute, Nematology Department , Giza, Egypt. and Suez Canal University Faculty of Agriculture, Ismailia, Egypt.

ALSTON, D. G. Development of Heterodera glycines life stages as influenced by temperature.

The effects of temperature on development of Heterodera glycines(HG) eggs and juveniles were examined as a basis for predicting the nematode's impact on soybean root growth. Eight eggs(2-cell stage) were placed in distilled water, incubated at 10, 16, 24, 30 and 36C, and observed at 2-day intervals until all eggs hatched or development ceased. In a loamy sand field infested with HG, root samples collected from soybeans planted weekly were used to determine juvenile development from May 23 to Nov 14. Rate of embryonic development increased from 10C to 24C, then decreased with greatest hatch at 24C. Development proceeded to J1 at 10C and to J2 at 16C, but hatch did not occur. All eggs died after 4 days at 36C. Nematodes matured in the field in 3 weeks at weekly mean temperatures(WMT) of 22-29C, and in 4 weeks at 17-22C. WMT for the first 2 weeks after root penetration may be the most critical for rapid maturation. Development of HG as influenced by soil temperature should be useful in the design of nematode population and nematode-plant root interaction models. Department of Plant Pathology, Box 7631, N. C. State University, Raleigh, NC 27695-7631.

ANAND, S. C., and J. A. WRATHER. Yield of soybeans as influenced by sand content in soil infested with Heterodera glycines.
Soybean cultivars Essex, Forrest and Bedford were planted in soil infested with soybean cyst nematode races 3 & 4 at four locations. The sand content at these locations was 84, 80, 75 and 67%. Essex and Forrest had more cysts/plant than Bedford 30 days after planting at all locations. The number of cysts/plant on Essex was greatest on 84% sandy soil. Bedford yielded significantly better than Essex and Forrest except in soil with 67% sand where all the three cultivars yielded alike. The results indicated that soybean losses due to cyst nematodes are greater in sandier soils. Departments of Agronomy and Plant Pathology, University of Missouri-Columbia, Portageville, MO. 63873.

BACHIREDDY, V.R., R. PAYNE, Jr., and K. L. CHIN. Effects of application of nematicides on nematode populations, flower and pod abortion, N -fixation, yield and other performance measurements of soybeans.

The efficacy of certain new nematicides were evaluated in the field infested with parasitic nematodes for four years. Field plots were sampled for nematode assay at pre-planting, flowering and at the harvest time. Nematode numbers in all experiments were significantly reduced by all treatments at the flowering period but the populations were increased to a high level at the end of the growing season. The results also indicate that nematicide treatments and nematode populations did not significantly increase or decrease soybean yields, flower abortion, N_2-fixation and other performance measurements. The data illustrate the variability of results indicating that reliable information of nematicde effects on soybean yields can be obtained only by long term experiments. Plant and Soil Science Department, College of Agriculture, Southern University, Baton Rouge, LA. 70813.

BERNARD, E.C. and W.T. WITTE. Parasitism of woody ornamental plants by Meloidogyne hapla.

Meloidogyne hapla is the most common root-knot nematode in plant nurseries in middle Tennessee. Thirty-five commonly grown species and cultivars were inoculated in pots in the greenhouse with 10,000 M. hapla eggs. Root systems were examined 44 and 70 days later, and galling and egg mass indices were determined. Plants with heavy galling and nematode reproduction were Abelia x grandiflora, Cornus florida, Hydrangea paniculata, Photinia x 'Fraseri', Spiraea x bumalda, Spiraea x vanhouttei, and Viburnum carlesii. Roots of Ligustrum sinense and Nandina domestica were galled but nematode reproduction did not occur. Nine conifers, five Prunus spp., and three Rhododendron spp. were not galled. In a histological study of the galled roots of C. florida, N. domestica, and tomato, giant cells of C. florida were larger with thinner walls and possessed larger, clumped nuclei than those of tomato. In N. domestica, cortical cells proliferated but giant cells were rarely formed, and nematodes were usually surrounded by lignified plant tissue. Departments of Entomology and Plant Pathology, and Ornamental Horticulture and Landscape Design, University of Tennessee, Knoxville, TN 37901-1071.

BOAG, B,, and P. B.TOPHAM. The application of Taylor's Power Law to the aggregation of plant parasitic nematodes.

Taylor's Power Law was used to determine the aggregation of several nematode species at a number of sites. The results indicated that the distance between sampling points and probably the soil type influenced the amount of aggregation of Longidorus elongatus. Samples taken in close proximity to each other had a near random distribution while those taken further apart became gradually more aggregated until a b value of just over 2 was reached. Scottish Crop Research Institute, Invergowrie, Dundee, Scotland DD2 5AH.

BOLLA, R.I., R.E.K. WINTER, C. WEAVER and K. FITZSIMMONS. Characterization of Two Isolates of Bursaphelenchus xylophilus. Bursaphelenchus xylophilus, from Pinus sylvestris in Missouri (MPS-1) and from P. strobus in Vermont (VPS-1) were characterized for infectivity to 2-yr-old pine seedlings, and for seedling response to infection. Seedlings were infected with either 25,000 or 5,000 nematodes. Beginning 15 days postinfection, wilt symptoms were assessed and the number of nematodes per seedling determined. Isolate MPS-1 infected to P. sylvestris and caused typical wilt symptoms; loss of resin flow to the site of a wound, decreased water flow, stomate closing and phytotoxin production. Total wilting occurred within 30 to 45 days. This isolate infected 2 to 3-year-old seedling of P. nigra, but typical wilt symptoms were not observed. P. strobus and P. taeda were not infected. Isolate VPS-1 infected, induced wilt symptoms and caused wilting of P. strobus but not of other species. The results of these studies suggest the possibility of biotypes for the pinewilt nematode. Departments of Biology and Chemistry, University of Missouri-St. Louis, St. Louis, MO 63121.

BRODIE, B. B. Some responses of encysted juveniles of Globodera rostochiensis to high temperatures and desiccation.

Air dried or presoaked (H_2O or potato root diffusate (PRD)) cysts of Globodera rostochiensis were exposed to 35 and 70 C or desiccated for various periods. After exposure, the status of encysted juveniles was determined by hatching tests in PRD and microscopic examination. Hatch from air dried cysts that were exposed to 70 C for 8, 16, and 24 hrs was 21, 34, and 39% greater than from nonexposed cysts, indicating that brief exposures to high temperature stimulate hatching. Hatch from cysts presoaked (24 hrs) in PRD or H_2O and exposed for 4 or 8 hours to 35 C was significantly greater than from cysts not presoaked. After 24 hrs at 35 C, there were no differences in hatch from presoaked cysts and those not presoaked, suggesting that commitment to hatch is reversed by increased temperature. Hatch from presoaked or air dried cysts was significantly reduced by desiccation. Microscopic examination revealed that 72, 97, and 100% of the encysted juveniles were killed by 2, 4, and 8 wks desiccation. USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

CARPENTER, A.S., and S.A. LEWIS. Responses of soybean selections to Meloidogyne arenaria in two South Carolina locations. Differing responses between Meloidogyne arenaria-resistant lines in two locations prompted an investigation of possible nematode biotype differences. During 1984, 24 soybean selections were planted in M. arenaria infested fields at Govan and Pelion, SC. M. arenaria densities in soil were recorded at planting and monthly for 4 months. Dried shoot samples were weighed at 1, 2, and 3 months after planting. Root fresh weights and gall and egg mass ratings were recorded 3 months after planting and height and stand counts 4 months after planting. Seed yield was recorded at harvest. Significant differences (P = 0.05) between selections were found in gall ratings and root fresh weights at Govan and in M. arenaria densities 4 months after planting at Pelion. Differences between locations were highly significant (P = 0.01) for all variables except M. arenaria densities at 1 and 2 months after planting. Selection X location interactions for gall ratings and root fresh weights were significant (P = 0.05). Highly significant differences (P = 0.01) between selections for yield were found at Govan. Department of Plant Pathology and Physiology, Clemson University, Clemson, SC 29631.

CHIN, K.L., V.R. BACHIREDDY and T. ABAYNEH. Effect of Cloethocarb on nematode population, flower abortion, yield and dinitrogen-fixation. An experimental insecticide, cloethocarb was both foliage applied and soil-applied. Foliar application was carried out at the beginning of flowering and two weeks after the first application. Soil application was carried out prior to planting. Foliage-applied cloethocarb at (10% G at 1.12 kg/ha, 3.36 kg/ha and 5.60 kg/ha, respectively, increased the rate of flower abortion and the number of nodules significantly. All cloethocarb treatments significantly increased seed yield but had no significant effect on dinitrogen fixation as measured by acetylene-reduction test. All soil-applied Cloethocarb treatments had no significant effect on nematode population in soil, incidence of flower abortion, seed yield and dinitrogen fixation. Department of Plant and Soil Science, College of Agriculture, Southern University, Baton Rouge, LA. 70813.

Cloud, G. L. and R. D. Riggs. The Genetic Variability of Races of Heterodera glycines.
Five soybean fields infested with the soybean cyst nematode (SCN), Heterodera glycines, which reproduced on cv Bedford and three soybean fields infested with SCN race 4 were studied. Three bulk sampes were taken from each field and five single cysts were selected from each bulk sample for increase on cv Lee. The 24 bulk sample populations (BSP) and 107 single cyst populations (SCP) have been subjected to standard race determinations. Results from the 5 "Bedford race" fields show no field with all three BSP's being of the same race, while only 25 out of 75 SCP's tested were similar in race to the BSP. Of the 75 SCP's established, 25.3%, 1.3% and 26.6% were race 2, 3 and 4 respectively, while 46.0% did not fit any race. Results from the three race 4 fields tested show the BSP's were 77.0% race 4 and 22.0% race 2. Of the 32 SCP's tested, 34.3% and 40.7% were race 4 and 2 respectively, while 25.0% did not fit any race. The variability of SCN reflects the sexual reproduction of a heterogeneous population which is present in the field. Department of Plant Pathology, University of Arkansas, Fayetteville, Arkansas 72701.

CULBREATH, A.K., R. RODRIGUEZ-KABANA, and G. MORGAN-JONES. The use of hemicellulosic waste matter for reduction of the phytotoxic effects of chitin and control of root-knot nematodes.

Alkaline hemicellulosic waste material (HW) from the paper pulp industry was added to soil at six levels (0-2.0% w/w) in combination with two levels (0 and 2.0% w/w) of crustacean chitin to control Meloidogyne arenaria. Treated soil was kept moist for one week before being planted with yellow crookneck squash (Cucurbita pepo). Six weeks after planting, survival rate of seedlings in chitin-amended soil was improved by the addition of HW; no plants survived in soil treated with chitin alone. HW amendments reduced galling of the roots by M. arenaria but were not as effective as chitin. Galling was eliminated in plants from soil with chitin. Upon removal of the squash plants, Rutgers tomato (Lycopersicon esculentum) seedlings were planted in the same soil. Six weeks after planting, shoots and roots from tomato plants grown in soil amended with both chitin and HW were heavier than those from plants grown in soil treated with chitin alone. Department of Botany, Plant Pathology and Microbiology, Auburn University, Agricultural Experiment Station, Auburn, AL 36849.

EISENBACK, J. D. and S. M. CURI. Techniques useful for the preparation of nematodes for scanning electron microscopy.

Second-stage juveniles of Meloidogyne incognita were prepared for scanning electron microscopy (SEM) using 12 different methods of fixation and drying. Fast, sequential fixation in 2% glutaraldehyde; post-fixation in 2% osmium tetroxide; dehydration with an ethanol series; and freeze-drying with liquid propane resulted in the best preparations. This technique was subsequently tested on many plant-parasitic and microbivorous genera and proved to be quite adequate for most nematodes tested; however, certain genera were better preserved than others. Dept. of Plant Pathology, North Carolina State University, Box 7616, Raleigh, NC 27695-7616; and Nematology Section, Biological Institute, P.O. Box 70, Campinas, Sao Paulo, Brazil.

