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ABSTRACTS/RESÚMENES

NEW NEMATICIDE ALTERNATIVES FOR THE CONTROL OF PLANT-PARASITIC NEMATODES IN CHILE (Nuevas alternativas de nematicidas para el control de nematodos fitoparásitos en Chile)

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The use of nematicides for the control of plant-parasitic nematodes (PPN) is mainly based on the use of old products, which have been in the market for many years. The phase out of methyl bromide has stimulated the assay of other soil fumigants, like the Nemasol (i.a. Metham Sodium), which has been assessed and used to control PPN and soil borne diseases in vegetables and perennial crops. It is being extensively applied through irrigation lines, prior to sowing a crop, with a well prepared soil and also at the end of annual crops, to advance the establishment of the second crop, under rates of 75-120 cc/m² with control percentages of 100 in most cases. Also the incorporation of other molecules like Movento (a.i. Spirotetramato), alone or in combination with other nematicides applied to the soil, is being used as a new tool, which has showed a good activity when has been applied to the foliage in 1-year-old grapevine plants, with a control near to 60% of damages and populations of *Meloidogyne ethiopica* and less effect on . Also the incorporation of the products Tervigo (i.a. Abamectina) and Solvigo (Abamectina+Thiametoxam) derived from *Streptomyces avermitilis* have been assessed in plots and under field conditions, showing that is able to decrease populations and damages caused by *Meloidogyne* spp. in tomatoes and potato crops.

EVALUACIÓN DE LA EFICACIA DEL PRODUCTO BIOLÓGICO BAFEX-N APLICADO EN POS COSECHA EN EL CONTROL DE NEMATODOS FITOPARÁSITOS EN VIDES (Assessment of the efficacy of the biological product BAFEX-N for the control of plant-parasitic nematodes in grapevines).

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Varias bacterias del grupo *Bacillus*, han mostrado promisorios resultados en el control de nematodos fitoparásitos. En este estudio se evaluó la eficacia de control de un formulado de una mezcla de cepas de *Bacillus cereus* y *Bacillus thuringiensis*, sobre el control de *Xiphinema index*, en uva vinífera, en un viñedo de Cv. Chardonnay, de 13 años, ubicado en el Valle de Casablanca, con sistema de riego tecnificado. Los tratamientos consistieron en un control, una referencia química en base a Cadusafos 15 l/ha de producto comercial, Bafex N en 5 y 3 kg/ha. Los tratamientos fueron inyectados al sistema de riego para su aplicación. La eficacia de los tratamientos se estableció en relación a las diferencias de los tamaños poblacionales pre y post tratamientos, a través de la metodología de Cobb Baermann, los porcentajes de control fueron calculados por la variación de las poblaciones a los 360 días post tratamientos y la relación con la dinámica de población del control. El diseño experimenta fue completamente al azas, con 5 repeticiones. Pese a que el ANOVA no presento diferencias significativas, el índice reproductivo (IR) en el tratamiento Bafex N a 5 kg fue 2.6, el IR de cadusafos 1.54, Bafex 3 kg N = 7.0 y en el control de 5.5. Es interesante que en ambos tratamientos biológicos, se observe un incremento en los primeros 3 meses, seguido por una declinación constante de las poblaciones *X. index*, mientras que en el control, se presentó una acentuada declinación en los primeros tres meses, seguido de un incremento contante, esto muestra una interesante oportunidad de realizar programas integrados, donde el químico aporta con un efecto knock down y el biológico mantendría las poblaciones bajas en largo plazo.

UNDERSTANDING THE MOLECULAR BASIS OF PINWOOD NEMATODE PATHOGENICITY - TRANSCRIPTOMIC AND PROTEOMIC APPROACHES (Comprensión de la base molecular de la patogenicidad del nematodo de madera de pino - estudios transcriptómicos y proteómicos).

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Progress has been made in understanding the molecular basis of pinewood nematode (PWN), *Bursaphelenchus xylophilus*, pathogenicity. The main objectives of this study are to provide information about gene(s)-encoding specific PWN proteins, to identify genes differentially expressed by PWN grown on fungus and on pine, and to identify PWN pathogenicity related proteins. A transcriptomic study of *B. xylophilus* isolates was performed and the results organised in a database with gene sequences and annotations. PWN expressed pathogenicity related genes, namely cellulase, expansin, pectate lyase, VAPs, calreticulin, annexin, ubiquitin, chitinase, SK1 and RING genes. In addition, the transcriptome of *B. mucronatus* and of PWN developmental stages grown on fungus and pine were also obtained and differences on biological processes such as oxidative detoxification, phenolic compound degradation and signaling pathways involved in juvenile development, gene targeting and host molecule recognition were identified. Protein composition differences between PWN and other non-pathogenic *Bursaphelenchus* species are being evaluated by 2-dimensional gel electrophoresis and liquid chromatography/mass spectrometry. These studies will lead to further understanding of PWN pathogenicity and will enable the identification of new targets for nematode control.

PRIMER REGISTRO DE UN POTENCIAL AGENTE DE BIOCONTROL SOBRE EL COLEÓPTERO *Lobiopa insularis* (NITIDULIDAE), PLAGA DEL CULTIVO DE FRUTILLA EN ARGENTINA (First record of a potential biocontrol agent on the beetle *Lobiopa insularis* (NITIDULIDAE), pest of strawberry in Argentina)

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Lobiopa insularis (Laporte), es un herbívoro generalista, registrado recientemente como plaga emergente en el cultivo de frutilla. Los adultos se alimentan de frutos maduros, ocasionando daños económicos en predios fruti-hortícolas del cinturón Platense, Buenos Aires, y Coronda, Santa Fe, Argentina. En este trabajo se evaluó la eficacia del parasitismo de un aislamiento nativo del entomonemátodo *Heterorhabditis bacteriophora* (cepa V.E.L.I), sobre esta especie de importancia. Larvas, pupas y adultos (n = 30), se expusieron a los nemátodos a una dosis de 100 juveniles infectivos (JI) /cm², en recipientes (200 cm³ suelo estéril). Para evaluar la mortalidad y desarrollo del ciclo, los insectos muertos se colocaron en la trampa de White para la recuperación de los nemátodos. La mortalidad fue alta en larvas y pupas (79 y 63%) respectivamente, siendo baja en adultos (10%), pudiendo ser influenciada por el comportamiento parásito/hospedador observado. La producción de JI a partir de los cadáveres se inició entre los días 11 y 22 post-infección. El ciclo y producción tuvo una mayor duración en pupas y adultos respecto de las larvas. Los insectos produjeron nemátodos durante una (larvas) y dos semanas (pupas y adultos), con un número entre 840-6000 (larvas), 1200-5000 (pupas), y 1360-4400 (adultos) JI. Los resultados demuestran la susceptibilidad de *L. insularis* a esta cepa local, y la capacidad para desarrollar su ciclo biológico, que facilitaría su establecimiento y dispersión en el ambiente. Este nemátodo constituye el primer registro de un potencial agente de biocontrol sobre esta plaga en Argentina, pudiendo ser una alternativa valiosa y segura.

***Hoplolaimus* SPECIES ON TURFGRASSES (Especies de *Hoplolaimus* en céspedes)**

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Lance nematodes (*Hoplolaimus* spp.) are widely distributed and many turfgrass species are considered good hosts. *Hoplolaimus* species feed ecto- and endoparasitically, and can cause stunting and chlorosis on bermudagrass, bentgrass, fescue, and other cultivated grasses. Adults and juveniles have been shown to migrate along the root surface, probing periodically. Once the cortex is penetrated, feeding can occur on different root tissues. The entire body of the nematode can be embedded in the root, and damage can include passageways that extend 2 to 4 cells in all directions. A relationship between root diameter and level of damage has been observed, with small diameter roots being more tolerant. The effects of lance parasitism on turf are often interrelated with stress caused by soilborne fungi, nutrient deficiencies, and drought. Seasonal fluctuation of root and soil populations by host is discussed, and special reference to distribution and existing damage thresholds for *H. columbus*, *H. concaudajuvencus*, *H. galeatus*, *H. magnistylus*, *H. stephanus*, and *H. tylenchiformis* is made. Knowledge of pathogenic relationships and damage thresholds is paramount for the development of sound management practices for this nematode.

BIOLOGICAL ACTIVITY OF ESSENTIAL OILS ON *Fusarium solani* AND *Meloidogyne enterolobii*, CAUSAL AGENTS OF GUAVA DECLINE (Actividad biológica de aceites esenciales sobre *Fusarium solani* y *Meloidogyne enterolobii* en guayaba)

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The objective of this work was to determine the chemical composition and evaluate the nematicides and fungicides effects of the following essential oils *Cymbopogon winterianus*, *Cinnamomum zeylanicum*, *Ocimum gratissimum* and *Syzygium aromaticum* on *Meloidogyne enterolobii* and *Fusarium solani*, the causal agents of guava decline. The essential oil was obtained by hydrodistillation. The analysis of gaseous chromatography and mass detector of essential oils led to the identification of compounds. To assess the effect of essential oils on mycelial growth, sporulation and germination of spores, aliquots of 5, 10, 15, 20, 25 and 30µl of each oil were distributed on the surface of PDA culture medium contained in Petri dishes before subculture of the fungus. To evaluate the effect of the oils on the hatching and the survival of J2 oils aliquots of 5, 10, 15, 20, 25 30µl were added in aqueous suspensions containing 200 eggs or 200 J2. A completely randomized design was used in a factorial 4 x 6 + 1 with 5 replicates. The main chemical components found in the oils were: a) *C. winterianus* (geraniol:28.62%); b) *S. aromaticum*, *O. gratissimum* and *C. zeylanicum* (eugenol:84.12%, 53.25% and 57%, respectively). The lower rate of the essential oils of *S. aromaticum*, *C. zeylanicum* and *O. gratissimum* inhibited more than 90% germination of spores, mycelial growth and sporulation of fungal as well as the J2 hatching, as for oil *C. winterianus* inhibition was greater than 90% from the rate of 15 µl.

EXTRACTOS DE *Thymus vulgare* Y *Origanum vulgare* PARA REDUCIR EL PARASITISMO DE *Meloidogyne ethiopica* SOBRE PLANTAS DE TOMATE EN CONDICIONES DE INVERNADERO (*Thymus vulgare* and *Origanum vulgare* extracts to reduce the *Meloidogyne ethiopica* parasitism of tomato plants in greenhouse conditions)

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Se evaluó el efecto de extractos de *Thymus vulgare* y *Origanum vulgare*, sobre *M. ethiopica* en condiciones de invernadero, en plantas de tomate, en macetas de 900 ml de suelo, con aplicaciones previas a la inoculación con *M. ethiopica* a las plantas, y posteriores a la inoculación con *M. ethiopica*. Los extractos se utilizaron a concentraciones de 0.1% y 0.5%, y también se evaluó una mezcla de ambos extractos. Los extractos redujeron el parasitismo de *M. ethiopica*, evidenciado en bajo número de nódulos en las raíces. La aplicación de extractos previo al inóculo de *M. ethiopica*, produjo disminución importante de nódulos, lo que significa que los extractos representaron una barrera protectora para las raíces a las dos concentraciones, particularmente cuando se aplicó antes de la inoculación. La aplicación de los extractos posterior al inóculo de *M. ethiopica*, presentó un número de nódulos más alto que las aplicaciones de los extractos previas a la inoculación. Los extractos de tomillo y orégano, muestran potencial para ser utilizados en el manejo de nematodos fitoparásitos en los huertos, y como una alternativa a los nematicidas sintéticos, que se encuentran cada día más objetados por su incidencia negativa sobre el medio ambiente.

