ABSTRACTS OF THE XXXVIII ANNUAL MEETING OF ONTA
RESÚMENES DE LA XXXVIII REUNIÓN ANUAL DE ONTA
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ALTERNATIVAS AL BROMURO DE METILO EN COSTA RICA [ALTERNATIVES TO METHYL BROMIDE IN COSTA RICA]. S. Abarca. Coordinador Nacional Proyecto Alternativas al Bromuro de Metilo, Costa Rica. sabarca@nobromuro.org.—El Bromuro de Metilo (BrMe) es utilizado en Costa Rica principalmente por tres sectores productivos: tabaco, flores y melón, este último consume el 97%. A partir de los objetivos y plan de trabajo del Proyecto, se procedió a identificar alternativas químicas y no químicas. Preliminarmente, se consideraron como alternativas la solarización, otros fumigantes de suelo (Metam sodio, Telone, Iodometano), plásticos impermeables y controladores biológicos. Inicialmente se llegó a la determinación de que la combinación de estas alternativas ha presentado resultados significativos en el proceso de sustitución de BrMe; aunque la implementación de éstas requiere de un mayor tiempo de espera (previo al inicio de la siembra) respecto al Bromuro de Metilo. En el caso de los biocontroladores, el Proyecto los considera como una de las alternativas complementarias más prometedoras, por lo cual se ha concebido un modelo integral para implementarla en el campo. Para gestionarlo, se diseñaron, construyeron, equiparon y se pusieron en marcha laboratorios de producción de hongos entomo y fungipatógenos que operan como centros de producción a nivel de finca. De acuerdo con los resultados obtenidos en campo, ninguna de las alternativas validadas a la fecha es sustituta del BrMe por sí sola. No obstante, el uso combinado de estas, bajo condiciones particulares, puede generar un programa de manejo que sea técnica y económicamente viable. Entre las actividades futuras, se tiene programado evaluar otras alternativas (Dazitol y Iodometano), afinar en campo la validación de alternativas ya probadas, efectuar pruebas semi-comerciales con alternativas promisorias y en algunos casos realizar adopciones definitivas de tecnología en sustitución del BrMe.

NEMATODOS ENTOMOPATÓGENOS Y SU ROL EN EL CONTROL DEL GORGOJO DE LA PAPA Y OTRAS PLAGAS EN LA REGIÓN ANDINA [ROLE OF ENTOMOPATHOGENIC NEMATODES IN THE CONTROL OF *PREMNOTRYPES* SP. WEEVIL AND OTHER POTATO PESTS IN THE ANDEAN REGION]. J. Alcázar, J. Salazar, S. Parsha, P. Hernández, G. Main, J. Kroschel and H. Kaya. Centro Internacional de la Papa. Av. La Molina 1895, La Molina, Apartado 1558, Lima 12, Perú. J.alcazar@cgiar.org.—El Gorgojo de los Andes, *Premnotrypes* sp. es uno de los principales problemas entomológicos del cultivo de papa en los países de la Región Andina. El uso de insecticidas es el método más usado, por lo que es necesario la búsqueda de nuevas medidas de control. Se reporta el primer hallazgo de un nematodo entomopatógeno del genero *Heterorhabditis* parasitando larvas del Gorgojo de los Andes *Premnotrypes suturicallus* en el departamento de Junín a 2,750 m de altitud. Se realizaron estudios de patogenicidad y caracterización ecológica determinándose la DL_{50} en 6 IJ/larva, con un potencial de reproducción de 266,163 JI/g, otras plagas de papa como *Phthorimaea operculella* y *Symmetrischema tangolias* fueron muy susceptibles al nematodo y en un primer ensayo de campo se logro reducir los daños de los tubérculos en 81.5%. Para la búsqueda de nuevos aislamientos se analizaron 208 muestras de suelo colectados entre 76 y 4,096 m de altitud, hallándose otros aislamientos de *Heterorhabditis, Steinernema* y nematodos de las familias Mermithidae y Diplogasteridae. Actualmente se esta coordinando con los Programas Nacionales de Ecuador (INIAP) y Bolivia (PROINPA) la búsqueda de aislamientos nativos, habiéndose encontrado 11 de 357 muestras de suelo en Ecuador y 2 de 42 muestras en Bolivia pertenecientes a las familias Heterorhabditidae y Steinernematidae, con la finalidad de probar su efectividad contra el gorgojo de los Andes.

RELATION BETWEEN *RADOPHOLUS SIMILIS* (COBB) THORNE IN PRODUCTION SUCKERS AND YIELD DECLINE OF MOTHER PLANTS IN COMMERCIAL BANANA PLANTATIONS (*MUSA* AAA) OF COSTA RICA WITH DIFFERENT YIELD STRUCTURES [RELACIÓN ENTRE *RADOPHOLUS SIMILIS* (COBB) THORNE EN HIJOS DE SUCESIÓN Y LA PÉRDIDA DE PRODUCCIÓN DE BANANO DE PLANTAS MADRE (*MUSA* AAA) EN PLANTACIONES COMERCIALES DE COSTA RICA CON DIFERENTE VIGOR DE PRODUCCIÓN]. J. Alfonso Cabrera[1,5], L. E.

Pocasangre[1,2], F. Rosales[2], J. Najera[3], R. Vargas[4], E. Serrano[4] and R. A. Sikora[5]. [1]Centro Agronómico de Investigación y Enseñaza (CATIE), [2]Red Internacional para el Mejoramiento de Banano y Plátano (INIBAP-LAC), [3]Universidad de Costa Rica (UCR), [4]Corporación Bananera Nacional de Costa Rica (CORBANA), [5]Universidad de Bonn, Alemania. acabrera@catie.ac.cr.—Six commercial banana plantations with high, medium and poor banana yielding records in Costa Rica were investigated. Farms were located either west or east of Reventazon River. The main objective of the study was to investigate the relationship between *Radopholus similis* per 100 g of functional roots from production suckers (*Musa* AAA) and the number of hands from mother plants in poor, medium and high yielding sectors in each farm. The study revealed that on one farm with medium and two with high yielding record high *R. similis* (x) densities were significantly correlated to banana yield decline (y); Calinda farm $p = 0.03$, $r^2 = 36$, $y = (2.86812\text{-}0.000044499544*x)^2$, Cartagena farm $p = 0.05$, $r^2 = 32$, $y = 9.94676\text{-}0.00889193*\text{sqrt}(x)$ and Palo Verde farm $p = 0.04$, $r^2 = 34$, $y = 8.68382\text{-}0.00711635*\text{sqrt}(x)$. In farms Las Juntas, El Esfuerzo and San Pablo, two with low and one with medium yield structure respectively, no correlations were detected. However in these latter farms *R. similis* populations were above the threshhold level indicating an interaction with other factors positively affecting yield.

PARASITISMO Y PATOGENICIDAD DE LOS NEMATODOS DEL BANANO (*MUSA* AAA SUBGRUPO CAVENDISH CULTIVARES GRANDE NAINE, VALERY Y WILLIAMS) [PARASITISM AND PATHOGENICITY OF NEMATODES ATTACKING BANANAS (*MUSA* AAA SUBGROUP CAVENDISH CULTIVARS GRANDE NAINE, VALERY AND WILLIAMS)]. M. Araya. Corporación Bananera Nacional (CORBANA S.A.), Apdo. 390, 7210 Guápiles, Costa Rica. maaraya@corbana.co.cr.—En plantaciones comerciales de banano de Latinoamérica usualmente ocurren solo comunidades poliespecíficas de nematodos, consistiendo de una mezcla de los endoparásitos migratorios *Radopholus similis* y *Pratylenchus coffeae*, el ecto-endoparásito *Helicotylenchus multicinctus* y el endoparásito sedentario *Meloidogyne incognita* y raramente *M. javanica*. Los 3 cultivares comerciales Grande Naine, Valery y Williams, son igualmente (P = 0,8654) susceptibles a estos nematodos. El daño se localiza en las raíces y en el caso de *R. similis* también puede observarse en el cormo. Todos los estados fenológicos de la planta de banano pueden ser infectados por los 4 géneros, pero nuevamente *R. similis* es el más frecuente y abundante en cualquier estado de desarrollo de la planta. En muchas ocasiones no hay diferencias (P > 0,1271) en el número de nematodos entre diferentes alturas de planta; aún raíces de hijos muy pequeños (10 cm de altura) pueden resultar infectadas. En experimentos comparando las poblaciones de nematodos de plantas próximas a la cosecha, con las de su respectivo hijo de sucesión y nieto, no se encontraron diferencias (P > 0,1835). En pruebas con plantas de banano sembradas en recipientes de 200 L, *R. similis* redujo (P = 0,0001) el contenido de raíces en 3,6 kg (66%), mientras *P. coffeae*, *M. incognita* y *H. multicinctus* a pesar que suprimieron el peso de raíces en 0,58 (11%), 0,5 (9%) y 0,42 kg (8%), respectivamente, la diferencia no alcanzó a ser significativa. Además, en orden decreciente *M. incognita*, *R. similis* y *P. coffeae*, disminuyeron (P = 0,003) el peso del racimo en 7,5 (32%), 6,4 (27%) y 5,6 kg (24%), respectivamente. *Helicotylenchus multicinctus* lo redujo en 0,9 kg (4%) pero sin diferir del control. Dado que los cuatro géneros de nematodos afectan el cultivo, al momento de tomar decisiones sobre su manejo es prudente considerarlos a todos y no basarse en una especie en particular.

LA ROTACIÓN CON PIÑA, UNA ALTERNATIVA PARA LA REDUCCIÓN DE *RADOPHOLUS SIMILIS* EN ÁREAS DE BANANO [ROTATION WITH PINEAPPLE, AN ALTERNATIVE FOR *RADOPHOLUS SIMILIS* REDUCTION IN BANANA FIELDS]. M. Araya. Corporación Bananera Nacional (CORBANA S.A.). Apdo 390, 7210 Guápiles, Costa Rica. maaraya@corbana.co.cr.—En evaluaciones *in vitro* con extractos de raíces de piña (*Ananas comosus* MD-2) se observó un 100% de mortalidad de *R. similis* en menos de 24h (P < 0,0001). En invernadero se observó una reducción no significativa de la población de *R. similis* en los cvs Valery (P = 0,5468) y Grande Naine (P = 0,4716) al ser tratadas con extractos de raíces de piña. El índice reproductivo (P < 0,0001) de *R. similis* en piña siempre fue

cercano a 0, mientras en los cultivares Cavendish varió de 32 a 104. *Meloidogyne* spp., prácticamente no se detectó en raíces de piña, mientras en los Cavendish alcanzó hasta los 45.490 individuos por 100 g de raíces. Extracciones de nematodos realizadas de raíces de piña a los 9 y 12 meses de sembrada en un área que se reemplazó de banano y se dejó dos meses en libre barbecho mostraron una reducción del 95% en la población de *R. similis* en comparación con la población detectada en las raíces del banano antes de su reemplazo. Plantas de Grande Naine desarrolladas en suelo bananero que se cultivo por 12 y 20 meses con piña, mostraron a los 60 días, 787 y 59 *R. similis* por 100 g de raíces, respectivamente. Técnicamente, áreas de banano con altas infecciones de nematodos pueden rotarse con piña MD-2 como alternativa para reducir las poblaciones de *R. similis* y *M. incognita*. Sin embargo, a nivel local las modificaciones en la infraestructura de los sistemas de producción requieren un análisis económico que demuestre su factibilidad.

SUSTAINABLE AGRICULTURAL PRACTICES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES ON PUMPKIN [PRÁCTICAS DE AGRICULTURA SOSTENIBLE PARA EL MANEJO DE NEMATODOS FITOPARÁSITOS EN CALABAZA]. S. Y. R. Arroyo[1], J. A. Chavarría-Carvajal[1] and C. F. Ortega[2]. [1]Department of Crop Protection, Mayagüez Campus, University of Puerto Rico, Mayagüez, Puerto Rico 00681, [2]Department of Horticulture, Isabela Substation, Isabela, 00662 Puerto Rico. jchavarria@uprm.edu.—A field experiment was established at Isabela Substation to study the effects of sustainable agricultural practices on phytonematodes associated to pumpkin (*Cucurbita moschata*). A RCB design with four replicates and six treatments was used. Treatments studied were: T1. Rotation scheme of corn (*Zea mays* var. 'Mayorbela') + pumpkin; T2. Rotation scheme of velvetbean (*Mucuna deerengiana*) + pumpkin; T3: Pre-plant soil incorporation of poultry litter (7.3 kg/plant) + two cropping cycles of pumpkin; T4. Soil solarization (period of 120 days) + two cropping cycles of pumpkin; T5. Chemical Control (Nemacur 15G 3.0 g a.i./plant) + two cropping cycles of pumking; and T6. Absolute Control (two cropping cycles of pumpkin). Results showed significant differences (LSD $P \leq 0.05$) in population levels of nematodes associated with the treatments. The sustainable agricultural practices were very effective in reducing nematode populations present in soil and associated with the roots of the main crop; when compared with the chemical control. The use of poultry litter improved plant development and crop yield when compared with the absolute control. Soil solarization was the method most effective in reducing nematode populations in soil.

PROGRESS TOWARDS TRANSGENIC NEMATODE RESISTANT BANANA [PROGRESO HACIA LA OBTENCIÓN DE PLANTAS DE BANANO TRANSGÉNICAS CON RESISTENCIA A NEMATODOS]. H. J. Atkinson and C. J. Lilley. Centre for Plant Sciences, University of Leeds, Leeds LS2 9JT, UK. H.J.Atkinson@leeds.ac.uk.—Nematicides are often essential in commercial banana plantations but WWF is campaigning for their use to be reduced with support from the banana industry. FAO considers the environmental issues surrounding nematicides provide compelling reasons for adopting genetic transformation of banana, but the risk of consumer rejection of such products is a challenge for the industry. Transgenic expression of a cysteine proteinase inhibitor (cystatin) confers resistance to a wide range of nematodes. A resistance of 70 ± 10% against *Radopholus similis* was achieved in containment for Cavendish banana and cystatins are of value against *Meloidogyne incognita* and other nematodes. The approach is not genotype dependent and was effective in a small-scale transformation effort for East African Highland cooking banana. Other biopesticides such as our chemoreception-disruptive peptides that reduce nematode root invasion are available to enhance the level of resistance if required. No transgenic approach can progress unless fully biosafe. This requires a case-by-case study of the transgene taking into account the crop and where it is grown. Cystatins are not toxic or allergenic to humans at many times the levels required to control nematodes. Root-specific promoters help exclude even these safe biopesticides from banana fruit. Our work with nematode resistant potato plants established that cystatins are not harmful to non-target organisms in contrast to current nematicides. Our aim is a genetically modified banana crop with reduced envi-

ronmental impact compared to either continued nematicide use or certain other standard cropping practices. The issue of potential gene flow does not arise for commercial banana. It is a male sterile, vegetatively propagated plant cropped far from its center of biodiversity. Risk-free biotechnology could reduce the current ecological footprint of commercial banana plantations.

ALTERNATIVAS NO QUÍMICAS AL BROMURO DE METILO Y SUS IMPLICACIONES EN LA UE [NON-CHEMICAL ALTERNATIVES TO METHYL BROMIDE AND IMPLICATIONS FOR THE EUROPEAN COMMUNITY] A. Bello, M. A. Díez-Rojo and L. Roberson. Dpto Agroecología, Centro de Ciencias Medioambientales, CSIC. Serrano 115 dpdo. 28006 Madrid, Spain. antonio.bello@cc-ma.csic.es.—Se analiza el proceso para la búsqueda de alternativas al bromuro de metilo (BM) como fumigante de suelo en preplantación de cultivos, planteando la necesidad de desarrollar un nuevo modelo en protección vegetal. Para ello, se define la protección vegetal como una parte de la agronomía que permite mantener y recuperar la capacidad de autoregulación de los cultivos, revisando cada una de las alternativas no químicas propuestas por el MBTOC, dentro del contexto de la UE, y se plantea la necesidad de encontrar una alternativa que sea de fácil aplicación por técnicos y productores, además, socioeconómicamente viable y que permita armonizar los diferentes compromisos internacionales sobre el medio ambiente. Se llega a la conclusión de que la alternativa al BM se centra en el diseño de sistemas de producción integrada, para lo cual es necesario utilizar criterios ecológicos en la gestión de los cultivos, que estén basados en un mejor conocimiento de los elementos y procesos claves de la capacidad de autoregulación del cultivo dentro del agroecosistema. Por ello, se plantea como objetivo alcanzar la sostenibilidad de los agroecosistemas, a través de la dinamización del conocimiento, proponiéndose el desarrollo de una investigación participativa, que sepa armonizar el saber de técnicos y productores con el conocimiento científico, y que permita alcanzar un compromiso social para el desarrollo de un nuevo modelo en la gestión de los recursos naturales.

ESTRUCTURA TRÓFICA DE COMUNIDADES DE NEMATODOS EN CINCO SISTEMAS CON DIFERENTE MANEJO AGRONÓMICO, EN SAN RAMÓN DE ALAJUELA, COSTA RICA [TROPHIC NEMATODE COMMUNITY STRUCTURE IN FIVE SYSTEMS WITH DIFFERENT AGRICULTURAL MANAGEMENT, IN SAN RAMÓN DE ALAJUELA, COSTA RICA]. I. V. Benavides and A. Esquivel. Laboratorio de Nematología, Escuela de Ciencias Agrarias, Universidad Nacional. ingavb@hotmail.com.—Se estudiaron cinco sistemas: bosque, café orgánico, tomate orgánico, café convencional y tomate convencional, con el objetivo de caracterizar las comunidades de nematodos en relación a su composición taxonómica y diversidad trófica. Los nematodos se extrajeron de las muestras por medio del elutriador de Oostenbrink, contados y fijados en formalina caliente de acuerdo a protocolos establecidos. Se prepararon montajes en masa, con un promedio de 150 nematodos, que se identificaron a nivel de familia, asignándoles el grupo trófico respectivo. Se observó una tendencia a la disminución en el porcentaje de omnívoros y al aumento en el porcentaje de los bacteriófagos en los sistemas orgánicos y convencionales con respecto al bosque. En diversidad de grupos tróficos, los índices más altos correspondieron al café convencional, seguido por el bosque, el tomate orgánico, café orgánico y tomate convencional. El índice de equidad de grupos tróficos se comportó de la siguiente forma: café convencional > bosque > tomate orgánico > convencional > café orgánico. La relación micófagos/bacteriófagos, tuvo un valor más alto en el bosque, mientras que la relación (micófagos+bacteriófagos)/fitófagos fue mayor en los cultivos convencionales, y menor en bosque. Los cultivos orgánicos tuvieron valores intermedios. Aunque se menciona la utilidad de estas variables, en el presente estudio no fueron útiles para distinguir entre sistemas de cultivo.

COMUNIDADES DE NEMATODOS EN CINCO SISTEMAS CON DIFERENTE MANEJO AGRONÓMICO, EN SAN RAMÓN DE ALAJUELA, COSTA RICA [NEMATODE COMMUNITIES IN FIVE SYSTEMS WITH DIFFERENT AGRICULTURAL MANAGEMENT, SAN RAMÓN DE ALAJUELA, COSTA RICA]. I. V. Benavides and A. Esquivel. Laboratorio de Nematología, Escuela de

Ciencias Agrarias, Universidad Nacional, Costa Rica. ingavb@hotmail.com.—Se estudió la diversidad, abundancia y estructura de las comunidades de nematodos de cinco sistemas: bosque, café orgánico, tomate orgánico, café convencional y tomate convencional. Los nematodos fueron extraídos de las muestras, contados e identificados de acuerdo a protocolos establecidos. Se identificaron 2395 nematodos pertenecientes a 45 familias. La densidad de nematodos decreció en el siguiente orden: bosque > tomate orgánico > café orgánico > café convencional > tomate convencional. El índice de diversidad tuvo un comportamiento distinto, mayor en café convencional > bosque > tomate orgánico > café orgánico > tomate convencional. El índice de equidad fue más alto en bosque, seguido por los sistemas orgánicos y los sistemas de cultivo convencionales respectivamente. El cálculo del índice de madurez, el índice de madurez total y el índice de madurez 2-5, mostró diferencias en cada uno de los sistemas. Los sistemas manejados orgánicamente tuvieron valores más altos, que los respectivos cultivos convencionales. Los valores para el índice de fitoparásitos fueron ligeramente menores para los cultivos convencionales. La abundancia de algunas familias, se correlacionó positivamente con la humedad en el suelo y negativamente con la densidad aparente. Los resultados obtenidos muestran que la comunidad de nematodos fue diferente en sistemas con distinto manejo y el índice de madurez fue útil en diferenciar estados de madurez del suelo.

BIOLOGICAL NOTES AND PARASITIC HABITS OF THE PECAN ROOT-KNOT NEMATODE, *MELOIDOGYNE PARTITYLA* IN FLORIDA [NOTAS SOBRE LA BIOLOGÍA Y LOS HÁBITOS PARASÍTICOS DEL NEMATODO NODULADOR DE LA CASTAÑA *MELOIDOGYNE PARTITYLA* EN FLORIDA]. **J. A. Brito[1], R. Kaur[2], D. W. Dickson[2], J. R. Rich[3] and L. A. Halsey[4]. [1]Division of Plant Industry, Gainesville, FL 32614, [2]Entomology and Nematology Department, University of Florida, Gainesville, FL 32611, [3]University of Florida, Quincy, FL, 32351, and [4]Monticello, FL 32344, USA. britoj@doacs.state.fl.us.—**Pecan, *Carya illinoensis*, a member of the Juglandaceae, is native to the southern United States and is an important nut crop throughout much of the region. *Meloidogyne partityla* has been reported only in South Africa and the United States. The nematode causes severe damage to pecans in Texas, New Mexico, Georgia, Arizona and Oklahoma. Under orchard conditions, dead branches in the upper canopy of infected trees are reported. Recently, *M. partityla* was found infecting pecan seedlings in a nursery in Florida. Infected seedlings exhibited leaf yellowing, poor and stunted growth, which occurred in patchy distribution throughout the nursery. Large and small galls were observed in the main, secondary and feeder roots. Frequently, seedlings infected with *M. partityla* showed callus on the main roots. Several female nematodes and egg masses were found inside of a single callus as well as galls. The external egg masses were also present on the roots. Isozyme analysis of individual female nematodes, especially esterase (Mp3), provided fast and reliable diagnosis of the pecan root-knot nematode. Sanitation practices should be implemented to avoid the spread of this nematode within and between nursery stock producing sites and pecan orchards.

EVALUATION OF ROOT-KNOT NEMATODE RESISTANCE IN C*OFFEA ARABICA* WITH CYSTEINE AND SERINE PROTEINASE INHIBITORS [EVALUACIÓN DE LA RESISTENCIA DE *COFFEA ARABICA* AL NEMATODO AGALLADOR CON INHIBIDORES DE CISTEÍNA Y SERINA]. **R. Cabos[1], B. S. Sipes[1], C. Nagai[2], D. P. Schmitt[1] and H. J. Atkinson[3]. [1]Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa, Honolulu, HI, U.S.A., [2]Hawaii Agriculture Research Center, Aiea, HI, U.S.A., and [3]Centre for Plant Biochemistry and Biotechnology, University of Leeds, Leeds, UK. roxana@hawaii.edu.—***Meloidogyne konaensis*, the Kona Coffee Root-knot nematode, causes widespread decline on *Coffea arabica* cv. Typica 'Guatemala' grown on the Big Island of Hawaii. Somatic embryos and leaf discs of *C. arabica* were transformed with particle bombardment or *Agrobacterium tumefaciens* containing a modified cystatin gene from rice, OcI?D86, and a cowpea trypsin inhibitor. These genes, alone or in combination, have successfully reduced nematode populations in banana and potato. A laboratory bioassay was performed on 41 coffee lines made up of 91 plants that survived a 7-month selection period on 30 mg/L geneticin sulfate. Wild-type *C. ara-*

bica and coffee transformed without the resistance genes were used for controls. Depending upon their size at the time of inoculation, 4,000, 2,000, or 1,000 *M. konaensis* eggs were applied to each pot. The experiment was harvested 347 days later. The reproduction factor, final nematode population, and plant growth were compared between the transgenic and control plants. Twelve lines containing the cystatin gene had a >70% reduction in the *M. konaensis* population as compared to the wild-type. The introduction of nematode resistance genes in coffee can provide an effective measure of control against root-knot nematodes.