EISENBACK, J. D. and K. M. HARTMAN. Distribution of Sphaeronema sasseri and its association with the decline of red spruce and Fraser fir.

Sphaeronema sasseri has been found parasitizing roots of red spruce and Fraser fir at elevations of 1,800 m to 2,036 m above sea level on several peaks in the Southern Appalachian Mountains in North Carolina, Tennessee and Virginia. The nematodes occur in colonies surrounding the base of lateral and feeder roots and ectomycorrhizae. Often several colonies of nematodes encircle the base of a single rootlet, and many roots appear stunted or dead. The association between this nematode and declining spruce and fir trees is clear, but its role in the etiology of the decline syndrome remains to be elucidated. Dept. of Plant Pathology, North Carolina State University, Box 7616, Raleigh, NC 27695-7616.

ESBENSHADE, P. R., and A. C. TRIANTAPHYLLOU. Characterization of Meloidogyne esterases by their reaction to specific inhibitors and substrates.

Two esterase fractions separated from five species of Meloidogyne by polyacrylamide gel electrophoresis were characterized regarding their activity in the presence of various substrates and inhibitors. The slow-migrating fraction (Rm 0-0.17) consisted primarily of cholinesterases. This fraction hydrolyzed both acetyl- and butyryl-thiocholine iodide, and was inhibited by 10^{-7} M eserine sulfate. The fast-migrating fraction (Rm 0.46-0.59) contained a number of isozyme bands which reacted in the same manner to all substrates and inhibitors tested, and had the same molecular weight (~ 60,000). These isozymes hydrolyzed α-naphthyl-proprionate (C3) and -butyrate (C4) at a higher rate than the corresponding C2-, C6-, C8-, or C10-substrates. They did not hydrolyze the choline substrates, and were totally inhibited by the organophosphates (E600 and DFP) at 5 x 10^{-8} M. These isozyme bands were classified as carboxylesterases (B-esterases). Departments of Plant Pathology and Genetics, North Carolina State University, Raleigh, NC 27695.

FAGHIHI, J., J. M. FERRIS and V. R. FERRIS. Indiana populations of soybean cyst nematode.

Five populations of Heterodera glycines, collected from geographically separated areas of Indiana, were maintained in the greenhouse for comparative studies of morphology and behavior on a range of soybean differentials. These populations, 2 from the northern third and 3 from the southern third of the state, could be divided into 2-5 groups on the basis of selected morphological characters of second stage juveniles. Using morphological characters of males, the five populations could be separated into 3 groups. Composition of the groups varied, depending on the particular phenotypic comparison under study. Characters of cysts and eggs were less useful for differentiating populations. Based on the response (amount of growth/reproduction) of these populations to the original "standard" differentials (proposed by soybean workers in 1970 for identification of races) all but one population was classified as "race 3". Reproduction of the fifth population on Pickett classified it as an "undefined race". With Pine Dell, PI79693 and PI87631 as additional differentials, 4 of the 5 populations were distinct from each other. Department of Entomology, Purdue University, West Lafayette, IN 47907.

FERRIS, H. and T. A. MULLENS. Egg Production Rates Of Four Meloidogyne Species on Two Tomato Cultivars.

Rates of juvenile recovery from tomato plants grown in aeroponic culture under constant temperature conditions were used to monitor egg production rates of Meloidogyne females parasitic in the roots. Hatched juveniles were washed from the roots by intermittent mist and collected daily from settling flasks. Cumulative egg production was linearly related to elapsed degree days base 10°C (DD) in all cases. Production rates (eggs/♀/DD) for all species tested were higher on cv Tropic than on cv UC82. On cv Tropic, M. incognita (1.44) and M. javanica (1.18) had higher production rates than M. arenaria (0.81) and M. hapla (0.15). On cv UC82 M. incognita (0.68) and M. javanica (0.76) again had higher production rates than M. arenaria (0.40) and M. hapla (0.05). The experiments were conducted at 30°C which may be above an upper threshold for M. hapla. Department of Nematology, University of California, Riverside, CA 92521.

FERRIS, V.R., J.M. FERRIS, and J. FAGHIHI. Comparison of 2-D protein patterns of Indiana Heterodera glycines.

Protein patterns obtained by 2-dimensional gel electrophoresis from 6 IN isolates of H. glycines, for which we have detailed morphometric and behavioral data, were compared qualitatively and quantitatively. Patterns for 3 southern isolates (from Posey, Vanderburg and Vigo Counties) appeared similar to each other, and none had conspicuous distinguishing protein spots. In matrices calculated for Jaccard coefficients of similarity, and for simple matching coefficients, these 3 isolates had higher pair-wise coefficients with each other than with northern isolates. Isolates from northern counties (White, Benton and Pulaski) shared protein constellations not present in isolates from the south, and each had unique spots as well. Their pair-wise similarity coefficients with each other tended to be higher than with southern isolates. Coefficients indicated more similarity of most IN isolates to each other than to a Mississippi isolate, and the least similarity to an isolate from Japan. Department of Entomology, Purdue University, West Lafayette, IN 47907.

FINNEY-CRAWLEY, J.R. Isolation of cold tolerant Steinernematid nematodes in Canada.

In 1983 soil samples were collected across the Province of Newfoundland and Labrador. The presence or absence of insect parasitic nematodes in the soil samples was determined by introducing late instar Galleria mellonella into them. The soil survey yielded promising results when 12 soil samples from the St. John's area, 49 from across the Island and 4 from Labrador (19% of total samples) proved positive for insect parasitic nematodes. Of these 3 have been cultured in vivo and in vitro and have been tentatively identified as strains of Steinernema species. All 3 nematodes will infect G. mellonella over the temperature range 8-24°C and are being further investigated as potential control agents of insect pests for field use under Canadian conditions. Department of Biology, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1B 3X9.

GASPARD, J. T. and R. MANKAU. Induced benomyl resistance in Paecilomyces lilacinus and Verticillium chlamydosporium.

Conidia of Paecilomyces lilacinus (PL) and Verticillium chlamydosporium (VC) were exposed to ultraviolet (UV) radiation. Thirty-one PL isolates and 20 VC isolates with resistance or tolerance to benomyl at concentrations < 100 ppm were selected. These isolates were equivalent to the wild types in ability to parasitize eggs of root-knot nematode (Meloidogyne spp.) in both laboratory and greenhouse tests. These have been cultured alternately on unamended medium and fungicide amended medium and retain resistance to benomyl when returned to amended medium. These isolates can be applied simultaneously with the fungicide to suppress competing soil fungi and encourage colonization of the antagonists. Fungicide resistance also acts as a marker for fungi recovered from soil after inoculation. Department of Nematology, University of California, Riverside, CA 92521.

GOLDEN, A.M., and D.T. KAPLAN. Details on an undescribed root-knot nematode on oak in Florida.

Perineal patterns of a new Meloidogyne species found on oak (Quercus falcata) at Altamonte Springs, FL characteristically have a high, squarish arch, and widely spaced, coarse, broken striae which tend to diverage at various angles especially in and above anal area. Female stylet measures about 13 µm in length and excretory pore opens about 16 µm from head end. Females may occur singly or as 2 or more enclosed with egg masses in a gall on the root. The galls are distinctive, appearing as a discrete nodule on the side of the root and without adjacent root swelling. Males, about 1200 µm long, have a short, delicate stylet, 17 µm in length, and 4 lines in lateral field with center band narrower than outer 2. Larvae measure about 430 µm, and tail 43 µm with blunt, rounded terminus 12 µm. This new species occurs commonly on Q. falcata throughout central Florida. USDA, ARS. Nematology Laboratory. Beltsville, MD 20705; and USDA, ARS, Horticultural Research Laboratory, Orlando, FL 32803.

HEALD, C.M. and W.W. CARTER. Management of the reniform nematode Rotylenchulus reniformis by crop rotation and nematicides.

In a six-year field study, Rotylenchulus reniformis populations were managed using crop rotation and 1,2-dichloropropene as a soil fumigant. Cantaloup, bell pepper, cotton, onion, and cabbage were used in the multiple cropping system. Nematode populations were successfully managed by integrating nonhost crops into the production system. Yields of susceptible crops, such as cantaloup and cotton, were maintained whether following soil fumigation or nonhost crops. The study concluded that R. reniformis can be effectively managed and susceptible crops grown by use of nonhost crops in an integrated program. Subtropical Agricultural Research Laboratory, P.O. Box 267, Weslaco, TX 78596. U.S. Department of Agriculture, Agricultural Research Service.

HENN, A. AND R. A. DUNN. Determining the optimal sampling method for the lance nematode, Hoplolaimus galeatus (Cobb, 1913) Filipjev and Schuurmans Stekhoven, 1941, in St. Augustinegrass, Stenotraphrum secundatum (Walt.) Kuntz.

Four of 26 St. Augustinegrass locations found to harbor lance nematodes were sampled using single 2.2-cm-d cores. These data were used to approximate the number of samples necessary to estimate a lance nematode population with a confidence interval of 20% of the population mean. A single site, representing a worse-case scenario, was then chosen for intensive study. The site was divided into horizontal quadrats on the basis of visual cues and into vertical quadrats by depth. Each quadrat was sampled proportionally in relation to size. Two sampling units were used: the standard 2.2-cm-d core was nested within a 10-cm-d core. A total of 258 samples (43 locations x 3 depths) were processed by a sieving-centrifugation technique with occasional processing checks. Lance nematodes were counted by life-stage. All steps were timed and the optimal sampling strategy determined using time as a cost factor. Sample types and depths differed greatly in their costs; for equal population estimates, 2.2-cm-d cores were more cost-efficient than 10-cm-d cores. Department of Entomology & Nematology, Univ. of Florida, Gainesville, FL 32611.

HILL, N.S. The influence of temperature and soybean phenology on inducing dormancy of Heterodera glycines eggs.

Temperature and soybean phenological stage effects on hatch inhibition of Heterodera glycines eggs were examined in growth chambers at the Southeastern Plant Environment Laboratory, N.C. State University, Raleigh. One 3-cm long 'Ransom' soybean seedling was transplanted per replicate 25-cm diameter clay pot filled with a mixture of steamed soil and sand, then immediately inoculated with 15,000 eggs of H. glycines Race 3. Inoculated plants were grown for 4 wk at 26/22C (day/night) with a 9+3 hr photoperiod (52 klx) for host-parasite establishment. The 3 temperature treatments (9-hr photoperiod) were 26/22C, 22/18C, for 6 wk, and decreasing 26/22C-22/18C-18/14C, each for 2 wk. Two photoperiods were used at 26/22C: 9+3 hr and 9 hr. Hatch in vitro and in bioassay was greatest at 26/22C and least in the 26/22C-22/18C-18/14C treatment. More eggs hatched and 5-fold greater nematode reproduction occurred on pod-bearing soybeans (9-hr photoperiod) than on those which were kept vegetative (9+3 hr photoperiod). Decreasing temperature may be more important than soybean phenology in dormancy induction and overwinter survival of H. glycines.

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HIRSCHMANN, HEDWIG, and A. C. TRIANTAPHYLLOU. Morphological and cytogenetic relationships of Meloidogyne spartinae to other Meloidogyne species.

Meloidogyne spartinae was originally described in the genus Hypsoperine because of certain morphological and biological features. Our studies have confirmed that although this nematode has a haploid number of only 7 chromosomes, as compared to the 14-19 of all other Meloidogyne species, most of its morphological and cytogenetic characteristics are typical of the genus Meloidogyne. Such features include the structure of head and tail regions of females, males and juveniles; the anatomy of female and male reproductive systems; and the morphology and behavior of chromosomes during spermatogenesis and oogenesis. It is concluded that this species should be treated as a member of the genus Meloidogyne.