VARIABILIDAD INTRA-ESPECÍFICA DE *Pochonia chlamydosporia* VAR. *catenulata* (KAMYSCHKO EX BARRON Y ONIONS) ZARE Y W. GAMS MEDIANTE MARCADORES RAPD. (Intraspecific variability of *Pochonia chlamydosporia* var. *catenulata* by RAPD markers)

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P. chlamydosporia es un hongo parásito facultativo de huevos de nematodos, presente en suelos supresores de nematodos formadores de quistes y agallas. Este muestra una alta variabilidad intra-específica; aislamientos individuales requieren de una rigurosa selección como potenciales agentes de control biológico. En Cuba, se produce y comercializa el bionematicida KlamiC®, a partir de la cepa autóctona seleccionada IMI SD 187 de *P. chlamydosporia* var. *catenulata*, efectivo para el manejo de *Meloidogyne* spp. La variedad *catenulata*, es la menos estudiada desde el punto de vista molecular, el objetivo del presente trabajo fue evaluar la variabilidad intra-específica mediante RAPD-PCR, de cepas cubanas y brasileñas de *P. chlamydosporia*, utilizando cepas de

Colecciones de Referencia. El análisis del polimorfismo mediante de RAPD-PCR con los 19 cebadores aleatorios evaluados permitió el agrupamiento de cepas de cada una de las variedades *chlamydosporia* y *catenulata* de forma independiente. La cepa brasileña CG1006 clasificada morfológicamente como var. *catenulata*, pero con reacción negativa al cebador específico para *catenulata*, se incluyó junto con las cepas de la var. *chlamydosporia*. Las de la var. *catenulata* de Cuba formaron un grupo independiente, dentro del cual, se logró separar distintivamente la cepa IMI SD 187. El resto de las cepas var. *catenulata* formaron grupos independientes. Se destaca la obtención de fragmentos específicos para la cepa IMI SD 187, con cuatro de los cebadores evaluados mediante RAPD, lo que pudiera emplearse en el diseño de marcadores de secuencia caracterizada (SCAR) que servirían para el monitoreo posplacación de KlamiC®.

COMPOSITION OF PLANT-FEEDING NEMATODES IN AGRICULTURAL SOILS WITH DIFFERENT SALINITY LEVELS (Composición de nematodos fitófagos en suelos agrícolas con diferentes niveles de salinidad)

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To determine the relationship between the plant-feeding nematodes abundance and soil salinity in orchards in the Upper Rio Negro Valley, Argentina, soil samples were collected in the 0 to 20 cm deep in 30 plants (sites) of *Pyrus communis* in spring 2008-2010. Each sample was composed of 15 cores of each tree. Nematodes were extracted using the sugar flotation and centrifugation. The content of exchange potassium K⁺, electric conductivity (EC dS m⁻¹), anions (Cl⁻ and SO₄²⁻) and exchangeable sodium percentage (ESP) were determined. A correlation analysis was performed to quantify the association between the physicochemical variables and nematofauna abundance. Eleven nematode taxa were found in this study: 3 sites corresponded to saline-sodic soils, 10 to saline soils and 17 to non-saline soils. Positive correlations were found between EC, ESP and the contents of Cl⁻ and SO₄²⁻ and some nematode genera such as *Boleodorus* and *Paratylenchus*, and negative correlations were found between *Paratylenchus* and *Xiphinema* and EC, ESP and the contents of K⁺, Cl⁻, SO₄²⁻. *Boleodorus* (39 %), *Paratylenchus* (36 %) and *Tylenchidae* (13 %) were dominant in saline-sodic soils. *Boleodorus* (36 %), Criconeematidae (29 %) and *Paratylenchus* (14 %) were the most abundant in saline soils. *Paratylenchus* (25 %), *Boleodorus* (21 %), *Xiphinema* (15 %) and Criconeematidae (11 %) were the most abundant in non-saline soils. Results showed that *Boleodorus* and *Paratylenchus* comprise the group of nematodes tolerant of saline soils.

NOVEL CYST NEMATODE EFFECTORS AND THEIR CELLULAR MECHANISMS (Nuevos efectores del nematodo quiste y sus mecanismos celulares)

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Cyst nematodes secrete effector proteins into host root cells and these proteins are instrumental in the formation of feeding cells and mediating susceptibility through the suppression of plant defenses. Consequently, the identification of effector proteins and their functions is of high importance. We have developed an effector identification method in which whole nematode glands are purified and subjected to RNA extraction for transcriptomic analyses. In addition to effector identification, the characterization of their functions in plant cells is of highest interest. In one example that we studied, a cyst nematode effector protein is phosphorylated by a cytoplasmic plant kinase, which results in translocation of the effector into the plant nucleus. There, the effector interacts with a plant transcription factor, likely resulting in gene expression alterations. Much more dramatic is our discovery that as a result of cyst nematode infection, and probably effector functions, microRNAs change expression in the developing syncytium. In particular, the microRNA396 regulatory network has strong impact on cyst nematode parasitic success. miR396 and other microRNAs that we have shown to change expression in the syncytium, thus, represent powerful molecular targets for cyst nematode effectors to modulate plant cell development. Ongoing functional characterizations of microRNAs as well as identification and characterization of nematode effectors promise to provide the mechanistic understanding required to devise novel control mechanisms.

UPDATE ON THE EFFICACY OF VARIOUS MANAGEMENT STRATEGIES OF *Globodera rostochiensis* IN QUEBEC, CANADA (Actualización sobre la eficacia de las estrategias manejo de *Globodera rostochiensis* en Quebec, Canadá)

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The population densities of *G. rostochiensis* Ro1 was monitored in field microplots planted annually with potato resistant (H1) cv. Andover over a 5-year period on two experimental sites. Yearly, the number of viable eggs of *G. rostochiensis* dropped by an average of 75%. So far, no sign has been observed that the H1 resistance gene could be overcome. Non-host crops such as pearl millet, corn and brown mustard lead to an annual decline of 37% in *G. rostochiensis* populations. Brown mustard cv. Caliente plowed under as a green manure at full bloom did not provide a significant increase in efficacy when compared to other non-host crops. Trap cropping with susceptible potato cv. Snowden harvested 5 weeks after planting has significantly reduced the number of viable eggs, but no significant increase in efficiency was observed when harvesting 6 weeks after sowing. Trap cropping with high potato densities (250,000 plants/ha) of both susceptible cv. Snowden (harvested after 5 weeks) and resistant cv. Andover did not provide a significant increase in efficacy when compared to the standard planting density (30,000 plants/ha). Sticky nightshade *Solanum sisymbriifolium*, an immune plant, did not provide a significant increase in *G. rostochiensis* decline when compared to H1-resistant potato. When direct seeded, *S. sisymbriifolium* had consistently a very poor establishment rate and was outcompeted/suffocated by grassy weeds.

EVALUATION OF HOST SUITABILITY OF CORN HYBRIDS TO ROOT LESION NEMATODE (Evaluación de la susceptibilidad de híbridos de maíz al nematodo lesionador de la raíz)

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The corn (*Zea mays*), today it is one of the principal cereals cultivated in the world, possessing a high economical and social value so much for the human feeding, as animal. It is still fundamental in the viability of other cultures, as the soy and the cotton. Through the rotation of cultures, the corn minimizes possible problems, as gall nematodes, cyst nematodes and diseases, as the white mold, giving consequently sustainability for different production systems in many agricultural areas of Brazil and of the world. The nematodes of the root lesions (*Pratylenchus brachyurus*) has been causing damages in several cultures of agronomic interest, mainly due to high polyphagy of this nematode. In this study, we evaluated the resistance of 24 maize hybrids to *Pratylenchus brachyurus*, having been used for this an experimental design of randomized blocks, with six replications. The tests were conducted in a greenhouse from January to March 2012. It was concluded that all hybrids tested in this experiment were susceptible to *Pratylenchus brachyurus*.

OCCURRENCE AND MANAGEMENT OF POTATO CYST NEMATODE IN CENTRAL ASIA (Presencia y manejo del nematodo quiste de la papa en Asia central)

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On a global basis, potato (*Solanum tuberosum* L.) is the most important non-grain food crop. Potatoes were introduced into Central Asia from Western Russia about 150 years ago. Today, potatoes in this region are considered the Second Bread. Potato cyst nematodes (PCN) are present in Kyrgyzstan and Tajikistan. Tuber yield losses associated with PCN are increasing. There is an urgent need for development and implementation of improved PCN management programs in both nations. Non-GMO potato varieties developed in the U.S.A. with molecularly documented resistance to Golden Nematode (GN) yielded well in preliminary trials in both countries. Cultivars Boulder and Missaukee were compared with the local standard, Picasso, in PCN-infested sites in Kyrgyzstan. The at-plant population density ranged from 395-561 eggs/100 cm³ soil. The mean at-harvest population density was 201 eggs/second-stage juveniles/100 cm³ of soil for Picasso. It was 25 and 12 for Boulder and Missaukee, respectively. At harvest, no new cysts or females were observed on Missaukee or Boulder tubers or roots, however, 15-20 were associated with each Picasso root/tuber system. Tuber yields associated with Boulder and Missaukee were statistically greater ($P = 0.0289$) than those of Picasso. The study is the first confirmation of *G. rostochiensis* resistance of Boulder and Missaukee under field conditions.

IMPACT OF MANAGEMENT PRACTICES ON NEMATODES IN MICHIGAN CHERRY ORCHARDS (Impacto de las prácticas de manejo de nemátodos en huertos de cerezo en Michigan)

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Michigan is the largest producer of tart cherries in North America. *Xiphinema americanum*, *Pratylenchus penetrans* and Criconematinae spp. are the three most prominent plant parasitic nematodes associated with this crop. Eleven northern Michigan orchards were used to evaluate the impacts of seven management practices (cover crops, mulch, compost, chemical fumigation, bio-fumigation, conventional management and organic management) on nematodes. Soil fumigation with Telone II reduced population densities of both plant parasitic and bacterial feeding nematodes to non-detectable levels. Populations of bacterial feeding nematodes recovered the following growing season, but the plant parasites did not. Bio-fumigation with mustards and oil seed radish reduced population densities of plant parasitic nematodes, but not to a non-detectable level, while population densities of bacterial feeding nematodes were not impacted. In a mature orchard, population densities of plant parasitic nematodes were significantly lower in the organic system, compared to the conventional system. The parameters associated with three other management practices were intermediate. Four organic and four conventional cherry orchards were compared. Significantly more bacterial feeding nematodes were recovered from the O-horizon of these orchards, compared to the A-horizon. The highest population density of herbivores was recovered from a 0 to 15 soil depth in the A-horizon. The population density of bacterial feeding nematodes associated with the organic orchards was significantly greater than the population density associated with the conventional orchards.

REPRODUCTION OF *Meloidogyne enterolobii* AND THREE OTHER *Meloidogyne* SPECIES ON SELECTED POTATO CULTIVARS (Reproducción de *Meloidogyne enterolobii* y tres otras especies de *Meloidogyne* en cultivares selectos de papa)

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Meloidogyne enterolobii was first reported in the USA in 2002 infecting ornamental plants. The objective of this study was to determine the suitability of potato 'Atlantic', 'La Chipper' and 'Red LaSoda' as host for *M. enterolobii*, *M. floridensis*, *M. incognita* race 3, and *M. javanica* race 3 in a duplicated experiment in a greenhouse. Each plant was inoculated with 5,000 eggs of the appropriated nematode species. 'Rutgers' tomato was included as a susceptible host. At harvest, numbers of galls and egg masses/root system, number of eggs/g of fresh roots, and the reproduction factor were determined. All potato cultivars were susceptible to the three nematode species ($P > 0.05$). No differences were observed in the root galling induced by *M. enterolobii*, *M. floridensis* and *M. javanica* among the potato cultivars ($P > 0.05$). *M. incognita* had a lower gall rating on La Chipper than the other two potato cultivars. *M. enterolobii* and *M. javanica* produced the highest egg mass numbers on Atlantic and Red LaSoda, whereas *M. incognita* and *M. floridensis* produced the highest numbers on Atlantic. Red LaSoda and Atlantic sustained more eggs of *M. incognita* and *M. javanica* than La Chipper. *M. enterolobii* produced the highest number of eggs per gram of roots on Atlantic (7,833), whereas *M. floridensis* produced the highest on Red LaSoda (2,334) ($P < 0.05$). All the potato cultivars were good host of the *Meloidogyne* spp. included in this study.