WATER VAPOR UTILIZATION FOR NEMATODE-INFESTED SOIL TREATMENT [UTILIZACIÓN DE VAPOR DE AGUA PARA TRATAR SUELOS INFESTADOS CON NEMATODOS]. S. A. Calzavara, J. M. dos Santos and L. Favoreto. CNPq-FAPESP, Faculdade de Ciências Agrárias e Veterinárias UNESP/FCAV, Brazil. seradca@bol.com.br.—The aim of this work was to use water vapor as a nematode-infested soil treatment. Vapor was produced by a 100% ecologic boiler (model CE 3000 manufactured by COPEC - Indústria e Comércio de Caldeiras). Concrete pipes (1.2 m diameter and 1.30 m depth) were filled with soil infested with nematodes and population estimated at three depths: 0.0-0.2 m, 0.2-0.4 m and 0.4-0.6 m with 1472, 1076 and 736 nematodes/100 g soil, respectively. Every treatment was replicated six times. Plant parasitic species identified were: *Pratylenchus jaehni*, *Tylenchulus semipenetrans*, *Aphelenchus* sp., *Aphelenchoides* sp., *Xiphinema* sp., *Mesocriconema* sp., and free-living nematodes. Metallic pipes connected to the boiler were buried at 0.8 m, equidistant 0.6 m, with holes each 0.1 m in order to assure uniform vapor distribution through the soil. Concrete pipes were covered with 120 µm plastic sheets to avoid vapor release to the atmosphere. Each concrete pipe had 30 minutes water vapor input at 170°C degrees and 8.2 kgf cm^{-2} pressure. The soil reached temperatures close to 100°C. Results showed total nematode elimination after soil vapor treatment in all evaluated depths.

RESISTENCIA DE PORTA-INJERTOS AL NEMATODO DE LAS LESIONES RADICULARES DE LOS CÍTRICOS (*PRATYLENCHUS JAEHNI*) [ROOTSTOCK RESISTANCE TO CITRUS LESION NEMATODE (*PRATYLENCHUS JAEHNI*)] S. A. Calzavara, J. M. Santos and L. Favoreto. Faculdade de Ciências Agrárias e Veterinárias, UNESP, CNPq-FAPESP. seradca@bol.com.br.—En Brasil, *Tylenchulus semipenetrans* y *Pratylenchus jaehni* son considerados nematodos importantes para en la producción de cítricos. Con el objetivo de estudiar la resistencia de porta-injertos al nematodo de las lesiones radiculares de los cítricos, fue realizado un estudio de cooperación entre FUNDECITRUS y UNESP/FCAV. Fueron usados seis porta-injertos: Limón Clavo (*C. limonia* Osbeck); Tangerina Cleópatra (*C. reshni* Hort. Tanaka); Citrumelo Swingle (*C. paradisi* × *Poncirus trifoliata*); Tangerina Sunki (*C. sunki* Hort. Tanaka); Trifoliata (*Poncirus trifoliata* (L.) Raf.) y Citrange Carrizo (*P. trifoliata* × *C. sinensis*). Plantas individuales fueron inoculadas con 3,000 nematodos, lo que constituyó la población inicial (PI). Fueron realizadas 10 repeticiones por porta-injerto, con una planta por maceta, mantenidas en invernadero por 220 días después de la inoculación. Al final de este período, la población de nematodos en el suelo y en las raíces de las plantas fue estimada considerando la población final (PF) y el factor de reproducción del nematodo (FR = PF/PI). Los valores de FR < 1 indican resistencia del porta-injerto al nematodo, mientras que los valores de FR > 1 indican susceptibilidad. El limón clavo presentó aumento de la población del nematodo en más de seis veces, en el período de estudio (FR > 1), por lo que es considerado susceptible. Los valores de FR para los otros porta-injertos fueran <1, indicando resistencia.

YOUNG CITRUS PLANTS PRELIMINARY EVALUATION (*CITRUS SINENSIS* OSBECK VR. PÊRA) INOCULATED WITH *PRATYLENCHUS JAEHNI* [EVALUACIÓN PRELIMINAR DE PLANTAS JÓVENES DE CÍTRICOS (*CITRUS SINENSIS* OSBECK VR. PÊRA) INOCULADAS CON *PRATYLENCHUS JAEHNI*]. S. A. Calzavara, J. M. dos Santos and L. Favoreto. CNPq-FAPESP, Produção Vegetal, Faculdade de Ciências Agrárias e Veterinárias UNESP/FCAV. seradca@bol.com.br.—This work aimed to evaluate under field conditions young "Pêra" citrus trees (*Citrus sinensis* Osbeck) grafted under Rangpur Lemon (*Citrus limonia* Osbeck). When the citrus plants were transplanted to concrete pipes (1.2 m

diameter 1.30m depth), each one constituting a micro-plot, 10 mL of *Pratylenchus jaenhi* suspension corresponding to 0; 10; 100; 1000; 10000 and 100000 nematodes/plant were inoculated in each micro-plot. Ten replications per treatment were used and arranged in a randomized block experimental design. The soil present in each concrete pipe was treated with boiled water. *P. jaehni* was reared *in vitro* on carrot discs as described by Moody *et al.* (1973), modified by Huettel (1985). Two preliminary evaluations were done measuring plant height and stem diameter at 30 and 60 days. Data were analyzed by Tukey test ($P \leq 0.05$). Results evidenced significant differences between highest nematode population inoculum level tested and the control, related to plant height in the first evaluation. However, this result was not confirmed in the second evaluation, but significant differences in stem diameter between the highest nematode population inoculum level and the second inoculum level were observed.

ESTUDIO DE CARACTERÍSTICAS FENOLÓGICAS DE *PSIDIUM FRIEDRICHSTHALIANUM* EN UN CAMPO INFESTADO CON *MELOIDOGYNE INCOGNITA* EN EL ESTADO ZULIA, VENEZUELA [STUDY OF PHENOLOGICAL CHARACTERISTICS OF *PSIDIUM FRIEDRICHSTHALIANUM* IN FIELDS INFESTED WITH *MELOIDOGYNE INCOGNITA* IN ZULIA STATE, VENEZUELA]. A. M. Casassa-Padrón[1], M. Marín[1], C. González-Palmar[2], C. González[3] and E. Pérez-Pérez[3]. [1]Universidad del Zulia, Facultad de Agronomía, Instituto de Investigaciones Agronómicas, Ciudad Universitaria, Núcleo Agropecuario, Av. 16 (Guajira), Maracaibo, ZU 4005, Venezuela, [2]Proyecto CONDES-LUZ No. CC-0802-01, No. CC-0194-03, No. 1736-98. FONACIT S1-2000000795, F-2001001117, S1-2808 y [3]Centro Frutícola del Zulia-CORPOZULIA, Municipio Mara, Zulia, Venezuela. casassae@cantv.net.— *Psidium friedrichsthalianum*, conocido como guayabo ácido o cas, es una especie reportada como resistente al nematodo agallador *Meloidogyne incognita*, por lo que su propagación asexual es de significativa importancia. Se estudió la fenología de dos selecciones de esta especie vegetal, creciendo en un campo infestado con el nematodo bajo condiciones del bosque seco tropical del Estado de Zulia. Se realizaron anualmente análisis nematológicos a muestras de suelo y raíces de los árboles desde 1990, y mensualmente durante los tres meses del estudio fenológico. Se seleccionó una rama de 25 cm por cuadrante/árbol para medir las variables: longitud de rama (LR) número de hojas (NH), número de yemas (NY), botón floral (BF), número de flores (NFL), número de frutos (NFR), caída de elementos (CE), semanalmente durante 12 semanas. Los resultados de la dinámica poblacional del nematodo indicaron que la población inicial de 64 J2/cm^3 de *M. incognita* disminuyó drásticamente a niveles no detectables. Las características fenológicas mostraron pequeños incrementos en las variables LR, NH y NY, sin embargo para las variables BF, NFL, NFR y CE no se detectaron cambios. Los resultados indican que *P. friedrichsthalianum* se puede recomendar como un promisorio portainjerto para guayabo en campos infestados con *M. incognita*.

***RADOPHOLUS SIMILIS* SPREADING BY WATER IN BANANA FIELDS GROWN ON HALLOYSITIC ULTISOLS IN MARTINIQUE [DISEMINACIÓN POR AGUA DE *RADOPHOLUS SIMILIS* EN PLANTACIONES DE BANANO EN ULTISOLES DE MARTINICA]. C. Chabrier, C. Desrosiers, C. Carles, P. Quénéhervé and Y. M. Cabidoche. CIRAD-PRAM, BP 214, 97285 Lamentin Cedex, Martinique, France. christian.chabrier@cirad.fr.—**In order to mitigate the damages caused by nematodes, especially the burrowing nematode *Radopholus similis*, different combinations of soil sanitation techniques (fallow and/or rotation crops) and use of nematode free plants (obtained by vitroculture) have been developed in the French West Indies. In less than a decade, these practices have reduced the nematicide applications by 63% without diminution of gross productivity. As a result, no nematicide is needed for 2 to 3 years after replanting. Therefore, basic knowledge on the *R. similis* infestation process is needed to increase this sanitation period. Previous studies show that water from rivers used for irrigation may contain numerous specimens of *R. similis*. Thus, we studied the dissemination ability of this nematode by water flow. At a metric scale, runoff spreading was studied using a 1m2 rain simulator; spreading by soil infiltration was studied in soil cylinders under different simulated rains. At a field scale, the recontamination of 1000 m^2 plots hydrologically isolated (or not) from a

highly contaminated area has been studied during a 3 year trial. Results show i) that run-off dispersion occurs mainly when soil surface is close to water-saturation; ii) that percolation is limited to the first 25 cm depth; iii) that at large scale, drainage pit of 0.6 m depth constitute an efficient barrier to delay the *R. similis* spreading within the field.

EFFECT OF ORGANIC AMENDMENTS ON NEMATODE POPULATIONS AND CROP YIELD OF PLANTAIN [EFECTO DE ENMIENDAS ORGÁNICAS SOBRE LAS POBLACIONES DE NEMATODOS Y LA PRODUCCIÓN DEL CULTIVO DEL PLÁTANO]. J. A. Chavarría-Carvajal[1], N. Vicente[1] and J. Ortiz[2]. [1]Department of Crop Protection, Mayagüez Campus, University of Puerto Rico, Mayagüez, Puerto Rico 00681, [2]Department of Agricultural Economics, Corozal Substation, Mayagüez Campus, University of Puerto Rico, Mayagüez, Puerto Rico 00681. jchavarria@uprm.edu.—Accumulation of solid wastes from human activities and agro-industries is a serious problem in Puerto Rico that represents an environment hazard and leads to significant pollution of soils, waterways, and lakes. The proper use and disposal of these materials in agricultural soils through application for management of phytonematodes could be very useful to find solutions to this problem. Research was conducted to determine the effects of poultry litter for the management of plant-parasitic nematodes on plantain (*Musa acuminata* × *M. balbisiana*). The amendment was applied to nematode-infested soil at rates ranging of 0, 7.3 and 14.5 kg/plant; also, a treatment with phenamiphos at 1.5 g a.i./plant was included to determine the effectiveness of the amendment. Results showed that poultry litter was effective in reducing final soil and root populations of *Radopholus similis*, *Meloidogyne incognita*, *Rotylenchulus reniformis* and *Helicotylenchus multcinctus* when compared with the chemical control. Also, the amendment improved plant development, root condition and crop yield (e.g., number of hands and fruits per bunch, and bunch weight). Poultry litter represents a suitable ecological alternative for nematode management and waste disposal in Puerto Rico.

ENDOPHYTE-ENHANCED TISSUE CULTURE BANANA IN EAST AFRICA: TOWARDS BIOLOGICAL MANAGEMENT OF THE BURROWING NEMATODE [PLANTAS DE CULTIVO DE TEJIDOS DE BANANO MEJORADAS CON ENDOFÍTICOS EN ÁFRICA DEL ESTE: HACIA UN MANEJO BIOLÓGICO DEL NEMATODO BARRENADOR]. D. Coyne[1], T. Dubois[1], S. Athman[1,2] and P. Paparu[1,2]. [1]International Institute of Tropical Agriculture (IITA), Namulonge, Kampala, Uganda and [2]Department of Microbiology and Plant Pathology, University of Pretoria, 0002 Pretoria, South Africa. d.coyne@iitaesarc.co.ug.—The burrowing nematode, *Radopholus similis*, is among the most damaging pests of banana (*Musa* spp.) worldwide. Crop losses due to nematode attack in banana under Ugandan conditions can surpass 50%. Such pests are mainly spread to new fields using infected planting material. The use of nematicides can maintain productivity in commercially managed banana plantations, but can also lead to problems. For resource-poor farmers nematicides are generally unfeasible. Propagation and distribution of pest-free banana planting material therefore, is a key component for managing nematode pests in East Africa. Tissue culture (TC) planting material is currently extensively used for establishing commercial plantations, and gradually increasing in importance in non-commercial settings in Africa. However, TC plants are also free of contamination by beneficials, such as naturally occurring endophytes, due to the sterile nature of the production system. Recent research at the International Institute of Tropical Agriculture (IITA) in Uganda has established that endophytic fungi can provide protection against nematodes. Incorporation of such biological control agents extend the benefits of clean planting material and potentially avoid nematicide use. At IITA, vast arrays of endophytic strains, of which the most frequently isolated belong to the genus *Fusarium*, have been isolated and screened in the laboratory. A handful of strains, exhibiting high pest antagonism, were further tested, with field studies currently underway. Upstream efforts have been focused on determination of modes of action. Apart from direct antibiosis and antixenosis, *Fusarium* spp. endophytes were found to induce systemic resistance. The potential benefits of using endophytes as biological control agents are many. Meanwhile studies are establishing the long-term benefits and field performance, while the

nature of resistance mechanisms is being closely studied. Public-private partnerships have also been established with producers in Uganda and Kenya to enable progress and uptake through the commercial sector, and bridge upstream research and downstream technology transfer.

***IN VITRO* SENSIBILITY OF *MELOIDOGYNE INCOGNITA* TO EXTRACTS FROM NATIVE PLANTS OF YUCATAN, MEXICO [SENSIBILIDAD *IN VITRO* DE *MELOIDOGYNE INCOGNITA* A EXTRACTOS DE PLANTAS NATIVAS DE YUCATÁN, MÉXICO] J. Cristóbal-Alejo[1], M. Gamboa-Angulo[2], N. Mendoza-Marbán[3], E. Herrera-Parra[1], J. Tun-Suárez[1], L. Medina-Baizabal[2] and P. Sima-Polanco[2]. [1]IT-Conkal, [2]CICY, [3]Universidad Autonoma, Chapingo, Mexico. jairoca54@hotmail.com.—**Screening of 56 plant extracts against second stage juveniles of *Meloidogyne incognita* was conducted. These extracts were obtained from leaves, stems, and roots of 20 native Yucatecan plants, of which thirteen species were characterized as endemic. These were *Acalypha gaumeri*, *Ageratum gaumeri*, *Caesalpinia yucatanensis*, *Calea urticifolia*, *Carlowrightia myriantha*, *Croton chichenensis*, *Eugenia yucatanensis*, *E. winzerlingii*, *Furcraea cahum*, *Stenandrium nanum*, *Trichilia minutiflora*, *Randia longiloba*, and *R. standleyana*. An *in vitro* nematicidal assay, carried out at 250, and 500 ppm showed that extracts from *C. urticifolia* leaves and roots, *E. winzerlingii* leaves, and *T. cinerea* stems were the most active against *M. incognita* to induce up to 65% mortality in nematodes. In a second assay, these plant extracts were evaluated at 0, 50, 100, 200, 300, 400, and 500 ppm to obtain the median effective dose. Results showed that *E. winzerlingii* leaf extracts induced at 300 ppm mortalities of 77%, and 84% in 48, and 72 h, respectively. The activity demonstrated by *E. winzerlingii* was good enough to propose the plant for further greenhouse and field studies to determine efficacy in soil.

NEMATODOS FITOPARÁSITOS ASOCIADOS AL AVE DE PARAISO (*STRELITZIA REGINAE* AITON.) [PLANT PARASITIC NEMATODES ASSOCIATED TO AVE DE PARAISO (*STRELITZIA REGINAE* AITON)]. J. Cristóbal-Alejo[1], G. Peraza-Canul[1], J. Tun-Suárez[1], V. Reyes-Oregel[1], A. Trejo-Rivero[1], N. Marbán-Mendoza[2] and E. Herrera-Parra[1]. [1]IT-Conkal y [2]Universidad Autonoma, Chapingo, Mexico. jairoca54@hotmail.com.—El ave de paraíso, junto con crisantemo, gerbera y anturio, son las principales ornamentales de la Península de Yucatán. A la fecha no se tienen estudios sobre la nematofauna presente en los cultivos tanto en invernadero como en campo. En plantaciones de ave de paraíso se observó clorosis, necrosis de raíz, disminución en producción de flor y muerte de plantas. El presente estudio consistió en realizar colectas de suelo y plantas con síntomas causados por nematodos. Muestras de 500 g de suelo se tomaron de la zona cercana a la raíz y se colocaron en bolsas. Los nematodos se extrajeron mediante el método de tamizado y centrifugado y las raíces se tiñeron con fucsina ácida. El principal nematodo asociado a este cultivo fue *Rotylenchulus reniformis*. Este hallazgo constituye el primer reporte de este nematodo atacando al ave de paraíso en la Península de Yucatán, México. Adicionalmente, se detectó la presencia de *Fusarium* spp. asociado al daño de este nematodo. Otros géneros identificados fueron *Helicotylenchus* sp. y *Tylenchorhynchus* sp. en poblaciones elevadas.

BIOLOGICAL CONTROL OF *BELONOLAIMUS LONGICAUDATUS* ON GOLF COURSE BERMUDAGRASS [CONTROL BIOLÓGICO DE *BELONOLAIMUS LONGICAUDATUS* EN CAMPOS DE GOLF CON PASTO BERMUDA]. W. T. Crow. University of Florida, Gainesville, FL 32611, USA. wtcr@ufl.edu.—The cancellation of the organophosphate nematicide fenamiphos has brought a critical need for alternative nematode management strategies for use on turfgrasses. Several biological control strategies are being evaluated for use against *Belonolaimus longicaudatus* on golf courses in Florida, USA. Among the strategies being investigated are entomopathogenic nematodes (*Heterorhabditis* spp. and *Steinernema* spp.), the nematode-egg parasitic fungus *Paecilomyces lilicanus*, and the bacterium *Bacillus firmus* which produces nematicidal metabolites. Results from greenhouse and field trials with these organisms will be presented. Applications of *B. firmus* were successful in reducing numbers of *B. longicaudatus* ($P \leq 0.05$) compared to untreated controls in both greenhouse and golf course putting green tests.

RESPONSE OF SOME LEGUMES TO A VENEZUELAN POPULATION OF ROOT KNOT NEMATODE *MELOIDOGYNE MAYAGUENSIS* [RESPUESTA DE ALGUNAS LEGUMINOSAS A UNA POBLACIÓN VENEZOLANA DEL NEMATODO AGALLADOR *MELOIDOGYNE MAYAGUENSIS*]. **R. Crozzoli[1], G. Perichi[1], D. Pérez[2] and M. Espinoza[2]. [1]Universidad Central de Venezuela, Facultad de Agronomía, Instituto de Zoología Agrícola, Laboratorio de Nematología Agrícola. Apdo. 4579, Maracay, Edo. Aragua, Venezuela and [2]Instituto de Investigaciones Agrícolas, Banco de Germoplasma INIA-CENIAP. Maracay, Edo. Aragua, Venezuela. rencro@telcel.net.ve.—**The reaction of lines and cultivars of common bean (*Phaseolus vulgaris*), cowpea (*Vigna unguiculata*), mung bean (*Phaseolus aureus* syn. *Vigna radiata* var *radiata*), lima bean (*Phaseolus lunatus*) and jack bean (*Canavalia ensiformis*) to Venezuelan population of *Meloidogyne mayaguensis* were evaluated in a greenhouse. Six seeds of each line or cultivar of the evaluated legumes were sown in plastic pots containing 350 cm^3 of a sterilized sandy soil. Seven days later they were inoculated with 10 eggs/cm^3 soil. Forty days after inoculation, the plants were uprooted and the roots washed to remove adhering soil. Then the gall and egg mass indexes of the root system were assessed according to a 0-5 scale proposed by Taylor and Sasser (1978). Line and cultivars were considered resistant when the average gall and/or egg mass index was ≤ 2. Only the cv MGM-10-02-35 of *P. vulgaris* was resistant to the population of *M. mayaguensis* tested. The remaining lines or cultivars were susceptible to this root knot nematode. The most susceptible species were *P. lunatus*, *P. aureus* and *C. ensiformis*.

DETERMINACIÓN EN CAMPO DE RESPUESTAS FISIOLÓGICAS RELACIONADAS CON FOTOSÍNTESIS Y CRECIMIENTO, EN VIDES ADULTAS VAR. CHARDONNAY, A NEMÁTODOS DEL GÉNERO *MELOIDOGYNE* [ASSESSMENT OF SOME PHYSIOLOGICAL PARAMETERS RELATED TO PHOTOSYNTHESIS AND GROWTH ON ADULT GRAPES VAR. CHARDONNAY TO NEMATODES OF THE GENUS *MELOIDOGYNE*]. **M. Escobar, E. Aballay and C. Pastenes. Laboratorio de Nematología, Departamento de Sanidad Vegetal, Facultad de Ciencias Agronómicas, Universidad de Chile, Av. Santa Rosa 11.315, La Pintana-Santiago, Chile. eaballay@uchile.cl.—**La incidencia de *Meloidogyne* spp. provocando importantes pérdidas económicas en el viñedo chileno ha llevado a frecuentes aplicaciones de agroquímicos de alta toxicidad. Debido a las nuevas tendencias que procuran reducir éstas aplicaciones, en un ensayo de campo, con distintos niveles de población de nematodos del género *Meloidogyne,* con dominancia de *M. incognita*, *M. javanica* y otra especie no identificada, separadas en 10 tratamientos, con poblaciones entre los 0 y 2000 juveniles/250 cc de suelo, se evaluó la variación de 6 parámetros fisiológicos asociados a la fotosíntesis, con el propósito de utilizarlos como indicadores de la oportunidad de aplicación de medidas de manejo. Ellos son asimilación de CO_2, concentración interna de CO_2, conductancia estomática, transpiración, temperatura foliar, y clorofila total. Aunque se encontró algunas diferencias significativas entre los tratamientos, para los parámetros fisiológicos evaluados, no hubo una tendencia clara que permitiera establecer un umbral de daño para las poblaciones de nematodos presentes. Los resultados posiblemente obedecen a la influencia de parámetros climáticos, de suelo o de manejo, que probablemente juegan un papel relevante.

NEMATODE FAUNA IN COSTA RICA: DIVERSITY AND PATTERNS [NEMATOFAUNA EN COSTA RICA: DIVERSIDAD Y PATRONES]. **A. Esquivel[1], H. Arias[2] and R. Gómez[2]. [1]Laboratorio de Nematología, Escuela de Ciencias Agrarias, Universidad Nacional and [2]Instituto Nacional de Biodiversidad, Costa Rica. aesquive@una.ac.cr.—**Nematode diversity in Costa Rica was studied intensely between 1998 -2002 by a project financed by the Dutch government. Five of the most diverse conservation areas in Costa Rica were selected and hundreds of samples were collected for nematode analysis. Two independent preparation methods, Cobb slides and mass slides, were compared for their ability to characterize nematode communities. Soil horizon, altitude, vegetation type, thermic and humidity province, and chemical and physical properties of soil were analyzed as variables associated with nematode communities. The inventory yielded more than 20,000 specimens, where new genera

and species have been described. More genera were detected in soil than other substrates because of more intensive sampling. However, substrates such as bromeliads and mosses were biologically diverse, yielding 72 and 71 genera, respectively. The relationship between environmental parameters and nematode communities was analyzed statistically using General Linear Models (GLM). Nematode abundance increased with altitude ($P < 0.0001$), percentage of organic matter ($P < 0.0001$) and number of dry-season months ($P = 0.0466$). Richness showed a contrasting pattern, decreasing negatively with altitude ($P = 0.0300$) and not affected by organic matter content of soil, humidity or dry season. None of the parameters measured affected maturity index values of nematode communities. More knowledge is necessary to clarify how biotic and abiotic factor influence nematode communities in the tropics.