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HUETTEL, R.N.

Chemical communicators in nematodes

Chemical signals released by one organism and perceived by another organism are classified as semiochemicals. Semiochemicals are divided into pheromones that elicit intraspecific responses whereas allelochemics elicit interspecific responses. It has been demonstrated that nematodes utilize and/or recognize signals from both categories of semiochemicals. Specific sex and aggregation pheromones have been demonstrated in numerous plant and animal parasitic and free-living nematodes. Chemical compounds isolated and purified from Nippostrongylus brasiliensis and Heterodera glycines have been identified as sex pheromones. Epidietic phermones have been shown to be responsible for the initiation of dauer larva formation in Ceanorhabditis elegans. Allelochemics known to cause interspecific responses have been demonstrated in insects and other invertebrates; but only postulated to occur in nematodes. The food-finding behavior of nematodes is probably due to allelochemic messengers released by their hosts. An understanding of the behavioral responses and the chemical messengers that affect the bioregulation of these processes in nematodes may contribute to future management strategies for nematode control.

Nematology Lab., PPI, USDA, ARS, Beltsville, MD 20705.

HUETTEL, R.N., AND F.A. HAMMERSCHLAG. In vitro screening of self-rooted peaches for resistance to nematodes.

A peach (Prunus persica) rootstock, 'Nemaguard' and a scion cultivar, 'Jerseyqueen' were in vitro propagated and rooted. The rooted plants were inoculated with Pratylenchus penetrans and Meloidogyne incognita. Root weight, stem height, and number of leaves were recorded six weeks post infection. Both cultivars were highly susceptible to P. penetrans, infected plantlets being significantly different from controls in all above measurements. 'Nemaguard' was not susceptible to M. incognita, whereas infected 'Jerseyqueen' differed significantly from controls in all above measurements and showed heavy galling and senesence. Growth on a high level (8.88uM) of 6-benzylamino purine (BA) did not produce significant differences compared to low levels (0.88uM) BA or the controls on 'Jerseyqueen' inoculated with M. incognita. 'Nemaguard' was galled initially by M. incognita on the high level of BA, however, the nematodes failed to mature; no early galling of the cultivar by M. incognita was observed on the low level of BA. This study indicates that in vitro screening of self-rooted peaches is possible and may facilitate early detection of nematode resistant lines. Nematology Lab and Tissue Culture and Molecular Biology Lab USDA, ARS, PPI, Beltsville Research Center, Beltsville, MD 20705.

HUSSEY, R.S., C.A.SUNDERMANN and D.B.DUSENBERY. Laser microbeam irradiation of the dorsal gland of Heterodera glycines.

Dorsal glands in second-stage juveniles of Heterodera glycines were irradiated with a laser microbeam to determine the importance of the gland to subsequent parasitism of soybean roots. Juveniles were anaesthetized with propylene phenoxytol and irradiated with a dye laser directed through a Zeiss microscope with Nomarski optics. Following irradiation of either the nucleus or orifice of the dorsal glands, juveniles were placed singly onto soybean root explants. After 14 days roots were stained to confirm the presence of adult nematodes. Less than 5% of irradiated juveniles developed into adults whereas development of anaesthetized or water control juveniles was over 50%. These results provide evidence that a functional dorsal gland is necessary for normal development of H. glycines on soybean. Department of Plant Pathology, University of Georgia, Athens, GA 30602.

IBRAHIM, I.K.A., M.W. TAHA, and M.W.A. HASSAN. Resistance of 7 citrus rootstocks to Tylenchulus semipenetrans and Meloidogyne spp. in Egypt.

The reactions of 7 citrus rootstocks to Tylenchulus semipenetrans, Meloidogyne arenaria (Race 1), M. incognita (Races 1 and 3), and M. javanica were determined in the greenhouse. Ten-week-old seedlings were inoculated with 5,000 second-stage nematode larvae per plant. Nematode treatments and untreated control were replicated five times. Plants were assessed for nematode infestation 8 and 14 months after inoculation with Meloidogyne spp. and T. semipenetrans, respectively. The results showed that sour orange, lime, and rough lemon were highly susceptible; grapefruit was susceptible; Troyer citrange and Cleopatra mandarine were moderately susceptible; and trifoliate orange was resistant to T. semipenetrans. In contrast, all the citrus rootstocks were highly resistant to the tested root-knot nematode populations.-Department of Plant Pathology, College of Agriculture, Alexandria University, Alexandria, Egypt.

INGHAM, R.E. and J.K. DETLING. The impact of root-feeding nematodes on aboveground net primary production in an ungrazed mixed grass prairie.

To examine the impact of consumption by root-feeding nematodes on primary production in a mixed grass prairie, two areas were treated with nematicide and compared to adjacent untreated areas. Monthly measurements of aboveground standing crop and nematode populations were made from each of the four areas for two growing seasons (1982 and 1983). Seasonal mean density of root-feeding nematodes was reduced approximately 75% by the nematicide. Current season shoot biomass was significantly greater ($P<0.001$) in the nematicide treatment for 1982 and 1983 in Site 1, but only for 1983 in Site 2. Averaged over the two growing seasons, nematicide treatment increased aboveground primary production by 44% in Site 1, but by only 6% in Site 2. Nematicide treatment reduced the average estimated nematode consumption by 5.8 $g \cdot m^{-2} \cdot y^{-1}$ at Site 1 and 10.6 $g \cdot m^{-2} \cdot y^{-1}$ at Site 2. This resulted in an average increase in annual aboveground net primary production of 97 and 18 g/m^2 from Site 1 and Site 2 respectively. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

INSERRA, R. N.,[1], N. VOVLAS[2], J. H. O'BANNON[3], and G. D. GRIFFIN[4]. Development of Meloidogyne chitwoodi on wheat.

Post-infection development of Meloidogyne chitwoodi from second-stage juveniles (J2) to mature females and egg deposition on 'Nugaines' winter wheat required 105, 51, 36, and 21 days at 10, 15, 20, and 25 C. At 25 C, the J2 induced cavities and hyperplasia in the cortex and apical meristem of root tips with hypertrophy of cortical and apical meristem cell nuclei, 2 and 5 days after inoculation. Giant cells induced by late J2 were observed in the stele 10 days after inoculation. Clusters of egg-laying females were common on wheat root galls 25 days after inoculation. Juveniles penetrated wheat roots at 4 C and above, but not at 2 C, when inoculum was obtained from cultures grown at 20 C, but no penetration occurred at 4 C when inoculum was stored for 12 hours at 4 C before inoculation. In northern Utah, J2 penetrated Nugaines wheat roots in the field in mid-May, about 5 months after seedling emergence. M. chitwoodi eggs were first observed on wheat roots in mid-July when plants were in blossom. Only 40% of overwintered M. chitwoodi eggs hatched at 25 C. [1,4]USDA ARS, Crops Research Laboratory, Utah State University, Logan, UT 84322; [2]Istituto Nematologia Agraria, CNR, 70126 Bari, Italy and [3]Division Plant Industry, Box 1269, Gainesville, FL 32602.

JAFFEE, B. A. Parasitism of Xiphinema americanum and X. rivesi by certain zoosporic fungi.

Living Xiphinema americanum (Xa) and X. rivesi (Xr) containing aseptate fungal hyphae were observed in extracted samples stored for 1-5 days at 4 or 20 C. The fungi appeared to directly penetrate the nematode's cuticle from spores encysted near the head. Penetration through the stoma, vulva, or anus was rarely observed. Catenaria anguillulae (Ca), Lagenidium caudatum (Lc), Aphanomyces sp. (Aph), and Leptolegnia sp. (Lep) were isolated into pure culture from these nematodes. The pathogenicity of these zoosporic fungi was measured by incubating (20 ± 2 C) a mixture of freshly extracted Xa (80%) and Xr (20%) in 6 ml of dilute soil extract (pH = 6.7) containing zoospores obtained from single-spore isolates. After 4 days, Ca, Lc, Aph, and Lep infected 78, 18, 13, and 22%, respectively, of the nematodes. Living specimens of both Xa and Xr were infected by each of the fungi; however, the relative susceptibility of Xa and Xr to these fungi was not determined. All uninoculated control nematodes remained uninfected and alive. Department of Plant Pathology, The Pennsylvania State University, Fruit Research Laboratory, Biglerville, PA 17307-0309.

JAFFEE, B. A., GOLDEN, A. M., and SAYRE, R. M. A bacterial parasite of Hoplolaimus galeatus.

A bacterial parasite was observed on and in juvenile and adult Hoplolaimus galeatus (Hg) extracted from peach and apple orchard soils near Biglerville, PA, and a peach orchard soil from FL. The spores and vegetative stages were similar to those described for Bacillus (= Duboscqia) penetrans (Bp). However, the spores associated with Hg were about twice as large as those described for Bp. The diameters (mean ± SD) of mature spores on the cuticle of parasitized Hg from PA, Hg from FL, and Pratylenchus brachyurus from SC (the same P. brachyurus specimens used by Thorne to describe Duboscqia penetrans) were 6.77 ± 0.34, 6.82 ± 0.49, and 3.14 ± 0.23 µm, respectively. The diameters of the central endospores from these specimens were 3.21 ± 0.26, 2.91 ± 0.37, and 1.53 ± 0.31 µm, respectively. The large-spored parasite may be a new species closely related to Bp. Department of Plant Pathology, The Pennsylvania State University, Fruit Research Laboratory, Biglerville, PA 17307-0309; Nematology Laboratory, Plant Protection Institute, BARC-W, USDA, Beltsville, MD 20705.

JOHNSON, A.W. Management of Meloidogyne incognita in an intensive cropping system.

Turnip-corn-cowpea were planted in an annual multiple-cropping system for 6 yr with the following soil treatments: 1) overall methyl bromide (MBR-CP) annually; 2) overall DD-MENCS annually + maximum pest control with herbicides and insecticides; 3) nonvolatile nematicides, herbicides, and insecticides to achieve an intermediate level of pest control; and 4) no nematicide, one herbicide and cultivation as needed on each crop for a minimum level of weed control. Numbers of M. incognita juveniles in the soil were near or below detectable levels on turnip on all sampling dates and levels were high on corn and 'Pink Eye Purple Hull' (PEPH) cowpea in August and November, respectively. Phenamiphos controlled M. incognita on corn, but ethoprop did not. PEPH cowpea supported large numbers of M. incognita, but 'Worthmore' did not. Average yields of turnip, corn, and cowpea from untreated plots were 0-30%, 2-9%, and 8-24% less than those from treated plots, respectively. USDA, ARS, Department of Plant Pathology, Coastal Plain Experiment Station, Tifton, GA 31793.

JATALA, P., J. FRANCO, A. GONZALEZ and C. M. O'HARA. Hatching stimulation and inhibition of Globodera pallida eggs by the enzymatic and exopathic toxic compounds of some biocontrol fungi.

The role of biological entities in controlling nematodes has principally been atributed to predation, trapping, or penetration of nematode eggs, larvae and adult nematodes. Greenhouse and field application of fungi for controlling Globodera pallida and Meloidogyne incognita lead us to the observation of peculiar changes in the nematode population densities. Paecilomyces lilacinus, in addition to penetrating and killing the eggs, larvae and females of these nematodes, caused substantial egg deformation and stimulated hatching of G. pallida. Laboratory and greenhouse studies on the effect of P. lilacinus on G. pallida indicated up to 30 percent egg damage without direct penetration while the hatching was stimulated prematurely in the eggs containing second stage juveniles. In other studies utilizing Penicillium anatolicum isolated from a G. rostochiensis and G. pallida infested field in Panama and Gliocladium roseum from Peru, we noticed a significant hatching inhibition of G. pallida eggs. P. anatolicum and G. roseum did not penetrate the eggs as did P. lilacinus. Hatching stimulation of G. pallida eggs by P. lilacinus and their inhibition by P. lilacinus, P. anatolicum and G. roseum is attributed to the activities of both enzymatic and exopathic diffusible toxic compounds produced by these fungi. CIP, Apartado 5969, Lima, Peru.