OCURRENCE, DISTRIBUTION AND SURVEY OF *Nacobbus aberrans* IN THE NORTHWEST REGION OF THE STATE OF MICHOACAN, MEXICO (Ocurrencia, distribución y abundancia de *Nacobbus aberrans* en la región Noroeste del estado de Michoacán, México)

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The relationship among the distribution and abundance of *Nacobbus aberrans* and the main physicochemical soil characteristics were studied in the northwest state of Michoacan, Mexico. Both soil samples and roots of several crops were collected in 16 counties of the Bajío and Lerma-Chapala regions. Root galling was used to

assess plant damage of *N. aberrans*. This nematode was found in Tanhuato, Yurecuaro and Pajacuaran counties associated with “calabacita” (*Cucurbita pepo*), cucumber (*Cucumis sativus*) and tomato (*Solanum lycopersicum*) with a root galling index ranging from 10 to 100%. The most favorable places for *N. aberrans* occurrence were those with low-half organic matter content, plus lime 20-54% and sand 18-62%. Interpolative maps showed different degree risks among the vegetable crops in the evaluated regions. So, Tanhuato, Yurecuaro, Ecuandureo, Cojumatlan de Regules, La Piedad e Ixtlan showed the best soil conditions for occurrence of *N. aberrans*, such as organic matter contain, lime and sand soil proportion.

CARACTERIZACIÓN DE UN AISLADO DE *Steinernema diaprepesi* DE LA PROVINCIA DE SANTA FE, ARGENTINA (Characterization of an isolate of *Steinernema diaprepesi* from Santa Fe province, Argentina)

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Los nematodos entomopatógenos (Heterorhabditidae y Steinernematidae) matan insectos mediante bacterias simbioses que llevan en su intestino. En 2002, se describió la especie *Steinernema diaprepesi* que fue detectada en Florida (Estados Unidos). El objetivo del trabajo fue caracterizar morfológica y morfométricamente un aislado proveniente de Santa Rosa de Calchines (Santa Fe, Argentina) e identificar su bacteria simbiote secuenciando el gen 16S. Juveniles infectivos (JI), machos y hembras (primera y segunda generación) fueron obtenidos infectando larvas de *Galleria mellonella* (Pyralidae). Los especímenes se fijaron y procesaron según técnicas clásicas en nematología para la confección de preparados permanentes. La mayoría de los caracteres evaluados coincidieron con la descripción original de la especie, a excepción de algunos que mostraron considerables diferencias: longitud total del cuerpo (JI, hembras y machos de primera generación), anillo nervioso (machos de segunda generación), ubicación del poro excretor (hembras de primera y machos de segunda generación) y longitud de la cola (JI y hembras de ambas generaciones). Con respecto al aislado de Estados Unidos, se observó un marcado ensanchamiento post-anal sólo en hembras de la segunda generación. Los estudios moleculares evidenciaron que la bacteria simbiote es *Xenorhabdus doucetiae*. Es la primera caracterización de un aislado de *S. diaprepesi* detectado en el país.

COMPARING SUGARCANE FIELDS AND FOREST FRAGMENTS: THE EFFECT OF DISTURBANCE ON SOIL PHYSICAL PROPERTIES AND NEMATODE ASSEMBLAGES. (Comparación entre campos de caña de azúcar y fragmentos de bosque: el efecto de la perturbación en las propiedades físicas y ensamblajes de nematodos)

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Comparisons of agricultural and natural ecosystems reveal the magnitude of the effects of agricultural practices on the diversity and abundance of soil nematodes. It is important to seek strategies for biological control, environmental monitoring and developing predictive models for policy decisions. It was studied soil nematode assemblages and soil physical attributes of five soil layers from sugarcane plantations and forest remnants in the sugarcane zone of Pernambuco State, Brazil. Structure and composition of the nematode assemblage and soil properties differed between forest and sugarcane soils, even in the same locality. Soil bulk density, abundance of all nematodes and of plant-parasitic nematodes were greater while soil porosity, soil respiration, and abundance of predator nematodes were lower in sugarcane than in forest areas. We suggest that sugarcane management practices result in changes in soil properties, and concomitantly alter the composition and structure of nematode assemblages. Canonical correspondence analysis indicated that other environmental factors also might be affecting the nematofauna.

IDENTIFICATION AND CHARACTERIZATION OF *Meloidogyne* spp. FROM BRAZIL USING MORPHOLOGICAL, BIOCHEMICAL AND MOLECULAR APPROACHES (Identificación y caracterización de *Meloidogyne* spp. de Brasil utilizando métodos morfológicos, bioquímicos y moleculares)

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Root-knot nematode diseases, caused by *Meloidogyne* spp., are one of the most important diseases in Brazil in many economically important crops. The implementation of alternative measures of control, such as resistant varieties or crop rotations are essential for maintaining or increasing agricultural production. For the adoption of these management measures, the correct identification of species and knowledge of intraspecific variability of populations are essential. There are about 90 species of *Meloidogyne* described worldwide and 15 of those species are recorded in Brazil. Some studies were conducted with foreign and Brazilian populations of *Meloidogyne* spp. and showed that different species can be split into clusters according to their phylogenetic relationship, enzymatic and SCAR profiles. The identification of species by esterase is highly correlated with the identifications through molecular techniques. No separation of physiological races through molecular markers was observed. A high intraspecific variability in populations of *M. exigua* and *M. arenaria* and a low variability among populations of *M. incognita*, *M. enterolobii* and *M. ethiopica* were observed. For *M. exigua*, the populations formed a cohesive group and for *M. arenaria*, probably clusters of swarm species. In recent years, some atypical species were characterized and identified in Brazil, as it is the case of *M. enterolobii*, *M. ethiopica* and *M. hispanica*. More recently, the revalidation of *M. inornata* as a valid species and its isozyme and molecular characterizations proved once again that the use of the perineal region as a parameter for *Meloidogyne* spp. identification is subjective and leads to many errors. Although some studies have been conducted using a series of complementary techniques to identify *Meloidogyne* spp., some new species were described in Brazil, using only classical taxonomical approaches and sometimes overlooking the enzymatic phenotypes and SCAR markers. This is the case of *M. brasiliensis*, *M. phaseolus* and *M. polycephanulata*. Thus, there is a pressing need for methodological advances in the taxonomy of species of the genus *Meloidogyne*, using all available tools together: classical taxonomy, isozymes and molecular techniques.

IDENTIFICATION OF NEMATODES: FROM MORPHOLOGY TO MOLECULES AND BACK (Identificación de nematodos: de morfología a moléculas y vice versa)

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More than 4,000 nematode species are currently considered as parasites of plants, some of which are responsible for considerable yield and quality losses in many important agronomical plants. Because of the homogeneity of their morphological characters, nematodes are amongst the most difficult animals to identify. In addition, their small size and soil distribution make most plant-parasitic nematode species difficult to detect. However, accurate identification to species level is central to the implementation of successful management strategies against these parasites. Traditional diagnostics relies on the delineation of morphological features, but the intraspecific variability of these frequently obscure characters renders reliable identification a formidable task, even for well-qualified taxonomists. Because they are independent of phenotypic variation, DNA-based technologies have provided avenues to overcome such limitations. Indeed, the “DNA revolution” started in plant nematology some 25 years ago, with the first use of DNA restriction fragment length polymorphisms as diagnostic characters. A major contribution was provided a few years later, with the first demonstration that the polymerase chain reaction (PCR) could efficiently be used to identify single individual nematodes. Since then, plant nematologists have increasingly employed molecular techniques for diagnostic purposes, and DNA-based technology now provides numerous avenues to overcome the limitations intrinsic to the nature and biology of these parasites. However, and although molecular taxonomy of nematodes indeed represents a powerful approach to provide diagnostics with greater robustness, precision and speed, it would nevertheless be misleading to consider it as the panacea for achieving the goal of species identification. In particular, considering that the actual total number of (plant-parasitic) nematode species is likely to be several-fold higher than is currently known, strong expertise in traditional (morphological) taxonomy will be needed to delineate species boundaries and to assign a taxonomic binomial to a molecular signature. In that respect, enhancing the linkage between molecular and morphological data to provide a more integrated taxonomy will undoubtedly strengthen the systematic exploration of the phylum Nematoda.

EVALUACIÓN *IN VITRO* DE FILTRADOS DE CEPAS RIZOBACTERIANAS SOBRE LOS NEMÁTODOS FITOPARÁSITOS *Xiphinema index* Y *Meloidogyne ethiopica* (In vitro assessments of rhizobacteria supernatants on plant-parasitic nematodes *Xiphinema index* and *Meloidogyne ethiopica*)

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El control tradicional de nemátodos se ha hecho con productos químicos altamente tóxicos para el ambiente y la salud humana. Filtrados de rizobacterias con características nematocidas fueron evaluadas en condiciones *in vitro*. Se evaluaron un total de siete cepas de rizobacterias en dos especies de nemátodos fitoparasitos, *Xiphinema index* y *Meloidogyne ethiopica*, en ensayos independientes. Las bacterias se reprodujeron en medio líquido de Tryptic Soy Broth (TSB) al 15%, con una concentración bacteriana de 1×10^4 UFC/ml, durante 24 horas; seguidamente fue separado el filtrado de las bacterias. En cajas petri con una población de 25 nemátodos, fueron inoculados los filtrados por 72 horas. Se realizaron evaluaciones cada 24 horas, registrando el porcentaje de mortalidad de los individuos. Los resultados mostraron que después de 72 horas de exposición de los individuos de *Xiphinema index*, a los filtrados rizobacterianos, hubo mortalidades del 94 y 100% con las cepas 203 y 805, respectivamente, las cuales en este mismo orden, tuvieron mortalidades del 76 y 83% en individuos de *Meloidogyne ethiopica*. Las cepas restantes, tuvieron mortalidades desde 54 a 81% en *Xiphinema index* y 44 a 59% en *Meloidogyne ethiopica*, al finalizar el periodo de evaluación. Las cepas rizobacterianas evaluadas, poseen compuestos con efecto nematocida, que pueden ser una alternativa interesante de control.