PHYTONEMATODES EXTRACTED FROM WASTE MATERIAL OF THE SEED PROCESSING AND THE SEEDS OF *BRACHIARIA BRIZANTHA* [NEMATODOS FITOPARÁSITOS EXTRAÍDOS DE MATERIAL DE DESECHO DEL PROCESAMIENTO DE SEMILLAS Y DE LAS SEMILLAS DE *BRACHIARIA BRIZANTHA*]. L. Favoreto, J. M. Santos and S. A. Calzavara. Departamento de Fitossanidade, UNESP/FCAV, Jaboticabal, SP, Brazil. lucianyfavoreto@hotmail.com.—The possibility of nematode dispersion through seed of forage grass has serious implications in the commercialization of those products. The present research was carried out with the objective of identifying and quantifying the phytonematodes in the waste material from the seed processing and in seeds of *Brachiaria brizantha*. Twelve lots of seeds were processed in the forage seed processing plant of the Comércio e Indústria Matsuda Imp. Exp. Ltda. in the County of Álvares Machado SP. Samples of crude seeds from the waste material from each of the nine steps of seed processing and from the processed seeds were collected for analysis. The analyses were performed at the Nematology Laboratory of the Department of Plant Health of the UNESP/FCAV, in subsamples of 10 g of each material. Samples were processed using the trituration in blender method, combined with the centrifugal flotation in sucrose solution. *Aphelenchoides* spp. and *Ditylenchus* spp. were found in all the examined materials. The largest numbers of those nematodes were recovered in the residue of the first table densimeter and in the residue aspirated in front of the second group of sieves. The lowest numbers of nematodes were obtained from the residue of the second table densimeter. The percentages of *Ditylenchus* spp. in larger plant residues removed at the first step of the seed processing were higher than those of *Aphelenchoides* spp. However, at the end of the seed processing, larger numbers of *Aphelenchoides* spp. than *Ditylenchus* spp. were found. Therefore, the seed processing method used removes more *Ditylenchus* than *Aphelenchoides*.

NEMATOLOGICAL ANALYSIS, GERMINATION AND TETRAZOLIUM TESTS IN IRRADIATED GRASS SEEDS [ANÁLISIS NEMATOLÓGICO Y PRUEBAS DE TETRAZOLIO Y GERMINACIÓN EN SEMILLAS DE PASTO IRRADIADAS]. L. Favoreto, J. M. Santos, S. A. Calzavara and J. M. M. Walder. Departamento de Fitossanidade, UNESP/FCAV, Jaboticabal, SP (Brazil). lucianyfavoreto@hotmail.com.—Irradiation can destroy bacteria, fungus and other microorganisms. The ripening lateness and the reduction of disease transmission using this technique are examples of its utility. Low doses of irradiation in seeds can produce plants with stronger roots and, thus more resistant. With the objective of removing nematodes from *Brachiaria brizantha* and *Panicum maximum* seeds provided by Matsuda LTDA (Seed Industry and Commerce Company) an experiment was carried out. Seeds were put in regular paper bags and irradiated with different gamma-ray (0; 500; 1000; 1500 and 2000 Gy) from ^{60}Co source at CENA (Agricultural Nuclear Energy Center), Piracicaba, SP Brazil. The dose rate was 186.8 Gy/h. Four replications per treatment were used each with 160 g of seeds. After that, nematode analysis, tetrazolium test and seedling were done. Results showed that 1000, 1500 and 2000 Gy rates interfere negatively on *Brachiaria brizantha* seedling. The tetrazolium test on *Panicum maximum* and *Brachiaria brizantha*, as well as seedling test on *Panicum maximum* and nematodes analysis did not present significant differences.

DETECTION OF IN-PLANT SUPPRESSIVENESS TO *RADOPHOLUS SIMILIS* IN SUCKERS FROM BANANA PLANTS PROTECTED WITH MUTUALISTIC FUNGAL ENDOPHYTES [DETECCIÓN DE SUPRESIVIDAD EN HIJOS DE PLANTAS DE BANANO A *RADOPHOLUS SIMILIS* PROTEGIDOS CON HONGOS MUTUALISTAS ENDOFÍTOS]. A. Z. Felde[1], L. E. Pocasangre[2] and R. A. Sikora[1]. [1]University of Bonn, Institute of Crop Science and Resource Conservation (INRES), Department of Plant Pathology, Nematology in Soil Ecosystems Research Unit, Nussallee 9, D-53115 Bonn, [2]INIBAP-Latin America and Caribbean Office, INIBAP c/o CATIE, 7170 Turrialba, Costa Rica. zumfelde@uni-bonn.de.—Control of the plant parasitic nematodes in banana, especially *Radopholus similis* (Cobb) Thorne, has proved difficult with applications of commercially available chemical nematicides resulting in short-term control. A major drawback of treating soils with biological control agents is the sheer quantity needed for successful control. To avoid this problem, we have concentrated on protecting plants with mutualistic fungal endophytes. Specifically, we have isolated and screened fungi from healthy banana roots from areas where *R. similis*-suppression is either suspected or proven. Four fungal endophytes, two *Trichoderma atroviride* (MT-20 and S2) and two non-pathogenic *Fusarium oxysporum* (S9 and P12) isolates effectively controlled *R. similis* in greenhouse experiments. They were chosen for a field experiment on commercial banana plantations in Costa Rica, using the 'Valery' (*Musa* AAA) cultivar. To test the hypothesis that control conferred onto banana plants by endophytes is transferred from mother to daughter plants, suckers of field plants were removed and planted in a greenhouse. Once shoots had emerged, plants were inoculated with 1000 *R. similis*. Nematodes were extracted and counted 9 weeks after inoculation. Plants from areas where endophytes protected mother plants from *R. similis* in the field presented lower *R. similis* densities in the root system. This indicates that the protection from *R. similis* conferred onto mother plants by a single preplanting inoculation of endophytes, once established in the field, is transferred onto suckers.

IMPORTANCE OF SPECIES AND ISOLATES OF MUTUALISTIC ENDOPHYTES IN PROMOTING SYSTEMIC INDUCED RESISTANCE IN BANANA—ONE MODE OF ACTION INVOLVED IN BIOCONTROL OF *RADOPHOLUS SIMILIS* [IMPORTANCIA DE ESPECIES Y AISLAMIENTO DE ENDÓFITOS MUTUALISTAS PARA PROMOVER LA RESISTENCIA SISTÉMICA INDUCIDA EN BANANO—MODO DE ACCIÓN EN EL BIOCONTROL DE *RADOPHOLUS SIMILIS*]. A. Z. Felde[1], L. E. Pocasangre[2] and R. A. Sikora[1]. [1]University of Bonn, Institute of Crop Science and Resource Conservation (INRES), Department of Plant Pathology, Nematology in Soil Ecosystems Research Unit, Nussallee 9, D-53115 Bonn and [2]INIBAP-Latin America and Caribbean Office, INIBAP c/o CATIE, 7170 Turrialba, Costa Rica. zumfelde@uni-bonn.de.—The majority of fungal endophytes encountered in banana roots and subsequently screened for antagonism against the burrowing nematode *Radopholus similis* were *Fusarium* and *Trichoderma* spp. Based on screening and greenhouse tests, four endophytes with the greatest antagonistic activity against *R. similis*, identified as non-pathogenic *Fusarium oxysporum* (S9 and P12) and *Trichoderma atroviride* (MT-20 and S2) isolates, were selected for the present study. The objective was to verify whether induction of resistance to nematode penetration is involved in the antagonistic relationship observed between fungi and nematode. Eight-week hardened micro-propagated 'Valery' (*Musa* AAA) plantlets were set-up in a modified split-root system. Roots were divided into two sets, slipped through holes in the bottom of a 500-ml planting pot and lowered into two 500-ml pots, placed side-by-side. One set was inoculated with 5 mL spore suspension (1×10^7 cfu/ml), before filling pots with substrate. Control plants were given 5 ml water. The other pot was filled with substrate and, two weeks after planting, inoculated with 1000 *R. similis*. Plants were harvested 10 days after nematode inoculation, roots and shoots weighed, and nematodes extracted and counted. The *T. atroviride* isolate S2 was observed to significantly reduce nematode penetration, the *F. oxysporum* isolate P12 reduced penetration somewhat, while no difference was observed between penetration rates in plants inoculated with isolate MT-20 or S9 and non-inoculated control plants. This indicates that modes of action of the four isolates differ, not only between genera, but also between isolates of the same species. Additional modes of action are currently being investigated.

PRACTICAS DE MANEJO DE NEMATODOS EN FINCAS DE LA AGRICULTURA URBANA DE CUBA [NEMATODE MANAGEMENT PRACTICES IN URBAN AGRICULTURE FARMS IN CUBA]. E. Fernández[1], L. Vázquez[1], J. Lauzardo[2], J. M. Draguiche[3] and M. Méndez[4]. [1]Instituto de Investigaciones de Sanidad Vegetal, [2]Delegación de la Agricultura, Ciudad Habana, [3]Laboratorios Provinciales de Sanidad Vegetal Villa Clara y, [4]Holguin, Cuba. efernandez@inisav.cu.—Los problemas fitosanitarios de la agricultura urbana se encuentran asociados a la presencia de varias plagas, que se presentan en diferentes sistemas de cultivos. En particular los nematodos, están representados por varias especies, donde *Meloidogyne incognita* ocupa el rol principal. Los trabajos realizados con esta especie, durante más de 10 años, han permitido atenuar sus daños sin necesidad de emplear nematicidas químicos. Se determinó que *M. incognita* puede presentarse en el 100% de los ecosistemas urbanos así como en las parcelas o campos cercanos a la agricultura rural perteneciente al sistema periurbano. Su importancia ha aumentado en la mayoría de los lugares evaluados durante los últimos cinco años, a pesar de no manifestarse en la percepción de los agricultores. Se han validado e implementado un número apreciable de alternativas como la preparación del suelo, biofumigación, solarización del suelo, variedades o cultivos resistentes y/o tolerantes, rotación de cultivos y el empleo de especies de *Trichoderma* así como cultivos trampas, uso de *Tagetes*, agua caliente (en tubérculos) y *Bacillus thuringiensis* (cepa LBT-3). La efectividad y factibilidad de estas alternativas se valoró en talleres participativos con los técnicos y productores de la agricultura urbana.

ON-LINE CROP AND COVER CROP SELECTION TOOLS FOR CROPPING SEQUENCE DESIGN IN NEMATODE MANAGEMENT [HERRAMIENTAS EN LíNEA PARA LA SELECCION DE CULTIVOS Y CULTIVOS DE COBERTURA PARA EL DISEÑO DE SECUENCIAS DE CULTIVO PARA EL MANEJO DE NEMATODOS]. H. Ferris. Department of Nematology, University of California, Davis, CA 95616, USA. hferris@ucdavis.edu.—Crop rotation and cover crops are useful in nematode management. Plants resistant to one nematode species may increase another. Databases of plant host status to nematodes may not provide sufficient flexibility for crop selection. In a database of over 14,000 plant genotypes, the host status of plants to many nematode species is not available. I assigned plants into categories for each of 650 nematode species: susceptible (5), moderately susceptible (4), moderately resistant (3), resistant (2), non-hosts (1), or unknown (2 or 5). A risk-tolerant user may rate unknowns as probably resistant (2); one who is risk averse may rate them as probably susceptible (5). Many reports of resistance or susceptibility of cultivars to single nematode species provide no indication of host status to other nematodes to which the plant is usually a host. Where data are not reported for a cultivar, I assumed the host status profile of related genotypes. Users of the crop selector can indicate which species are present in the field and the relative importance of those species in relation to future crop sequences. Plants are ranked in ascending order of the product of perceived importance and host status. Two spreadsheets; one for all plant species and the other for potential cover crops, are available for testing crop sequence scenarios on the Nemaplex web site http://plpnemweb.ucdavis.edu/nemaplex.

FOODWEB SERVICES AND DISSERVICES: DOES BOTTOM UP REGULATE TOP DOWN? [SERVICIOS Y PERJUICIOS DE LA RED ALIMENTARIA: CUÁL ES LA DIRECCIÓN DE LA REGULACIÓN?] H. Ferris and S. Sánchez-Moreno. Department of Nematology, University of California, Davis, CA 95616, USA. hferris@ucdavis.edu.—In the soil food web, resources produced by autotrophs pass through channels mediated by herbivores, bacterivores and fungivores. Flow through the herbivore channel is controlled by consumer abundance and moderated by plant defenses. The bacterivore and fungivore channels are bottom-up controlled by plant resources. Carbon flow in all channels is potentially regulated by generalist predators whose abundance is resource-dependent and which are sensitive to environmental conditions. Resources are exploited by a diversity of functional guilds which are, in turn, exploited by their predators in an equilibrium of bottom-up and top-down forces. The potential exists for an auto-regulatory process; diverse communities create diverse resources that maintain diverse communities. But, field observations indicate that the two regulatory

forces are asynchronous and do not equally affect all trophic or functional groups; that is, the equilibrium between the forces is in dynamic flux. In agricultural fields, where bottom-up resources are abundant, soil microbial biomass is often many times greater than that of all microbial-feeding organisms and higher-level predators are almost absent; other regulatory forces, such as slower rates of increase, inter-guild competition, environmental quality, or recovery from recent disturbance, may be affecting microbial feeder abundance. Under natural conditions, generalist predator guilds are often abundant and may impose top-down pressure on microbial- and plant-feeding nematodes while bottom-up resources may be limiting.

EFECTO DE *FUSARIUM OXYSPORUM* F SP. *ASPARAGI* EN LA INFECTIVIDAD Y REPRODUCCIÓN DE *HETERORHABDITIS* SP. CEPA CABORCA (NEMATODA: HETERORHABDITIDAE) [EFFECT OF *FUSARIUM OXYSPORUM* F SP. ASPARAGI ON THE INFECTION AND REPRODUCTION OF THE ENTOMOPATHOGENIC NEMATODE *HETERORHABDITIS* SP. CABORCA STRAIN (NEMATODA: HETERORHABDITIDAE)]. Y. Flores-Lara[1,2], B. Rivera-Orduño[1] and S. P. Stock[2]. [1]Universidad de Sonora, Unidad Caborca, Sonora, Mexico, [2]Department of Entomology, University of Arizona, Tucson, AZ 85721, USA. yolanda@ag.arizona.edu.—El Estado de Sonora, México, tiene el 85% del área total establecida con espárrago (*Asparagus officinalis* L). El hongo *Fusarium oxysporum* y la cicada *Diceroprocta ornea* limitan la productividad y el tiempo de vida productiva del cultivo. *Fusarium oxysporum* causa la pudrición de la raíz y marchitez de la plántula. Penetra el tejido por las raíces a través de heridas causadas por implementos agrícolas o por insectos. *Diceroprocta ornea* se alimenta a nivel de la corona de la planta. El nematodo entomopatógeno *Heterorhabditis* sp. (Rhabditida: Heterorhabditidae) fue aislado del suelo y de cicadas provenientes de campos de espárrago de la región. En estudios regionales anteriores un 70% de las cicadas colectadas estaban infestadas con *Fusarium* spp. Se infiere que la presencia de *F. oxysporum* afecta la infectividad y propagación del nematodo *Heterorhabditis* sp."cepa Caborca" bajo condiciones naturales. Varias pruebas de laboratorio fueron diseñadas para evaluar la interacción entre estos dos organismos y comprobar si el hongo *Fusarium* interfiere en la capacidad infectiva y diseminación del nematodo *Heterorhabditis* sp.

BIOMANAGEMENT OF *NACOBBUS ABERRANS* WITH *POCHONIA CHLAMYDOSPORIA* UNDER FIELD CONDITIONS [BIOMANEJO DE *NACOBBUS ABERRANS* CON *POCHONIA CHLAMYDOSPORIA* BAJO CONDICIONES DE CAMPO]. F. Franco-Navarro[1], I. Pérez-Rodríguez[1] and D. Godinez-Vidal[2]. [1]Phytopathology Program-Colegio de Postgraduados, Montecillo 56230, Mexico State, Mexico, [2]Agronomy-Biological Sciences and Health Division, UAM-Xochimilco 04960, Mexico D.F., Mexico. ffranco@colpos.mx.—A trial to evaluate the efficacy of a Mexican isolate of *P. chlamydosporia* on *N. aberrans* population, in conjunction with rotation using a non-host crop, was established in a field with drip irrigation system and naturally infested by the nematode from March to November 2005. One application of the fungus (5000 chlamydospores/g soil + vermicompost at 10 ton/ha) was done one week before planting for each crop tested: cabbage (non-host) and chili (host). Population dynamic of the fungus (CFU/g of soil and roots) and the nematode (nematodes 200/g of soil, juveniles and mature females/g of roots), were achieved monthly; gall numbers in chili plants and egg parasitism were also assessed. During cabbage cycle, nematodes were not found, but the fungus reached high numbers of CFU in soil and roots at the final crop cycle (51,833 and 15,167, respectively). Before planting chili, the number of CFU/g of soil was 13,833, and 45,500 CFU 90 days after planting (dap). Nematodes and gall numbers/g of root were lower at 90 dap where fungus was applied in comparison with the absolute and chemical controls. During the chili crop, egg parasitism at 60 and 90 dap were 37% and 58%, respectively.

OCCURRENCE OF *PASTEURIA* ON SOIL NEMATODES IN A BIOSPHERE RESERVE IN MEXICO [HALLAZGO DE *PASTEURIA* EN NEMATODOS EDÁFICOS EN UNA RESERVA DE LA BIÓSFERA EN MÉXICO]. F. Franco-Navarro[1] and D. Godinez-Vidal[2]. [1]Phytopathology Program-Colegio

de Postgraduados, Montecillo 56230, Mexico State, Mexico, [2]Agronomy-Biological Sciences and Health Division, UAM-Xochimilco 04960, Mexico D.F., Mexico. vdamaris@colpos.mx.—Inside the Biosphere Reserve "Los Tuxtlas", in the southeast of Mexico, three localities and five land uses with different degree of disturbance were selected and eight sampling points were located in each one; one soil compound sample was taken from each point. Nematodes were extracted from 300 g of soil per sample by sieving and centrifugation-sugar flotation method. The extracted nematodes were killed, fixed and dehydrated; from each sampling point, one hundred nematodes were randomly picked and mounted to identify them to genus level and detect the occurrence of *Pasteuria* on them; bacterial spores were measured with light microscopy at 1000×. According to some reviews, this finding would be the first report of *Pasteuria* from Mexico, a new geographic record for this endospore-forming bacterium. *Pasteuria* spores infecting nematodes were observed in two of three localities (San Fernando and Venustiano Carranza), and in eight of 120 sampling sites (two from secondary forest, two from maize fields, one from white lily and three from pasture fields). A total of 1189 nematodes belonging to six genera were detected with *Pasteuria: Helicotylenchus* (1116), *Pratylenchus* (44), *Criconemella* (9), *Tylenchus* (10), *Plectus* (6) and *Aporcelaimium* (4).

NEW ISOLATES OF THE NEMATOPHAGOUS FUNGUS, *POCHONIA CHLAMYDOSPORIA*, FROM MEXICO [NUEVOS AISLAMIENTOS DEL HONGO NEMATÓFAGO, *POCHONIA CHLAMYDOSPORIA*, DE MÉXICO]. F. Franco-Navarro[1], J. Miranda-Damián[2] and D. Godinez-Vidal[3]. [1]Phytopathology Program-Colegio de Postgraduados, Montecillo 56230, Mexico State, Mexico, [2]FESC-UNAM, Cuautitlan Izcalli, Mexico State, Mexico, [3]Agronomy-Biological Sciences and Health Division, UAM-Xochimilco 04960, Mexico D.F., Mexico. ffranco@colpos.mx.—One hundred six soil samples from three localities inside the Biosphere Reserve "Los Tuxtlas", Ver., Mexico, were examined for the presence of native isolates of *P. chlamydosporia*. Samples were collected from sites with different land uses (natural forest, secondary forest, pasture fields and maize fields) and were processed using semi-selective medium to isolate the fungus. Thirty five soil samples were positive for *P. chlamydosporia*; twenty five of them belong to *P. chlamydosporia* var. *chlamydosporia* and ten to *P. chlamydosporia* var. *catenulata*. Six isolates were from pasture fields, four from maize fields, thirteen from secondary forest and twelve from natural forest soil samples. Isolates have been preserved through ultrafreezing at -80°C and parasitism tests against eggs of *Nacobbus aberrans* and root colonization tests have been conducted. There were highly significant differences in percentage of egg parasitism among isolates (Tukey $\alpha = 0.01$). Eleven isolates showed egg parasitism higher than 80% (80.6-93.6), thirteen between 70-80% (70.6-80.0), and eleven lower than 70% (50.2-69.4). Root colonization ranged from 75 to 100%: 13 isolates colonized 100% of roots, 14 colonized 90-99%, five colonized 80-89% and three colonized only 75%. This is the first evidence of *P. chlamydosporia*. var. *catenulata* in Mexican soils.

SOIL NEMATODE COMMUNITY UNDER FOUR LAND USE INTENSITIES IN THE MEXICAN TROPIC [COMUNIDAD DE NEMATODOS EDÁFICOS BAJO CUATRO INTENSIDADES DE USO DE SUELO EN EL TRÓPICO MEXICANO]. F. Franco-Navarro[1] and D. Godinez-Vidal[2]. [1]Phytopathology Program-Colegio de Postgraduados, Montecillo 56230, Mexico State, Mexico, and [2]Agronomy-Biological Sciences and Health Division, UAM-Xochimilco 04960, Mexico D.F., Mexico. ffranco@colpos.mx.—This study was conducted inside the Biosphere Reserve "Los Tuxtlas", Mexico, to determinate the effect of different land use intensities on the nematode community structure in soil. Three localities within the Reserve were chosen as replicates and from each of them, different fields belonging to four land use intensities (natural forest, secondary forest, pasture fields and maize fields) were selected. Ecological measures of soil nematode community structure, diversity, and maturity indices were assessed and compared among land uses. Fifty three families and 124 genera were identified; dominant families were Criconematidae, Hoplolaimidae, Cephalobidae and Tylenchidae, whereas the most abundant genera were *Helicotylenchus*, *Discocriconemella*, *Tylenchus* and *Acro-*

beloides. The highest nematode abundance in 300 mL of soil, richness of genera and diversity (Simpson's Index) corresponded to natural forest soil (1144, 26 and 0.86, respectively), closely followed by secondary forest soil. Intensive agricultural systems like maize fields and pasture fields presented low richness of genera and significant lower diversity than non-disturbed systems. Some disturbance indices showed differences among land uses, with most of the highest values corresponding to non-disturbed systems. Most of the ecological indices were useful to establish significant effects of different land uses on soil nematode community.

IDENTIFICACIÓN DE ESPECIES DE *MELOIDOGYNE* SPP. POR MEDIO DE DOS TÉCNICAS MOLECULARES [IDENTIFICATION OF NEMATODE SPECIES OF *MELOIDOGYNE* SPP. USING TWO MOLECULAR TECHNIQUES]. A. C. García[1], L. Gómez-Alpízar[1] and L. Flores[2]. [1]Laboratorio de Biotecnología de Plantas, Centro de Investigaciones Agronómicas, Universidad de Costa Rica, Apdo. 2060, San Pedro, Montes de Oca, Costa Rica y [2]Centro de Investigaciones en Protección de Cultivos, Universidad de Costa Rica, Apdo. 2060, San Pedro, Montes de Oca, Costa Rica. anacathy@gmail.com.—Los nematodos formadores de nódulos de la raíz (*Meloidogyne* spp.) causan pérdidas de importancia económica a diferentes cultivos en Costa Rica. Algunas especies de *Meloidogyne* spp. son plagas cuarentenarias, por lo que se encuentran entre los nematodos de mayor regulación en el comercio agrícola. En este trabajo se pretende estandarizar algunas técnicas para el diagnóstico molecular de las especies de este género. Se realizaron amplificaciones en reacción múltiple, con cebadores universales y específicos (JMV1, JMV2, JMVhapla y JMVtropical), amplificaciones con PCR simple (Blo4/Blo5) y PCR-RFLPs de la región ITS del ADN ribosomal, utilizando las enzimas *Alu*I, *Dra*I y *Rsa*I. Se lograron identificar las especies *M. hapla, M. incognita* y *M. salasi*; algunas muestras no pudieron ser identificadas, pero se descartó la posibilidad de que correspondieran a una de las tres especies mencionadas. La reacción múltiple con cebadores específicos es más apropiada y ventajosa para el diagnóstico molecular en análisis de rutina, ya que permite detectar especies simultáneamente en la misma muestra. La enzima *Alu*I fue la que mostró los mejores resultados para la distinción de especies de *Meloidogyne* spp. La especie *M. salasi* fue descrita en Costa Rica en 1984 y hasta el momento no existía confirmación molecular de su estatus de especie, por lo que esta es la primera vez que datos moleculares apoyan la nominación de *M. salasi*.