KAPLAN, D.T. and L.S. OSBORNE. Plant parasitic nematodes associated with leatherleaf fern.

Seven species of plant parasitic nematodes were associated with leatherleaf fern (Rumohra adiantiformis) in central Florida. Of these, Pratylenchus penetrans, Tylenchorhynchus claytoni, and Criconemoides curvatum were commonly encountered. Nematode communities generally included 2-3 species of plant parasitic nematodes with greatest diversity in nematode species occurring in ferneries shaded by oak trees (Quercus spp.). Species diversity was not correlated with fernery age. Leatherleaf fern was demonstrated to be tolerant of P. penetrans and T. claytoni in microplots. U.S. Department of Agriculture, Horticultural Research Laboratory, 2120 Camden Road, Orlando, FL 32803; University of Florida, IFAS, AREC, Apopka, FL 32703.

KINLOCH, R. A. Soybean yield responses to 1,3-dichloropropene applications to Meloidogyne incognita infested soil.

Single chisel injections (0.45 m deep) of 1,3-dichloropropene at 17.2, 25.8, 34.4, and 51.6 l/ha applied 3 days preplant and at planting significantly ($P<.01$) reduced galling and M. incognita juvenile populations in the soil in association with 'Ransom' soybean. Yields were significantly ($P<.01$) increased above the nontreated check (2006 kg/ha) and were related to the amount of nematicide applied. The relationship for preplanting treatments was $Y = 2015.57 + 45.19X - .57X2$, ($P<.01$) predicting a maximum yield of 2911 kg/ha at X = 40 l/ha. The relationship for at planting treatments was $Y = 2033.03 + 54.96X - .9X2$, ($P<.01$) predicting a maximum yield of 2870 kg/ha at X = 30 l/ha. University of Florida, Agricultural Research and Education Center, Route 3, Box 575, Jay, FL 32565-9524.

KOENNING, S. R. and D. P. SCHMITT. Hatching and diapause of field populations of Heterodera glycines.

The population dynamics, hatch and host influence on soybean cyst nematode (SCN) were studied at two sites in North Carolina. Soil samples were collected at five week intervals from November 1983 through June 1984. Samples were split and one-half was processed by elutriation and centrifugation to enumerate cysts, eggs, and juveniles. The eggs were saved and the number of juveniles which hatched was determined after 7 days. The other half-sample was used in a bioassay, and the number of cysts on soybean plants was determined after 26 days. Hatch increased slightly, from November to May, but was less than 1% until June. A similar trend was observed in the bioassay, but the number of cysts in the bioassay was much greater than would be expected from hatch. Evidently, diapause is broken gradually and host exudates stimulate the hatch of diapausing juveniles. Department of Agronomy, U.M.C. Delta Center, P. O. Box 160, Portageville, MO 63873: and Department of Plant Pathology, N.C. State University, Raleigh, NC 27695.

KOTCON, J. B. and R. LORIA. Control of Pratylenchus crenatus and potential for groundwater contamination by 1,3-dichloropropene.

Small plots, 9 x 30 m, in two commercial potato fields infested with Pratylenchus crenatus were fumigated with 0, 93.5, 116.8 or 140.3 l/ha of Telone II (94% 1,3-dichloropropene (1,3-D)) in a replicated randomized block design. Fumigant was shank-injected into tilled soil in Sept. 1984. Soil samples, collected immediately before and 2 weeks after fumigation, were assayed using Baermann Pans. Samples of groundwater, collected from wells installed adjacent to two 2.5-ha plots (water table depth < 4 m), were taken 1 day before, 1 week after, and at 3-week intervals after fumigation with 93.5 or 140.3 l/ha of Telone II. Water samples were analyzed for 1,3-D and related hydrocarbons. Population density of P. crenatus was reduced by all rates of Telone II. Up to 96% control was obtained with 140.3 l/ha. No detectable levels (>2 ppb) of 1,3-D or related hydrocarbons were found in groundwater samples collected through 117 days after fumigation with 93.5 or 140.3 l/ha. Department of Plant Pathology, Cornell University, Long Island Horticultural Research Laboratory, Riverhead, NY 11901.

LAMONDIA, J. A., AND B. B. BRODIE. Factors affecting the recovery of cyst nematodes from organic soil.

A USDA cyst extractor (Modified Fenwick Can: MFC) and an underflow elutriator (UE) developed by USDA-APHIS were used to compare percent recovery of Globodera rostochiensis cysts and amount of flotsam collected from organic soil. Sample size was negatively correlated with recovery and positively correlated with amount of flotsam. There were no differences between cyst recovery with the two machines from 500 to 3000 cc soil samples (recovery 93-76%, respectively). The amount of flotsam recovered from the UE was less than half that of the MFC. Presoaking air dried samples up to 1/2 hr reduced the flotsam by ca. 50% for both machines with no effect on cyst recovery. Processing wet samples without prior drying reduced cyst recovery to 1% for the MFC and 12% for the UE, but did not affect the amount of flotsam. USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

LAMONDIA, J. A., B. B. BRODIE, and R. CARTER. The effect of solarization on decline of Globodera rostochiensis in naturally infested soil.

Solarization experiments were conducted in Steuben Co., NY and on Long Island, NY (L.I.) in 1984. Treatments at each site consisted of no plastic (fallow), clear plastic (CP), and clear plastic over a black soil surface (PBS) (powdered charcoal 500 kg/ha). Decline of G. rostochiensis (GN) under PBS was greater than under fallow at the L.I. site ($P = .05$). Population decline was 99.9, 94.0, 55.7 under PBS and 15.3, 18.0, and 8.7% under fallow at 0-5, 5-10 and 10-15 cm deep, respectively. Decline under CP was 93.0, 53.0, and 21.1% and was not different from that under PBS or fallow. The effect of solar heating on GN decline was less at the cooler Stueben Co. site; decline under PBS and CP was greater than under fallow only in the top 5 cm. USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

LUEDDERS, V.D. Effect of soybean genes of cysts of Heterodera glycines.

The resistance of soybean lines to cyst nematodes is defined as relatively few cysts compared to the number on a susceptible check cultivar. Resistance is frequently considered to be a plant characteristic although its expression depends also on nematode genes. The nematode genetic component is inadequately described by the ["physiological"] race designations currently used. Some nematode-soybean genes appear to affect the size and fecundity of females-cysts. A preponderance of small white females or of small brown cysts were noted in some specific associations of nematode inbreds-soybean lines 28 days after inoculation (at ca 27 C). The phenotypic variation in adult nematodes reflects genetic variation in both organisms which may be different than the genes interacting to determine numbers of adults. Department of Agronomy, University of Missouri, Columbia, MO 65211.

LUEDDERS, V.D. Identifying the genes of cyst nematodes-soybeans.

No specific genes of Heterodera glycines-Glycine max have been identified. This failure may be due to the use of soybeans with several genes for resistance, which interacted with corresponding nematode genes of variable frequencies. Nematode genetic heterogeneity must be resolved before progress in genetic studies of either organism can be made. A gene frequency model has been developed, based on interactions of nematode and soybean genes that might be either dominant (in both), or recessive, for cyst production. Dominance for cysts ("recessive resistance") is most common: a zero frequency of one dominant allele and selection intensity of 1.0 results in no cysts. Frequencies near zero may be rare since natural selection increases the frequencies of dominant alleles for cyst success. Their frequencies can be decreased by artificial selection and inbreeding. Data from several experiments support the validity and usefulness of these concepts. Department of Agronomy, University of Missouri, Columbia, MO 65211.

MACGUIDWIN, A. E. Post-harvest population dynamics of Pratylenchus penetrans.

Microplots established in 1980 and planted to potato (cv Russet Burbank) in 1984 were sampled five times from harvest (9-1-84) until December. The plots remained fallow following harvest. Soil samples (100 cm^3) collected at 0-15, 16-30, and 31-45 cm depths were assayed for Pratylenchus penetrans by a centrifugation-flotation technique. Population levels did not differ between depths on any sampling date. Neither the density or age structure of the nematode population changed over time. Higher ($P=0.05$) levels of juveniles than adults were present on all dates and depths. In general, second-stage juveniles were most abundant in the 0-15 cm depth, third-stage juveniles were distributed uniformly between depths, and fourth-stage juveniles were most abundant in the 31-45 cm depth. There was no evidence that migration between the sampling depths occurred. Many nematodes died following harvest, although no stage-specific mortality factor could be identified. Population levels within root fragments were lower than in the soil, but followed similar trends. Department of Plant Pathology, University of Wisconsin, Madison, WI 53706.

MCKENRY, M.V. and T. BUZO. Reproduction and damage of various nematodes to alfalfa.

Populations of Meloidogyne hapla, M. incognita, M. arenaria and M. javanica were inoculated into 6 alfalfa, Medicago sativa, cultivars. Two populations of M. hapla and one each of Xiphinema americanum, Paratrichodorus minor, Merlinius brevidens, Pratylenchus neglectus, Pratylenchus scribneri and Helicotylenchus dihystera were further compared in a second test involving 3 alfalfa cultivars. After 19 harvests of each treatment the nematode development and yield changes were compared. M. hapla from central California resulted in a 15% yield reduction on sandy loam soil. Significant yield loss occurred among each cultivar except Nevada Syn XX. The latter cultivar was a suitable host for the M. hapla. The M. hapla population from northern California did not damage Moapa 69 or Lahontan cultivars and did not reproduce well on Nevada Syn XX. Vernal was the only cultivar which provided a good host for M. javanica and resulted in a 25% yield reduction. X. americanum and P. minor reproduced well on each cultivar tested. Other species were either absent or at low population levels after 4 years. The non successful species of Meloidogyne tended to increase yields during the first year's growth.
Department of Nematology, University of California, Riverside, CA 92521.

MC SORLEY, R. Dispersion of the nematode community on marl soils in southern Florida.

Taylor's power law was used to investigate the preplant spatial distribution and dispersion of the soil nematode fauna in fallow fields of Perrine marl soils intended for winter potato production. The data base consisted of counts from 12 cores collected from each of 18 different 0.4-ha plots. Over all plots, the nematode community averaged 46.1% Tylenchina, 13.7% Aphelenchina, and 37.8% Rhabditida. All genera tested showed highly significant (P=0.01) fits to the log (variance)/log (mean) linear regression defining Taylor's power law. Parameter b, an index of dispersion, ranged from 1.06 to 1.69, with a similar range for both plant parasites (1.17 for Quinisulcius acutus to 1.69 for Meloidogyne incognita) and free-living nematodes (1.06 for Cephalobus spp. to 1.62 for Aphelenchoides spp.). Parameter b was stable even if plot size was changed, although this introduced variation in parameter a. Similar sampling plans were developed for both potential plant parasites of potato and for non-parasitic genera.
Tropical Research and Education Center, 18905 S.W. 280 Street, Homestead, Florida 33031.

MOJTAHEDI, H., PINKERTON, J. N., and G. S. SANTO. Differential development and vertical migration of intraspecific variants of Meloidogyne chitwoodi.