EVALUACIÓN DE DISTINTOS MANEJOS DE SUELO PARA EL CONTROL DEL NEMATODO AGALLADOR, *Meloidogyne* spp., EN VIÑEDOS DE MENDOZA, ARGENTINA (Evaluation of different soil management to control *Meloidogyne* spp, in vineyards of Mendoza, Argentina)

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Se efectuaron estudios para controlar *Meloidogyne* spp. en un viñedo cv. Chardonnay, con infestación media del nematodo y suelo franco. Se compararon distintos manejos de suelo: a) Estrategias de uso en Producción Orgánica (PO): control mecánico de malezas en línea de plantación y verdeo de verano (mijo) en interfilar, e incorporación de orujo de uva fresco OUF) en receso vegetativo; b) Manejo Integrado (MIP): dos aplicaciones anuales de glifosato en línea de plantación y mijo en interfilar; en la primer temporada se incorporó OUF y Fenamifos con 10 cm de brote y en la segunda, sólo OUF; c) Control Químico (CQ): en cada ciclo cuatro aplicaciones de glifosato en toda la superficie y una de Fenamifos y d) Testigo. Se evaluó población inicial (Pi) y final (Pf) de nemátodos, rendimiento y peso de poda. Las tres estrategias se diferenciaron del testigo pero no entre ellas, con una Pf/Pi promedio de 0,86 y 4,9 para el testigo. *Rhabditidos* y *Dorylaimidos*, se incrementaron 5,5 veces en MIP y PO, diferenciándose de CQ (1,3) y testigo (2,2). Las tres estrategias se diferenciaron del testigo en rendimiento, con valores de 5,8 (PO); 5,9 (CQ); 6,5 (MIP) y 3,3 (testigo) kg.planta⁻¹. El peso de poda fue de 1,2 kg.planta⁻¹ para MIP, que se diferenció de PO (0,9) y del testigo (0,6), pero no de CQ (1,1). Los resultados indican que PO representa el mejor tratamiento.

TRATAMIENTO NEMATOCIDA DE “SEMILLA” DE AJO CUANDO EXISTE BAJA INFESTACIÓN CON *Ditylenchus dipsaci*. (Nematicide treatment of garlic cloves with low infestation levels of *Ditylenchus dipsaci*)

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Ditylenchus dipsaci es plaga primaria de las aliáceas y se encuentra en toda región donde se cultiva ajo. Mendoza es la principal productora de ajo en Argentina. Se han establecido tolerancias en dientes y suelo para este nematodo. Actualmente, su incidencia ha disminuido y con el tratamiento nematocida de los bulbillos, se logran rendimientos comerciales aceptables. El objetivo fue determinar si la realización del tratamiento de bulbillos con nematocidas es imprescindible, cuando se cuenta con niveles de infestación de dientes por debajo del umbral de tolerancia. Se partió de una semilla de ajo cv. Violeta con infestación natural de 10 *D. dipsaci* kg⁻¹ de dientes que fue tratada por inmersión rápida de 5 min con: a) Carbofuran; b) Fenamifos y c) Testigo. Los dientes se plantaron en dos zonas ecológicas distintas (Luján de Cuyo y Tunuyán), con ausencia de *D.dipsaci* en suelo, e igual textura de suelo, diseño estadístico y manejo cultural y de riego durante el ciclo de cultivo. Se evaluó plantas.metro lineal⁻¹, rendimiento, calibre de bulbos y población final (Pf) del nematodo en bulbos. En ambos sitios se obtuvo ausencia de diferencias significativas entre tratamientos en: plantas.metro lineal⁻¹, rendimientos y calibre; y diferencias en la Pf entre los tratamientos químicos y el testigo. Pf/Pi resultó 2,5 veces superior en Tunuyán que en Luján de Cuyo, pero en ambos casos las poblaciones finales no superaron el umbral

de daño establecido. Con infestaciones menores a 50 *D. dipsaci* kg⁻¹ de dientes no sería necesario el tratamiento de semillas con nematocidas.

EVALUACIÓN DE LA SUCEPTIBILIDAD DE TRES PATRONES DE PALTO (AGUACATE) A *Meloidogyne* spp. (Evaluation of the susceptibility of three avocado root-stocks to *Meloidogyne* spp.)

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El nematodo del nódulo de la raíz (*Meloidogyne* spp.) constituye una de las mayores limitaciones fitosanitarias en los cultivos de exportación, tales como espárrago y pimiento, que se desarrollan principalmente en suelos arenosos de la costa peruana. En los últimos años éstas áreas, están siendo reemplazadas con palto Hass, utilizando diferentes patrones o portainjertos entre ellos Lula, Zutano y Topa – Topa. Para evaluar la susceptibilidad de estos patrones a *Meloidogyne* spp., estos fueron sembrados en suelos con alto nivel de infestación (2000 huevos/100cc de suelo) y mantenidos en invernadero durante cuatro meses, al cabo de los cuales solamente en el patrón Topa – Topa se determinó 1025 huevos y 56 J2/5 g de raíces, índice de nodulación igual a 3.0 y un promedio de 24.5 J2 en 200 cc de suelo.

TOLERANCIA DE *Pochonia chlamydosporia* VAR. CATENULATA (KAMYSCHKO EX BARRON Y ONIONS) ZARE Y W. GAMS A DIFERENTES NIVELES DE CLORURO DE SODIO (Tolerance of *Pochonia chlamydosporia* var. *catenulata* to different levels of sodium chloride)

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Las sales presentes en aguas y suelos dedicados a la agricultura pueden producirle efectos adversos a los componentes bióticos de los agroecosistemas, incluyendo a los agentes de control microbiano de plagas. Por ello, se propuso como objetivo evaluar el efecto de diferentes concentraciones de sales de cloruro de sodio (NaCl) sobre el hongo nematófago *Pochonia chlamydosporia* var. *catenulata* (IMI SD 187). En un primer ensayo, se analizó la relación entre la inhibición de la germinación de clamidosporas y conidios con diferentes niveles de NaCl: control (agua 0,3dS.m⁻¹), 2dS.m⁻¹, 4dS.m⁻¹, 6dS.m⁻¹, 8dS.m⁻¹, 10dS.m⁻¹, 12dS.m⁻¹, 14dS.m⁻¹ y 16dS.m⁻¹. En un segundo ensayo, se evaluó el efecto, in vitro, sobre crecimiento y esporulación del hongo en medio PDA y suelo (0, 40, 80, 120, 160 mM.L⁻¹ de NaCl). Las clamidosporas fueron más tolerantes que los conidios, con inhibición de 50% de la germinación a 13dS.m⁻¹ y 12dS.m⁻¹, respectivamente. *P. chlamydosporia* logró crecer y producir esporas en todas las concentraciones salinas a las que se expuso. El crecimiento micelial fue menos sensible a las sales en suelo comparado con PDA, con 50% de inhibición a 256mM.L⁻¹, en suelo, y 129 mM.L⁻¹, en PDA. Esta investigación demostró las potencialidades que posee este hongo de persistir y multiplicarse bajo concentraciones altamente salinas; lo que señala nuevas perspectivas de uso de *P. chlamydosporia*, en agroecosistemas con problemas de salinidad. Su potencial en la mitigación de los efectos adversos que confieren las sales sobre las plantas está en investigación.

ALTERNATIVE PRACTICES FOR MANAGING PLANT-PARASITIC NEMATODES ON *Musa* sp. (Prácticas alternas para el manejo de nematodos fitoparásitos en *Musa* sp.)

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A field experiment was conducted to study the effects of alternative practices for managing plant-parasitic nematodes on *Musa* sp. The experiment was established in a soil naturally infested with the most important phytonematodes causing losses on *Musa* (*Radopholus similis*, *Pratylenchus coffeae*, and *Meloidogyne incognita*). Plantain (*Musa* sp., AAB) was used as planting material due to its susceptibility to phytonematodes. Plantains were spaced at 1.80 m x 1.80 m, for a population density of 3,086 plants per hectare. The experimental design

was a RIBD with 8 treatments and 4 replicates. Treatments consisted on a series of alternative management practices, such as a short rotation scheme (120 days) with velvetbean (*Mucuna deeringiana*), poultry litter, sanitary measures, and a commercial nematicide. The effects of alternative practices on soil microbial structure were evaluated. At harvesting (120 days after planting) *Mucuna* yielded an average of 57.8 tons biomass per hectare. The rotation scheme with *Mucuna deeringiana* reduced soil populations of *R. similis* and *M. incognita* when compared with bare soil plots. *Mucuna* showed changes on soil microbial structure when compared with bare soil plots. Total population of bacteria was improved in plots where velvetbean was planted in contrast with control plots.

HANDBOOK ON DESCRIPTION OF PLANT-PARASITIC NEMATODE SPECIES FOUND IN ARGENTINA (Manual de descripción de especies de nematodos parásitos de plantas encontrados en Argentina)

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A handbook concerning the status of plant-parasitic nematodes from Argentina was made with the support of Servicio Nacional de Sanidad y Calidad Agroalimentaria and Banco Interamericano de Desarrollo (BID). The objective of this work is to collect information on plant-parasitic nematodes present in Argentina, whose data can be used by the plant health agencies and by those who are interested in the problem of the nematodes. The manual contains forty chips of plant-parasitic nematodes cited for Argentina until June 2012, of which eight are of quarantine importance and its presence has not been really confirmed by what its current status is absent in the country, and one species of quarantine importance not cited for our country. The description of each species contains an introduction to species, morphology and morphometry of them by means of national and international data, biology, races, hosts, damage, association with other pathogens, distribution of species in Argentina and in the world, forms of introduction of nematode to the country, methods, nematode extraction and bibliography. An introduction is added to the description of soil nematodes (morphology, general biology), methods of sampling, extraction and fixation of these organisms, a glossary of names commonly used in nematology and acknowledgements. The characters of the nematodes are shown from the illustrations taken from the bibliography. The SENASA will make use of this manual into its national policy of monitoring pests, phytosanitary certification and plant quarantine.

THE POTENTIAL OF SOIL MICROBIOME IN SUSTAINABLE NEMATODE MANAGEMENT (El potencial del microbioma del suelo en el manejo sostenible de nematodos)

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The soil microbiome has a significant impact on phytoparasitic nematodes but, given the huge number of microbial species and niches present in soil, its role has been very difficult to study with traditional approaches. The advent of advanced technologies, i.e., Next Generation Sequencing (NGS) allows the identification and quantitative determination of almost all species present in a sample, enlarging our view about their effects in the rhizosphere. Metagenomic analyses showed that the biodiversity of microbial species present in a few g of soil may reach the order of 10^4 or more distinct taxonomic units. When comparing these numbers with those of the bacterial antagonists of nematodes known thus far we can infer that biocontrol studies have yet a large space to explore. However, the activity of the whole soil microbiome in nematode control can be often observed and referred to as “soil suppressivity”, leaving the active microbial species as undetected or unknown. To measure suppressive potentials of soil, a study was carried out with soil proceeding from a carnation crop, infested by *Meloidogyne* spp. but showing patchy nematode infestation levels. After 4-years continuous croppings on tomato plants in the greenhouse, 40% of pots showed nematode extinctions, suggesting that suppression or biological containment may act on a long term, multi-seasonal time scale. Trophic niches and microbiome interactions with roots represent a ideal target for transcriptomic studies on a complex of species. The same holds for the study on the role of root exudates and their changes in function of the different plant developmental stages. In conclusion, NGS-based studies will provide a wide basis to understand the value of soil microbiome and how the insurgence of plant nematode attacks may be counteracted through its management.

EDUCATION IN NEMATOLOGY (Educación en Nematología)

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During the last 10 years, some of the leaders in Nematology have passed away and others have reached retirement or have left Nematology. In some Institutes, the Nematology Department has less and less academic staff and, at this critical time, it is important that active nematologists and the scientific nematology societies take the initiative and engage in teaching activities with the objective of the formation of new generations of young nematologists. Our science needs such new people, and needs new information to be generated. Nematodes will be here forever and growers need assistance to resolve their nematology problems. What do we need to do? First and foremost, we need to use all the talent and experience of the leaders in our subject. It would be a pity if all their accumulated experience were not used – we are all aware of instances of that saying about the wheel being invented again and we need to make sure that time and effort is not wasted on this. We also need to exploit any good relationships with people that have important administrative roles to help in our teaching objectives, and we need to use the facilities of our institutions to reduce the cost of nematology courses. In all of this, the role of the scientific nematology societies needs to be more pre-emptive and active. Pre-congress courses are good and useful, but the time is never enough to cover the topics in sufficient detail. We can do more in this area and, with time, this will increase the recognition and prestige of our own special society, ONTA. This is a society that is characterized by its well organized congresses and by the feeling of a family environment, but I would also like it to be recognized by its strong contribution to the formation of new generations of nematologists. These nematologists will be required urgently in the near future as new problems in crop production arise. Such problems will be an inevitable result of global warming, both as a result of the spread of nematodes to new areas, but also because they existed already in many areas and climatic changes favoured their development to the detriment of crops. Too often in recent years we have seen the loss of support for our discipline and even the closure of nematology departments, all at a time when the work of nematologists would be of more value than ever.