MOLECULAR IDENTIFICATION AND DETECTION OF THE POTATO CYST-FORMING NEMATODE *GLOBODERA PALLIDA* IN SOIL SAMPLES FROM COSTA RICA [IDENTIFICACIÓN Y DETECCIÓN MOLECULAR DEL NEMATODO DEL QUISTE DE LA PAPA, *GLOBODERA PALLIDA* EN MUESTRAS DE SUELO DE COSTA RICA]. D. García[1], A. Brenes[1], L. Gómez-Alpízar[1] and L. Salazar[2]. [1]Universidad de Costa Rica, Laboratorio de Biotecnología de Plantas, Centro de Investigaciones Agronómicas, Universidad de Costa Rica, Ap 2060, San Pedro, Montes de Oca, Costa Rica, [2]Universidad de Costa Rica, Centro de Investigaciones en Protección de Cultivos, Ap 2060, San Pedro, Montes de Oca, Costa Rica. davidgg04@gmail.com.—Potato cyst nematodes or PCN (*Globodera pallida* and *G. rostochiensis*) are major pests in potato production causing significant yield and economic losses worldwide. In Costa Rica, *G. rostochiensis* was detected in soil surveys in 1972-1974, however repeated surveys of the same area from 1975 until 1998 failed to confirm its presence and the country was certified as free of PCN. At the beginning of the year 2005, PCN were found in two farms in the Cartago-potato producing area raising questions about their identity. Polymerase chain reaction (PCR)-based methods were used to identify the PCN using DNA extracted from cysts and soil samples from both farms. PCR with species-specific primers (single or multiplex reaction) produced an amplification product of the same size as produced from control *G. pallida*. PCR-RFLP patterns obtained from ten DNA extractions of each farm revealed no difference among them and were identical to those from the *G. pallida* control. Detection of *G. pallida* DNA in soil was also possible using the multiplex PCR. No evidence of the presence of *G. rostochiensis* was found. The molecular assays used in the present study may allow monitoring the species distribution.

NEMATODES ASSOCIATED WITH INVERTEBRATES, FIGS AND GALLS: THE TROPICS OR BUST! [NEMATODOS ASOCIADOS CON INVERTEBRADOS, HIGOS Y AGALLAS]. R. M. Giblin-Davis, N. Kanzaki, W. Ye and R. H. Scheffrahn. Fort Lauderdale Reserach and Education Center, Fort Lauderdale, FL 33314, USA. giblin@ufl.edu .—We are testing the hypothesis that simple soil sampling is insufficient for measuring nematode biodiversity as you move towards the equator. One component of this study involves measurement of the contribution of nematodes in association with invertebrates to total nematode biodiversity. The order Isoptera (termites) was sampled as a focal group at several latitudes. We sampled along transects using "time trial sampling" of termite colonies within 5-m-radius areas or did whole area sampling. We dissected at least 10 workers per colony to examine for the presence, number, stage, and location of nematode associates. Termites were vouchered for identification and nematodes were collected for partial SSU rDNA amplification and sequencing attempts. About 30% of the termite colonies dissected had nematodes. Within each infested colony, we typically recovered less than five nematodes per insect with about 20-100% of the workers infested. Termites and their associated nematodes increased in diversity as the latitude decreased. If we count a termite species as a habitat then the increase in nematode diversity is due mostly to between-habitat diversity and not within-habitat diversity. Because insects take advantage of and partially represent (by being hosts or via the niches they occupy) the spatial heterogeneity that is characteristic of the tropics, effective biodiversity sampling should include entomophilic nematodes. Unfortunately, as diversity goes up, abundance usually goes down, making collection and identification of invertebrate hosts and detection of nematode associates difficult. Other radiations of entomophilic nematodes with potential for studying biodiversity will be discussed.

THE *FERGUSOBIA-FERGUSONINA* (NEMATODE-FLY) GALLING COMPLEX FOR BIOLOGICAL CONTROL OF *MELALEUCA QUINQUENERVIA* IN FLORIDA [EL COMPLEJO FORMADOR DE AGALLAS *FERGUSOBIA-FERGUSONINA* PARA EL CONTROL DE *MELALEUCA QUINQUENERVIA* EN FLORIDA]. R. M. Giblin-Davis, W. Ye, K. A. Davies, S. J. Scheffer, G. S. Taylor, M. F. Purcell, T. D. Center, K. Morris, W. K. Thomas, S. Wineriter, S. Blackwell and P. Pratt. Fort Lauderdale Reserach and Education Center, Fort Lauderdale, FL 33314, USA. giblin@ufl.edu.—One of the most aggressive introduced terrestrial weed species in southern Florida is *Melaleuca quinquenervia* (paperbark or punktree) which has invaded over 200,000 hectares of wetlands since its first introduction from Australia over 100 years ago. The weed was introduced as seed without any of its natural enemies. One complex of organisms that is considered a good candidate for classical biological control because of the damage it causes to Australian populations of *M. quinquenervia* involves an insect (*Fergusonina turneri* gall fly) and its mutualistically-associated entomophilic nematode (*Fergusobia quinquenervia*) which together form galls in developing shoot and inflorescence buds. Molecular sequence comparisons from collected pairs of *Fergusonina* flies and *Fergusobia* nematodes from different gall types, plant hosts, and geographical regions in Australia generally showed strict host specificity within the Myrtaceae for these complexes. The *Fergusonina turneri/Fergusobia quinquenervia* complex was demonstrated to be host specific on *M. quinquenervia* using molecular methods and "no choice" host testing. Recently, USDA-APHIS issued a permit for the release of this complex, the first obligate mutualist approved for release as a biological control agent in the United States. It has been released in southern Florida using several different methods, including the release of adult flies, galled plants placed at field sites, and field plants caged with flies. The unique biology of the association, the molecular work assessing host specificity, and preliminary observations concerning establishment and dispersal will be discussed.

SPATIAL DISTRIBUTION OF NEMATOLOGICAL DIVERSITY (ORDERS DORYLAIMIDA AND MONONCHIDA) IN MEDITERRANEAN ENVIRONMENTS FROM THE SOUTHERN IBERIAN PENINSULA [DISTRIBUCIÓN ESPACIAL DE LA DIVERSIDAD NEMATOLÓGICA (ÓRDENES DORYLAIMIDA Y MONONCHIDA) EN AMBIENTES MEDITERRÁNEOS DEL SUR DE LA PENÍNSULA IBÉRICA]. P. Guerrero, G. Liébanas, J. Abolafia and R. Peña-Santiago. Dpto. de Bio-

logía Animal, Biología Vegetal y Ecología, Universidad de Jaén. Campus "Las Lagunillas" s/n, Edificio B3, 23071-Jaén, España. rpena@ujaen.es.—The available information about distribution patterns of nematode diversity, and its causes (processes) are very scarce. Following a survey protocol in 100 × 100 m experimental plots from the Southern Iberian Peninsula, a study ot the variations of specific richness (number of species per geographic unit) in different habitats from the same geographic area (beta-β diversity) was carried out, as well as in the same type of habitat in different geographic areas (delta-δ diversity). All the comparative indexes used (similarity, turnover and complementarity) show a common pattern characterized by a decreasing elevational gradient of (β) diversity. Concerning δ diversity, specific richness does not undergo significant changes, although the indexes show the same behaviour as for β diversity, the differences were still more marked in the case of δ diversity.

QUIOL-S NUEVA ALTERNATIVA ORGANICA PARA AL MANEJO INTEGRADO DEL NEMATODO *MELOIDOGYNE INCOGNITA* EN EL CULTIVO DE VID EN PERÚ [QUIOL-S A NEW ORGANIC ALTERNATIVE FOR INTEGRATED MANAGEMENT OF *MELOIDOGYNE INCOGNITA* IN VINEYARDS IN PERU]. E. Herrera. Nematólogo Consultor, Lima, Perù. eherreraalva@hotmail.com.—En el Perú la uva de exportación se produce en casi 2000 hectáreas con un crecimiento sostenido de un 20% anual. La incidencia de daños por el nematodo nodulador *Meloidogyne* spp. se presenta fundamentalmente en plantaciones francas (sin patrones resistentes), que cubren un estimado de 50% del área cultivada. El uso de los nematicidas tradicionales se ha venido restringiendo por la implementación de las nuevas prácticas agrícolas, dando paso a productos naturales con acción nematicida y/o nematostática, que permitan integrar otras prácticas agrícolas eficientes como son: el riego, la nutrición mineral, los inductores de defensa y las propias sustancias húmicas y hormonales. El producto QUIOL-S es un compuesto de naturaleza orgánica cuyos componentes son: materia orgánica 250 g/L, extracto de quillaja 2.50 g/L, oligosacarina 3.00 g/L, Zinc 30.0 g/L, activador de suelo 30.00 g/L, aminoácidos totales 50.00 g/L y extractos de algas 25.00 g/L. Los resultados de las pruebas preliminares realizadas en una zona importante productora de vid de exportación, en el Valle de Ica, con la variedad Red Globe en plantación franca, muy seriamente afectada por *Meloidogyne incognita*, mostraron una reducción de la infección de un 60%. Además, se observó un aumento significativo en la masa radicular, lo cual permitió la recuperación del aparato foliar y del vigor de la planta en la primera aplicación de 10 L/ha en poscosecha.

AISLAMIENTO Y EVALUACIÓN DE STEINERNEMATIDOS (NEMATODA: STEINERNEMATIDAE) NATIVOS ASOCIADOS A LARVAS DE COLEÓPTEROS SCARABAEIDAE EN MÉXICO [ISOLATION AND EVALUATION OF NATIVE STEINERNEMATID NEMATODES RECOVERED FROM SCARAB BEETLE LARVAE (COLEOPTERA: SCARABAEIDAE) IN MEXICO]. E. G. Herrera Navarro, J. A. Ramos Martines and R. Alatorre Rosas. Depto de Entomología, Colegio de Postgraduados 56230, Estado de México. herreran@colpos.mx.—Nematodos entomopatógenos (Steinernematidae) en asociación con larvas de *Phyllophaga*, *Cyclocephala* y *Anomala* spp. (Coleoptera: Scarabaeidae) se encontraron en las comunidades de La Virgen Tarandacuao y Puruagua Jerecuaro en el estado de Guanajuato, y sobre un curculiónido depredador de pastos en el estado de México. La mayor incidencia se notó en La Virgen, caracterizada por tener suelos arcillo-arenosos (48.70% arena, 36.16 arcilla y 15% limo), presentándose una correlación positiva entre la precipitación y la presencia de nematodos. Estos nematodos fueron identificados con base en caracteres morfológicos y moleculares. La capacidad reproductiva de estos nematodos fue examinada en larvas de *Galleria mellonella* (Lepidoptera: Pyralidae) utilizando un diseño completamente al azar. La capacidad infectiva fue evaluada en larvas de *Phyllophaga*, *Cyclocephala* y *Anomala* y analizada por medio de una regresión logística binaria. Los tres aislamientos de *Steinernema* spp. se reprodujeron obteniendo en promedio 135,792,106,708 y 71,750 juveniles/larva de Chapingo, Tarandacuao, Jerécuaro respectivamente, siendo estadísticamente inferior la producción de nematodos procedentes de la última localidad (Tukey p = 0.05). La caracterización molecular preliminar fue realizada a través del alinenamiento de secuenias de ADN ribosómico [subunidad 28S], utilizando el análisis

CLUSTAL W (1.82). Este estudio mostró que el aislamiento Chapingo tiene similitud con *S. carpocapsae* y que las cepas *Steinernema* spp. de Jerecuaro y Tarandacuao constituyen nuevas especies.

EXTRACTOS ACUOSOS PARA EL CONTROL DE *MELOIDOGYNE INCOGNITA* [AQUEOUS EXTRACTS FOR CONTROL OF *MELOIDOGYNE INCOGNITA*]. E. Herrera-Parra[1], M. Gamboa-Angulo[2], J. Cristóbal-Alejo[1], N. Mendoza-Marbán[3], E. Tut-Pech[1], L. Medina-Baizabal[2] and P. Sima-Polanco[2]. [1]IT-Conkal, [2]CICY y [3]Universidad Autonoma, Chapingo, Mexico. elian09@hotmail.com.— Con el propósito de disminuir el parasitismo de *Meloidogyne incognita* en plantas de tomate en condiciones de invernadero se evaluaron cuatro extractos acuosos del tallo de *Tephrosia cinerea*, la hoja y raíz de *Calea urticifolia* y la hoja de *Eugenia winzerlingii*, en concentraciones de 50 y 100% (10 y 20 gL^{-1}). Se incluyó un testigo químico (Oxamyl 1 ml L^{-1} agua) y un testigo absoluto. Los tratamientos se aplicaron al momento del trasplante y ocho días más tarde. El experimento se realizó en macetas con 2 kg de suelo previamente esterilizado e inoculado con 450 juveniles (J_2) cerca de la raíz de las plántulas de tomate. Se utilizó un diseño completamente al azar con 4 repeticiones, evaluándose 45 días después del transplante. El menor número de agallas se obtuvo con la aplicación de Oxamyl con un promedio de 9.6 agallas por planta y 13 hembras por gramo de raíz teñida. Los extractos de *Calea urticifolia* de hoja y de raíz en 100 y 50%, respectivamente mostraron los mejores resultados, al permitir 544 y 762 agallas en promedio por planta, lo cual significó una disminución en la formación de agallas del 59.9 y 43.99% en relación al testigo. El número de hembras por g de raíz teñida en estos tratamientos fueron de 229 y 98, respectivamente.

A REVIEW OF THE BIODIVERSITY OF VIRUS VECTOR NEMATODES, WITH SPECIAL REFERENCE TO THE *XIPHINEMA AMERICANUM* GROUP [REVISIÓN DE LA BIODIVERSIDAD DE NEMÁTODOS VECTORES DE VIRUS CON ÉNFASIS EN EL GRUPO DE *XIPHINEMA AMERICANUM*]. S. Hockland[1], W. Decraemer[2] and R. Neilson[3]. [1]Pest and Disease Identification Team, Plant Health Group, Central Science Laboratory, Sand Hutton, York YO41 1LZ England, UK, [2]Royal Belgian Institute of Natural Sciences, Department of Invertebrates, Vautierstraat 29, B-1000 Brussels, Belgium, and Ghent University Nematology Section, Ledeganckstraat 35, B-9000 Gent Belgium, [3]Environmental and Plant Interactions Research Programme, Scottish Crop Research Institute, Dundee DD2 5DA, Scotland, UK. s.hockland@csl.gov.uk.— The biodiversity of plant-parasitic nematodes is important for all nematologists, having implications for taxonomists, researchers and consultants working in phytosanitary services and sustainable crop production. The Longidoridae and Trichodoridae comprise many species that are known to be vectors of viruses and are economically important. However, many species are known only from their type description and there is a lack of comprehensive geographic and ecological data. Taxonomists also face the task of working with species which may have been described with little or no discussion of species concepts used. Consultants in crop protection need to be able to label species and be aware of their ecology, including their interactions with plants. Increasing trade in plants and plant products has the potential to influence the biodiversity of these nematodes in countries worldwide, but many records of passive dispersal are not complemented by subsequent records of established populations. A review of biodiversity information for important groups such as *Xiphinema americanum sensu lato* will be discussed.

COMPARISON OF PATHOGENICITY OF SIX ISOLATES OF *MELOIDOGYNE MAYAGUENSIS* FROM FLORIDA ON TOMATO (*LYCOPERSICON ESCULENTUM*) 'SOLAR SET' [COMPARACIÓN DE LA PATOGENICIDAD DE SEIS AISLAMIENTOS DE *MELOIDOGYNE MAYAGUENSIS* PROVENIENTES DE FLORIDA EN TOMATE (*LYCOPERSICON ESCULENTUM*) 'SOLAR SET']. E. A. Johnson,[1] J. A. Brito[2] and D. W. Dickson.[1] Entomology and Nematology Department, University of Florida, Gainesville, FL 32611, USA, [2]Division of Plant Industry, Gainesville, FL 32614, USA. britoj@doacs.state.fl.us.— *Meloidogyne mayaguensis* is a pathogen of agronomic, vegetable, and ornamental crops in Florida and has the ability to reproduce on root-knot nematode resistant tomato and

pepper cultivars. The objective of this study was to compare the pathogenicity of six Florida isolates of *M. mayaguensis* on the root-knot nematode susceptible 'Solar Set' tomato. Plants were inoculated with 5,000 eggs/J2 of each isolate. 'Solar Set' tomato was equally susceptible to all isolates of *M. mayaguensis*, supporting high egg production. Egg mass values ranged from 3 to 4 and galling values were all 5 (0 to 5 scale). The reproduction factor (Rf = final population/initial population) for the six isolates ranged from 2.6 to 44.5, therefore 'Solar Set' tomato was a good host for all six isolates of *M. mayaguensis*. The average number of eggs/g root ranged from 518 to 5,173. Fresh shoot and root weight for the six isolates ranged from a low of 42.1 g and 27.2 g to a high of 96.1 g and 50.2 g, respectively. Preliminary results of the study indicate that the isolates of *M. mayaguensis* reproduced well on 'Solar Set' tomato but did vary in pathogenicity.

EFFECT OF *PASTEURIA PENETRANS* ENDOSPORE DENSITY ON ATTACHMENT, PENETRATION AND FECUNDITY OF *MELOIDOGYNE ARENARIA* RACE 1 [EFECTO DE LA DENSIDAD DE ENDOSPORAS DE *PASTEURIA PENETRANS* SOBRE LA ADHERENCIA, PENETRACIÓN Y FECUNDIDAD DE *MELOIDOGYNE ARENARIA* RAZA 1]. G. M. Kariuki[1], J. A. Brito[2] and D. W. Dickson[1]. 1Entomology and Nematology Department, University of Florida, Gainesville, FL, 32611, USA, [2]Division of Plant Industry, Gainesville, FL 32614, USA. gkariuki@ufl.edu.—*Pasteuria penetrans*** is an obligate mycelial endospore forming bacterial parasite of root-knot nematodes that has shown great potential as a biological control agent of root-knot nematodes. Endospores of *P. penetrans* attach to the cuticle of second-stage juveniles (J2) of *Meloidogyne* spp. when they move through the soil in search of a host. The percentage of J2 with endospores attached and number of endospores per J2 was correlated with infection in adults and therefore often used as an indirect measure of biocontrol potential. This study was carried out to test the effect of different endospore concentration on attachment, host penetration, and root-knot galling and fecundity. Different attachment levels were achieved using different ratios of J2 to endospores. As the mean attachment level per juvenile increased the percentage of J2 penetrating host plant roots decreased. As few as 3.5 endospore/J2 reduced the ability of *M. arenaria* to enter host roots. Higher levels of endospore attachment reduced the egg mass number but not the galling indices. This study confirms that *P. penetrans* induced soil suppressiveness is dependent on endospore concentrations and is manifested at the level of root penetration by J2 and egg mass production.

PRACTICAL USES OF PRECISION AGRICULTURAL TECHNOLOGY: EXAMPLES FROM AGRONOMIC CROPPING SYSTEMS [USOS PRÁCTICOS DE TECNOLOGÍA AGRÍCOLA DE PRECISIÓN: EJEMPLOS DE SISTEMAS AGRONÓMICOS DE CULTIVO]. T. W. Katsvairo, J. R. Rich, D. L. Wright and J. J. Marois. University of Florida, NFREC, Quincy, FL 32351, USA. twkatsvairo@ufl.edu.—The introduction and use of Global Positioning Satellite (GPS) systems has created numerous opportunities for agriculturists. 'Precision Agriculture' is a term commonly associated with those technologies that have been developed using GPS, and the technologies have been rapidly incorporated in agricultural production systems. Basically, GPS allows highly accurate field mapping, and these data are used to provide site specific management of pests, fertility, and water on much smaller areas of a field than was previously possible. Precision agriculture has tremendous promise but methods and uses are still evolving. Some currently successful practical applications are discussed, including site-specific applications of fertilizers and pesticides, yield monitors, and auto-steering of tractors and other farm equipment. Precision agriculture allows more efficient use of agricultural inputs such as fertilizers and pesticides and hence reduces input costs and potentially increase returns. It also reduces the amount of agricultural chemicals that could contaminate the environment. Precision agriculture offers a greater level of efficiency and could achieve even greater importance in the future.

HOST STATUS OF WEED SPECIES FOR FIVE *MELOIDOGYNE* SPP. [MALEZAS COMO HOSPEDANTES DE CINCO ESPECIES DE *MELOIDOGYNE*]. R. Kaur,[1] J. A. Brito[2] and J. R. Rich[3].

[1]Entomology and Nematology Dept., University of Florida, Gainesville, FL 32611, [2]Division of Plant Industry, Gainesville, FL 32614, [3]University of Florida, Quincy, FL, 32351, USA. ramanz15@ufl.edu.—
The host status of five species of root-knot nematodes (*M. arenaria* race 1, *M. floridensis*, *M. incognita* race 4, *M. javanica* race 1, and *M. mayaguensis*) to 15 weed species commonly found in agricultural fields in Florida was determined. Five weeds (*Amaranthus spinosus*, *A. retroflex*, *Abutilon theophrasti*, *Brassica kaber*, and *Dichondra repens*) were good hosts ($Rf \geq 1$) to at least three of the nematodes (*M. arenaria*, *M. javanica*, and *M. mayaguensis*) and seven weeds (*Crotolaria spectabilis*, *Desmodium purpureum*, *Digitaria sanguinalis*, *Oenothera biennis*, *Panicum dichotomiflorum*, *Setaria pumila*, and *Sorghum helepense*) were nonhosts ($Rf \leq 0.1$) to all five nematodes ($P \leq 0.05$). *Echinochloa muricata* was a good host for *M. arenaria*, a poor host for *M. incognita*, and a nonhost for *M. floridensis*, *M. javanica* and *M. mayaguensis*. *Senna obtusifolia* was a good host for *M. mayaguensis*, and a poor host ($0.1 < Rf < 1$) for the other four nematodes. *Cassia occidentalis* was a poor host to *M. mayaguensis*, and nonhost to the other three nematodes. *M. mayaguensis* produced the highest egg mass index 4.8 (0-5 scale) on *Brassica kaber*, whereas *M. arenaria* and *M. mayaguensis* produced the highest gall ratings (80%) on *A. spinosus*. *A. spinosus* sustained the highest number of eggs per gram of root regardless of the nematode species ($P \leq 0.05$).

DEVELOPING A MICROBIAL BIOLOGICAL CONTROL AGENT FOR ROOT-KNOT NEMATODES WITH ESPECIAL REFERENCE TO *POCHONIA CHLAMYDOSPORIA* [DESARROLLO DE UN AGENTE DE CONTROL BIOLÓGICO PARA NEMATODOS AGALLADORES CON ESPECIAL ENFASIS EN *POCHONIA CHLAMYDOSPORIA*]. B. R. Kerry[1] and L. Hidalgo-Diaz[2]. [1]Nematode Interactions Unit, Rothamsted Research, Harpenden, Herts, AL5 2JQ, UK, [2]Centro Nacional de Sanidad Agropecuaria (CENSA), Carretera de Jamaica y Autopista Nacional, Apartado 10, San Jose de las Lajas, La Habana, Cuba. brian.kerry@bbsrc.ac.uk.—Bacterial and fungal parasites, competitors and antagonists have been evaluated for the control of root-knot nematode (*Meloidogyne* spp.) damage to crops and the regulation of nematode populations in soil. Most microbes show much intraspecific variation. Only 5% of biotypes of the nematophagous fungus, *Pochonia chlamydosporia* had the characteristics considered essential for the control of root-knot nematodes and there is a need for careful selection of potential agents. Biological control agents rarely provide adequate nematode control and they must be incorporated with other measures. *Pochonia chlamydosporia* used in combination with poor host crops has provided control of root-knot populations in intensive vegetable production in Cuba. The production of *P. chlamydosporia* and some organisms has been optimised and stable, high quality inoculum produced. *Paecilomyces lilacinus* is the most tested biological control agent for nematodes and formulated products such as Bioact®WG have been developed, which are applied at rates equivalent to 40 kg/ha. Endophytes and rhizosphere bacteria that can be applied with transplants or as seed treatments may require much lower rates of application. Data will be presented for the evaluation of potential agents in tropical soils and methods for their exploitation will be reviewed.