The behaviour of an atypical alfalfa variant of Meloidogyne chitwoodi was compared with type culture population. Freshly hatched juveniles of either culture were added around roots of young potato plants and maintained at 12 or 24 C. The number of penetrating juveniles and development of nematode stages of both populations were monitered by periodic examination of stained roots. The lower temperature was less favorable for larvae penetration and development of the alfalfa variant of M. chitwoodi than the type culture population. In a second study, the juveniles of either population were injected into the bottom ring (5 cm high, 9 cm diam.) of a 12 ringed column filled with fumigated sandy loam soil. Vertical migration of both isolates was determined by extracting nematodes from each of the rings at 3, 6, and 9 days. Larvae migrating the furthest were tested for infectivity on tomato seedlings. The alfalfa variant migrated slower than the type culture population. Both populations infected tomato at their furthest distance of migration.
College of Agriculture, Isfahan University of Technology, Isfahan, Iran and IAREC, Washington State University, Prosser, WA 99350.

MOUSA, E.M. and HAGUE,N.G.M. Studies on the interaction between Meloidogyne incognita and Fusarium oxysporum glycine on soybean.

Soybean cultivars resistant(Coll) and susceptible (Amsoy) to Fusarium wilt were exposed to both Fusarium oxysporum and the root-knot nematode M.Incognita to study the interaction.
Both resistant and susceptible cultivars were severely wilted when the nematode was introduced either at the time the plants were exposed to the fungus or one or two weeks earlier. Three times as much fungus was isolated from vascular elements or roots and stems inoculated with both pathogens and gall tissue, including giant cells and nearby xylem vessels, were very heavily invaded by fungal hyphae:the interaction occurred regardless of the time at which the nematode was inoculated. Occlusion of xylem vessels by tylosis and gels was found to be greater in the resistant cultivar Coll than in the susceptible cultivar Amsoy and it is suggested occulsion of xylem vessels could represent a mechanism for resistance: when Coll was inoculated with both pathogens fewer occlusions and more fungus were observed.

NIBLACK, T.L., R.S. HUSSEY, and H.R. BOERMA. Comparison of yield and nematode reproduction potential as measures of Meloidogyne incognita resistance in selected soybean cultivars.

Five soybean cultivars (Braxton, Gordon, Jeff, Bragg, and Wright) differing in purported levels of resistance to Meloidogyne incognita (MI) and three susceptible cultivars (Coker 156, GaSoy 17, and Coker 237) were grown for four seasons in the Georgia Piedmont and Coastal Plain in microplots with initial MI populations (Pi) of 0, 31, 125, and 500 eggs/100 cm^3 soil. Yields were highest in the Coastal Plain and, on the resistant cultivars, were affected little by Pi. MI reproductive factors (RF = population at 120 days/PI) were inversely related to Pi and differed among cultivars depending on the level of resistance and, for Wright and GaSoy 17, were lower in the Coastal Plain. RF was better than yield as an indicator of the degree of MI resistance over seasons and locations. Braxton, Gordon, and Jeff were highly resistant. Bragg, Wright, and Coker 156 were moderately resistant. GaSoy 17 and Coker 237 showed no resistance. Department of Plant Pathology, University of Georgia, Athens, GA 30602.

Nickle, W. R. Pine Wood Nematode Causing Raw Wood Export Problems.

In August of 1984, the Plant Quarantine Service of Finland found pine wood nematodes in pine wood chips from Georgia destined for a paper mill in Finland and imposed a temporary ban on these shipments. After a three month study period, Finland has imposed a permanent ban on coniferous wood chips from the United States and Canada because of the PWN, thus stopping the export from the United States of millions of dollars worth of pine chips. Research efforts are needed to find an inexpensive and reliable method of ridding wood chips of pine wood nematodes and residual vector insects. Coniferous wood chips are often a secondary product of logging, or part of wood salvage operations, both of which can harbor PWN. The Europeans do not have PWN and as they have vast areas of scotch pine and other hard pine timber, they are concerned about it. So far, European surveys have revealed only Bursaphelenchus mucronatus in France and Siberia. Nematology Laboratory, Plant Protection Institute, Beltsville Agricultural Research Center, USDA, ARS, Beltsville, MD 20705.

NORDGREN, R. M., J. A. VEECH, and J. L. STARR. Partial characterization of stylet exudates from Meloidogyne incognita and M. arenaria.

The esophageal gland secretions (EGS), collected as stylet exudate from Meloidogyne incognita races 3 and 4 and M. arenaria race 1, were analyzed with sodium dodecyl sulfate-polyacrylimide gel electrophoresis (SDS-PAGE). Adult female nematodes, reared on 'Rutgers' tomato plants for 4-6 weeks, were excised from host roots and incubated 12-18 hrs in phosphate buffered saline (0.04M, pH 7.8). EGS that accumulated at the stylet aperture was collected with a micro-manipulator and stored frozen in glycerol. Upon SDS-PAGE analysis, six bands (2 major and 4 minor) were detected with silver stain; comparable samples were negative with Coomasie stain. The detected proteins ranged in size from 20,000 to 140,000 daltons. No major difference was detected among races or species. Dept. Plant Pathology and Microbiology, Texas Agr. Exp. Sta., College Station, TX 77843, and National Cotton Pathology Research Laboratory, Drawer JF, College Station, Texas 77841.

NYCZEPIR, A.P. and P.L. PUSEY. Interaction of Criconemella xenoplax and Fusarium sp on growth and feeder root necrosis of peach.

The interrelationship of Criconemella xenoplax (Cx) and Fusarium sp (Fus) on feeder root necrosis of peach was investigated under greenhouse conditions. Three month old certified Nemaguard seedlings were transplanted into 15-cm-d plastic pots containing steam pasteurized sand and vermiculite (1:1,v/v) in October 1984. At planting treatments were established and replicated eight times, they included: (i) Cx alone, (ii) Fus alone, (iii) Cx + Fus, (iv) Fus 4 weeks after Cx inoculation and (v) check. Check pots received a nematode-free extract suspension from the same soil which the inoculum was collected. Ninety days later roots in all treatments showed symptoms of necrosis but was especially severe in treatments in which Cx preceded Fus by 4 weeks and least severe in checks. Shoot growth, as evidenced by increased height and dry weight, was greater for all treatments in which Cx was present but more so in soil where Cx and Fus occurred in combination. These observations stress the importance of a nematode-fungus interaction in root necrosis and their influence on peach tree physiology. USDA-ARS, S.E. Fruit and Tree Nut Res. Lab., Byron, GA 31008

Overman, A.J. Oxamyl and phenamiphos for control of root-knot nematodes in Caladium x hortulanum Birdsey.

Tubers of Candidum x hortulanum cv. 'Candidum' were hot water treated and planted in root-knot nematode infested EauGallie fine sand. Oxamyl at 1250 ppm and 3750 ppm or phenamiphos at 1250 ppm was applied as a weekly foliar spray beginning 8 weeks after planting (3-leaf stage) and continuing for 18 weeks. All treatments reduced the incidence of root-knot galls on plant roots inspected at harvest of the tubers 20 weeks after planting. Tuber production was improved 118 and 90 percent by the low and high concentration of oxamyl, respectively. Phenamiphos improved yield 40 percent. Gulf Coast Research and Education Center, 5007 60 St. E. Bradenton, FL., 34203.

O'BANNON, J. H., W. L. BOGE, and R. N. PEADEN. A comparison of NaOCl or water extraction on development and survival of Meloidogyne chitwoodi and M. hapla eggs at four temperatures.

Meloidogyne chitwoodi (Mc) and M. hapla (Mh) eggs were extracted in either a 0.525% NaOCl aqueous solution for 4 minutes or in tap water for 15 minutes. Development of eggs incubated in distilled water at 5,10,15 and 20 C was determined weekly for 10 weeks. Eggs and J2 were pipetted weekly on roots of tomato and grown 63 days, harvested, and egg mass numbers/seedlings counted. At 5, 10 and 15 C, development of Mc and Mh eggs extracted by NaOCl or water was not statistically different after 1,2 or 3 weeks. At 20 C Mh or Mc egg development was significantly slowed by NaOCl extraction after 3 and 4 weeks incubation. There was no difference in Mc or Mh development between NaOCl and water at 5 C for 10 weeks, or 10 C for 6 weeks. Greatest infection and highest reproduction of both species occurred in the first 3 weeks by either extraction method at all temperatures. NaOCl extraction does not adversely affect development or reproduction of Mc or Mh when incubated at 4 temperatures for up to 3 weeks. Division of Plant Industry, P.O. Box 1269, Gainesville, FL 32602; and Irrigated Agricultural Research and Extension Center, Prosser, WA 99350.

O'HARA, C. M. and P. JATALA. Ultrastructure of Meloidogyne, Globodera and Nacobbus egg shells as related to the activities of biocontrol fungi.

Success of the biocontrol agents in infecting eggs of nematodes is dependant upon their ability to penetrate the eggs directly or produce substances which may affect the development of embryo. Egg shell make-up of different nematode species may play an important role in the success of these organisms. To determine if there are outstanding ultrastructural differences in the egg shells make-up of Meloidogyne incognita, Globodera pallida and Nacobbus aberrans, eggs were processed for transmission electron microscopy. M. incognita egg shell consists of a thin vitelline layer followed by a thick chitinous and thin lipid layer. G. pallida egg shell is more robust with its vitelline and chitinous layers considerably thicker than that of M. incognita. N aberrans egg shell consists of a yet thicker vitelline layer than that of G. pallida. The chitinous and vitelline layers of N. aberrans egg shell each consists of 3 distinct electron dense material. The complexity of N. aberrans egg shell may play an important role in its capability to withstand dessication, direct fungal penetration or the action of their exopathic compounds. Similarly, the simplicity of M. incognita egg shell may account for its vulnerability to direct fungal penetration or to the action of their exopathic compounds. Dept. Nematology & Entomology, The International Potato Center, Apdo. 5969, Lima,Peru.

OSMAN, A.A. AND A.A. FARAHAT. Reaction of Soybean cultivars to Meloidogyne populations.

Thirty six Soybean (Glycin max) cultivars were screened in greenhouse tests for susceptibility and resistance to infection by Meloidogyne mixed populations (I-VI) collected from 6 vegetable growing regions of Egypt. Nineteen cvs. were found to be highly resistant to pop.I (Abo-Rowash), 33 to II (Nubaria), 8 to III (South-Tahrir), 26 to IV (Bahr EL-Bakar), 4 to V (Talkha) and 2 to VI (Salhia). Five cvs. were susceptible and highly susceptible to pop.I, 0 to II, 9 to III, 0 to IV, 19 to V and 14 to VI. None were immune to I, III, V but 3 to II, 3 to IV and 2 to VI. The remaining cultivars ranged between moderately resistant and moderatley susceptible. The results showed that the nematode populations could be classified as virulent or non-virulent according to the intesity of infection of the same cultivar. Cairo University, Faculty of Agriculture, Giza, Egypt.

OSMAN, A.A., A.A. FARAHAT and A.W. AMIEN. Non-fumigant nematicides for control of Meloidogyne isolates infecting cowpea plants.

Four non-fumigant nematicides were tested in the greenhouse for their efficiency in controlling eight field Meloidogyne mixed populations. Aldicarb, the most effective against the eight tested populations was followed in decreasing effectiveness by phenamiphos, oxamyl and carbofuran when applied 7 days after inoculation. Carbofuran was least effective particularly for the isolates II (Nubaria) and VIII (Rashied). Aldicarb provided 99-100% control as determined by female and egg-masses counts in comparison to the checks.These results established the efficacy of using any of the above mentioned nematicides in controlling Meloidogyne regardless the source and aggressiveness of nematode populations. Cairo University, Faculty of Agriculture, Giza, Egypt.

PINKERTON, J.N., H. MOJTAHEDI and G.S. SANTO. Intraspecific variation between populations of Meloidogyne chitwoodi from Washington.