SURFACE FEATURES OF SOME GENERA OF *Tripylidae* (NEMATODA: ENOPLIDA) REVEALED BY SCANNING ELECTRON MICROSCOPY (Características superficiales de algunos géneros de *Tripylidae* (Nematoda: Enoplida) reveladas por microscopía electrónica de barrido)

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Four new *Tripylina* species (*T. bravoae*, *T. tlamincaensis*, *T. ixayocensis* and *T. montecilloensis*) and one new species of *Tripylella* were collected in México; one new species of *Tripylella* was collected in Fatima, Portugal and another in Quito, Ecuador. The surface morphology of all species was studied by scanning electron microscope (SEM). The cuticle of the *Tripylina* species is distinctly annulated and there are two cervical setae; the oral aperture is surrounded by three triangular lips with two inner labial papillae at the base of each; the six outer labial setae are strongly developed and posterior to them is a whorl of four cephalic setae; the amphid apertures are oval in *T. bravoae* but circular in *T. tlamincaensis*, *T. ixayocensis* and *T. montecilloensis*; somatic setae, present in all the *Tripylina* species, are most abundant in *T. bravoae*. The tail tapers gradually to a terminal spinneret in all the species. In the tail, there is one pair of latero-dorsal somatic setae in *T. bravoae* and *T. tlamincaensis* but not in *T. montecilloensis* and *T. ixayocensis* which have a pair of pre-anal somatic setae. The male of *T. bravoae* has five pre-cloacal supplements and one pair of latero-dorsal setae posterior to the cloaca. The species of *Tripylella* have a distinctly annulated cuticle and cervical setae are absent; the oral aperture is surrounded by three small triangular lips each with two inner labial papillae at the base; the whorls of outer labial and cephalic setae are very close together so that they almost appear as a single circle of 12 setae. Amphid apertures are oval and body pores and somatic setae are present in all species studied. The tail in *Tripylella* is almost cylindrical proximally and then narrows abruptly at 50-60% of its length before tapering to a terminal spinneret. There are two pairs of somatic setae on the tail, one pair postanal and other anterior to the abrupt narrowing of the tail. In the species from México there is also a single dorsal seta anterior to the abrupt narrowing of the tail.

A METAGENOMIC ANALYSIS OF SOIL BACTERIA AS AFFECTED BY ROOT-KNOT NEMATODES AND FENAMIFOS (Un análisis metagenómico de los efectos de nematodos agalladores y fenamifos sobre bacterias del suelo)

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The study of soil microorganisms through classical microbiology approaches is helpful to characterize the ecological roles of biological antagonists. However, it involves a loss of information given that less than 1% of the bacteria present in soil are culturable *in vitro*. Next generation sequencing (NGS) metagenomic approaches allow identification of many or even all bacteria present in a sample, including new taxa, through their DNA/RNA sequences, without the need of isolation and culturing. To evaluate factors affecting the biodiversity of soil bacteria in an organic crop soil, a greenhouse assay with a NGS metagenomic study was carried out. The aim was to identify the effects induced by newly introduced root-knot nematodes (RKN) and of related chemical treatments, on the soil microbial composition. A RKN-free soil, proceeding from an organic farm located at Mesagne (Italy), was planted with tomato cv Tondino seedlings. Treatments included plants inoculated with J2 of *Meloidogyne incognita*, treated or not with fenamiphos. Treated and untreated RKN-free soils were used as controls. Soil samples were collected from the pots at three different times at the beginning of the experiment, after J2 inoculation (T₀), at the third month before a treatment with fenamifos (T₁), and three months later (T₂). The RNAs extracted from each soil sample were sequenced with a Multiplexed 16S microbial sequencing Illumina MiSeq System, using the V4 ribosomal region. A total of more than 6.65 • 10⁶ sequences were obtained, allowing the identification of up to 97% of the phyla present in all samples. The dominant phyla were represented by Proteobacteria, Actinobacteria, Bacteroides and Gemmatimonadetes with varying percentages, in different treatments and times. A reduction of Proteobacteria and an increase of Actinobacteria and Gemmatimonadetes were observed in the control during the time course. RKN increased by 24% the number of sequences from Proteobacteria, decreasing the Actinobacteria, Bacteroides, Gemmatimonadetes by 13, 2 and 5%, respectively. The same behavior was observed for inoculated samples treated with fenamiphos. Treatments with the nematicide showed an increase of less than 14% of Proteobacteria compared to RKN inoculated samples, and a reduction of 7 and 3% of Actinobacteria and Bacteroides. The number of sequences associated to Gemmatimonadetes remained unchanged. NGS data are under scrutiny at finer taxonomic scales to identify specific groups or genera directly affected by nematodes and chemical treatments.

EL NEMATODO DEL QUISTE DE LA SOJA, *Heterodera glycines*, EN TUCUMÁN, ARGENTINA (Soybean cyst nematode, *Heterodera glycines*, in Tucumán, Argentina)

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En Argentina, *Heterodera glycines*, fue encontrado en cultivo de soja en 1997 en la región pampeana. Posteriormente fue localizado en el noroeste argentino en las provincias de Tucumán, Salta y Santiago del Estero. En algunos lotes los niveles poblacionales registrados fueron elevados. El objetivo del trabajo fue determinar la situación actual de este nematodo en cultivo de soja en la provincia de Tucumán. Se colectó un total de 30 muestras compuestas de suelo en lotes de 12 localidades. Las muestras fueron procesadas en laboratorio para la extracción de quistes. *H. glycines* fue detectado en 16,7 % de las muestras analizadas, en niveles poblacionales entre 1 y 33 quistes/100cm³ de suelo, 180 y 10.784 huevos/100cm³ de suelo respectivamente. Aunque los niveles poblacionales encontrados fueron inferiores a los detectados en los primeros monitoreos, en algunos casos superaron el umbral de daño determinado para esta especie y estuvieron relacionados a lotes con bajos rendimientos sin manifestación de síntomas foliares. En algunas muestras pudieron detectarse hongos patógenos parasitando quistes de *H. glycines* los cuales estarían actuando como controladores naturales de este nematodo. En lotes de soja con presencia de esta plaga se recomiendan la rotación con cultivos no hospederos como maíz, el empleo de variedades resistentes y el tratamiento de semillas.

GENETIC DIVERSITY OF THE ROOT-KNOT NEMATODE *Meloidogyne ethiopica* AND DEVELOPMENT OF A SPECIES-SPECIFIC SCAR MARKER FOR ITS DIAGNOSIS (Diversidad genética de *Meloidogyne ethiopica* y desarrollo de un marcador específico SCAR-PCR para su diagnóstico)

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Meloidogyne ethiopica is an important nematode pathogen causing serious economic damage in grapevine in Chile. In Brazil, *M. ethiopica* has been detected with low frequency in kiwi and other crops. The objectives of this study were to evaluate the intraspecific genetic variability of *M. ethiopica* isolates from Brazil and Chile using AFLP and RAPD markers and to develop a species-specific SCAR-PCR assay for its diagnosis. Fourteen isolates were obtained from different geographic regions or host plants. Three isolates of an undescribed *Meloidogyne* species and one isolate of *M. ethiopica* from Kenya were included in these analyses. The results showed a low level of diversity among the *M. ethiopica* isolates, regardless of their geographical distribution or host plant origin. The three isolates of *Meloidogyne* sp. showed a high homogeneity and clustered separately from *M. ethiopica* (100% bootstrap). RAPD screenings of *M. ethiopica* genome allowed the identification of a differential DNA fragment that was converted into a SCAR marker. Using genomic DNA from pooled nematodes as a template, PCR amplification with primers designed from this species-specific SCAR produced a fragment of 350-bp in the fourteen isolates of *M. ethiopica*, in contrast with other RKN species tested. This primer pair also allowed successful amplification of DNA from single nematodes, either juveniles or females and when used in multiplex PCR reactions containing mixtures of other RKN species, thus showing the sensitivity of the assay. Therefore, it is concluded that the method developed here has potential for application in routine diagnostic procedures.

NEMATOLOGY CAPACITY BUILDING IN AFRICA AT THE INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE (Capacidad de formación nematológica en África en el Instituto de Agricultura Tropical)

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With output per capita increasing across the developing world, but decreasing in sub-Saharan Africa, the need to improve crop productivity on this continent becomes ever more urgent. Improved pest and disease management will be crucial, including nematode pests, to sustainably improve productivity. Addressing the issue of nematode pests requires not only innovative IPM options for their management but also a paradigm shift in raising awareness and providing training in nematology. This will require substantial investment in training and capacity building, as well as strengthening links between the public and the private sectors. Nematology per se is vastly under-represented across sub-Saharan Africa, with no expertise present in some countries even. At IITA harnessing interest and appeal in the discipline is being addressed through a number of routes. Integrating formal training into new projects with full financial support is a satisfying but a relatively rare occurrence. Other mechanisms involve provision of bench training for national technical staff, under-graduate and graduate students with limited resources. Use of workshops for highlighting nematology issues is also helpful and, where possible, using simple protocols to simplify the topic. In sub-Saharan Africa awareness and activity in nematology continues to remain insufficient. Retaining students and staff with skills, knowledge and interest in nematology is key to sustaining the science at the national level towards reducing the food security gaps.

NEW TOOLS FOR NEMATODE MANAGEMENT ON TURFGRASSES IN THE USA. (Nuevas herramientas para el manejo de nematodos en céspedes en Estados Unidos)

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The loss of fenamiphos has brought about a great need for new nematode management tools for use on turfgrasses. Among the new tools developed and being developed for use on turfgrasses in the USA are new chemistries, new uses for old chemistries, and biopesticides. Highlights of research with promising technologies evaluated over the past decade will be presented. The emphasis will be on commercial products that have turf uses either approved by the US Environmental Protection Agency or with registration under current review. New chemistries discussed will be fluensulfone and furfural. Old chemistries that have been adapted for new uses on turfgrasses are 1,3-dichloropropene and abamectin. Biopesticides presented include microbials such as *Bacillus firmus* and *Paecilomyces lilacinus*, and botanical products derived from *Brassica juncea*. The technologies discussed have all demonstrated consistent efficacy in University of Florida field trials.

OPPORTUNITIES AND CHALLENGES TO NEMATODE MANAGEMENT ON GOLF COURSE PUTTING GREENS (Oportunidades y desafíos en el manejo de nematodos en campos de golf)

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Turfgrasses on putting greens can be impacted by a number of nematode species that include ectoparasites, migratory endoparasites and sedentary endoparasites. These grasses are grown perennially, so nematode management should focus on a post-planting integrated pest management (IPM) programs rather than solely on pre-planting fumigation. Because the life cycle and seasonal activity of plant-parasitic nematodes varies among species and with environmental conditions, knowledge of the target nematodes' biology is essential to the application timing of pesticides or biological controls for effective management. The treatment zone on a putting green is 5 to 15 cm-deep, so treatments do not need to go deep into the soil profile to be effective. However, because putting greens are generally constructed with sand and are irrigated frequently, preventing leeching of treatments out of the treatment zone can be problematic. Additionally, putting green turfgrasses are frequently associated with an organic thatch layer which can impact movement of pesticides and biological control organisms into the turf root zone. Case studies of successes and failures with numerous fumigant and non-fumigant nematicides and biopesticides will be used to illustrate key considerations for development of IPM programs for nematodes on golf course putting greens.