SITE-SPECIFIC NEMATICIDE APPLICATION ON THE FARM: PROBLEMS AND PROGRESS [APLICACIÓN SITIO-ESPECÍFICA DE NEMATICIDAS EN CULTIVOS: PROBLEMAS Y PROGRESO] T. L. Kirkpatrick[1], W. S. Monfort[2], A. H. Khalilian[3] and J. D. Mueller[3]. [1]University of Arkansas, Southwest Research and Extension Center, Hope, AR 71801, USA, [2]University of Georgia, Plant Pathology Department, Tifton, GA 31794, USA, [3]Clemson University, Edisto Research and Education Center, Blackville, SC 29817, USA. tkirkpatrick@uaex.edu.—Cotton growers in the southern U.S. routinely include the application of either 1,3-dichloropropene (Telone II) or aldicarb (Temik) in their farming operations for nematode management. Nematicide applications are made at a single rate on a whole-field basis, and decisions to apply these chemicals are usually based on assay of a single composite soil sample arbitrarily collected from each field. The nematodes of economic concern in this region (*Meloidogyne incognita*, *Rotylenchulus reniformis*, and *Hoplolaimus columbus*), however, are not uniformly distributed in these fields due to various historical, environmental, and edaphic factors. Blanket, whole-field application of a single rate of these nematicides is rapidly becoming cost

prohibitive due to high chemical and fuel costs. These chemicals also pose considerable environmental risk. Soil texture is a key factor influencing the reproductive success and damage potential of these nematode species on the crop, and an understanding of soil textural changes within individual fields could allow more efficient sampling for nematode detection and quantification and provide a platform for determining strategies for site-specific nematicide placement. In field investigations (2001-2005), mobile soil electrical conductivity (EC) meters (Veris Technologies) were used to estimate and map site-specific soil textural variations within production fields in Arkansas and South Carolina. In two Arkansas fields, these soil EC maps were used to identify soil textural regions (zones) that were sampled individually for nematodes. Nematode population densities from each zone were then compared with known damage threshold values, and prescription application maps for site-specific placement of 1,3-dichloropropene were developed. Replicated comparisons in these fields indicated that cotton yield was comparable in zones receiving site-specific nematicide application to that where a single rate was applied, but 30-42% less chemical was applied with the site-specific approach. Both approaches resulted in significantly greater yield than where no nematicide was applied. A pilot program, the Site-specific Nematicide Placement system (SNP), supported in part through the U.S. Department of Agriculture Natural Resources Conservation Service, is currently underway to introduce this concept to cotton producers in Arkansas and South Carolina.

BLENDS OF *HETERODERA GLYCINES* RESISTANT AND SUSCEPTIBLE CULTIVARS FOR MANAGEMENT OF SOYBEAN YIELD SUPPRESSION. S. R. Koenning. Plant Pathology Department, North Carolina State University, Raleigh, NC 27695, USA. Stephen_koenning@ncsu.edu.—Five cultivars (Delsoy 5710, Fowler, Anand, Holladay and Hutcheson) were selected on the basis of their resistance or lack thereof to the soybean cyst nematode (SCN) *Heterodera glycines*. Each cultivar was grown individually or in blends of ratios of 30:70, 50:50, 70:30 of resistant to susceptible soybean. Delsoy 5710 was highly resistant to the race 5 population present at the Caswell research station, and Fowler and Anand were also resistant to this population. Resistant varieties yielded more than susceptible varieties, but the highest yield was for a blend of 70% Fowler (SCN resistant) and 30% Holladay (SCN susceptible) in both 2005 and 2006. Lowest numbers of SCN were on resistant varieties but blends with a high proportion of either Delsoy 5710 or Fowler had lower SCN numbers than expected. There is a trend toward increasing SCN reproduction on Anand and Delsoy 5710, but not on Fowler.

NEMATODOS FITOPARÁSITOS ASOCIADOS A LOS PRINCIPALES CULTIVOS DEL ESTADO FALCÓN, VENEZUELA [PLANT PARASITIC NEMATODES ASSOCIATED WITH THE MAIN CROPS IN FALCON STATE, VENEZUELA]. Z. Lugo[1,2], R. Crozzoli[2] and G. Perichi[2]. [1]Instituto Nacional de Investigaciones Agrícolas (INIA), Apdo. 4101, Coro, Falcón, Venezuela y [2]Universidad Central de Venezuela, Facultad de Agronomía, Post Grado en Zoología Agrícola, Apdo. 4579, Maracay, Aragua, Venezuela. zlugo@inia.gob.ve.—Para identificar géneros y algunas especies de nematodos fitoparásitos asociados a hortalizas, frutales y zábila, se tomaron muestras de suelos y raíces en la rizosfera de las plantas en las zonas productoras de 18 municipios del estado Falcón. Las muestras de suelo se procesaron con el aparato de Oostenbrink y las raíces se trituraron en licuadora. La limpieza de las muestras se realizó con el filtro de algodón modificado por Crozzoli y Rivas (1987). La identificación de nematodos se basó en la morfometría tradicional. Los cultivos seleccionados por su importancia económica fueron: cucurbitáceas (melón, patilla, auyama), cebolla, pimentón, tomate, musáceas, aguacate, papaya, cítricos, guanábana y zábila. En asociación con dichos cultivos, se identificaron los siguientes géneros y especies de nematodos fitoparásitos: *Aorolaimus*, *Paratylenchus* sp., *Tylenchorhynchus capitatus* y *Hemicriconemoides strichtathecatus* en el cultivo de zábila; *Meloidogyne incognita* en cucurbitáceas, pimentón, aguacate, cítricos, musáceas, zábila y ciruela de huesito; *Xiphinema* spp. en cítricos, níspero, tamarindo, aguacate; *Pratylenchus* spp. en auyama, lechosa y melón; *Helicotylenchus dihystera* en tomate; *Helicotylenchus* spp. en zábila, musáceas, cítricos y pimentón; *Tylenchulus semipenetrans* en cítricos y *Rotylenchulus reniformes* en tomate, cebolla y papaya. Se observaron daños en

raíces de cítricos y lechosa causados por *T. semipenetrans* y *R. reniformis*, respectivamente y severos agallamientos en cucurbitáceas y pimentón causados por *M. incognita*; lo anterior acompañado por clorosis, reducciones de crecimiento de la parte aérea y de rendimiento.

RESISTANCE OF SIX GRAPE ROOTSTOCKS TO *MELOIDOGYNE ETHIOPICA* WHITEHEAD IN FIELD AND GREENHOUSE CONDITIONS IN CHILI [RESISTENCIA DE SEIS PORTAINJERTOS DE VID A *MELOIDOGYNE ETHIOPICA* WHITEHEAD EN CONDICIONES DE CAMPO E INVERNADERO EN CHILE]. R. Mancilla and J. C. Magunacelaya. Pontificia Universidad Católica de Valparaíso, Chile. jmagunac@ucv.cl.—Resistance to *Meloidogyne ethiopica* was evaluated under field and greenhouse conditions in *Vitis* rootstocks Harmony, SO4, 101-14 MG, 110R, 3309C and Kober 5BB, using the Chardonnay cultivars as a control. In the field trial the rootstocks were planted in a soil severely infested with *M. ethiopica,* in Chile, while in greenhouse they were inoculated with eggs of the same nematode at levels of 0, 200 and 400 eggs per plant, equivalent to 0, 25 and 50 eggs per 250 ml of soil, respectively. In both trials shoot weight, root weight, gall and egg number, number of second stage juveniles and male presence of *M. ethiopica* in 250 ml of soil were evaluated. In the greenhouse trial, the rootstocks performed similarly in the presence of the nematode showing no significant differences among them, but Chardonnay showed greater damage, in addition to a high presence and reproduction of the nematode. In the field trial, Chardonnay was the most susceptible to nematode attack, developing the greatest number and size of root galls, and the greatest number of eggs, while rootstocks Harmony, SO4, 101-14 MG, Kober 5BB and 110R showed more resistance and hindered nematode reproduction. Rootstock 3309C was the least resistant in this condition.

ASSESSING GENETIC DIVERSITY OF *POCHONIA CHLAMYDOSPORIA* POPULATIONS USING ERIC PRIMERS [EVALUACIÓN DE LA DIVERSIDAD GENÉTICA DE POBLACIONES DE *POCHONIA CHLAMYDOSPORIA* USANDO CEBADORES ERIC]. R. H. Manzanilla-López, I. M. Clark, P. R. Hirsch and B. R. Kerry. Nematode Interactions Unit, Rothamsted Research, Harpenden, Herts, AL5 2JQ, UK. Rosa.manzanilla-lopez@bbsrc.ac.uk.—The fungus *Pochonia chlamydosporia* has potential as an effective biological control agent of cyst and root-knot nematodes. To assess variation between isolates of the fungus, molecular markers are a powerful tool and the method of choice. Consensus sequences derived from highly conserved palindromic inverted repeat regions found in enteric bacteria have been used successfully to fingerprint closely related, as well as widely divergent, strains of bacteria and fungi. The potential use of ERIC (enterobacterial repetitive intergenic consensus) as a molecular marker has been tested with several isolates of *P. chlamydosporia* as part of ongoing research on the importance of variation in the regulation of host populations. However, to assess reliably variation in a large number of samples of isolates, problems related to PCR inhibitors and PCR conditions must first be resolved. A methodology combining the growth of mycelium on Czapek Dox Broth, a non-toxic and easy DNA extraction method from fungal isolates, and optimisation of ERIC PCR conditions, was developed to assess the diversity of *P. chlamydosporia* populations in bulk soil, rhizosphere and *M. incognita* egg masses. Using this technique, parameters such as fungal diversity and habitat occurrence (e.g., soil, rhizosphere, nematode eggs) related to the infection potential of selected isolates was investigated.

METHYL BROMIDE USERS IN MEXICO [USUARIOS DE BROMURO DE METILO EN MÉXICO]. N. Marbán-Mendoza and A. Aguilar-Carpio. Master Crop Protection Program, Departamento de Parasitología Agrícola, Universidad Autónoma Chapingo. Road Mexico-Texcoco km 38.5 Chapingo, Mexico. nmarbanm@yahoo.com.mx.—The project consists of assisting the government of Mexico to reduce (by 20%) the consumption of methyl bromide. This represents 162.36 tons ODP of MB used in 4,547 ha for 675 producers that grow tomatoes, strawberries, chili peppers, blackberries, garlic, cut flowers and nurseries. The main consumer states of MB are Baja California Norte and Baja California Sur (North and South Baja California) mostly in tomato and strawberry. The key chemical

alternatives to replace MB for soil disinfestation are Metham Sodium, Dazomet and 1,3 Dichloropropene (Telone) + chloropicrin (PIC), used alone or in combination with plastic mulches. Ongoing development of new formulations and mixtures containing even lower concentrations of MB/PIC (67:33, 50:50) are becoming available in many places around the world. Non fumigant chemical alternatives to control soilborne pests are fungicides (e.g., thiram, tiabendazol, carbendazim), nematicides (oxamyl, cadusafos, carbofuran, fenamiphos) and herbicides (halosulfuron methyl). Non-chemical alternatives within the framework of Integrated Pest Management involve cultural practices, the addition of materials in the soil (amendments), crop rotation, resistant varieties and grafting, mulch and cover crops, water and nutrient management, virtually impermeable film, biological agents (e.g., *Trichoderma harzianum*, *Bacillus subtilus*), biofumigants, solarization, steam treatment and substrates. The strategy of the project is to organize and carry out different seminars, workshops and training sessions with the growers who are the main MB users of the country in order to transfer the adoption of key alternatives and technologies.

CHEMICAL MANAGEMENT OF NEMATODES IN LOUISIANA: 2000-2005 FIELD AND MICROPLOT TRIALS WITH COTTON, SOYBEAN, SUGARCANE, RICE, ASSORTED VEGETABLES AND TURF [MANEJO QUÍMICO DE NEMATODOS EN LOUISIANA: PRUEBAS EN CAMPO Y MICRO PARCELAS CON ALGODÓN, CAÑA DE AZÚCAR, ARROZ, VEGETALES VARIADOS Y CÉSPED DE 2000 A 2005]. E. C. McGawley and M. J. Pontif. Department of Plant Pathology and Crop Physiology, Louisiana State University, Baton Rouge, LA 70803 USA. emcgawley@agctr.lsu.edu.—Agri-Terra has proven to be a safe and efficacious material for the management of many economically important plant parasitic nematode species in Louisiana. Popular cultivars of all major row crops plus a wide variety of vegetable species were evaluated in microplot and field trials during the period 2000-2005. In every trial, significant reductions in nematode populations were observed following application of this material. Harvest data from microplot trials, averaged over years, and showed increases in plant dry weights over those of controls which averaged 39% for cotton, 87% for sugarcane, 75% for rice, and 42% for soybean. In field trials in which Agri-Terra was employed as an at-planting, in-furrow spray treatment (10 GPA of a 100:1 dilution), significant yield responses, when compared with those of non-treated controls, were observed in five consecutive years with cotton, in two of three years with soybean and in 1 of 2 years with sugarcane. For each of these three crops, Agri-Terra was equal to or better than either Telone II or Methyl Bromide (applied two weeks prior to planting at rates of 80.8 and 115.3 lbs a.i./a, respectively). During 2005 Agri-Terra was evaluated for control of turf-associated nematode species. Greens and fairways of 7 commercial golf courses which had high levels of nematodes (>4500/kg of soil) were treated with Agri-Terra following aerification of turf. In all cases, nematode communities were reduced significantly (61-85%) within 3 weeks of application. At 4 of the sites there was visible improvement in turf density and quality.

PRELIMINARY STUDY ON *HETERODERA CAJANI* POTENTIAL TO ESTABLISH IN BRAZIL [ESTUDIO PRELIMINAR DEL POTENCIAL DE ESTABLECIMIENTO DE *HETERODERA CAJANI* EN BRASIL]. L. M. P. Melo, H. F. Silva and R. V. Tenente. Embrapa/Cenargen, CP02372 (70849-970), Brasília/DF, Brasil. renata@cenargen.embrapa.br.—Since 1970s Brazilian Agribusiness has shown fast modernization, high diversification, increasing of production and significant world competitiveness. In order to guarantee production quality it is necessary to apply phytosanitary actions, as the attendance and adviser of exotic pests with the purpose of minimizing its introduction and establishment into the country. Cyst nematode *Heterodera cajani* is an exotic pest with economic interest for Brazil because it can parasite important crops such as *Cajanus cajan*, *Glycine max*, *Phaseolus vulgaris*, and *Pisum sativum*, among others. There are reports stating that this nematode occurs in India, Pakistan, and Egypt, where it has high survival and spreading capacity under different conditions and can cause severe damages to the hosts. This work shows a preliminary study on the potential of *H. cajani* to establish in different Brazilian localities. The followed procedures were developed: 1) nematode

bibliographical survey; 2) determination of temperature range for parasite development; 3) use of the Climex software of geographic information to detect the Brazilian areas with the optimum temperature for pest development (Map1); 4) use of ArcView software of geographic information to identify the production areas of soybean, bean and peas crops (Map 2). With this information a trimming of Map1 and Map 2 was done generating a third Map that shows the specific areas where this nematode can establish and can be harmful. This study has relevant information to strongly support the importance of phytosaniraty preventive measures against *H. cajani*.

BIOLOGICAL CONTROL OF *RADOPHOLUS SIMILIS* IN BANANA WITH THE ANTAGONISTIC FUNGI *PAECILOMYCES LILACINUS* STRAIN 251 (PL251) AND *FUSARIUM OXYSPORUM* STRAIN 162 (FO162) [CONTROL BIOLÓGICO DE *RADOPHOLUS SIMILIS* EN BANANO CON EL HONGO ANTAGONISTA *PAECILOMYCES LILACINUS* CEPA 251 (PL251) Y *FUSARIUM OXYSPORUM* CEPA 162 (FO162)]. A. Mendoza, R. A. Sikora and S. Kiewnick. University of Bonn, INRES-Plant Health Dept., Nematology in Soil Ecosystems Nussallee 9, 53115 Bonn, Germany. mendozaal66@yahoo.com.—*Paecilomyces lilacinus*** and the mutualistic endophyte *Fusarium oxysporum* are known biocontrol agents that control *R. similes* and other nematodes. *P. lilacinus* is an egg pathogen whereas the *F. oxysporum* reduces nematode penetration by a repellent mechanism. Experiments were conducted to evaluate the effect of dose, application time and multiple applications on control efficacy. The possibility of using the repellent effect of Fo162 to increase exposure of the nematode to the killing activity of PL251 was one of the main goals. Results showed a significant relationship between the rates of PL251 applied and the degree of *R. similes* control. Good control was achieved when plantlets and soil received a pre-plant treatment and an additional soil treatment with PL251 at transplanting. The combination of Fo162 and PL251 resulted in significantly lower penetration rates compared to the nematode inoculated control and Fo162 alone. The existence of synergistic effect between two antagonistic fungi was not significant. Alternative inoculation techniques are being tested to enhance synergism. In dual culture *in-vitro* bioassays no negative interactions were found between the two fungi. The data indicate a potential to combine these biocontrol agents for increased control of *R. similis* on banana. Data from additional experiments will be presented and discussed.

DETECCIÓN Y CARACTERIZACIÓN MORFOMÉTRICA DEL NEMATODO FOLIAR *APHELENCHOIDES BESSEYI* EN SEMILLAS DE ARROZ DE LA VAR. SENUMISA-2, EN COSTA RICA [DETECTION AND MORPHOMETRIC CHARACTERIZATION OF THE FOLIAR NEMATODE *APHELENCHOIDES BESSEYI*, IN RICE SEEDS VAR SENUMISA-2, IN COSTA RICA]. Z. Montero and L. Salazar. Laboratorio de Nematología, Centro de Investigación en Protección de Cultivos, Escuela de Agronomía, Universidad de Costa Rica, Ap. 2060, San Pedro, Montes de Oca, San José, Costa Rica. zeidy.montero@gmail.com.—Como parte de los controles de calidad rutinarios realizados por algunas empresas semilleristas, dedicadas a la producción y comercialización de semillas de arroz, se detectó, en varios lotes de las variedades CR-1821, CR-5272, Senumisa-3, CR-4102, CR-4477, Senumisa-2 y Fedearroz 50, densidades poblacionales de 30, 300, 480, 530, 700, 6270 y 23440 *Aphelenchoides* sp. por 100 gramos de semillas respectivamente. Basados en la poca información disponible sobre este nematodo en Costa Rica y conociendo la capacidad de *A. besseyi* para causar daños de importancia económica al cultivo del arroz, al provocar el vaneo de la semilla, se realizó un estudio morfométrico de hembras y machos de la población detectada en la var. Senumisa-2, cuyos valores permitieron confirmar la identificación de *A. besseyi*.

IDENTIFICACIÓN DE *MELOIDOGYNE INCOGNITA* CAUSANDO DAÑOS A LA CALIDAD DE LOS TUBÉRCULOS DE PAPA, EN DOS LOCALIDADES DE LA PROVINCIA DE CARTAGO, COSTA RICA [IDENTIFICATION OF *MELOIDOGYNE INCOGNITA* CAUSING POTATO TUBER DAMAGE IN TWO LOCALITIES OF CARTAGO PROVINCE, COSTA RICA]. Z. Montero[1], C. García[2], L. Salazar[1], R. Valverde[2] and L. Gómez-Alpízar[2]. [1]Centro de Investigaciones en Protección de Cultivos

y [2]**Laboratorio de Biotecnología de Plantas, Centro de Investigaciones Agronómicas, Facultad de Ciencias Agroalimentarias, Escuela de Agronomía, Universidad de Costa Rica, Apdo. 2060, San Pedro, Montes de Oca, Costa Rica. zeidy.montero@gmail.com.—**Especies del género *Meloidogyne* causan importantes daños al cultivo de la papa (*Solanum tuberosum*) alrededor del mundo. Su efecto puede ser directo al disminuir el rendimiento o indirecto al infectar los tubérculos y causar agallas o protuberancias que les confiere una apariencia verrugosa la cual afecta su calidad y reduce su valor comercial. Recientemente el Laboratorio de Nematología de la Universidad de Costa Rica recibió tubérculos de papa de las variedades Floresta y Bananito con numerosas protuberancias en su superficie, de dos localidades de la provincia de Cartago, Costa Rica. De las protuberancias se extrajo hembras ovígeras de *Meloidogyne* spp. Estudios morfológicos (diseño perineal de las hembras) y moleculares (PCR y PCR-RFLP) mostraron que las hembras extraídas pertenecen a la especie *M. incognita*. Se recomienda estudiar las causas que promueven la infección de los tubérculos en dichas localidades, ya que cerca del 90% del área cultivada de papa en el país corresponde a la variedad Floresta. En adición, se debe prestar especial atención a las zonas de producción de semillas, ya que tubérculos-semilla podrían servir como fuente de inóculo.

ANGIOSTRONGILOSIS ABDOMINAL: UNA ZOONOSIS CRIPTICA [ABDOMINAL ANGIOSTRONGYLOSIS: A CRYPTIC ZOONOSIS]. P. Morera. Escuela de Medicina e Instituto de Investigaciones en Salud, Universidad de Costa Rica, San José, Costa Rica. pmorera@cariari.ucr.ac.cr.—La Angiostrongilosis Abdominal es una enfermedad parasitaria causada por un nemátodo, *Angiostrongylus costaricensis* Morera y Céspedes, 1971 (=*Morera-strongylus costaricensis* Chabaud, 1973). El primer caso de la enfermedad se encontró en Costa Rica en 1952, pero su causa se identificó en 1971. Posteriormente se investigó y se encontró el huésped definitivo y el huésped intermediario y se dilucidó su ciclo de vida. Actualmente sabemos que la enfermedad existe desde Estados Unidos hasta Argentina. También se encontró un caso autóctono en África, La prevalencia en Costa Rica es de unos 10 casos/100.000 habitantes/año. El ciclo de vida del parásito se desarrolla entre un roedor (varias especies han sido identificadas) y un molusco, más comúnmente babosas. En el hombre, igual que en el roedor, los parásitos se localizan en las arterias de la región ileocecal causando inflamación y daños del endotelio arterial, lo que en ocasiones causa trombosis y necrosis de la pared intestinal y como consecuencia, perforación y peritonitis. Además, hemos observado casos con localizaciones ectópicas, especialmente en el hígado y en el testículo en niños pequeños. En el primer caso se observa un cuadro muy similar al de *larva migrans visceral* y en el segundo, el cuadro clínico es generalmente confundido con aquél de la torsión testicular. En el Valle Central se observan más casos durante la época lluviosa, pero en la Zona Norte (con mayor precipitación) se presentan casi todo el año.

MOLECULAR EVIDENCE FOR DISCRETE NEMATODE COMMUNITIES IN THE RAINFOREST [EVIDENCIA MOLECULAR DE COMUNIDADES DISCRETAS DE NEMÁTODOS EN EL BOSQUE LLUVIOSO]. P. Mullin[1], T. O. Powers[1], T. Harris[1], A. Esquivel[2], R. M. Giblin-Davis[3], D. A. Neher[4] and S. P. Stock[5]. [1]Department of Plant Pathology, University of Nebraska, Lincoln, NB, USA, [2]Escuela de Ciencias Agrarias, Universidad Nacional, Heredia, Costa Rica, [3]Institute of Food and Agricultural Sciences, University of Florida, Fort Lauderdale, FL 33314, USA, [4]Plant and Soil Science Department, University of Vermont, Burlington, VT, USA, [5]Department of Entomology, University of Arizona, Tucson, AZ 85721, USA. tpowers@unl.edu.—The humid tropics are well-known for their rich diversity of plants and animals. Historical estimates of nematode diversity in the tropics however, suggest low to moderate levels of diversity when compared with temperate habitats. Several ecological explanations have been proposed to explain this "missing nematode diversity" in the tropics. Our studies in the rainforest preserve of the La Selva Biological Station in Costa Rica indicate that a majority of the nematode diversity may exist above the soil layer associated with organic litter and understory habitats. Using a molecular barcode approach based on 18S ribosomal DNA sequence and a vertically stratified sampling design, 167 unique molecular operational taxonomic units (MOTUs)

have been identified from 360 individual nematodes. MOTUs of 104 specimens were associated with litter or understory, but not observed from soil samples. Many of these non-soil inhabitants (17%) appear to be Tylenchinae or related subfamilies based on their phylogenetic position on the 18S nematode evolutionary tree. Within the tylenchid suborder Criconematina Siddiqi, 1980, *Discocriconemella*, *Hemicycliophora*, *Hemicriconemoides*, *Macroposthonia*, and *Paratylenchus* species are associated exclusively with soil, whereas Tylenchocriconema species are only recovered from the understory, presumably feeding on bromeliads. Estimates of total species richness range from 464 to 502 for the sample area, exceeding species richness estimates from the temperate grasslands.

CAL-AGRI PRODUCTS FOR THE MANAGEMENT OF IMPORTANT AGRICULTURAL PESTS [PRODUCTOS CAL-AGRI PARA EL MANEJO DE PLAGAS IMPORTANTES EN LA AGRICULTURA]. N. Nakada[1], R. M. Steckler[1] and E. C. McGawley[2]. [1]Cal Agri Products, LLC, Los Angeles, CA 90034, [2]LSU Agricultural Center, Department of Plant Pathology and Crop Physiology, Baton Rouge, LA, USA. norikinakada7@yahoo.com.—Over the past six years, entomologists plant pathologists and nematologists in California, Florida, North Carolina, New York, Minnesota, Louisiana, Idaho and in Spain, China, United Kingdom, Mexico, Saudi Arabia, Italy, Belgium, Australia, India, Indonesia, Korea, Pakistan, Vietnam and Morocco have evaluated the efficacy of the Agri 50 family of foliar pesticides and Agri-Terra against insects, phytoparasitic fungi and nematodes. This pesticide family has demonstrated efficacy against whiteflies, scale insects, selected aphid species and powdery mildew. This material is currently labeled in China, Morocco and in the European Union.