Meloidogyne chitwoodi, an important pest in potato production, is widely distributed in the Pacific Northwest. Wheat, alfalfa and pepper have been reported as excellent, poor to none, and immune hosts to M. chitwoodi, respectively. Recently, two nematode populations which reproduce on alfalfa were isolated from infected potato tubers. Preliminary studies with one population demonstrated that it differs from the type culture in morphology, host range, and host response at infection sites. The perineal pattern is M. chitwoodi-like, with sunken vulva, moderately high arch, and no wings, however, striae are finer than those observed with type culture females. Hypodermal terminus is tapered in alfalfa variant J2's, whereas type culture individuals have a bluntly rounded terminus. The alfalfa variant reproduced moderately on wheat, slowly on pepper, and it induced root proliferation on all hosts tested. These phenomena are divergent from type culture responses. IAREC, Washington State University, Prosser, WA 99350 and College of Agriculture, Isfahan University of Technology, Isfahan, Iran.

POWERS, T. O., E. G. PLATZER, and B. C. HYMAN. Mitochondrial DNA: structural variation in populations of Romanomermis culicivorax.

The rapidly diverging nature of mitochondrial genomes allows genetic comparisons to be made between closely related populations. Nematode mitochondrial DNA (mtDNA) has been purified by methods which exploit base pair composition and circularity of the mitochondrial genome. Restriction endonuclease analysis of mtDNA from laboratory cultures of the mosquito parasite Romanomermis culicivorax has revealed two surprising features. The mitochondrial genome size of this nematode is approximately 24 kilobases, the largest value yet reported for metazoans. Secondly, most individuals are monomorphic for one of three distinct mtDNAs found in this population, as confirmed by Southern hybridization of mixed polymorphic mtDNA's to restriction digests of isofemale lineages. These mitochondrial genomes vary by the addition of less than 1,000 base pairs. Both variable and constant regions of the mitochondrial genome have been cloned and subjected to detailed fine structure restriction mapping. Our observations of restriction site polymorphisms among mtDNA indicates that species-specific diagnostic probes can be easily constructed. Department of Nematology and Department of Biology, University of California, Riverside, CA 92521.

RADEWALD, J. D., F. SHIBUYA and G. NEIL MCRAE. Biannual Multiple Drip Irrigation Applications of Chemicals Coinciding with Nematode Population Levels Leads to a Profitable Increase in Table Grape Production in the Coachella Valley of Southern California.
Previous studies demonstrated monthly applications of 24 different chemical treatments was a poor management decision for nematode control. Studies of population dynamics showed both Meloidogyne incognita and Tylenchulus semipenetrans peaked biannually in March and again in September. We found four applications applied three days apart of six different chemicals at 100 ppm ai in the drip system previous to population build up in March and September provided a high degree of control of both nematodes. This information was developed in 10 vine replicated plots and supported by nematode control data and grape yield. Field scale trials were then initiated with fenamiphos, the only material registered for usage in this manner and some yields of red variety table grapes were doubled by this control measure. Responses in the green varieties were less, but still highly profitable. Total ai usage of chemicals was 1/3 that of proposed allowable usage. Department of Nematology, University of California, Riverside, CA 92521.

RADEWALD, J. D., F. SHIBUYA and G. NEIL MCRAE. Chemical Nematode Control on Table Grapes in California Using Drip Irrigation as the Vehicle and Population Dynamics for Timing of Application.
Population levels of Meloidogyne incognita and Tylenchulus semipenetrans were monitored weekly for six months and monthly for two years on table grapes in two different vineyards of the Coachella Valley of California. Both vineyards were watered by drip irrigation. Eight different chemicals were tested alone and at different rates and in combinations on single vine plots for a total of twenty five treatments. Treatments were applied monthly and semi-monthly for one year. Control was monitored by soil samplings monthly for the year during treatment and an additional year after treatment. Results showed monthly applications were not adequate to control M. incognita and led to more precise and timely application frequencies. Department of Nematology, University of California, Riverside, CA 92521.

Radice, A. D., R. D. Riggs and F. E. Huang. Protein and enzyme polymorphism or Heterodera glycines.
Single cysts of twelve populations of Heterodera glycines from the United States (8), China (2), Columbia (1) and Japan (1) were propagated on soybean Glycine max c.v. Essex. Individual mature females were analyzed using ultra-thin (240 μm) polyacrylamide isoelectric focusing (UT-IEF) for esterases, malic dehydrogenase and malic enzyme. Allelic frequencies of isozyme loci (presumptive individual genotypes) show significant level of polymorphism. Separation of the soluble proteins of 25-100 mature females by UT-IEF and analysis by scanning densitometer show considerable differences in protein banding patterns among most populations. Populations from Japan and Columbia however, have strikingly similar protein banding patterns. Substantial levels of protein polymorphism were detected within populations from the United States and China. Our results warn against the use of mass homogenates to estimate genetic variation and relatedness among sibling and non-sibling species.
Department of Plant Pathology and Department of Horticulture, University of Arkansas, Fayetteville, Arkansas 72701.

RAWSTHORNE, DENISE and B. B. BRODIE. Tolerance of two potato cultivars resistant to Globodera rostochiensis (Rol).

Resistance in potato cultivars to Globodera rostochiensis (Rol) is conferred by the H_1 gene which, from trials in Europe, appears to be associated with tolerance. Because management strategies used in the USA to manage G. rostochiensis densities far below damaging levels, the question of tolerance in resistant cultivars has not been considered. A field trial was conducted to compare the performance of the resistant cultivars 'Hudson' and 'Rosa' and the susceptible cultivar 'Katahdin'. Mean population densities of G. rostochiensis were 32, 53 and 52 eggs g^{-1} soil for 'Katahdin', 'Rosa', and 'Hudson' plots, respectively. Eight weeks after emergence, 'Hudson' had a significantly greater shoot dry weight than 'Rosa' or 'Katahdin'. However, this was not reflected in final yields that were reduced by 30% in 'Hudson' and 'Rosa' and 38% in 'Katahdin'. Thus, these resistant cultivars appear to have greater tolerance to G. rostochiensis than does the susceptible cultivar 'Katahdin'. USDA, ARS, Department of Plant Pathology, Cornell University, Ithaca, NY 14853.

REDDIGARI, S.R., C.A. SUNDERMANN, and R. S. HUSSEY. Isolation of secretory granules from second-stage juveniles of Meloidogyne incognita.

Secretions from dorsal and subventral esophageal glands of second-stage juveniles of the root-knot nematode, Meloidogyne incognita, are considered to be responsible for initiating formation of giant cells. Secretory granules from pre-parasitic second-stage juveniles were isolated by isopycnic centrifugation on Percoll. The granules had an apparent density of 1.13 $g.cm^{-3}$. The relative specific activity of acid phosphatase in the granule extract was 8.4. Acid phosphatase activity was detected by electron cytochemistry in the sub-ventral gland granules of second-stage juveniles. Electron microscopy and malate dehydrogenase activity indicated that mitochondrial contamination of the granule preparation was negligible. Electrophoresis of granule extract in the presence of sodium dodecyl sulfate showed 15-20 major protein bands. Monoclonal antibodies are being produced against the constituents of the isolated granules. Department of Plant Pathology, University of Georgia, Athens, GA 30602.

Riggs, R. D. Races of soybean cyst nematode in People's Republic of China.

In 1981 a group of USA scientists visited northern People's Republic of China to look for new soybean germplasm and possible biological control agents. Mature females and cysts were collected at several stops as follows: 1 at Harbin, Heilungjiang Province; 3 at Gongzhuling, 1 at Jilin and 1 at Changchun, Jilin Province; 2 at Shenyang, and 1 at Teiling, Liaoning Province; 2 at Jinan and 2 in Dong Ping County, Shan dong Province; and 1 was obtained from Mr. Chen of the Agricultural Academy of Science in Beijing. Mature females and cysts were picked from the roots and placed in vials of sterile sand for shipment to the USA. Each population was placed on cv Lee soybean for increase and race tests were run using the prescribed differential hosts plus cv Bedford. Eight of the 14 populations reproduced and were race tested. Of these one was race 2, three were race 3, two were race 5 and two belonged to two different undescribed races. The race 2, two race 3's, both race 5's and both undescribed races reproduced on cv Bedford. Department of Plant Pathology, Univeristy of Arkansas, Fayetteville, AR 72701.

Riggs, R. D., L. Rakes and M. L. Hamblen. Status of the race situation in soybean cyst nematodes.
Heterodera glycines (SCN) has been obtained from several states in the US, from China, Columbia and Korea and subjected to the standard SCN race determination test. The cv 'Bedford' was included because of its commercial importance. Female indices were calculated as a % of the number on Lee. An index of 10 or more was called positive; <10 was called negative. Of the 58 populations tested, 19 were race 3, with nine positive on Bedford; 9 were race 2, five positive on Bedford; five were race 4, all positive on Bedford; two were race 5, both positive on Bedford; three were in one unidentified race, two were positive on Bedford; 16 were in another unidentified race, 12 were positive on Bedford; and there was on in each of the four other unidentified races, all positive on Bedford. These results strongly suggest that, although the race system has been very useful it is no longer adequate to cover the variations that must be faced by breeders and growers. Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

ROBERTS, P.A., D. MAY, and W.C. MATTHEWS. Resistance and tolerance to Meloidogyne incognita in processing tomatoes.
In replicated field experiments on two sites infested with Meloidogyne incognita, resistant tomato lines were compared with standard susceptible cultivars, in 1,3-Dichloropropene fumigated plots and in nonfumigated plots. The two susceptible cultivars in nonfumigated plots yielded only 51.8% and 45.0% of the yield attained in fumigated plots in one experiment, and only 43.5% and 44.5% respectively in a second experiment, while the eight resistant lines showed no significant reduction in yield on nonfumigated compared to fumigated plots. These results indicate that the Meloidogyne resistant genotypes being developed in the major processing tomato breeding programs can effectively tolerate high initial population densities without nematicide protection. In nonfumigated plots, final population densities in roots and soil were greatly reduced by resistant lines, compared to significant increases on susceptible cultivars, however a small amount of reproduction occurred in root systems of each resistant tomato line. Department of Nematology, University of California, Riverside, located at Kearney Agricultural Center, 9240 South Riverbend Ave., Parlier, CA 93648.

Robbins, R.T. The effects of consecutively planting cv Bedford soybean in field plots on maturation of Heterodera glycines.
In 1980 field plots infested with race 4 of the soybean cyst nematode (SCN) Heterodera glycines were established and planted consecutively to cv Bedford or a susceptible variety. Maturation tests were conducted on cv Lee, Pickett, and Bedford in soil samples collected in: May, 1981 (A); June, 1982 (B); October, 1982 (C); May, 1983 (D); October, 1983 (E); and November, 1984 (F). SCN maturation on Pickett and Bedford is expressed as a percentage of that on Lee. For the indicated test dates (A-F) the order of these percentages are 1) Pickett, 2) Bedford (after Bedford), 3) Pickett, 4) Bedford (after susceptible): A) 54.9, 2.4, 96.3, 6.4, B) 76.5, 9.9, 117.0, 3.1; C) 104.3, 16.2, 118.3, 7.5; D) 81.0, 11.7, 94.9, 2.8, E) 87.5, 37.0, 93.5, 9.7; and F) 78.9, 26.8, 42.6, 4.1. In adjacent plots planted to cotton in 1980, the percentages were: B) 101.2, 1.7, 98.3, 2.0; C) 45.0, 35.0, 111.4, 2.8, D) 90.7, 13.4, 53.8, 17.0; E) 75.5, 25.9, 91.8, 4.1; and F) 133.3, 28.1, 60.0, 5.7. In these tests the SCN maturation on Bedford after consecutively planting Bedford has increased to about 25-30% of that on Lee, while that after consecutive susceptible generally has stayed below 10%. Dept. of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.

ROBINSON, A.F. Comparative hydration of juveniles of Meloidogyne incognita in soil and in aqueous solutions.