CHARACTERIZATION OF A POPULATION OF THE GENUS *Thelastoma* ASSOCIATED WITH *Gymnetis litigiosa* (Caracterización de una población del género *Thelastoma* asociada con *Gymnetis litigiosa*)

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The genus *Thelastoma* comprises 61 species mainly associated with arthropods. Morphological, morphometric and ecological characteristics were considered to characterize a population detected in *Gymnetis litigiosa* (Scarabaeidae) from Uruguay; moreover, the 18S gene was partially amplified and sequenced. The hindgut of larvae (n = 23) and adults (n = 20) of the coleopteran was dissected; nematodes were fixed and processed following classical techniques. Females exhibited a spermatheca on each reproductive branch, the one located on the posterior branch being the most noticeable. Excretory pore located at the middle of the basal esophageal bulb (the most frequent location) or slightly anteriorly, near the isthmus. Tail long and filiform, representing 28% (22-33%) of body length. Males presented a pair of longitudinal lateral wings; spicules absent. Ventrally, some males showed irregular protuberances near the anus; in other specimens, transversal lines composed of small protuberances were observed in the mid and posterior body region. Adults of the insect were not infected whereas in larvae, prevalence was 74% and abundance and mean intensity values were 8.8 and 11.9, respectively. An 885-bp fragment of the 18S gene was amplified; genetic similarity percentages obtained were 95% with *T. gueyei* and 97% with *T. krausi*. This genus is first detected in *G. litigiosa*.

A STUDY INTO THE CAUSES OF LITCHI TREE DIEBACK (Estudio de las causas de la muerte regresiva del árbol de Litchi)

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Litchi dieback is becoming a serious problem in orchards where adult trees get sick and eventually die. Several organisms have been linked with the disease, but while a combination of fungi have been identified, none were directly linked with the disease and its symptoms. Factors like nematodes, drought stress and other biotic factors were never really considered to play an important role. An intensive survey was conducted in all litchi producing areas. Sampling was done irrespective of presence of litchi tree dieback but when present a representative sample of both healthy and sick plants were taken. The amount of samples was determined by the size of the area. Besides nematodes and fungi, present on roots and in the soil, other data collected included irrigation schedule and type, soil nutrients, fertilization, age, cultivar and size of trees. Fungi identified were *Pythium*, *Phytophthora* and *Cylindrocladium* with *Pythium* being the most abundant species found in all areas and in 88% of the samples including samples from healthy trees. Although several nematode species like *Xiphinema*, *Hemicyclophora*, *Meloidogyne*, *Helicotylenchus* and *Pratylenchus* were present in the samples, the ring nematode *Hemicriconemoides mangiferae* was associated with all the orchards confirming it as the most

important nematode species on litchi in production areas in South Africa. However, with the principal component analysis only 3 parameters namely *Hemicycliophora*, *Pythium* and Ca+Mg/K were significantly different between diseased and healthy trees. *Hemicycliophora* was only found in diseased trees indicating its pathogenicity when present. The survey confirmed that litchi dieback is directly linked to trees under stress. Factors that are important are nematodes, water and nutrients and infection by *Pythium* and most probably *Phytophthora* and *Pythium*. Although nematodes are not the primary cause of litchi dieback they can play an important role in the development of the disease, particularly when numbers are high they should be controlled to reduce the risk of litchi dieback.

WEED MANAGEMENT AND SOIL NEMATODE DIVERSITY CONSERVATION IN ORGANIC COFFEE PLANTATIONS OF PUERTO RICO (Manejo de malezas y la conservación de la diversidad de nematodos del suelo en plantaciones de café orgánico de Puerto Rico)

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Weed management is one of the greatest constraints to the coffee plantations in transition to organic agroforestry systems in Puerto Rico. Among different ecosystems services, nematode diversity conservation, is one affected by these practices by suppressing or enhancing parasitic or free-living nematodes, that play a significant role in the decomposition of soil organic matter, mineralization of plant nutrients, and nutrient cycling, and serve as indicators of the ecological condition of soils. This experiment evaluated the effect of weed management practices in nematode diversity conservation at two sites independently: Orocovis (established organic coffee agroforestry system) and Utuado (organic coffee agroforestry system in transition). The organic weed management treatments were: a) mechanical control, b) OMRI-listed herbicide, c) cover crop *Arachis pintoi*, d) cover crop *Heterotis rotundifolia*, and e) a control, (weeds were not managed). Soil nematodes were sampled pre and post treatment application and processed for nematode extraction using the centrifugal-flotation method. Nematodes were counted and identified to species and classified as plant-parasitic, fungivores, bacteriovores, omnivores and predators. Nematode abundance and species richness were compared among treatments using a one-way ANOVA statistical analysis. Preliminary results showed that nematode abundance was significantly different among treatments in Utuado site but not in Orocovis. Differences were observed between pre and post treatment in both sites for abundance. However, species richness was not different among weed management treatments in both experimental sites. Plant and bacterial feeders were the most abundant in both experimental sites.

VALIDACIÓN DEL MANEJO BIOLÓGICO Y QUÍMICO ORGÁNICO DE *Meloidogyne incognita* EN JITOMATE EN AGRICULTURA PROTEGIDA (Validation of the biological and chemical-organic management of *Meloidogyne incognita* in tomato grown in a protected agriculture system)

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Se evaluó el efecto nematicida de productos químicos orgánicos y biológicos sobre *Meloidogyne incognita* (Kofoid y White) Chitwood en plantas de jitomate (*Solanum Lycopersicum* L.) en agricultura protegida. Se diseñaron microparcelas de 50 x 30 x 20 cm que contenían suelo franco arenoso (pH 7.09, arena:arcilla:limo, 64:10:26); en las cuales se transplantaron 10 plantas de jitomate cv. Río grande de 30 días de edad. Los tratamientos se establecieron bajo un diseño experimental de bloques completamente al azar con cinco repeticiones. Se aplicaron 50 ml de la suspensión nematicida en la base de cada planta en cuatro momentos (al transplante, 7, 21 y 35 días después del transplante). La biofumigación con extracto de brócoli (75 t·ha⁻¹) suprimió de manera significativa las poblaciones del nematodo ($\alpha = 0.05$), proporcionando la menor población final con 21 J2 y redujo el porcentaje de agallamiento en 96% con una eficacia del 92%. El producto biológico a base de *Paecilomyces lilacinus* (*P. lilacinus* 1) en dosis de 12 L·ha⁻¹ presentó una población final de 51 J2, disminuyendo el agallamiento en un 88.9%, con una eficacia del 72.2%. El testigo químico no fumigante, oxamil (4 L·ha⁻¹) proporcionó poblaciones finales de 25 individuos, reduciendo el agallamiento en un 92%; mientras que el dicloropropeno + cloropicrina (250 L·ha⁻¹) redujo el agallamiento en un 91.6%, con respecto al control, este último aplicado una sola vez, 20 días antes del transplante. No se encontraron diferencias significativas en altura y peso fresco de planta, siendo las resinas + ác. orgánicos en dosis de 20L·ha⁻¹, la que proporcionó los valores más altos con 4.5 frutos por planta y 564g·UE⁻¹, respectivamente.

DISPERSIÓN Y PERSISTENCIA DE *Heterorhabditis colombica* SL0708 n.sp. (NEMATODA: RHABDITIDA) APLICADO COMO CADÁVERES INFECTADOS EN SUELO. (Spread and persistence of *Heterorhabditis colombica* SL0708 n.sp. (Nematoda: Rhabditida) applied as infecteds corpses in the soil)

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En los cultivos donde las plagas de insectos se concentran bajo el dosel, los nematodos entomopatógenos pueden aplicarse como cadáveres infectados. Este estudio evaluó la distribución de *Heterorhabditis colombica* cepa SL0708 aplicada como uno ó 15 cadáveres por parcela en un cultivo de guayaba, dada su eficacia para el control de *Conotrachelus psidii* Marshall (Coleoptera: Curculionidae) en Colombia. Las parcelas se encontraban entre los árboles de guayaba, con los cadáveres infectados en el centro. Las muestras de suelo fueron tomadas 1, 3, 5, 8 y 11 semanas después de la aplicación del cadáver. En cada fecha, las parcelas fueron muestreadas a 30, 60, 90 y 120 cm desde el punto de aplicación del cadáver, y a tres profundidades (0 - 10, 10 - 20 y 20 - 30 cm) en cada punto. Se presentaron diferencias significativas en la recuperación de juveniles infectivos (JI) para la aplicación de uno y 15 cadáveres. En la primera y tercera semana de evaluación se recuperó el mayor número JI sin encontrarse diferencias significativas entre las distancias, ni profundidades. *Heterorhabditis colombica* SL0708 a partir de cadáveres infectados se desplaza en los primeros 20 cm de la superficie del suelo a una distancia de 120 cm, en un tiempo de 3 semanas principalmente.

PERFIL MICROBIOLÓGICO, NEMATÓXICO Y NEMASTÁTICO DE AVIBIOL, UNA ENMIENDA ORGÁNICA SOSTENIBLE (Microbiological, nematotoxic and nematostatic profile of Avibiol, a sustainable organic amendment)

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Gran parte de la oferta agro-exportable del norte peruano está amenazada por el nematodo del nudo, *Meloidogyne* spp., debido a las condiciones ecobiológicas favorables en suelos, clima y extensos monocultivos altamente susceptibles. Las tendencias más recientes, en el manejo integrado de plagas y enfermedades, impulsan el retorno al uso sostenido de sustratos orgánicos. En esta investigación se evaluó el perfil microbiológico, nematológico y nemastático de Avibiol, una enmienda orgánica peruana proveniente de la fermentación anaeróbica del estiércol de gallinas ponedoras. La población de actinomicetes, bacterias totales, fluorescentes, así como de hongos fue determinada mediante pruebas de dilución en medios de cultivo selectivos para cada grupo de microorganismos. El efecto nematológico de la enmienda a 100, 75 y 60% se evaluó in vitro, depositando de 100 a 200 huevos de *Meloidogyne* spp. en placas de Petri con las tres concentraciones de Avibiol. En condiciones de campo naturalmente infestado con *Meloidogyne* spp., se aplicó la enmienda a razón de 200 y 300L/ha, fraccionados en 3 a 4 oportunidades y la densidad poblacional de *Meloidogyne* spp. (J-2/100cc de suelo) fue determinada mediante muestreos sistemáticos de suelo tratado y no tratado en diferentes cultivos. Los resultados mostraron que Avibiol posee una carga bacteriana termorresistente estable de 10⁴ u.f.c./mL. No se encontraron bacterias fluorescentes, la población de actinomicetes varió de 15 a 600 u.f.c./mL y la de hongos de 3 a 600 propágulos/mL. La emergencia en huevos de *Meloidogyne* spp. en Avibiol a 75 y 100% fue de 0.76 a 0.98% mientras que en el testigo fue de 14.26 a 21.15% siendo la mortandad de juveniles 100% en las placas con Avibiol y 0% en el testigo. Avibiol a 60% no produjo ningún efecto nematológico. Raíces de banano orgánico tratado con Avibiol aplicado por sistema de riego presurizado a 200L/ha (4% de concentración) mostraron 0 huevos (Avibiol) y 41 huevos/5g de raíces (testigo sin Avibiol). Los juveniles/5g de raíces en el testigo fueron 418 *Radopholus* spp., 14 *Helicotylenchus* y 41 *Meloidogyne*; mientras que en plantas tratadas con Avibiol la población fue de 12 *Radopholus* spp., 4 *Helicotylenchus* spp., y 4 *Meloidogyne*. Los resultados no acreditan que la depresión poblacional de nematodos fitopatógenos se debe a un efecto nematológico de Avibiol, por lo que se postula que las bacterias de esta enmienda están jugando un rol rizosférico, de modo tal que al tomar los exudados radiculares de la planta tratada, los nematodos se quedan sin orientación electrostática para alcanzar la raíz y mueren por inanición.