NEMATODE DIVERSITY IN THE TROPICS [DIVERSIDAD DE NEMATODOS EN EL TRÓPICO]. D. Neher. Plant and Soil Science, University of Vermont, USA. deborah.neher@uvm.edu.—Nematodes are known as one of the most speciose, abundant, and ubiquitous small animals on earth. In many habitats the species richness of nematodes exceeds that of all other multicellular animals. Ironically, the tropical rainforest is known as a region of relatively low nematode biodiversity. The simplest explanation is the tropics have not been adequately sampled. The symposium will begin to answer the critical question, "Where is the biodiversity of nematodes in the tropics?"

PERFORMANCE OF COMMERCIAL SOYBEAN VARIETIES WITH PI437.654 RESISTANCE TO *HETERODERA GLYCINES* [DESEMPEÑO DE VARIEDADES COMERCIALES DE SOYA CON RESISTENCIA DE PI437.654 A *HETERODERA GLYCINES*]. G. R. Noel[1], S. Bauer[2] and N. Atibalentja. [1]USDA, ARS and [2]University of Illinois, Urbana, IL 61801, USA.—The PI437.654 source of resistance to soybean cyst nematode (SCN), *Heterodera glycines,* has an immune reaction to almost all populations of SCN. The first variety developed with this resistance was 'Hartwig'. 'Hartwig' subsequently was used as the resistant parent to develop 'Ina' and 'CystX'. Resistance of 'Hartwig', 'Ina', and 'Cyst X' were evaluated in the greenhouse against SCN HG Types 0, 1, 1.2, 1.3, 3, and 5 by comparing the number of females that developed one month after inoculation with 3,000 eggs/7 cm diam pot. In field studies during 2002-2004, yield of CystX was compared to varieties with resistance from PI88.788 and Peking. 'CystX' expressed a high level of resistance to all populations in the greenhouse, however moderately susceptible plants were found. 'CystX' was not as resistant as 'Hartwig'. Resistance of 'CystX' and 'Ina' were similar except for HG Type 1.3 for which the IP was 0.3 for 'CystX' and 31 for 'Ina'. In the field trials yield of 'CystX' was 390 kg/ha, 1,189 kg/ha, and 659 kg/ha less than the highest yielding variety in 2002, 2003, and 2004, respectively.

GROUND TRUTHING: ASSESSING ACCURACY OF REMOTE SENSING FOR PRECISION AGRICULTURE [VERIFICACIÓN DE LA PRECISIÓN DE SENSORES REMOTOS EN LA AGRICULTURA DE PRECISIÓN]. J. W. Noling. University of Florida, Citrus Research and Education Center, Lake Alfred, FL 33850, USA. jnoling@ufl.edu.—Hyperspectral reflectance and other plant, field, and satellite imaging technologies have been used to characterize differences in crop yields, vegeta-

tive cover, as well as water, nutrient, and pest induced crop stresses. The ability to create accurate maps of nematode distributions, crop yields, loss indices, or prescription maps for nematicide application depends on the intensity of field sampling and spatial resolution describing nematode, crop, or soil characteristic. Given the inability to monitor nematode population density and distribution in real time, prescription maps for nematicide treatment decisions are frequently based on indirect measures, such as plant growth or root symptoms, or from other nematode-correlated soil factors. Ground truth surveying is an essential requirement for determining the accuracy of in-field or remotely sensed information, providing an independent, corroboration of information quality and validity. Since substantial crop and soil heterogeneity are often observed in the field, some form of ground based accounting is always needed to define causes of data variability, particularly when these technologies are unable to discriminate between nematode and other crop stress factors. Based on ground survey, interpolation of field measurements into more specific, unambiguous infestation or plant growth categories may also serve to dampen data variability influenced by site, soil, temporal, and environmental factors.

ISOLATION, IDENTIFICATION AND MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERIZATION OF NEMATOPHAGUS FUNGI FROM FIVE COUNTIES OF COSTA RICA [AISLAMIENTO, IDENTIFICACIÓN Y CARACTERIZACIÓN MORFOLÓGICA Y FISIOLÓGICA DE HONGOS NEMATÓFAGOS DEPREDADORES DE CINCO PROVINCIAS DE COSTA RICA]. **M. Orozco[1], V. Álvarez[2], A. Jiménez[3] and O. Acuña[4]. [1]Escuela de Ciencias Agrarias, Universidad Nacional, Apartado 86-3000, Heredia, Costa Rica, [2]Dirección de Sanidad Animal, Ministerio de Agricultura y Ganadería, [3]Laboratorio de Parasitología Veterinaria, Escuela de Medicina Veterinaria, Universidad Nacional, [4]Laboratorio de Procesos Orgánicos, Centro de Investigaciones Agronómicas, Universidad de Costa Rica. morozc@una.ac.cr.—**Samples of soil, organic fertilizers and faeces collected from five counties of Costa Rica were screened in order to isolate nematode destroying fungi through sprinkling technique. Twenty seven strains were isolated; 15 were identified as *Candelabrella musiformis*, 11 as *Arthrobotrys oligospora* and one as *Dactylella* sp., all of them bi or tridimensional nets producers. All the strains were characterized morphologically; micro and macroscopically, describing characteristics like shape, color, appearance of colonies as well as size of conidiophores, conidia, hyphae, etc. Next, 15 strains were chosen to determine their growth capability in five different carbon sources through the measurement of their rate of growth on those substrata. All the strains showed a similar pattern with rates of growth in the following order: cellulose>chitin>pectin>starch>skim milk. Also, a qualitative appreciation of mass production was done, all the strains developed the next pattern: pectin>skim milk>cellulose=chitin>starch. The rate of growth of fungi was independent of biomass production, but it depends on carbon source type. Information obtained in this study will be useful to mass production of spores, efficient inoculation ways and management of nematophagus fungi in soils in order to enhance their predatory activity.

***IN VITRO* PREDATORY ACTIVITY AND *IN VITRO* VIABILITY TEST OF SPORES OF NEMATOPHAGUS FUNGI ISOLATED FROM COSTA RICA FOR THE BIOLOGICAL CONTROL OF GASTROINTESTINAL NEMATODES OF RUMINANT [CAPACIDAD DEPREDADORA *IN VITRO* Y PRUEBA DE VIABILIDAD DE ESPORAS *IN VITRO* DE HONGOS NEMATÓFAGOS AUTÓCTONOS DE COSTA RICA PARA EL CONTROL BIOLÓGICO DE NEMÁTODOS GASTROINTESTINALES EN RUMIANTES].** **M. Orozco[1], V. Álvarez[2], A. Jiménez[3] and O. Acuña[4]. [1]Escuela de Ciencias Agrarias, Universidad Nacional, Apartado 86-3000, Heredia, Costa Rica, [2]Dirección de Sanidad Animal, Ministerio de Agricultura y Ganadería, [3]Laboratorio de Parasitología Veterinaria, Escuela de Medicina Veterinaria, Universidad Nacional, [4]Laboratorio de Procesos Orgánicos, Centro de Investigaciones Agronómicas, Universidad de Costa Rica. morozc@una.ac.cr .—**The predatory activity of 16 nematophagus fungi strains (*Candelabrella musiformis*, 9; *Arthrobotrys oligospora*, 6; and *Dactylella* sp., 1) was determined by means of an *in vitro* assay using a mixed larval population of gastrointestinal

nematodes (*Haemonchus* sp., *Trichostrongylus* sp. and *Oesophagostomum* sp.) from sheep and goats. The statistical analysis revealed highly significant differences in the predatory activity of the 16 strains, ranging between 9.8% and 99.6%. *C. musiformis* strains developed a heterogeneous range of activity compared with *A. oligospora* strains. *Dactylella* sp. developed an intermediate predatory activity. In general, *A. oligospora* strains were more efficient capturing larvae of the gastrointestinal nematodes used in the assay. Next, 11 strains were chosen (*Candelabrella musiformis*, 5; *Arthrobotrys oligospora*, 6) in order to test their spores; conidia in case of *A. oligospora* and chlamydospores and conidia in case of *C. musiformis* in an assay imitating the conditions of ruminant gastrointestinal tract. Only two *C. musiformis* strains presented positive results in the viability test of spores, which means they were able to survive the conditions of the assay. The information obtained in these trials will be useful in the development of inoculation methods of faeces, soil, or formulations for the biological control of gastrointestinal nematodes of ruminant.

PROGRESS IN FIELD MAPPING NEMATODE POPULATIONS AND POTENTIAL USES OF ELECTRICAL CONDUCTIVITY TO CREATE MANAGEMENT ZONES [PROGRESOS EN EL MAPEO DE POBLACIONES DE NEMATODOS Y USOS POTENCIALES DE LA CONDUCTIVIDAD ELÉCTRICA PARA CREAR ZONAS DE MANEJO]. C. Overstreet[1], E. C. McGawley[1], E. Burris[2], D. Cook[2], G. B. Padgett[3] and M. Wolcott[1]. [1]LSU Agricultural Center, Department of Plant Pathology and Crop Physiology, Baton Rouge, LA 70803, USA, [2]Northeast Research Station, St. Joseph, LA 71366, USA and [3]Northeast Research Station-Macon Ridge, Winnsboro, LA 71295, USA. coverstreet@agctr.lsu.edu.—Most of the cotton production areas in Louisiana are alluvial soils and many have variable soil textures (sands-clays) throughout the fields. This variability in texture can be measured using a Veris 3100 soil EC mapping system which measures apparent soil electrical conductivity (EC_a). The Veris 3100 soil EC mapping system sends and measures an electrical current (measured in mS/m) down to a depth of 0-30 cm ($EC_{a\text{-}sh}$) and 0-91 cm ($EC_{a\text{-}dp}$). Both sand and clay were found to be strongly correlated with $EC_{a\text{-}sh}$ (R^2 = -0.87 and 0.90, respectively) and $EC_{a\text{-}dp}$ (R^2 = -0.88 and 0.86, respectively). A number of fields totaling 162 ha were grid sampled for nematodes using a 0.4 ha size and predominate texture (based on EC_a) for that grid. The southern root-knot nematode (*Meloidogyne incognita*) was found to occur when the $EC_{a\text{-}sh}$ readings were <32 mS/s. Each field could be divided up into management zones based on the likelihood of root-knot nematode occurring in these zones. The area from all the fields that would require treatment with a nematicide averaged 69% and ranged from 38-100% in each field. Soil formations vary considerably between different areas, regions, or even countries and EC_a readings and ranges where root-knot nematode occurs would likewise vary. In soils that have at least some variability in texture, EC_a could be utilized to determine where root-knot nematode occurs and develop management zones based on predicted presence. Additionally, instead of sampling entire fields for nematodes, management zones that have been delineated by EC_a could be developed and a limited number of samples collected from these zones with similar soil texture.

NEMATODES BELONGING TO DORYLAIMIDA AND MONONCHIDA ORDERS AS SOIL QUALITY INDICATORS: THE CASE OF THE GUADIAMAR RIVER BASIN IN THE SOUTHERN IBERIAN PENINSULA [LOS NEMATODOS DE LOS ÓRDENES DORYLAIMIDA Y MONONCHIDA COMO INDICADORES DE LA CALIDAD DEL SUELO: EL CASO DE LA CUENCA DEL RÍO GUADIAMAR EN EL SUR DE LA PENÍNSULA IBÉRICA]. R. Peña-Santiago[1], D. Jiménez-Guirado[2], R. Murillo[2], G. Liébanas[1], P. Guerrero[1] and J. Abolafia[1]. [1]Dpto. de Biología Animal, Biología Vegetal y Ecología, Universidad de Jaén, Campus "Las Lagunillas" s/, Edificio B3, 23071-Jaén, España, [2]Dpto. de Zoología, Universidad de Córdoba, Campus de Rabanales, Edificio Ch. Darwin, 14071 Córdoba, España. rpena@ujaen.es.—In April 1998 a serious accident took place in a mining plot located near Aznalcóllar village (province of Seville, SW Iberian Peninsula) which caused a spill of toxic liquid waste to the Guadiamar River basin, and the subsequent soil contamination by heavy metals. Since 2000 a nematological study, focused on the species belonging to the orders Dorylaimida and Monon-

chida, was carried out to monitor the recovering process of the edaphic fauna in the affected area. The study of more than 200 soil samples led to the identification of two basic patterns in the nematode diversity (specific richness): i. a north-south spatial gradient of increasing diversity from the point of origin of the accident in the foothills of Sierra Morena towards the surrounding area of the Doñana National Park, near the Atlantic coast, ii. a temporal increase of diversity until the original levels before the accident was reached. These results reveal the usefulness of these nematode taxa as excellent bioindicators of the quality of the soil they inhabit.

DIFERENCIACIÓN MORFOLÓGICA Y MORFOMÉTRICA DE POBLACIONES VENEZOLANAS DE *MELOIDOGYNE MAYAGUENSIS* Y DE *MELOIDOGYNE INCOGNITA* [MORPHOLOGICAL AND MORPHOMETRIC DIFFERENTIATION OF VENEZUELAN POPULATIONS OF *M. MAYAGUENSIS* AND *M. INCOGNITA*]. G. Perichi[1], R. Crozzoli[1] and Z. Lugo[1,2]. [1]Universidad Central de Venezuela, Facultad de Agronomía, Postgrado de Zoología Agrícola, Apdo. 4576, Maracay, Aragua, Venezuela e [2]Instituto Nacional de Investigaciones Agrícolas (INIA-Falcón), Coro, Falcón, Venezuela. perichig@hotmail.com.—*Meloidogyne mayaguensis***, es un problema para las plantaciones comerciales de guayabo (*Psidium guajava* L.) del estado Zulia, Venezuela. Ha sido identificado recientemente en el país utilizando patrones isoenzimáticos y es difícil de diferenciar de *Meloidogyne incognita* utilizando taxonomía tradicional. Con la finalidad de contribuir a un diagnóstico rápido y confiable que permita identificar las especies, se caracterizaron morfológica y morfométricamente machos, hembras y juveniles de segundo estadio, de tres poblaciones de *M. mayaguensis* provenientes del estado Zulia y una de *M. incognita* procedente del estado Aragua, obtenidas a partir de una masa de huevos y multiplicadas en tomate cv Rutger. Algunas características de los machos, hembras y juveniles de segundo estadio de las poblaciones estudiadas no difieren entre si; sin embargo, otras, permiten diferenciar las especies. Los machos de *M. mayaguensis* se caracterizan por presentar una cabeza truncada y sin estriaciones cuticulares en cambio *M. incognita* presenta un disco labial cóncavo centralmente. El poro excretor de las hembras de *M. mayaguensis* se encuentra generalmente ubicado a nivel del bulbo medio, mientras que en *M. incognita* está ubicado anteriormente y cercano a la base del estilete; observándose una relación entre el poro excretor y la longitud del estilete (EP/ST) de 4,1-4,5 y 1,5-2,5, respectivamente. Los juveniles no poseen características importantes que permitan diferenciar fácilmente las dos especies.

USO DE HONGOS ENDOFÍTICOS PARA EL CONTROL BIOLÓGICO DEL NEMATODO BARRENADOR DEL BANANO *RADOPHOLUS SIMILIS* [USE OF ENDOPHYTIC FUNGI FOR THE CONTROL OF THE BURROWING NEMATODE *RADOPHOLUS SIMILIS*]. L. E. Pocasangre[1], R. D. Menjivar[2], A. Zum Felde[2], A. S. Riveros[3], F. E. Rosales[4] and R. A. Sikora[5]. [1]CATIE/INIBAP para América Latina y El Caribe, 2Convenio Universidad de Bonn, Alemania/CATIE, [3]Convenio CATIE/Universidad de Tolima, Colombia. C/O. CATIE, [4]INIBAP para América Latina y El Caribe y, [5]Universidad de Bonn, Alemania, Nussalle 9, D53115, Bonn, Alemania. lpoca@catie.ac.cr.—El objetivo de la presente investigación fue evaluar el efecto de cuatro hongos endofiticos sobre el nematodo barrenador *Radopholus similis* en el primer ciclo de cultivo en una siembra de renovación en la finca Formosa, situada en el Cantón Pococí, Costa Rica. Seis tratamientos fueron evaluados: dos aislamientos de *Trichoderma atroviride*, dos cepas no patogénicas de *Fusarium oxysporum*, un testigo químico, que consistió en la rotación de 3 nematicidas, Nemacur 15 G, Mocap 15 G y Counter 15 G. La primera aplicación se realizó 15 días después de la siembra y las subsiguientes en intervalos de 3 meses. El testigo absoluto consitió en plantas no inoculadas con hongos endofiticos, ni tratadas con nematicidas. Los seis tratamientos con diez repeticiones fueron distribuidos en un diseño completamente al azar con mediciones en el tiempo. Para el análisis de la información se realizaron contrastes ortogonales, análisis de variancia y separación de medias de los promedios de los 7 muestreos. Los resultados después de 7 muestreos mensuales demostraron que plantas protegidas con hongos endofiticos presentaron densidades de *R. similis* estadísticamente diferentes en comparación con el testigo químico (P =

0.0001). El número promedio detectado de *R. similis* por 100 g de raíces de los dos mejores hongos endofiticos *T. atroviride* S-2, y *F. oxysporum* P-12 fue de 13.468 y 15.918 respectivamente en comparación con 28.113 del tratamiento químico. Adicionalmente plantas protegidas con los hongos *T. atroviride* S-2 y *T. atroviride* MT-20 incrementaron en 21.39 y 8.43 libras el peso de racimo en comparación con el control químico (P = 0.0001). Estudios tendientes a conocer la persistencia del biocontrol en plantas protegidas en el segundo ciclo de producción están siendo realizados.

INTERACTION OF *POCHONIA CHLAMYDOSPORIA* VAR. *CATENULATA* WITH *RHIZOBIUM* SP., *TRICHODERMA HARZIANUM* AND *GLOMUS CLARUM* IN THE CONTROL OF *MELOIDOGYNE INCOGNITA* [INTERACIÓN DE *POCHONIA CHLAMYDOSPORIA* VAR. *CATENULATA* CON *RHIZOBIUM* SP., *TRICHODERMA HARZIANUM* AND *GLOMUS CLARUM* EN EL CONTROL DE *MELOIDOGYNE INCOGNITA*]. A. Puertas[1,2], B. M. de la Noval[3], B. Martínez[1], I. Miranda[1] and L. Hidalgo[1]. [1]Centro Nacional de Sanidad Agropecuaria, Apdo 10, San José de Las Lajas, La Habana, Cuba, [2]Universidad de Granma, Apdo 21, Bayamo, Granma, Cuba, [3]Instituto Nacional de Ciencias Agrícolas, Apdo 1, San José de Las Lajas, La Habana, Cuba. lhidalgo@censa.edu.cu.—The fungus *Pochonia chlamydosporia* var. *catenulata* (IMI SD 187) is a facultative parasite of root knot nematodes. The interaction of this fungus with *Rhizobium* sp., *Glomus clarum* and *Trichoderma harzianum*, biological agents extensively used in Cuban urban agriculture, was examined on kidney bean (*Vigna unguiculata* L. Walp sub-sp *sesquipedalis* L.) c.v Lina and tomato (*Lycopersicon esculentum* Mill) c.v Amalia crops grown in glasshouse conditions at the National Centre of Plant and Animal Health, La Havana, Cuba. The compatibility of *P. chlamydosporia* var. *catenulata* with *Rhizobium* sp., *T. harzianum* and *G. clarum* was demonstrated and its parasitic activity was promoted in the combined applications with *Meloidogyne incognita*. The smallest numbers of juveniles of *M. incognita* in soil were found in the treatments that included *P. chlamydosporia* var. *catenulata,* although the significant reductions in nematode populations were also observed in soil receiving the combined treatment of *T. harzianum* and *G. clarum*. The results suggest that nematode control could be improved by combining the use of *P. chlamydosporia* var. *catenulata* with *Rhizobium* sp., *T. harzianum* and *G. clarum*.

OVERVIEW ON THE USE OF FALLOW AND CROP ROTATION FOR NEMATODE MANAGEMENT IN BANANA CROPPING SYSTEMS [REVISIÓN SOBRE EL USO DE BARBECHO Y ROTACIÓN DE CULTIVOS PARA MANEJO DE NEMATODOS EN SISTEMAS DE CULTIVO DE BANANO]. P. Quénéhervé, R. Achard and C. Chabrier. IRD-Cirad, Laboratoire de Nematologie Tropicale, Pôle de Recherche Agro-environnementale de la Martinique, BP 214, 97285, Le Lamentin Cedex 2, Martinique (FWI). queneherve@ird-mq.fr.—During the last decade, considerable changes occurred in banana cropping systems, from the former concept of Integrated Pest Management (IPM) that relied heavily on the use of chemical control towards a more sustainable concept of Integrated Crop Management that favours non-chemical management of nematode populations. This transformation has been particularly more rapid in countries where environment, health and safety conditions were politically prioritized. But there are also other causes to this rapid transformation, i.e. economical context, environmental policies, or retailing chain requirements. In the French West Indies the reduction of pesticide use and impact on the environment is a major goal of agronomy research. As a result, approaches that combine different tools for nematode management such as the use of fallow, crop rotation and banana vitroplants are discussed in relation with the different banana cropping systems. For example, alternate cropping of bananas (5 years) and pineapple (2.5 years) combined with appropriate horticultural practices (chemical destruction of former banana plants, tillage, weeding) can be performed without insecticide and nematicide application. Also, some forage crops (*Brachiaria* spp., *Panicum maximum*) or green pasture (i.e., *Crotalaria* spp.) may be used as intercrops to remove key-pests from soil. However, the adoption of these horticultural practices strongly depends on the farm sizes and the growers' economic constraints.

IMPORTACIÓN DE NEMATICIDAS EN COSTA RICA, PERÍODO 2000-2004 [COSTA RICA NEMATICIDE IMPORTATION, PERIOD 2000-2004]. F. Ramírez-Muñoz. Área de Alternativas y Diagnóstico, Instituto Regional de Estudios en Sustancias Tóxicas (IRET), Universidad Nacional, Red de Acción en Plaguicidas y sus Alternativas para América Latina (RAPAL). Apdo 86-3000, Heredia, Costa Rica. framirez@una.ac.cr.—Costa Rica ha experimentado aumentos en la cantidad importada de nematicidas, a pesar de que el área agrícola se ha mantenido relativamente constante. Todos estos plaguicidas están clasificados por la Organización Mundial de la Salud, en cuanto a toxicidad aguda, como tipo I y II. El 70,3% son extremadamente peligrosos (tipo Ia) y el 29,6% son altamente peligrosos (tipo Ib). En el periodo 2000-2004, alrededor del 9% de los plaguicidas importados fueron nematicidas; productos como aldicarb, etoprofos, forato y terbufos significaron el 99% de la importación de plaguicidas tipo Ia, con 3377 toneladas de ingrediente activo. Otros nematicidas como el carbofuran, oxamil, cadusafos, carbosulfan, benfuracarb y triazofos representaron del 64 al 83% de las importaciones de plaguicidas Ib, con 1420 toneladas. Varios de estos nematicidas están incluidos en la lista de los 12 "plaguicidas a prohibir o restringir" de la XVI Reunión del Sector Salud de Centroamérica y República Dominicana (RESSCAD), por ser los responsables de la mayor morbimortalidad por intoxicaciones agudas. Debido a lo anterior, se hace necesario, por parte de centros de investigación y autoridades correspondientes, mayores esfuerzos en la búsqueda de alternativas agroecológicas a nematicidas y políticas más fuertes de restricción y prohibición de plaguicidas Ia y Ib, que eviten la gran cantidad de intoxicaciones agudas y los efectos crónicos producidos en la salud humana y el ambiente.

TRACEABILITY OF INFESTED PLANT GERMPLASM USING NEMATOLOGICAL ANALYSIS DATABASE BY THE INFORMATION COMPUTER SYSTEM [RASTREO DE GERMOPLASMA DE PLANTAS INFESTADAS USANDO ANÁLISIS NEMATOLÓGICO DE BASES DE DATOS POR MEDIO DE UN SISTEMA COMPUTARIZADO DE INFORMACIÓN]. V. R. V. Rissoli, H. R. F. Silva, J. E. Cares, R. C. V. Tenente and H. I. Nascimento. Universidade Católica de Brasilia, QS 07 Lote 01 70.022-900, Taguatinga, DF, Brasil. vandor@ucb.br.—The computer system of the Nematological Laboratory of Embrapa Genetic Resources and Biotechnology, denominated "Sistema de Informação de Germoplasma" (SIG), consists of a database showing the results of nematological analysis from imported plants into Brazil. SIG has permitted a fast and accurate interaction with data of intercepted exotic nematodes of the genus *Ditylenchus* from 1981 to 2005. The objectives of this program are to contribute to the traceability of intercepted nematodes in Brazil and to alert the national agriculture on a phytosanitary risk. The most intercepted species of nematodes came from USA in the products: rice (*D. parvus*), oat (*D. dipsaci*), cowpea (*D. obesus*), onion and cauliflower (*D. myceliophagus*), guizotia and sorghum (*D. dipsaci*); followed by Mexico: maize (*D. dipsaci*) in three different introductions (two in 1998 and one in 2001), France: potato (*D. acutus*) and melon (*D. dipsaci*). Other countries showing only one interception were: Argentina, soybean (*D. dipsaci*); Canada and Peru: potato (*D. dipsaci*); Israel: onion (*D. dipsaci*); Australia: Mirtaceae (*D. emus*); Colombia: rice (*D. equalis*). These results have shown the importance of this kind of research and that the exchanging of crops has to receive much more attention, especially for the mentioned countries.