Water loss by juveniles of Meloidogyne incognita in response to decreases in external water potential from 0 to -5000 kPa were compared in polyethylene glycol (PEG) solutions and in four soils of diverse moisture release behavior. Water potential of soil was controlled by dialysis. Nematode water loss was quantified through morphometric analysis. Two methods were used to compare nematode volume in soil with volume in PEG solutions. In the first method, nematodes were fixed prior to sugar flotation by mixing soil with 2% formaldehyde. In the second method, nematodes were separated from soil by centrifugation in solutions with various water potentials at equivalent specific gravity. Length measurements obtained for individual nematodes within extraction solutions ca. 8 and 16 minutes after initial contact with soil were used to estimate lengths before extraction by extrapolation. Results obtained with both methods indicated that nematode hydration within soil and PEG solutions was similar at equivalent water potentials. Subtropical Agricultural Research Laboratory, USDA-ARS, P. O. Box 267, Weslaco, TX 78596.

ROBINSON, A.F., and W. W. CARTER. Physiological processes essential to water regulation and to nematode survival during changes in hydration.

Aerobic respiration was arrested in juveniles of Meloidogyne incognita and Orrina phyllobia through exposure to cyanide ion, and through the physical removal of ambient molecular oxygen. Treatments were at strategic points within a 48-hour cycle of fluctuating external water potential. Nematodes in hypotonic solutions took up water following death by exposure to cyanide ion. Upon transfer of these nematodes to hypertonic solutions, water loss was greater than in living nematodes. Loss of water by dead and by living hypoxic nematodes resulted in radial collapse of the body wall rather than in longitudinal shortening, as occurred in control nematodes. These results suggest the existence of a mechanism that continuously removes water in hypotonic solutions, osmotic adjustment within hypertonic solutions, and morphological constraints on water loss and uptake imposed by rigor of the somatic musculature. Subtropical Agricultural Research Laboratory, USDA-ARS, P. O. Box 267, Weslaco, TX 78596.

Rodríguez-Kábana, R. Organic and inorganic nitrogen soil amendments as nematode suppressants.

Inorganic fertilizers containing ammoniacal or releasing this form of N in the soil are most effective for suppressing nematode populations. Anhydrous NH_3 has been shown to reduce soil populations of Tylenchorhynchus claytoni, Helicotylenchus dihystera and Heterodera glycines; the rates required to obtain significant suppression of nematode populations are generally in excess of 150 Kg N/ha. Urea is also suppressive of several nematode species, including Meloidogyne spp., when applied at rates above 300 Kg N/ha. Additional available carbon must be provided with urea to permit soil microorganisms to metabolize excess N and avoid phytotoxic effects. There is a direct relation between the amount of "protein" N in organic amendments and their effectiveness as nematode population suppressants. Most nematicidal amendments are oil cakes, or animal ordures containing 2-7% (w/w) N; these materials are effective at rates of 4-10 MT/ha. Organic soil amendments containing mucopolysaccharides (e.g. mycelial wastes, chitinous matter) are also effective nematode suppressants. Department of Botany, Plant Pathology and Microbiology, Auburn University, Agricultural Experiment Station, Auburn, AL 36849.

SCHMITT, D. P. Aldicarb dosage-yield response relationships for Heterodera glycines-infected soybeans in North Carolina. The effects of aldicarb on the yield of soybean susceptible to Heterodera glycines (HG) were determined in three soil types. Aldicarb treatments (0, 0.28, 0.56, 1.12, 2.24, 4.48, and 8.97 kg [a.i.]/ha) were replicated 6 times in microplots in sandy loam and muck soils which were artificially infested with HG 2 years earlier. The third soil, a sand, was fumigated with methyl bromide and infested with initial HG egg numbers (P_i) of 0, 85, 170, 510, 2,040, and 10,200 /500 cm^3 soil. These treatments were replicated 8 times, and aldicarb (6.78 kg [a.i.]/ha) was applied to half of the plots. Aldicarb enhanced yields 12-15% at P_i's of 85-510, but plots with P_i's of 2,040-10,200 had yields 19-32% below those of the nontreated, HG-free controls (384g/plot) in sand. Low rates of aldicarb (0.28-1.12 kg [a.i.]/ha) gave no yield response in HG-plots, whereas high rates (2.24-8.97 kg/ha) resulted in yields 13% less than those of nontreated, HG-free controls (673g/plot). The yield response in the loamy sand was described by the regression model $Y=30.6+101.8X-7.8X^2$, $R^2=0.97$ (X=rate of aldicarb). Thus, optimum dosage rates of aldicarb vary with soil type. Department of Plant Pathology, Box 7631, N.C. State University, Raleigh, NC 27695-7631.

SMITH, G.S., R W. RONCADORI, AND R.S. HUSSEY. Development of Meloidogyne incognita on cotton as affected by the endomycorrhizal fungus, Glomus intraradices and phosphorus. Penetration, development, and reproduction of M. incognita (MI) was studied on the root-knot susceptible cotton cultivar, Stoneville 213, grown in soil receiving no amendment (control), 25 g soil and root inoculum of G. intraradices, or 75 mg/kg $CaHPO_4$. Plants were inoculated at planting or after 28 days growth with 250 MI eggs/100 cm^3 soil and destructively sampled at 7, 14, 21 and 28 days after nematode inoculation. MI penetration at 7 days and eggs per female determined at 21 and 28 days were similar in all treatments. On plants inoculated at planting, phosphorus enhanced the rate of development of MI to fecund females compared to control and mycorrhizal plants. On plants inoculated after 28 days growth, the number of MI parasitizing mycorrhizal root systems after 14 days was reduced 36% and 47% over control and phosphorus treatments, respectively. Mycorrhizal root systems also supported fewer numbers of fecund females and eggs per plant after 21 and 28 days. Thus phosphorus enhanced MI development on seedlings whereas mycorrhizal effects on MI parasitism were apparent only after root systems were sufficiently colonized by G. intraradices. Department of Plant Pathology, University of Georgia, Athens, GA 30602.

SMITH, P., B. BOAG and A.R. STONE. Cyst nematode identification using a computer. Qualitative characters are used together with cyst and juvenile dimensions to identify species. A microcomputer may be used to record qualitative and numeric information and to make measurements, and aid identification by comparing sample means with a stored table of the range of each character for each species. A computer program for this purpose was modified for identification of cyst nematodes. Alternative subsets of cyst characters are used for different genera, selected automatically by type of fenestration. Cyst and juvenile characters are recorded separately for varying numbers of cysts and of larvae per cyst. This allows a single set of characters to be used for input and a single data file for identification. Scottish Crop Research Institute, Invergowrie, Dundee, Scotland, DD2 5DA; Rothamsted Experimental Station, Harpenden, Herts., England.

THIES, J.A., D.K. BARNES, C.C. SHEAFFER, D.L. RABAS, and R.D. WILCOXSON. Effect of seeding date, carbofuran and alfalfa genotype on Pratylenchus penetrans and alfalfa stand establishment and yield. A field study was conducted at Grand Rapids, MN in 1982 to evaluate the effects of four seeding dates (biweekly starting in May), carbofuran (0 or 2.2 kg a.i./ha) and cultivars (Baker, susceptible to P. penetrans; WL-219, more resistant than Baker) on alfalfa stand establishment and yield in the presence of P. penetrans. The experiment was repeated in 1983 and 1984 with the addition of MN-GRN-2 and MN-GRN-4, two alfalfa populations selected for resistance to P. penetrans. Seeding dates, carbofuran treatment and alfalfa entries were different (p=.05) for plant numbers, nematodes/g root and yield. Differences associated with seeding dates were not consistent across years. Carbofuran increased (p=.05) plant numbers for some early summer seedings and reduced (p=.05) P. penetrans populations. In 1984, plant numbers and shoot and root dry weights for MN-GRN-2 and MN-GRN-4 were greater (p=.05) than for Baker and WL-219. These results indicate that carbofuran and plant resistance will increase alfalfa stand establishment and yield in the presence of P. penetrans.

THOMAS, S. H. and C. J. GODDARD. Plant-parasitic nematode development on guayule, a latex-producing desert shrub. Guayule (Parthenium argentatum Gray) is indigenous to the southwestern United States and northern Mexico. It is important as an alternative to Hevea species as a source of latex for natural rubber production. In this study, pots containing 4-month-old guayule plants were inoculated with 1,000 individuals from one of 4 species of nematodes: Criconemella xenoplax, Helicotylenchus pseudorobustus, Meloidogyne incognita race 3 or Pratylenchus sp. Plants were grown in the greenhouse and destructively sampled at 6-week intervals over a period of 9 months. Measured parameters included numbers of nematodes recovered, shoot and root dry weight and shoot fresh weight. Populations of C. xenoplax increased, while those of H. pseudorobustus declined throughout the study. Meloidogyne incognita and Pratylenchus sp. were not recovered after week 12 of this experiment. Significant reduction in plant fresh weight, but not dry weight, was associated with C. xenoplax development in guayule. Department of Entomology and Plant Pathology, Box 3BE, N.M. State University, Las Cruces, NM 88003.

THOMASON, I. J. and C. OMWEGA. Meloidogyne spp. as pathogens of dry beans in California. The nematodes Meloiodgyne incognita, M. javanica and M. arenaria attack common (Phaseolus vulgaris), lima (P. lunatus), and blackeye (Vigna unguiculata) beans in California. M. incognita the the most widespread species and limas and blackeyes suffer the greatest damage. Resistance to M. incognita, but not M. javanica, occurs in blackeye, common and lima beans. Resistance to M. javanica has been difficult to obtain although numerous lines have been screened. Recently 3 lines of tepary beans (Phaseolus acutifolius) were found with resistance as measured by reduced galling and egg production. Greenhouse tests on the effect of M. incognita on phenology of P. vulgaris showed that infected plants were determinate in growth whereas healthy plants continued to flower after the first set was mature. Other growth parameters significantly reduced by M. incognita were root weight, numbers of main stem branches, pod numbers and yield of seed. Yield of seed was reduced 14.7 and 23.6 percent in soil infested with 67 and 135 eggs/g respectively. Department of Nematology, University of California, Riverside, CA 92521.

VEECH, J. A., and J. L. STARR. Aggressiveness of races 3 and 4 of Meloidogyne incognita on cotton.

Aggressiveness of Meloidogyne incognita races 3 and 4 on cotton was compared in terms of rate of nematode development, host response to nematode infection, and nematode reproduction indices. Both races developed similarly on cotton at 28 C; ovipositing females were first detected 23 days after inoculation. In microplot experiments, linear negative correlations ($r = -0.88$ to -0.98, P 0.05) were obtained between initial nematode population densities ($Pi = 0.3$ to 167 eggs and juveniles/100 cm^3 soil) and seed cotton yields. Slopes of regression lines for the races of M. incognita were not different. There were no differences in the reproduction indices (final nematode population/initial nematode population) of races 3 and 4 in the microplot experiments. We conclude that race 3 and race 4 of M. incognita do not differ in aggressiveness on cotton. National Cotton Pathology Research Lab., Drawer JF, College Station, TX 77841; Dept. Plant Pathology and Microbiology, Texas Agr. Exp. Sta., College Station, TX 77843.

WINDHAM, G.L., K.R. BARKER. Reproductive and damage potential of Meloidogyne incognita host races on soybean.