EFFECTO DE LA TEMPERATURA SOBRE EL CRECIMIENTO DE TRES AISLADOS DEL

GÉNERO *Xenorhabdus* (Effect of temperature on growth of three *Xenorhabdus* isolates)**E.E. Del Valle**¹, L.S. Frizzo², M.V. Zbrun², M.E. Doucet³¹Facultad de Ciencias Agrarias, Universidad Nacional del Litoral, Esperanza, Santa Fe, Argentina; ²ICIVET (CONICET-UNL) - Departamento de Salud Pública, FCV, Universidad Nacional del Litoral, Esperanza, Santa Fe, Argentina; ³IDEA (CONICET-UNC) - Centro de Zoología Aplicada, FCEFYn, UNC, Córdoba, Argentina. edelvalle@fca.unl.edu.ar

El objetivo de la investigación fue evaluar el efecto de algunas temperaturas sobre el crecimiento de las bacterias simbióticas *X. szentirmaii*, *X. doucetiae* y *X. mauleonii*, relacionadas con aislados de *S. rarum*, *S. diaprepesi* y *Steinernema* sp. respectivamente, provenientes de Santa Fe, Argentina. Las bacterias fueron sembradas en medio TSB e incubadas en aerobiosis a 11 temperaturas diferentes (10, 15, 20, 25, 30, 35, 37, 39, 41, 42 y 43°C). El crecimiento de los microorganismos fue evaluado mediante la determinación de la densidad óptica de los cultivos bacterianos en un espectrofotómetro ajustado a 600 nm de longitud de onda. Las mediciones se realizaron por triplicado a intervalos de 12 h, finalizando a las 96 hs posteriores a la siembra. *X. doucetiae* y *X. szentirmaii* alcanzaron su máximo crecimiento a las 96 h de incubación a 30°C. Para *X. mauleonii*, el máximo crecimiento observado fue a 25°C. La temperatura mínima de crecimiento para los 3 aislados fue de 15°C. La temperatura máxima de crecimiento fue de 42°C para *X. mauleonii* y *X. doucetiae*; y de 39°C para *X. szentirmaii*. Los resultados obtenidos demostraron que los aislados *X. mauleonii* y *X. doucetiae* crecen a temperaturas superiores a 40°C, manifestando mayor tolerancia a este factor en relación a la mayoría de las especies del género.

EFFECTO DE LA TEMPERATURA SOBRE LA SUPERVIVENCIA Y CAPACIDAD INFECTIVA DE UN AISLADO DE *Steinernema diaprepesi* (Effect of temperature on survival and infectivity of an isolate of *Steinernema diaprepesi*)**E.E. Del Valle**¹, L.S. Frizzo², M.V. Zbrun², M.E. Doucet³¹Facultad de Ciencias Agrarias, Universidad Nacional del Litoral, Esperanza, Santa Fe, Argentina; ²ICIVET (CONICET-UNL) - Departamento de Salud Pública, FCV, Universidad Nacional del Litoral, Esperanza, Santa Fe, Argentina; ³IDEA (CONICET-UNC) - Centro de Zoología Aplicada, FCEFYn, UNC, Córdoba, Argentina. edelvalle@fca.unl.edu.ar

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***Solanum sisymbriifolium*: BIOLOGICAL CONTROL OF *Globodera rostochiensis* (*Solanum sisymbriifolium*: CONTROL BIOLÓGICO DE *Globodera rostochiensis*)**M. Dias, L. Silva, **I. Abrantes**, M.J. Cunha, I. Conceição

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Globodera rostochiensis commonly known as potato cyst nematodes (PCN) are plant pathogenic nematodes. They are considered the major pests to potato production worldwide and are the issue of quarantine regulations in some countries. *Solanum sisymbriifolium*, a trap crop, has been considered ideal for PCN control. It stimulates hatching of the second stage juveniles (J2) but is totally resistant to PCN populations. The main goal of this research was to evaluate the interactions between *S. sisymbriifolium* (cvs Melody, Pion, Sharp, Sis 4004 and Sis 6001) and *G. rostochiensis*. Five plants from each cultivar and five plants of the susceptible potato (*S. tuberosum* cv. Désirée) were inoculated with 1800 J2/pot. Pots were kept in a growth chamber (25 ± 2°C, 12 h and 70–75% relative humidity). Pathogenicity studies showed that all cultivars were resistant to *G. rostochiensis*. The

root exsudates were obtained by successive soil leaching and tested on hatching of J2, with daily counts, for a maximum period of 30 days. The potato cv. Désirée root exsudate and water were used as controls. Five replicates with 15 cysts were done for each exsudate. The hatching in *S. sisymbriifolium* cvs Sharp and Sis 6001 exsudates was higher (cv. Sharp – 1.83%; cv. Sis 6001 – 13.66%) than in water (1.39%).

HATCHING AGENTS OF *Solanum sisymbriifolium* EXTRACTS AGAINST *Globodera* spp. (Agentes de eclosión de extractos de *Solanum sisymbriifolium* frente *Globodera* spp.)

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Potato cyst nematodes (PCN), *Globodera* spp. are relevant pests of potato crops and quarantine organisms with economic consequences. There are several control strategies useful in the management of PCN such as the use of trap crops, artificial hatching and biocontrol agents. *Solanum sisymbriifolium* has been used as a successful trap crop, but its mode of action is unknown. Therefore, research is being conducted in order to identify those phytochemicals and to find out the effect of the components on PCN. The main goal of this study was to evaluate the hatching effects of root exsudates and root extracts of *S. sisymbriifolium* (cv. Sis 6001) on *Globodera* spp. The root exsudate extracts were obtained from the soil, where plants had grown, that was placed in water during 24 h, in the dark, and the root extracts were obtained from dried and pulverized roots. The powdered roots were dissolved in water, placed in water bath at 100°C, during 60 min. The samples (soil and roots) were filtered, concentrated and lyophilized. Laboratory assays were performed with five concentrations of each extract (0.4, 0.2, 0.1, 0.05 and 0.0025 mg/ml), using potato (*S. tuberosum*, cv. Désirée) root exsudate and water as controls and four replicates with 15 cysts/replicate/treatment. The hatching of second-stage juveniles was evaluated, with weekly counts, during 30 days. The hatching in all concentrations of the soil extract was higher in *G. rostochiensis* and the hatching in all the concentrations of root exsudate was similar for both species.

PAST, PRESENT AND FUTURE OF NEMATODE MANAGEMENT (Pasado, presente y futuro del manejo de nematodos)

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The management of plant-parasitic nematodes has made limited advances during the past 50 years. In fact it can be argued that nematode management has regressed during this period, especially in terms of chemical nematicides. Nematicides remain among the most practical and assured ways of managing plant-parasitic nematodes on some of our most valuable crops. Unfortunately, numerous nematicides have been suspended, withdrawn or cancelled during the past 50 years. Many of those nematicides were cheap to purchase, and highly efficacious. Meanwhile practically no replacement chemistry has been labeled. For example, high value vegetable crops were highly dependent on methyl bromide for the past 45+ years. This product, whether used singly or in mixed formulations with chloropicrin, was highly efficacious against soilborne pathogens and pests. Task forces were set in place beginning in 1994 to find viable alternatives to replace methyl bromide but little success has been attained. Finding alternatives was made difficult because of the lack of highly efficacious products, environmental constraints, worker protection issues, and newly imposed regulations that impact the use of soil applied pesticides. As a consequence we are moving toward a period when growers will be forced to choose less efficacious chemical products, if such products receive Federal registration, or choose other nematode management tactics. There has been only limited success with development of crop plants with resistance to nematodes, especially with high value crops. Although promising, biological control has not yet made an impact on nematode management. Crop rotation, which has been listed as a control tactic for many years, remains one of the better choices for growers, but again has many limitations. Other tactics, e.g., solarization, organic amendments, and fallowing-flooding, etc. have only limited use. The pros and cons of each of these possible nematode management tactics will be discussed.

STING NEMATODE (*Belonolaimus* sp.), AN EMERGING PATHOGEN ON PEANUT (*Arachis hypogaea*) IN FLORIDA (Nematodo del aguijón, un patógeno emergente en maní (*Arachis hypogaea*) en Florida)

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Plant-parasitic nematodes are one of the major limiting factors for peanut (*Arachis hypogaea*) grown in the southeast and southwest United States. In these regions the nematode species most commonly reported infecting peanut are *Meloidogyne arenaria*, *M. javanica*, *Pratylenchus brachyurus* and *Criconeimoides ornatus*. The sting nematode, *Belonolaimus longicaudatus*, has also been reported as a pathogen of peanut, but much less frequently and then only in small geographical areas in North Carolina, Oklahoma and Virginia. In the summers of 2012 and 2013, peanut plants cultivated on two different farms, Levy County, FL were found infected by sting nematode. In 2012 the peanut cultivar grown was Tiftguard, whereas in 2013 the cultivar was Georgia 06. Infected plants exhibited severe stunting, leaf yellowing, and when plants were lifted from the soil their roots exhibited the typical stubby or abbreviated root systems that have been previously reported for sting nematodes on other crops. An examination of pegs and pods revealed numerous distinctive small round brown lesions of approximately 1mm in diameter. Preliminary data on the morphology indicates this nematode to be *Belonolaimus longicaudatus*. Molecular characterization studies are in progress. This is the first report of sting nematode infecting peanut in Florida.

BIOLOGICAL CONTROL IN CONVENTIONAL AGRICULTURE A VIEW FROM ECOLOGY TO ECONOMY (Control biológico en la agricultura convencional, una vista desde la ecología a la economía)

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In the last few years the biocontrol industry give a jump, triggered by a increase in the market restriction to chemical pesticides, the recalcitrance of several gap in the phytosanitary programs, and the concentration of the industry in 10 principal players with the 50% of the biocontrol sales. Among these big players is the traditional biocontrol enterprise, but in the last two years, several acquisitions by Bayer (Agraquest), Basf (Becker Underwood), Syngenta (Pasteuria Biosciences), and several more, give a new status to the biological control industry and technology. A top down driver is the market exigencies to reduce residues levels and more important reduce the number of active ingredient residues, a bottom up driver, the gap of chemical control in soil sanitary problems, insect, fungus and nematodes. The biological control agents had several differences with chemical and botanical products, but the notorious is they can do thing the chemical and botanical cannot, as the use of physical space over or inside the plants, and produce exclusion in both way, competition (niche competitive exclusion principle), or by become a new filtering environmental factor (change in niche conditions, predation, parasitism). But the biological evolutive bases are not enough to achieve agronomical effectiveness, it is necessary make an integration with the grower programs, and it means segregation and complementation. To achieve this we need to determine compatibilities between chemical and biological, in a systemic context, we call this the alcohol and patch strategy, have quick and high population reduction of the pest with the chemical and keep the soil free of pest by reduction of the lambda of the pest population.