UTILIZACIÓN DE NEMATODOS ENTOMOPATÓGENOS PARA EL COMBATE DE *PHYLLOPHAGA ELENANS* [USE OF ENTHOMOPATHOGENIC NEMATODES FOR *PHYLLOPHAGA ELENANS* CONTROL]. D. Rodríguez-García[1], M. Torres-Zamora[1], L. Uribe[1] and L. Flores[2]. [1]Centro de Investigaciones Agronómicas, Universidad de Costa Rica, y [2]Escuela de Agronomía, Universidad de Costa Rica. leo220883@hotmail.com.—La investigación tiene por objetivo detectar la presencia de nematodos entomopatógenos en muestras de suelo de diferentes fincas, y evaluar de forma preliminar, a nivel de laboratorio, su capacidad para infectar *Phyllophaga elenans*. Para ello se utilizaron como insecto trampa larvas de *Tenebrio mollitor* y en las pruebas de susceptibilidad, larvas de *Phyllophaga elenans* (10 larvas por tratamiento). De las muestras analizadas, el 31.6% presentaron nematodos y de estas se utilizó el 9.5% para las pruebas de susceptibilidad. Los mayores porcentajes de infección se

presentaron con la cepa 1 (procedente del agroecosistema "cerca arbolada" ubicada en una finca de Zarcero), a concentraciones de 25, 50 y 100 nematodos/mL con infecciones de 10%, 40% y 40% respectivamente. La cepa 2 (obtenida de suelo del sistema "café", situado en Los Santos) infectó el 30% de las larvas expuestas a una concentración de 25 nematodos/mL. Se determinó la susceptibilidad para los estadíos L2 y L3 de *P. elenans*; la cepa 1 a concentraciones de 50, 75 y 100 nematodos/mL presentó porcentajes de infección de 10%, 30% y 20% en L3, y en L2 de 40%, 60% y 40% respectivamente. Las cepas evaluadas tienen potencial para ser usadas como controladores biológicos de larvas de *Phyllophaga elenans*, sin embargo, es necesario realizar otras pruebas de laboratorio y campo con el fin de validar los resultados obtenidos.

INORGANIC AZIDES AS ALTERNATIVES TO METHYL BROMIDE IN THE FUMIGATION OF SOILS: A REVIEW [AZIDAS INORGÁNICAS COMO ALTERNATIVAS AL BROMURO DE METILO EN LA FUMIGACIÓN DE SUELOS: UNA REVISIÓN]. R. Rodríguez-Kábana and R. H. Walker. Auburn University, Auburn, AL 36849, USA. rrodrigu@acesag.auburn.edu.—Sodium and potassium azides have been researched for use in the dinsinfestation of soils for over three decades. These salts can be formulated in stable, safe, liquid or solid preparations that can be delivered into soil by a variety of techniques. SEP 100[R] a liquid formulation of sodium azide (NaN_3) has performed as well as or better than methyl bromide (MBr) for control of weeds, nematodes, and other soil-borne pests in extensive field testing in Alabama for the past four years. Applications of the formulation by drip irrigation have controlled nutsedges (*Cyperus* spp.) and other hard-to-kill weeds in field tests with cantaloupe, green pepper, and tomato. In addition, NaN_3 treatments controlled root-knot nematodes (*Meloidogyne* spp.), Fusarium crown rot of tomato (*Fusarium solani* f.sp. *lycopesici*) in tomato, and other fungal diseases in tests with the three crops. Yield response and disease control in the crops have been consistently as good or better than those obtained with MBr. Field tests with turf in Alabama, demonstrated potential of NaN_3 to substitute for MBr to solve problems caused by weeds and plant pathogenic nematodes. Results of field tests in other parts of the United States and in Canada by other researchers have corroborated the Alabama findings. Use of NaN_3 requires not only knowledge of its chemical and physical properties but also, understanding of its optimal placement in relation to the target pests. Accurate knowledge of NaN_3 movement and distribution by irrigation water in soil is prerequisite for successful pest control with the compound. NaN_3 has good potential for replacement of MBr in the production of most crops.

COMBINATIONS OF UREA WITH HYDROGEN CYANAMIDE AND PROPIONIC ACID FOR NEMATODE CONTROL [COMBINACIONES DE UREA CON CIANAMIDA DE HIDRÓGENO PARA EL CONTROL DE NEMATODOS]. R. Rodríguez-Kábana and L. J. Simmons. Department of Entomology and Plant Pathology, Auburn University, Auburn, AL 36849, USA. rrodrigu@acesag.auburn.edu.—A greenhouse study was conducted to assess the potential for nematicidal activity of mixtures of urea in combination with Procyan, an aqueous 50:50 (w:w) solution of hydrogen cyanamide (H_2CN_2) and propionic acid. Soil for the study was a sandy clay loam (pH 6.2; org. matter <1.0%; CEC <10 meq/100 g soil) from a cotton (*Gossypium hirsutum*) field infested with the reniform nematode (*Rotylenchulus reniformis*). Pots for the experiment were 10-cm-diam each with 1 kg soil. Urea was applied to soil by drenching at rates of: 0, 25, 50, 75, 100, and 125 mg/kg soil alone, and in combination with Procyan at 200 mg a.i./kg soil. The pots were covered with plastic bags immediately after treatment. After 9 days the bags were removed, soil samples (100 cm^3) were taken for nematological analyses (salad bowl incubation technique), and the pots were planted with 'Hutcheson' soybean (5 seed/pot). After 2 months the plants were removed and soil samples were taken from each pot. The roots were washed free of soil and the number of plants/pot and the fresh weights of roots and shoots were recorded. Number of nematodes in the roots was determined with the salad bowl technique. Applications of urea alone were ineffective for controlling the reniform nematode; however, all rates in treatments with Procyan resulted in almost complete suppression of the reniform nematode in pre-

plant samples. Microbivorous nematodes in the samples were increased by urea alone or with Procyan. No suppression of the reniform nematodes was observed in the final soil samples in response to applications of urea alone, while the opposite was true for combination treatments. Root populations of the reniform nematode were suppressed by both urea and the urea + Procyan treatments. Final populations of microbivorous nematodes in soil and roots were augmented by combination treatments but were unaffected or reduced by those with urea alone. Treatments with urea + Procyan resulted in heavier shoots and roots than all those with urea alone, except for the 125 mg rate. Data from the study indicate that urea applied at fertilizer rates can be nematicidal if combined with appropriate mixtures of propionic acid and H_2CN_2.

CROTONALDEHYDE FOR CONTROL OF NEMATODES [CROTONALDEHIDO PARA EL CONTROL DE NEMATODOS]. R. Rodríguez-Kábana and J. Simmons. Department of Entomology and Plant Pathology, Auburn University, Auburn, AL 36849, USA. rrodrigu@acesag.auburn.edu.—Crotonaldehyde (*trans*-2-butenal) is a naturally occurring liquid, volatile and lachrymatory compound used in industry for the synthesis of many other compounds and as a warning agent. Information on its nematicidal properties is limited. A greenhouse study was conducted to evaluate its activity against the reniform nematode (*Rotylenchulus reniformis*). Soil for the study was a sandy clay loam (pH 6.2; org. matter <1.0%; CEC <10 meq/100 g soil) from a cotton (*Gossypium hirsutum*) field infested with the reniform nematode. Pots for the experiment were 10-cm-diam each with 1 kg soil. Crotonaldehyde was applied to soil by drenching at rates of: 0, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 300 and 400 mg/kg soil. The pots were covered with plastic bags immediately after treatment. After 10 days the bags were removed, soil samples (100 cm^3) were taken for nematological analyses (salad bowl incubation technique), and the pots were planted with 'Hutcheson' soybean (5 seed/pot). After 2 months the plants were removed and soil samples were taken from each pot. The roots were washed free of soil and the number of plants/pot, shoot height, and the fresh weights of roots and shoots were recorded. Number of nematodes in the roots was determined by the same technique used for the soil samples. All rates of crotonaldehyde resulted in near total suppression of reniform and microbivorous nematodes in pre-plant samples. No reniform nematodes were observed in the final soil samples and in roots from pots treated with rates ≥200 mg. Control of the reniform nematode in the final soil samples by crotonaldehyde at rates <200 mg was directly proportional to application rates; populations in the roots were increased by the two lowest rates and suppressed proportionally to rates (R) in the range $100 \leq R \leq 200$ mg. Numbers of microbivorous nematodes in soil and root samples were enhanced by rates $25 \leq R \leq 200$ mg; applications at doses ≥200 mg resulted in drastic suppression of the nematodes. The height and fresh shoot weights of soybean plants increased sharply in response to applications of all but the highest rate of the compound. Root weights were improved only by applications in the range of $25 \leq R < 150$ mg. These results and the chemical properties of crotonaldehyde indicate that the compound is suitable for development as a nematicide with fumigant potential.

NEMATICIDAL PROPERTIES OF SODIUM AZIDE IN COMBINATION WITH PROPIONIC ACID [PROPIEDADES NEMATICIDAS DE LA AZIDA DE SODIO EN COMBINACIÓN CON ÁCIDO PROPIÓNICO]. R. Rodríguez-Kábana and L. J. Simmons. Department of Entomology and Plant Pathology, Auburn University, Auburn, AL 36849, USA. rrodrigu@acesag.auburn.edu.—A greenhouse study was conducted to assess the nematicidal properties of sodium azide (NaN_3) alone and in combination with propionic acid. Soil for the study was a sandy clay loam (pH 6.2; org. matter <1.0%; CEC < 10 meq/100 g soil) from a cotton (*Gossypium hirsutum*) field infested with the reniform nematode (*Rotylenchulus reniformis*). Pots for the experiment were 10-cm-diam each with 1 kg soil. NaN_3 was applied to soil by drenching at rates of: 0, 5, 10, 15, 20, and 30 mg/kg soil. NaN_3 (SEP 100^R) was applied alone and in combination with propionic acid at 100 mg/kg soil. The pots were covered with plastic bags immediately after treatment. After 2 wks the bags were removed, soil samples (100 cm^3) were taken for nematological analyses (salad bowl incubation technique), and the pots were planted

with 'Rowden' cotton (5 seed/pot). After 2 months, the plants were removed and soil samples were taken from each pot. The roots were washed free of soil and the number of plants/pot, shoot height, and the fresh weights of roots and shoots were recorded. Number of nematodes in the roots was determined by salad bowl technique. All rates of NaN3, with and without propionic acid, resulted in almost complete suppression of the reniform nematode in pre-plant samples. Microbivorous nematodes in the samples were suppressed by treatments containing the acid; NaN_3 alone had either no effect or increased numbers of these nematodes. No reniform nematodes were observed in the final soil samples and in roots from pots treated with NaN_3 at rates > 15 mg. Suppression of the reniform nematode by NaN_3 at rates ≥15 mg was enhanced by propionic acid. Final populations of microbivorous nematodes in soil and roots were either unaffected or were augmented by NaN_3 applications, with or without propionic acid. Azide treatments increased shoot height, shoot weights, and the number of plants per pot; combinations with propionic acid further increased values for these 2 variables. Roots were heaviest in plants from pots treated with NaN_3 alone at the 5 and 10 mg rates or with the 5, 10, and 15 mg rates plus the acid; all other NaN_3 rates had no effect on root weights. Data from the study suggest a degree of synergy between propionic acid and NaN_3 for nematode control and plant growth enhancement.

APPLICATION OF MOLECULAR PROCEDURES FOR DETECTION OF *POCHONIA CHLAMYDOSPORIA* FROM SOIL [APLICACIONES DE PROCEDIMIENTOS MOLECULARES PARA LA DETECCIÓN DE *POCHONIA CHLAMYDOSPORIA* A PARTIR DE SUELO]. L. Rosso[1], A. Ciancio[1] and M. Finetti-Sialer[2]. Istituto per la Protezione delle Piante, CNR, Bari, Italy[1], Dipartimento di Protezione delle Piante e Microbiologia Applicata, Università degli Studi, Bari, Italy[2]. a.ciancio@ba.ipp.cnr.it.—We compared two procedures for detection of the nematode parasitic fungus *Pochonia chlamydosporia,* directly from soil. Since DNA amplification from soil is often limited by organic contaminants purified together with nucleic acids, we tested two DNA extraction and detection procedures. The methods relied on the extraction of DNA through a traditional, phenol-chloroform based extraction protocol, or on the use of magnetic beads binding to nucleic acids in the suspension. Tests for sensitivity and specificity were developed using DNA extracted from a sandy soil treated with a commercial product based on *P. chlamydosporia,* or from pure cultures of the same isolate as control. The detection of the fungus DNA was performed through molecular hybridization (Dot-blot) and Real-time PCR amplification. Two probes of 500 and 600 nucleotides, respectively, were synthesized for Dot-blot detection. They recognized an internal region complementary to an alkaline serineprotease (VCP1) gene, or a fragment of the rRNA mitochondrial (rDNA) gene. For Real-time PCR, a molecular beacon was used to detect a specific sequence of 23bp in the VCP1 gene. The DNA obtained from the conventional procedure was not sufficiently pure to allow PCR amplification, but it enabled identification through the Dot-blot procedure. This protocol, although more time consuming, allowed the testing of several samples with a high sensitivity and specificity with a lower detection limit of 100ng of total DNA from soil. The use of magnetic beads in the DNA extraction from soil appeared as a simple procedure allowing the collection in a few minutes of large amounts of high quality DNA, ready for use in Real Time PCR.

THE ENVIRONMENTAL IMPACT OF THE USE OF NEMATICIDES ON THE AQUATIC ECOSYSTEM IN COSTA RICA [IMPACTO AMBIENTAL DEL USO DE NEMATICIDAS EN ECOSISTEMAS ACUÁTICOS EN COSTA RICA]. C. Ruepert, F. Ramírez and L. E. Castillo. Central American Institute for Studies on Toxic Substances (IRET), Universidad Nacional, Heredia, Costa Rica. cruepert@una.ac.cr.—The control of nematodes by nematicides is still very common, 9% of the total amount of the imported pesticides in Costa Rica during 2000-2004 were nematicides. Nematicides may enter watercourses especially when not incorporated in the soil and applied in the rainy season. Most of them have a high acute and chronic toxicity for fish and crustaceans and therefore pose ecological risks for the aquatic ecosystems downstream of the agricultural areas. Several studies carried

out during the past years in the Caribbean basin, have detected the presence of pesticides, including nematicides, in surface waters. Several insecticide-nematicides (chlorpyrifos, diazinon, cadusafos, carbofuran, ethoprofos and terbufos) were detected in concentrations that have the potential to damage aquatic life. The relative persistent ethoprofos was found in low levels in some of the lagoons of the Caribbean coastal wetland system. Fish kills have occurred in the surroundings of the banana and pineapple plantations in this area and some have been linked to the presence of terbufos and ethoprofos. To avoid environmental impact of the use of nematicides, and to protect the quality of the aquatic ecosystems, further actions are needed to reduce the emissions of nematicides from the field to water resources.

COMPARACIÓN *IN VITRO* DE CEPAS DE *ARTHROBOTRYS* Y *CANDELABRELLA* SEGÚN LA CAPACIDAD PARA CAPTURAR *RADOPHOLUS SIMILIS* [*IN VITRO* COMPARISON OF ABILITY OF STRAINS OF *ARTHROBOTRYS AND CANDELABRELLA* TO CAPTURE *RADOPHOLUS SIMILIS*] E. Salas, M. Obregón and R. Vargas. Dirección de Investigaciones, CORBANA S.A., Apdo. 390-7210, Guápiles, Costa Rica. esalas@corbana.co.cr.—Hongos aislados de suelo costarricense se cultivaron en papa-dextrosa-agar acidificado y se incubaron a 28°C por 8 días. Suspensiones de conidios en agua destilada estéril, se contaron en un hemacitómetro para ajustarlos a cerca de 9000 conidios inoculados por plato Petri con agar agua. Cuatro días después se agregó a estos platos 250 ± 40 *R. similis* reproducidos en discos de zanahoria que fueron originalmente aislados de raíces de banano. Los platos se mantuvieron en incubación a 28°C. El diseño utilizado fue de bloques al azar con 21 tratamientos y 8 repeticiones. Un testigo en agar-agua con la misma cantidad de nematodos permitió verificar la viabilidad de los mismos. Los bloques se evaluaron en diferentes fechas. A los cuatro días de inoculados los nematodos, se contó al estereoscopio el número de *R. similis* capturados y se estimó el porcentaje de captura según la suma del número de nematodos libres y capturados. Los datos se transformaron al arcoseno y se sometieron a un ANDEVA y separación de medias sin considerar el testigo que no tenía los hongos. Se encontraron diferencias (P = 0.0321) en la capacidad de captura de *R. similis* entre las cepas de los hongos. El porcentaje promedio de captura varió de 27% ± 9.7 a 88% ± 10.7. Las cepas con mayor porcentaje de captura variaron entre 60 y 88% y están siendo reevaluadas *in vitro*. De confirmarse los resultados, se evaluarán posteriormente en ensayos de invernadero.

RESEÑA DE LA INVESTIGACION FITONEMATOLOGICA EN COSTA RICA (1976-2006) [REVIEW OF NEMATOLOGICAL RESEARCH IN COSTA RICA (1976-2006)]. L. Salazar. Laboratorio de Nematología, Centro de Investigación en Protección de Cultivos, Escuela de Agronomía, Universidad de Costa Rica, Ap 2060, San Pedro, Montes de Oca, San José, Costa Rica. salazarf@cariari.ucr.ac.cr.—En las últimas tres décadas, los problemas causados por nematodos fitoparásitos se han vuelto más frecuentes en Costa Rica. El género *Meloidogyne*, el más común e importante por los daños y pérdidas en cultivos como hortalizas, arroz, cafeto, melón, ñame, fresa y plantas ornamentales de flor y follaje entre otros, esto justifica los numerosos esfuerzos en investigaciones que se continúan realizando para conocer y combatir por diversos métodos este importante grupo de nematodos. Identificados morfológicamente hasta el momento están *M. incognita*, *M. hapla*, *M. javanica*, *M. exigua*, *M. salasi*, *M. arabicida* y *M. arenaria*, actualmente se trabaja en nuevos materiales que podrían dar nuevas especies para Costa Rica. En banano, entidades involucradas con el cultivo han generado valiosas investigaciones relacionadas con el serio problema de *Radopholus similis*. Con *Pratylenchus* al menos cinco especies *P. brachyurus*, *P. zeae*, *P. penetrans*, *P. coffeae* y *P. gutierrezi*; han sido identificadas para Costa Rica en una amplia gama de cultivos. Investigaciones de la empresa privada con *Rhadinaphelenchus cocophilus* en palma aceitera han culminado con la reducción de la enfermedad gracias al manejo integrado del problema. En el 2005 por medio de métodos convencionales y moleculares se determinó por primera vez en Costa Rica la presencia de *Globodera pallida* en papa. La inminente salida del mercado de algunos de los productos nematicidas convencionales, ha obligado en los últimos años, a realizar múltiples esfuerzos en la búsqueda de alternativas más amigables con el medio ambiente, razón

por la que se han explorado en el control biológico (hongos, bacterias, micorrizas, etc.), el físico (solarización, vapor de agua), el cultural (rotación de cultivos) y la aplicación de diferentes tipos de materia orgánica.

POPULATION REDUCTION OF *HETERODERA GLYCINES* FROM HARVEST TO PLANTING OF SOYBEAN IN PARAGUAY [REDUCCIÓN DE LA POBLACIÓN DE *HETERODERA GLYCINES* DE LA COSECHA A LA SIEMBRA DE SOJA EN PARAGUAY]. Z. Sano[1], L. Pedrozo[2] and Z. Trabucco[2]. [1]Japan International Research Center for Agricultural Sciences, [2]Instituto Agronomico Nacional, Ruta 48.5, Caacupe, Paraguay. sanoz@affrc.go.jp.—Population changes in *Heterodera glycines* from harvest to planting of soybean were examined in three field plots in Paraguay. Susceptible soybean cultivars were grown from late October, 2004 to early March the following year. Oat was grown after soybean in two of the three plots and the remaining plot was kept under fallow. Soil samples were collected once every two months from the end of November in 2004 to early October in 2005 from a soil depth of 0-20 cm in the soybean rows. Nematode cysts were extracted using a flotation sieving technique from air dried soil and counted. Approximately 40 cysts per sample were randomly selected, crushed individually, and eggs and second-stage juveniles (J2) were counted. Egg and J2 populations initially decreased rapidly for two months from early March (soon after harvest) and decreased gradually thereafter. Final survival rates (percentage of March population) in early October (before planting) were fairly low, less than 25%. Average numbers of eggs and J2 per cyst were more than 80 in early March which rapidly decreased until July, but decreased only slightly after that. Considerably large percentages of empty cysts were present even in March which attained 70% in July, but a few cysts still contained considerably large numbers of eggs and J2 in October. Results suggest eggs may hatch without delay in many cysts resulting in a rapid population reduction during the over-wintering period in Paraguay, though a few cysts may become dormant and survive longer.

INTEGRATED MANAGEMENT OF PLANT-PARASITIC NEMATODES AND THE CORM-WEEVIL ON PLANTAINS [MANEJO INTEGRADO DE NEMATODOS FITOPARÁSITOS Y DEL PICUDO DEL CORMO EN PLÁTANO]. J. C. Santiago González, J. A. Chavarría-Carvajal and R. A. Franqui-Rivera. Department of Crop Protection, Mayagüez Campus, University of Puerto Rico. Department of Crop Protection, Mayagüez Campus, University of Puerto Rico, Mayagüez, Puerto Rico 00681. jchavarria@uprm.edu.—Plantains have many natural enemies, the worst of which are the plant-parasitic nematodes and the corm-weevil *Cosmopolites sordidus* (Germar). Traditional management strategies for both pests are based on chemical pesticides. However, recently some of these chemicals have been banned because of environmental risk and food safety. Alternative practices to the use of broad-spectrum synthetic pesticides for the management of phytonematodes in high value tropical crops are receiving increasing attention. A field experiment was established at Isabela Substation to study the effectiveness of selected practices for the management of plant-parasitic nematodes and the corm weevil. As planting material, plantain (*Musa acuminata* × *M. balbisiana* cv. 'Maricongo') was spaced at 1.8 m × 1.8 m for a population density of 3,086 plants/ha. The experimental design was a RCB with four replicates and five treatments. Treatments consisted of: T1. Rotation scheme of velvetbean (*Mucuna deeringiana*) + plantain; T2. Pre-plant soil incorporation of poultry litter (7.3 kg/plant) + plantain; T3. Rotation scheme of velvetbean + pre-plant soil incorporation of poultry litter (7.3 kg/plant) + plantain; T4. Chemical Control (Nemacur 15G 3.0 g a.i./plant/application) + plantain; and T5. Absolute Control. Nematode populations were estimated at the end of the rotation cycle and at intervals of 4 months thereafter. Nematode populations in the rotation scheme with velvetbean (T1), velvetbean plus poultry litter (T2) or poultry litter alone (T3) showed the lower nematode populations associated to soil between 8 and 12 months alter planting. There were not significant differences between treatments for nematode populations associated to root tissue at the end of the experiment. Treatments T1, T3 and T2, showed the best increase in bunch weight. Damage caused by corm-weevil was significantly superior in the absolute control in comparison with the integrated management practices.