The sensitivity and host efficiency of susceptible ('Lee 68', 'Coker 156') and resistant ('Bragg', 'Centennial', 'Forrest', 'Lee 74') soybean cultivars for Sasser's host races of Meloidogyne incognita were determined in the greenhouse. Nine populations from the southeastern United States were utilized. Shoot dry weights and nematode reproduction were determined 90 days after inoculation. All populations reproduced readily on Lee 68 and Lee 74 with moderate reproduction on Forrest and Bragg. Coker 156 exhibited tolerance to host races 1, 2, and two race 3 populations. However, this cultivar was very intolerant to one population of races 3 and 4. Reproduction of all populations was lowest on Centennial. Forrest and Centennial shoot growth was not significantly suppressed by any host race. Considerable variation in reproduction existed within host races 1 and 3. Soybean resistance to M. incognita does not appear to be race specific. Crop Science Research Laboratory, USDA-ARS, Box 5367, Mississippi State, MS 39762; Department of Plant Pathology, North Carolina State University, Box 7616, Raleigh, NC 27695-7616.

YAMASHITA, T.T., D.R. VIGLIERCHIO and R.V. SCHMITT. *Altered responses in plant-parasitic nematodes to nonfumigant nematicides following subnematicidal preconditioning.*

Long-term preconditioning of *Xiphinema index*, *Meloidogyne incognita* and *Pratylenchus vulnus* to subnematicidal concentrations of carbofuran, oxamyl and phenamiphos can alter their responses to subsequent nematicidal treatments. Responses vary with both the specific nematode treated and nematicide used. Behavioral changes which became apparent during nematicidal treatments to preconditioned nematodes included effects on reproductive potentials, direct and cross-susceptibility, indifference and direct and cross-resistance. In some instances the response to treatment appeared to be a form of dependence or stimulation. Addition of nematode-free soil leachings from stock cultures both protected and enhanced kill following treatment. This response appeared to be specific to a nematode species.-*Division of Nematology, University of California, Davis, CA. 95616.*

CHITWOOD, D.J., and R. LOZANO. Recent developments in nematode steroid biochemistry.

Current knowledge of steroid nutrition, metabolism, and function in free-living, plant-parasitic and animal-parasitic nematodes is reviewed, with emphasis upon recent investigation of Caenorhabditis elegans. A large number of 4-desmethylsterols with a trans-A/B ring configuration can satisfy the steroid nutritional requirements in C. elegans, but sterols with a cis-A/B configuration or a 4-methyl group cannot. C. elegans removes methyl or ethyl substituents at C-24 of the plant sterols sitosterol, campesterol, stigmasterol, stigmastanol, and 24-methylenecholesterol to produce various sterols with structures partially dependent upon that of the dietary sterol. Additional metabolic steps in C. elegans include reduction of Δ^{22}- and Δ^{5}-bonds, C-7 dehydrogenation, isomerization of Δ^{7}- to $\Delta^{8(14)}$-bonds, and 4α-methylation. An azasteroid and several long-chain alkyl amines interfere with the dealkylation pathway in C. elegans by inhibiting the Δ^{24}-sterol reductase; these compounds also inhibit growth and reproduction in various plant- and animal-parasitic nematodes. Comparative studies with Turbatrix aceti, Panagrellus redivivus and Heterodera zeae are also discussed.

MINTON, N. A. Impact of conservation tillage on nematode populations.

Conservation tillage has been defined as any tillage and planting system that retains at least 30 percent residue cover on the soil surface after planting. Conservation tillage includes no-till or slot planting, ridge-till, strip-till, mulch-till (including stubble mulching) and other tillage and planting systems that meet 30 percent surface residue requirement. Residue cover may be from meadow, winter cover crop, small grain or other row crops. The effects of conservation tillage on nematode population densities have varied and may be related to nematode species, crop and/or cultivar, geographical location, weed control, and type of tillage utilized. The effects have ranged from negligible to decreasing or increasing population densities. Crop response to nematode population densities have also occurred. - USDA, ARS Costal Plain Experiment Station, Tifton, Georgia 31793.

MORTON,H.V. Modification of proprietary chemicals for increasing nematicidal efficacy.

The efficacy of nematicides can be increased in a number of ways. Initially, the synthesis chemists optimize the chemical moiety. Further improvements can be made through formulation technology using various rates of surfactant, utilizing slow release technology, or by combining the active ingredient with a synergist. The method of application, placement, and timing of the application can have a marked influence on the efficacy. In many cases, frequent applications at lower rates have proven more efficacious. Nematicidal activity can be further enhanced by using the principles of integrated crop management. CIBA-GEIGY Corporation, P.O.Box 18300, Greensboro, NC 27419.

NIGH, E.L. Allelopathic Activity of Plants to Nematodes

Various plants possess biochemical substances toxic to nematodes. These can be responsible for resistance through oxidation of phenolic compounds resulting in hypersensitivity or phytoalexin production that follows infection by the parasite. The host may be toxic in itself or produce toxic substances lethal to the nematode. These allelopathic substances have been reported in crotalaria, tangetes, garlic, sesame, wormseed, mustard, fern, various grass species and asparagus. They may occur in root exudates, homogenized plant parts, decayed organic matter or plant ash. In field investigations crop residues or root exudates from sesame, wild mustard, asparagus and guayule have been evaluated for control of Tylenchulus semipenetrans. Citrus and asparagus have been interplanted to determine plant interaction and nematode response to continuous supply of root exudates. Controlled glasshouse investigations with the same plants and/or their root exudates have demonstrated their influence on development and reproductive potential of Meloidogyne and Xiphinema species. Reductions in populations of each nematode have been obtained with one or more of the plants tested. Univ. Arizona, Yuma 85364

BIRD, G. W. Distribution and regulation of *Meloidogyne nataliei* in southwestern Michigan.

Meloidogyne nataliei (Michigan Grape Root-Knot Nematode) was discovered in 1977, in Van Buren County near Mattawan, MI and described in 1981. M. nataliei is a pathogen of Vitis labrusca. It has a narrow host range. Four surveys were conducted (1978-1982) to determine the distribution of this nematode. M. nataliei is currently known to exist only in Sections 13 and 14 of Antwerp Township. Because of this limited distribution and the perceived risk associated with M. nataliei, California envoked the Interstate Pest Control Compact. The Michigan Department of Agriculture quarantined four adjacent properties in 1983, and implemented a regulatory program designed to reduce population densities of M. nataliei to non-detectable levels. Deep and shallow applications of EDB were made to all sites known to be infested. In a 1985 survey of the treated areas, M. nataliei was recovered from four samples. Department of Entomology, MI State Univ., East Lansing, MI 48824.

DUNCAN, L. W. Influence of bare fallow on population levels of phytoparasitic nematodes in the Sahelian region of Senegal.

Population levels of Scutellonema cavenessi, Dolicorhynchus elegans, Helicotylenchus dihystra and Hoplolaimus pararobustus declined in bare fallow treatments consisting of cultivation at daily and one, two and three week intervals. The experiment was conducted for 19 weeks during a single rainy season in Senegal's Sahelian region. Linear regression of mean monthly population levels of S. cavenessi in each treatment against time explained 93-97% of the population variation within treatments. In contrast, changes in the survival of S. cavenessi in response to gradual soil desiccation (an annual, regional occurrence) during the course of the experiment was best fit by an exponential decay model. A visual index of relative body food reserves described the ability to survive soil desiccation (r^2 = 0.89) when used in a logistic model. Although final population levels of S. cavenessi were exponentially related to time between cultivations, all treatments resulted in higher mortality rates than were observed in adjacent, experimental plots fumigated with recommended rates of DBCP. Citrus Research and Education Center, 700 Expt. Sta. Rd., Lake Alfred, FL 33850.

DUNCAN, L. W. Quantitative host-parasite relationships in a dryland farming region of Senegal.

Nematode density dependent reproduction functions and crop yield functions were determined for cowpea, millet and peanut parasitized by Scutellonema cavenessi and naturally occurring combinations of five other phytoparasitic nematode species. Experiments were conducted in small field plots at two locations in Senegal in 1984. The population dynamics of S. cavenessi were similar at both sites and indicate that host suitability of cowpea >> millet > peanut. Severity of host damage caused by S. cavenessi as measured by Seinhorst's model $y = m + (1-m)\, z^{P-1}$ followed the same trend. In general, millet and cowpea were superior to peanut as hosts of the other nematode species present. Quantitative host-parasite relationships were elucidated for use in a model of long-term crop-nematode interactions being developed to help optimize efforts in a regional nematode management program. Citrus Research and Education Center, 700 Expt. Sta. Rd., Lake Alfred, Fl 33850.

GRANEY, L.S.O. Observations on the morphology of *Heterodera carotae* and *Heterodera avenae* in Michigan.

Numerous cysts and white females observed on the roots of carrot, Daucus carota cv. Spartan Banner from Grant, MI were identified as Heterodera carotae in August, 1984. Cysts are typically lemon-shaped, often light brown in color, abullate and ambifenestrate. The underbridge when present is weak and sometimes appears as remnants in older cysts. Second-stage larvae (L2) have average body, stylet, DGO, tail and hyaline terminal lengths of 445, 23.4, 6.2, 51.7 and 29.7 µm, respectively. This is believed to be the first report of H. carotae parasitizing carrots in the United States. H. avenae was discovered in Gilford Twp., Tuscola Co., on September 14, 1983. The lemon-shaped cysts of H. avenae are dark brown, bifenestrate with a short vulval slit. There is no underbridge and the vulval cone is often crowded with bullae. L2 average 570 µm long with stylet, DGO, tail and hyaline terminal lengths averaging 25.8, 5.8, 64.2 and 37.3 µm, respectively. The dorsal stylet knob of L2 in the lateral orientation is slightly concave anteriorly. In general, the morphometrics of H. carotae and H. avenae in MI correspond well with previous descriptions. Dept. of Entomology, MI State Univ., East Lansing, MI 48824.

DICKSON, D.W. and D.J. MITCHELL. Evaluation of Paecilomyces lilacinus as a biocontrol agent of Meloidogyne javanica on tobacco.

Paecilomyces lilacinus alone and in combination with ethoprop and fenamiphos was evaluated for management of Meloidogyne javanica on tobacco in microplots. The fungus grown on autoclaved wheat seed was added to 76-cm-d microplots at 45.6g/cm^2. Controls included no treatment, nematode alone, wheat seed infested with fungus, autoclaved wheat seed, and wheat seed infested with fungus and autoclaved. Plots, replicated seven times, were infested with M. javanica at 120 eggs/100 cm^3 soil, and NC-2326 tobacco was transplanted into the plots 16 April 1984. Populations of P. lilacinus estimated on a selective medium were 1.1-1.4 x 10^6 propagules/g soil 1 week after infestation; levels dropped to 1.7-7.6 x 10^5 propagules/g soil at harvest. The root galling index was 2.7-3.9 in nematode-infested plots treated with nematicides; however, plants with M. javanica alone or in combination with P. lilacinus had a galling index of 5 (1 = low, 5 = high). Yields were 1,592-1,976 g of green leaf/plot except in treatments with M. javanica alone (932 g/plot) or in combination with fungus (997 g/plot). Depts. Ent. & Nema. and Plant Path., Univ. Florida, Gainesville, FL 32611

Riggs, R. D., M. L. Hamblen and L. Rakes. Race stability of greenhouse cultured populations of soybean cyst nematode. Soybean cyst nematode (SCN) in Arkansas was found to reproduce differentially on the soybean cv 'Pickett', greenouse cultures were started, one each on cv 'Lee' and Pickett. Upon differention, the race on cv Lee was identified as race 3 while the one on cv Pickett was race 4. These populations have been used for testing breeding lines and other investigations. Because much variability has been observed in some SCN populations, tests were initiated to check the stability of the populations being used for testing purposes. Eleven tests were run over a period of a year. The race 3 population was most stable with an average index (% of females on Lee) on Pickett of 1.7 and was lower on the other differentials. The indices on cv 'Bedford' was more variable (1.0-10.7). The race 4 population was less stable and the "Bedford race" was even more variable. These results emphasize the need for stabilization of a test population as much as possible. In addition the race differentials should be included in each test to make sure the population is still true to race. Department of Plant Pathology, University of Arkansas, Fayetteville, AR 72701.