ALTERNATIVES FOR METHYL BROMIDE IN THE WESTERN USA, IMPACT FOR NEMATODE CONTROL ON MAIN CROPS [ALTERNATIVAS AL BROMURO DE METILO EN EL OESTE DE ESTADOS UNIDOS, IMPACTO EN EL CONTROL DE NEMATODOS EN LOS CULTIVOS PRINCIPALES]. S. Schneider[1], T. Trout[2] and H. Ajwa[3]. [1]USDA ARS, Parlier, CA, 93648, U.S.A., [2]USDA ARS, Ft. Collins, CO, 80526, USA, and [3]University of California, Salinas, CA, 93905, USA. sschneider@fresno.ars.usda.gov.—Methyl bromide has been used for decades to provide consistent control of soilborne pests, pathogens and weeds in a diversity of cropping systems, including annual fruits and vegetables, floral crops, perennial crop replant, and certified propagative materials. Alternatives to methyl bromide for nematode control have been found for many situations. Western crops for which the USA continues to submit Critical Use Nominations include propagative material nurseries (including fruit and nut trees, grapevines, raspberries, roses, forest trees, strawberry runners, sweet potato slips, and flower bulbs), perennial crop replant (stonefruit, grapes, walnuts, and almonds), flower crops, and strawberry fruiting fields. The barriers to adoption of new alternatives are not only technical (diagnostics and consistent efficacy), but also regulatory, economic, and human nature. California strawberries and flower crops are mainly concerned with pathogen and weed control, rather than nematode control. Strawberries have transitioned a significant amount of production to fumigation with 1,3-dichloropropene (1,3-D) + chloropicrin or chloropicrin alone. It is possible that after multiple years of fumigation with weaker nematicides, such as chloropicrin, nematodes might re-emerge as significant problems. Perennial crop replant situations have adopted alternatives, where possible, due largely to economics. Regulatory constraints limit the use of 1,3-D per township and restrict the maximum allowed rate to a level that is insufficient for acceptable nematode control in fine-textured soils. Propagative material must be certified as free from economically important nematodes in California. Methyl bromide and 1,3-D (under a narrower range of soil conditions) are approved as certified nursery treatments prior to planting. Iodomethane has performed well in field trials, but is not yet registered for use. Progress is being made, but challenges remain in the identification of methyl bromide alternatives for nematode control in the Western USA.

SITE-SPECIFIC NEMATODE MANAGEMENT—WHAT GOES WHERE AND WHY? [MANEJO SITIO-ESPECÍFICO DE NEMÁTODOS—DÓNDE Y POR QUÉ?]. S. M. Schneider. USDA ARS, San Joaquin Valley Agricultural Sciences Center, Parlier, CA, 93648, USA. sschneider@fresno.ars.usda.gov.—Site-Specific Management, also known as Precision Agriculture, has two primary components. First, is the gathering of on-farm information pertaining to the variation and interaction of site-specific spatial and temporal factors affecting crop production. Second, using that information to select and deliver site-specific application of agricultural management practices and inputs for agriculture production systems to maximize productive efficiency while minimizing negative environmental impacts. The availability of Global Positioning Satellite (GPS) systems and Geographic Information Systems (GIS) for agricultural production practices makes site-specific crop management possible. Maps of crop yield and quality, soil characteristics (texture, pH, nutrient status, etc.), topography, and pest population levels can be developed and used to make management decisions. Fertilizer, irrigation water, and pesticides can be applied only where needed and only at the rates needed. Economic thresholds based on whole field management must be re-evaluated in light of site-specific control strategies. Management zones can be identified based on economic thresholds, equipment constraints, and relevant site-specific data. Site-specific application and monitoring equipment is available. Additional biological research is needed to develop site-specific management plans based on a thorough understanding of the interactions of the physical, chemical, biological, economic, and environmental components of the agricultural production system. Only then can the capabilities of site-specific technologies be fully realized.

EFFECTS OF ACROLEIN (2-PROPENAL) SOIL TREATMENT FOR SOYBEAN AND CUCUMBER [EFECTO DEL TRATAMIENTO DE SUELO CON ACROLEINA PARA SOYA Y PEPINO]. L. J. Simmons and R. Rodríguez-Kábana. Department of Entomology and Plant Pathology, Auburn University,

Auburn, AL 36849, USA. simmole@auburn.edu.—The herbicidal properties of acrolein have been known for quite some time, and recently the nematicidal properties have also been reported. The nematicidal activity of this compound has yet to be reported in relation to crop production. Greenhouse trials using field soil infested with *Meloidogyne* spp. were conducted in 2006 to evaluate the effects of acrolein treatments (by drench application) on soil to be planted in soybean (*Glycine max*) and cucumber (*Cucumis sativus*). Pre-plant samples of both trials (approx. 10 days after treatment) indicated that rates of 30-40 mg/kg soil reduced root-knot populations to zero, while saprophagous nematode populations still remained intact. Initial soybean stand counts were significantly increased with acrolein rates of 40-80 mg/kg and at 160-200 mg/kg soil; final soybean stand counts were significantly higher with 40, 60, 80, 140, 160, and 200 mg/kg soil. No significant differences were noted in initial cucumber stand counts; however, excellent germination was noted in response to all acrolein treatments. No acrolein treatment averaged less than 4.6 plants out of 5 germinating and surviving, while the two controls averaged 4.3 and 4.1. In the soybean test, treatments ≥60 mg/kg soil had no extractable root-knot nematodes from the roots, and treatments ≤50 mg/kg soil had low populations of the nematode at harvest. All treatments had high populations of saprophagous nematodes in the roots and soil. These data show that drench application of acrolein (comparable to drip irrigation in field situations) may be an effective means of controlling plant parasitic nematodes in these two plant systems.

HOST STATUS OF *MELOIDOGYNE FLORIDENSIS* ON SELECTED WEEDS AND COVER CROPS COMMON TO FLORIDA [EVALUACIÓN DE LA REPRODUCCIÓN DE *MELOIDOGYNE FLORIDENSIS* EN MALEZAS SELECCIONADAS Y CULTIVOS DE COBERTURA COMUNES EN FLORIDA]. **J. Stanley[1], N. Kokalis-Burelle[2] and D. Dickson[3]. [1]Florida Department of Agriculture, Gainesville, FL 32614, USA, [2]USDA, ARS, U.S. Horticultural Research Lab, Ft. Pierce, FL 34945, USA, [3]Entomology and Nematology Department, University of Florida, Gainesville, FL 32611, USA. stanlej@doacs.state.fl.us.—***Meloidogyne floridensis* is a new species of root-knot nematode infecting peach (*Prunus persica*) in Florida. The host status of 10 plant species to *M. floridensis* was determined. Plants included five weeds: *Datura stramonium*, *Ipomoea quamoclit*, *Malva sylvestris*, *Nasturtium officianalis*, *Passiflora edulis*, and five cover crops: *Brassica napus*, *Crotalaria juncea*, *Sesamum indicum*, *Sorghum bicolor* var. sudanense, and *Trifolium incarnatum*. Five plants of each species were inoculated with 5,000 *M. floridensis* eggs and five were noninoculated controls. Good hosts were *T. incarnatum* (Rf = 18), *M. sylvestris* (Rf = 14), *B. napus* (Rf = 8), *N. officianalis* (Rf = 6), and *I. quamoclit* (Rf = 5). Poor hosts included *C. juncea* (Rf = 0.5) and *S. indicum* (Rf = 0.2). Nonhosts were *D. stramonium* (Rf = 0.04), *S. bicolor* (Rf = 0.04), and *P. edulis* (Rf = 0.01). Eggs per gram of roots ranged from 8025 to 2116, 244 to 76, and 9 to 2 for good, poor, and nonhosts, respectively. Gall rates ranged from 0 to 2.8 for good hosts and 0 for poor and nonhosts. Differences regarding fresh root and shoot weight of inoculated vs. noninoculated plants occurred with root weights of *T. incarnatum* and *C. juncea*.

EFFICACY OF AGRI-TERRA AGAINST PHYTOPARASITIC NEMATODES [EFICACIA DE AGRI-TERRA CONTRA NEMATODOS FITOPARÁSITOS]. **R. M. Steckler[1], N. Nakada[1] and E. C. McGawley[2]. [1]Cal Agri Products, LLC, Los Angeles, CA 90034 and [2]LSU Agricultural Center, Department of Plant Pathology and Crop Physiology, Baton Rouge, LA, USA. rms@usinter.net.—**Nematologists in California, Florida, North Carolina, Minnesota, Louisiana, Idaho and in Spain, China and Morocco have evaluated the efficacy of Agri-Terra, a reduced risk pesticide, against phytoparasitic nematodes over the last six years. Agri-Terra has been tested on Bermuda grass, lantana, pepper, tomato, cotton, soybean, rice, sugarcane, cabbage, endive, lettuce, mustard, tobacco, cucumber, and potato against a wide spectrum of nematodes including reniform, root-knot, soybean cyst, lesion, lance, stunt, ring, stubby-root, dagger and spiral. In all cases the material has been shown to be nematicidal.

INTRODUCTION TO THE USE OF ENTOMOPHILIC AND ENTOMOPATHOGENIC NEMATODES [INTRODUCCIÓN AL USO DE NEMATODOS ENTOMOFÍLICOS Y ENTOMOPATÓ-

GENOS]. S. P. Stock. Department of Entomology, University of Arizona, Tucson, AZ 85721, USA. spstock@ag.arizona.edu.—Sustainable IPM in the 21st century will dependent on alternative strategies for pest management that are environmentally friendly and reduce the amount of human contact to chemical pesticides. One of the most promising choices to help minimize usage of chemical pesticides is the implementation of biological control agents such as natural enemies, parasites and pathogens. Among them, entomophilic and entomopathogenic nematodes have shown they can exert considerable control of target populations of noxious pests. Over the past years, emphasis has been placed on both the discovery of native species and strains, as well as in the introduction of exotic species, particularly currently available nematode formulations for the control of diverse invertebrate pests of agricultural and forestry relevance. Hundreds of laboratories worldwide are now exploring the potential of these nematodes to control native and exotic noxious pests. The invited speakers of this symposium will provide an overview of the research currently being conducted at their respective countries and/or institutions.

UNEARTHING THE SECRETS OF ENTOMOPATHOGENIC NEMATODE DIVERSITY [DESENTERRANDO LOS SECRETOS DE LA DIVERSIDAD DE NEMATODOS ENTOMOPATÓGENOS]. S. P. Stock. Department of Entomology, University of Arizona, Tucson, AZ, 85721 USA. spstock@ag.arizona.edu.—The tropics are one of the world's hot spots for biological diversity. This diversity is mostly represented by inconspicuous invertebrates, such as insects, crustaceans, mites, and nematodes, among others. Because of their biological control potential, entomopathogenic nematodes (EPN) *Steinernema* and *Heterorhabditis* are the most studied group of insect-parasitic nematodes. Significant efforts have been placed to document the biological diversity of these nematodes, indicating they are a major component of the soil environment of our planet. Variation in their abundance across seasons, habitats and geographic regions has also been documented. Factors such as soil texture, moisture content, temperature, and host availability are thought to be important in determining distribution of EPN. In the past decade, the number of newly described EPN species had an exponential growth. Interestingly, more than 60% of these species were discovered in tropical and subtropical regions, suggesting that the greatest diversity of these nematodes may be harbored in such regions. In this presentation, EPN biogeographic patterns will be discussed in the context of biotic and abiotic parameters, sampling efforts and current diagnostic approaches.

PEST IMAGE DATABASE WITH EMPHASIS ON NEMATODES OF THE GENUS *DITYLENCHUS* [BASE DE DATOS DE IMÁGENES DE PLAGAS CON ÉNFASIS EN NEMATODOS DEL GÉNERO *DITYLENCHUS*]. R. C. V. Tenente, V. R. V. Rissoli, J. E. Cares, A. P. Passos, A. P. B. Souza and G. O. Hiragi. Embrapa/Cenargen, CP 02372 (70849-970), Brasília, DF, Brasil. renata@cenargen.embrapa.br.—Pest introduction in production areas can be a disaster from the social, economic and environmental points of view. The strong support of a national phytosanitary defense system is crucial to prevent this and for agricultural business success. Several species of plant parasitic nematodes show characters indicating the potential of becoming alien invasive species. The accurate and fast identification of those species in imported material is fundamental for the adoption of control measures, avoiding the introduction of these organisms. This work aims to elaborate image database referring to morphological characters of each species as a complement to permanent slides. The database contains about 250 images of 12 different species of *Ditylenchus*: *D. africanus*, *D. destructor*, *D. dipsaci*, *D. myceliophagus*, *D. triformis*, *D. equalis*, *D. terricolus*, *D. parvus*, *D. obesus*, *D. medicagines* and *D. filimus*. For this year the purpose is to include more than 400 images.

THE REACTION OF DIFFERENT BANANA CLONES ON THE DEVELOPMENT OF TWO *MELOIDOGYNE INCOGNITA* RACES [REACCIÓN DE DIFERENTES CLONES DE BANANO AL DESARROLLO DE DOS RAZAS DE *MELOIDOGYNE INCOGNITA*] R. C. V. Tenente, M. B. Fonsêca Junior, A. I. M. Sousa, S. O. Silva, S. P. Silva Neto, E. G. Silva and O. A. Carrijo. [1]Embrapa/Cenargen,

CP02372, Brasília/DF (70770-900); [2]Bolsista/CNPq; [3]Bolsista/Embrapa; [4]Embrapa/CNPMF, Cruz Almas/BA; [5]Campo Biotecnologia, Paracatu/MG and [5]Embrapa/CNPH, BrasíliaDF. renata@cenargen.embrapa.br. This experiment was included in one big project that studies the banana clone reaction to *Meloidogyne* species. This experiment was carried out at Embrapa Genetic Research and Biotechnology in Brazil, to determine the reaction of 20 clones to *M.incognita* races 1 and 4, under greenhouse conditions. The evaluated parameters were the multiplication rate (RR), root and aerial part weight, and plant height. The results showed that highest value for RR of the *M. incognita* race 1 and race 4 was in Tropical variety that was denominated the standard clone. The ranges used for RR were from 7.43 to 2.19 (race 1) and 7.49 to 1.09 (race 4). The RR for others clones were 4.53 and 5.46 (Grande Naine); 6.58; 5.3 (PA42-44); 3.8; 6.43 (ThapMaeo); 4.25; 7.3 (PrataZulu) and only for race 4, 6.34 (FHIA2). These clones showed the reaction type was Lower Resistant (LR) for ST4231; ST4208; FHIA18; Willians; Bucaneiro; Maçã; Prata Anã and Preciosa, for both races. Only for race 4, LR was in PA4219 and Mação. Only Prat Anã and Preciosa showed Moderate Resistant for race 4. There were differences for the root weight and height, among the studied clones. Therefore, the results showed the possibility to find resistance reaction among banana clones.

CONSTRUCTION AND CALIBRATION OF A NEMATODE POPULATION DYNAMICS MODEL: APPLICATION TO THE MANAGEMENT OF PLANT-PARASITIC NEMATODES IN BANANAS [CALIBRACIÓN Y CONSTRUCCIÓN DE UN MODELO DE DINÁMICA DE POBLACIÓN DE NEMATODOS: APLICACIÓN PARA EL MANEJO DE NEMATODOS FITOPARÁSITOS DEL BANANO]. P. Tixier. CIRAD, UR 26, PRAM, BP 214, Le Lamentin, Martinique, France. tixier@cirad.fr.—*Radopholus similis*** and ***Pratylenchus coffeae*** are plant-parasitic nematodes that generate extensive root lesions and are considered to be among the most detrimental pathogens of banana. The management of these pests includes the understanding of the dynamic of their populations. We present the biological background needed to design a population model to simulate the *R. similis* and *P. coffeae* populations in banana cropping systems. This model called SIMBA-NEM is based on a cohort chain structure and a logistic function to describe population growth in relation with i) an environmental carrying capacity (K) depending on the available banana root biomass, ii) an intrinsic growth rate (c), and iii) the interspecific competition. Soil water content and nematicide applications are considered to be the main variables influencing the intrinsic population growth rate of each species. Nematode population datasets collected from experiments conducted in Guadeloupe and Martinique (French West Indies) were used to calibrate and to validate the model. This modelling method has permitted to formalize and to integrate the knowledge of nematologists in a predictive tool. The specificities of the relation in the nematode-banana complex were accounted by the root biomass dynamic and the choice of parameters that impact the nematode populations. SIMBA-NEM can be used in different ways, it allows an *Ex-Ante* analyse of *R. similis* and *P. coffeae* populations in banana monoculture and in sugarcane-banana rotations. We also used this model to optimize the effect of nematicide application. Such a tool can already be helpful for designing sustainable and more environment-friendly banana based cropping systems.

AISLAMIENTO DE NEMÁTODOS ENTOMOPATÓGENOS EN FINCAS DE MANEJO AGROECOLÓGICO EN COSTA RICA [ISOLATION OF ENTOMOPATHOGENIC NEMATODES FROM ORGANIC FARMS IN COSTA RICA] L. Uribe[1], L. Flores[2], M. Solano[1] and A. Rodríguez[3]. [1]Centro de Investigaciones Agronómicas, Universidad de Costa Rica, [2]Escuela de Agronomía Universidad de Costa Rica y, [3]Dirección de Investigación y Extensión de la Caña de Azúcar (DIECA), Costa Rica. luribe@cariari.ucr.ac.cr.—La caña de azúcar, cultivo que constituye un importante aporte la economía de Costa Rica, se ve afectado por diferentes insectos plaga. Una de las especies que se encuentra con mayor frecuencia es *Phyllophaga elenans* (Coleoptera: Scarabaeidae), que se distribuye a lo largo de la Región del Pacífico Central y Norte del país. El estado larval del insecto se alimenta de la raíz de la planta afectando el desarrollo de la misma. Debido a que el control químico no ha sido efectivo, con-

sideramos importante explorar el uso de nemátodos entomopatógenos (NEP) para el control delesta plaga. Para ello, durante el año 2005, se implementó un pie de cría de *P. elenans* y se procedió al aislamiento de NEP a partir de cinco fincas con manejo agroecológico. Las fincas forman parte del proyecto Agricultura Orgánica y Gases con efecto invernadero ejecutado por la Corporación Educativa para el Desarrollo Costarricense (CEDECO). Se recolectaron muestras a partir de diferentes cultivos y de una zona boscosa presente en cada finca y se analizó la biomasa y respiración microbianas así como los grupos dominantes de artrópodos. Se obtuvo un total de 12 aislamientos procedentes de todas las fincas y de la mayoría de manejos, sugiriendo que las fincas agroecológicas constituyen un importante reservorio para la diversidad del sistema. De los seis aislamientos evaluados a nivel de laboratorio por su capacidad de infectar el estadío L2 de *P. elenans*, se encontraron 3 cepas de NEP nativas causan muerte de las larvas de *Phylophaga*, indicando que existe potencial para el control de larvas de Scarabaeidae utilizando cepas NEP autoctonos.

AISLAMIENTO E IDENTIFICACIÓN DE NEMATODOS ENTOMOPATÓGENOS Y SUS BACTERIAS SIMBIONTES EN ZONAS PROTEGIDAS Y AGROECOSISTEMAS DE COSTA RICA [ISOLATION AND IDENTIFICATION OF ENTOMOPATHOGENIC NEMATODES AND THEIR SYMBIOTIC BACTERIA FROM NATURAL AND PROTECTED ECOSYSTEMS IN COSTA RICA]. **L. Uribe-Lorío[1], E. Castillo[1], M. Mora[1] and S. Patricia Stock[2]. [1]Centro de Investigación en Biología Celular y Molecular, Universidad de Costa Rica y, [2]Department of Entomology, University of Arizona, Tucson, AZ 85721, USA. loreuribe99@yahoo.com.—**El neotrópico y en particular Costa Rica constituye un reservorio exhuberante de biodiversidad. En el afán por preservar esta biodiversidad, Costa Rica ha dedicado alrededor del 25% de su territorio al establecimiento de diversas áreas y reservas de conservación. Los microorganismos son un componente esencial de esta biodiversidad. El Área de Microbiología Ambiental y Prospección génica del CIBCM esta abocado a estudiar diversos ambientes asociados a áreas protegidas. Esto incluye la búsqueda e identificación de nematodos entomopatógenos de las familias Steinernematidae y Heterorhabditidae y el aislamiento de sus bacterias simbiontes, con el fin de aislar nuevas especies y/o cepas que esten adaptadas a plagas nativas y su posterior implementacion en el control de das mismas. Hasta el momento, se han logrado aislar 5 nematodos entomopatógenos pertencientes a la familia Steinernematidae en diferentes areas protegidas y agroecosistemas de Costa Rica. De estas cepas, dos de ellas han sido identificadas (por medio de morfología y secuencias de ADN ribosómico) como especies nuevas y se encuentran en proceso de descripción, y se esta llevando a cabo la caracterización de 3 aislamientos de reservas naturales y 1 de agroecosistemas. Se han logrado aislar y caracterizar por métodos bioquímicos clásicos y automatizados a cuatro simbiontes bacterianos extraídos de estos nematodos, y se determinó mediante taxonomía molecular su similitud a *X. nematophilus*, *Xenorhabdus bovienii* y *Xenorhabdus szentirmaii* y *Xenorhabdus* sp.

EFECTO DEL NÚMERO DE APLICACIONES DE NEMATICIDA SOBRE EL NÚMERO DE NEMATODOS, CONTENIDO DE RAÍCES Y LA PRODUCCIÓN DE PLANTAS *IN VITRO* DE BANANO (*MUSA* AAA) SEMBRADAS EN ÁREAS DE RENOVACIÓN [EFFECT OF NEMATICIDE APPLICATION ON NEMATODE POPULATION, ROOTS AND PRODUCTION OF *IN VITRO* BANANA PLANTS (*MUSA* AAA) IN RENEWED AREAS]. **R. Vargas[1], C. Calvo[2], M. Araya[1] and M. Collado[2]. [1]Dirección de Investigaciones, CORBANA S.A., Apdo. 390-7210, Guápiles, Costa Rica y [2]Dirección de Asistencia Técnica, CORBANA, S.A. Costa Rica. rvargas@corbana.co.cr.—**En dos áreas de renovación con plantas *in vitro* de Grande Naine y Williams se evaluó en primera generación 0, 1, 2 y 3 aplicaciones de nematicida y de la segunda a la cuarta generación de cero a cuatro aplicaciones por año. Las poblaciones de nematodos y contenidos de raíces se evaluaron en muestras compuestas de raíces de cuatro plantas por repetición tomadas mensualmente. Las variables de producción se evaluaron 12 semanas después de la floración. El diseño experimental fue bloques completos al azar con seis repeticiones. En primera generación en ambos cultivares hubo menor número de *R. similis* ($P < 0{,}0054$)

y nematodos totales (P < 0,0039) y mayor contenido de raíz funcional (P < 0,0187) con dos aplicaciones. En Williams hubo mayor peso del racimo (P = 0,0039) y número de manos (P = 0,0038) con dos aplicaciones. De segunda a cuarta generación en ambos experimentos conforme aumentó el número de aplicaciones de nematicida por año, disminuyó el número de *R. similis* (P < 0,0001) y nematodos totales (P < 0,0001) y aumentó el contenido de raíz total (P < 0,0368) y funcional (P < 0,0019). En ambos cultivares se observó aumento en el peso del racimo con el uso de nematicida, pero las diferencias no llegaron a ser significativas (P > 0,0789) probablemente por la alta densidad de siembra (>1.800 plantas ha^{-1}) que afecta la expresión de las variables de producción.

NEMÁTODOS Y HONGOS ENTOMOPATÓGENOS PARA EL MANEJO INTEGRADO DE GALLINA CIEGA *PHYLLOPHAGA VETULA* HORN (MELOLONTHIDAE) [ENTOMOPATHOGENIC NEMATODES AND FUNGI FOR INTEGRATED MANAGEMENT OF *PHYLLOPHAGA VETULA* HORN (MELOLONTHIDAE)]. J. R. Vega, T. A. Bolaños and R. P. Pacheco. CIIDIR Oaxaca, Instituto Politécnico Nacional, Calle Hornos 1003 Santa Cruz Xoxocotlan, Oaxaca, C.P. 71230, México. jvega@ ipn.mx.—En México el combate de las larvas de gallina ciega, que atacan principalmente al maíz, se realiza preferiblemente utilizando insecticidas, por lo que es necesario encontrar métodos alternativos de combate. Diferentes ensayos han permitido determinar que solo se requiere de una larva de segundo estadio/planta para afectar a plantas de maíz en la etapa de crecimiento V2, mientras que en V4 se requieren de hasta 4 larvas por planta. El hongo *Metarhizium anisopliae* aplicado a una dosis de 1.7 g de sustrato de arroz/larva (2×10^{13} esporas/ha) y la combinación de (1.7 g de sustrato arroz/larva) + *Heterorhabditis bacteriophora* (25 nemátodos/cm^2) requirió de 20 días para lograr un 87.5% de mortalidad. En 2001 *Steinernema carpocapsae* fue el tratamiento con mayor % de efectividad. Una dosis de 10 nematodos/cm^2 (1×10^9 nemátodos/ha) permitió obtener un control de (87,0%). Se encontraron diferencias estadísticamente significativas en todos los experimentos. Los experimentos mostraron que los nemátodos entomopatógenos fueron igual de efectivos cuando se aplicaron solos ó en combinación con el hongo, por lo que se recomienda aplicar *S. carpocapsae* ó *M. anisopliae* para el control de la plaga.