SOIL NEMATODES AND POTATO CROP IN ARGENTINA (Nematodos del suelo y el cultivo de papa en Argentina)

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In Argentina, potato crop is affected by diverse soil nematodes. Species of the genus *Meloidogyne* and the species *Nacobbus aberrans* have a wide geographical distribution and parasitize the varieties most commonly used for consumption. Furthermore, the genus *Globodera* would be restricted to the Andean region in the north of the country, associated with Andean potato. So far, the incidence of the three genera on the different producing regions is unknown. These nematodes not only parasitize the root but also can infect the tubers, with the consequent problem involved in the use of seed potato. Therefore, avoiding tuber dispersal and contaminated soils is of great importance; in some cases, ancestral traditions favor this dispersal, hindering nematode eradication. The presence of weeds that ensure the persistence of these parasites makes management difficult, especially in the case of

Meloidogyne spp. and *N. aberrans*, due to their polyphagous habits. Enhancing the knowledge of the biology of these nematodes is essential for designing adequate management strategies and defining phytosanitary policies.

RESEARCH, TEACHING, AND EXTENSION RELATED TO AGRICULTURAL NEMATOLOGY (Investigación, docencia y extensión relacionadas con la nematología agrícola)

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Experience indicates that – in many cases – the knowledge generated by scientific research does not always reach those who need it to make important decisions. This situation happens in many countries with the knowledge generated for soil nematodes. The processes of extension and transfer of information have not been and are not adequate, and do not give access to growers and technical advisors to the necessary information. Often, growers are unaware of the existence of soil nematodes and the different trophic groups they represent. When nematode management practices are considered, too frequently chemical control is the first thought and is perceived as a quick and magical solution to the problem. The main reason for this situation is the lack of knowledge of nematode biology, which in turn is caused by the low importance given to nematology courses in universities, along with ineffective extension policies. It is possible to minimize the damage caused to crops by plant-parasitic nematodes, but basic knowledge of their identification, biology and ecology is needed. For this, it is most important that Agricultural Nematology courses are included in Agronomy and related educational programs.

RNAi SILENCING OF THE VENOM ALERGEN LIKE PROTEIN GENE (*Mhi-vap-1*) IN *Meloidogyne hispanica* (Silenciamiento del gen venom allergen like protein (*Mhi-vap-1*) en *Meloidogyne hispanica*)

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Gene silencing using RNAi is a powerful tool for functional analysis of nematode genes and can provide a new strategy for plant-parasitic nematode control. The transcript of the *Meloidogyne hispanica* venom allergen like protein gene (*Mhi-vap-1*) was localised in the subventral oesophageal gland cells with highest transcriptional level in the second-stage juvenile (J2). The purpose of this study was to assess whether the silencing of this gene could affect nematode behavior and was essential for successful infection of tomato plants. J2s were incubated in a soaking solution containing double stranded RNA (dsRNA) and the neurostimulant octopamine for 24h in the dark at room temperature. Soaking solutions without octopamine and/or dsRNA were used as controls. After incubation, J2s were washed to remove the soaking solution and used for attraction and penetration bioassays. Time course experiments were carried out in 23% Pluronic gels to evaluate the effect of *Mhi-vap-1* silencing for the attraction and penetration of tomato roots cv. Easypeel. Preliminary results showed that the *Mhi-vap-1* gene was silenced and this caused a reduction in nematode attraction and penetration of tomato roots, a decrease of the nematode reproductive rate was also observed.

NEMATODES: PART OF THE COMPLEX MESOFAUNAL COMMUNITY STRUCTURES ASSOCIATED WITH CAVES IN SOUTHERN AFRICA (Nematodos: Parte del complejo de estructuras comunitarias de la mesofauna asociada con cuevas en el sur de África)

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Cave environments present a unique ecosystem type that depends on alternative energy sources, other than solar energy, to ensure the survival of its inhabitants. Mesofauna is vital as decomposers, diversity stimulators and food sources in such systems. Disturbances in the cave ecosystem can be identified by monitoring the changes in community structures of the associated mesofauna. The objective of this study was i) to analyse the nematode community structures present within soil and guano of four selected caves (Botswana and South Africa) and ii) sample and identify other mesofaunal species present. Nematodes were extracted using standard methods, while other mesofauna were caught mainly by using pitfall traps. High populations of non-parasitic

nematodes, predominantly bacteriovores, were present in all of the substrates, namely *Prismatolaimus*, *Zeldia*, *Panagrolaimus* and *Rhabditis* spp., as well as representatives of the predatory Dorylaimida. Plant-parasitic nematodes were only represented by a few individuals and were sampled from all caves with *Criconema* and *Meloidogyne* spp. dominating. Diversity analyses revealed that complex community structures exist between different and within single caves. Various other mesofauna species were sampled of which many are considered new to science. Future research will focus on the use of nematodes as bioindicators of pollution.

ROOT PROTECTION OF *Solanum lycopersicum* L. PARASITIZED BY *Meloidogyne ethiopica* (WHITEHEAD, 1968) BY *Rhodotorula mucilaginosa* [(A. JÖRG.) FC HARRISON] IN GREENHOUSE CONDITIONS. (Protección de raíces de *Solanum lycopersicum* parasitadas por *Meloidogyne ethiopica* por *Rhodotorula mucilaginosa*) bajo condiciones de invernadero)

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The yeast *Rhodotorula mucilaginosa* is proposed as a biological solution to agricultural problems caused by *Meloidogyne ethiopica* and is recognizes that provides root protection. Plants of *S. lycopersicum* with and without *R. mucilaginosa* were infested with 0, 10, 100, 500, 1000, 4000 and 8000 eggs of *M. ethiopica*. Was measured the amount of galls, weight and quality of the roots, and assessed histologically the radical region of maturation. In inoculated treatments between 500 and 4000 eggs of *M. ethiopica*, *R. mucilaginosa* produced an improvement in root condition resembling the negative control in: quality, weight, thickness of the cortex, vascular cylinder and xylem cells diameter. In plants inoculated with 8,000 eggs of *M. ethiopica*, *R. mucilaginosa* decreased by one third the number of galls per root. This study also demonstrates that in low presence of *M. ethiopica*, *R. mucilaginosa* can be detrimental to the root. This suggests that *R. mucilaginosa* could be applied as a root protective agent in soils with high population of *M. ethiopica*, in which has a great potential to improve the condition of the root.

MECHANISMS BY WHICH SOIL pH MIGHT MODULATE THE POPULATION DENSITY OF AN ENTOMOPATHOGENIC NEMATODE (Mecanismos mediante los cuales el pH del suelo podría modular la densidad poblacional de un nematodos entomopatógeno)

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Numbers of the native entomopathogenic nematode (EPN) *Steinernema diaprepesi* were reduced and spores of *Paenibacillus* sp., a bacterial ectoparasite of *S. diaprepesi*, were increased by a new management regime in a field experiment comparing various citriculture practices. Compared to conventional methods, the new cultural regime changed several soil properties including an increase in soil pH from 5.6 to 7.2 due to daily fertigation with calcium nitrate. In laboratory trials, *Paenibacillus* spores increasingly detached from the *S. diaprepesi* cuticle as soil pH decreased over a range between 4.0 and 8.0. A second field experiment was initiated in a different orchard where sulfur was used to reduce soil pH from 7.1 to 6.2. Six months after soil pH in sulfur amended plots differed from that in control plots, *Paenibacillus* sp. were reduced by 89% ($P = 0.03$) and *S. diaprepesi* were more than twice as numerous (NS) in sulfur amended plots. High and low pH soils from both field experiments were autoclaved and used to study their effects on *S. diaprepesi* in the absence of *Paenibacillus* sp. When incubated in soils from either site, fewer *S. diaprepesi* were recovered from high pH soils compared to low pH soils. When *S. diaprepesi* were incubated with nematophagous fungi, soil pH had little effect on mortality caused by the trapping fungus *Arthrobotrys musicola*, but the zoosporous fungus *Catenaria* sp. killed the nematode at a higher rate in high pH soils from both sites. Soil pH adjustment may be an effective strategy to conserve some EPN species and a variety of mechanisms may be involved.

FORAGE PLANT REACTION TO *Pratylenchus brachyurus* (Reação de plantas forrageiras ao *Pratylenchus brachyurus*)

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This work's aim was to evaluate different forages as option against the *Pratylenchus brachyurus* in a soy-forage growth system. An experiment was carried out under greenhouse and field conditions. In the greenhouse experiment, 15 forages were put in a randomized block design with four replications. After 15 days of germination a 10 ml of suspension with 60 specimens of *P. brachyurus* per ml (Pi) were inoculated. The final population (Pf) was calculated at 70 days after inoculation. The field experiment was carried out under a *Pratylenchus brachyurus* infested area that was identified in a soybean farm in Barretos, SP. The sowing was done in line, with four replications. After 90 days of sowing, the Pf and reproduction factor were estimated. The forages that provided $FR > 1$ were considered susceptible. The ones with $FR < 1$ were considered resistant to the nematode. The field results were inconsistent. The greenhouse experiment showed that the forages *Andropogon gayanus* (Planaltina), *Stylosanthes capitata* + *S. macrocephala* (Campo Grande), *Cajanus cajan* (Caqui), *Crotalaria juncea* (IAC-1), and *Macrotyloma axillare* (Java) presented $FR < 1$.

THE BIOLOGICAL COMPONENT OF SOIL HEALTH: NEMATODES AS FACILITATORS AND BIOINDICATORS. (El componente biológico de la salud del suelo: los nematodos como facilitadores y bioindicadores)

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The health of the soil is defined by its physical, chemical and biological characteristics; the three are intimately and intricately interconnected. Soil health is an assessment of the importance of ecosystem services resulting from the biological and behavioral functions of the soil organisms in their current environment. Using nematodes as an example, the three legs of the assessment of the biological component of soil health are: 1. Faunal Analysis - an assessment of habitat quality, soil food web condition, and the nature of ecosystem services available; 2. Metabolic Footprints - assessments of the magnitude of the ecosystem services; and, 3. Functional Diversity - an assessment of the complementarity of ecosystem services across soil microhabitats and of their successional potential in a temporal context. The three assessments of the biological component of soil health are facilitated by the ubiquity and species richness of nematodes, the diversity of their contributions to ecosystem functions, and the ease with which they can be sampled, extracted and identified. Existing datasets will be used to demonstrate potential applications of these assessments. Current and anticipated advances in molecular techniques for determination of nematode abundance, diversity and function will facilitate application of bioindicator-based measures of soil health.

HIGH PRESSURIZATION – AN ALTERNATIVE FOR PINEWOOD NEMATODE ELIMINATION FROM WOOD (Alta presurización – una alternativa para la eliminación del nematodo de la madera del pino)

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The introduction of several invasive alien plant pests into non-native areas led to the development of appropriate phytosanitary measures against the introduction and spread of these species. The use of pine wood material has enlarged significantly over recent decades resulting in an increased risk of dissemination of the pinewood nematode (PWN), *Bursaphelenchus xylophilus*, the causal agent of the pine wilt disease. In this study, we have evaluated the efficacy of the high pressure processing (HPP), a non-thermal phytosanitary treatment, to eliminate PWN in wood. Infected *Pinus pinaster* wood sections (7.5 cm long/2 cm width) and wood chips were exposed to HPP in a high pressure unit, at room temperature, for 5 min at 5, 15 and 30 MPa. The total number of nematodes was quantified before and after the HPP. No nematodes were detected in the wood material treated at 30 MPa. These results revealed that the HPP has potential to eliminate the PWN from wood and can be considered as an alternative to the thermal phytosanitary treatment with particular interest for industrial applications.

THE SEARCH OF MICROORGANISMS THAT ARE GROWTH-PROMOTING AND/OR ANTAGONISTIC TO PLANT-PARASITIC NEMATODES OF ANDEAN POTATOES (Búsqueda

de microorganismos promotores del crecimiento y/o antagónicos a nematodos fitoparásitos de la papa andina)

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El crecimiento microbiano más importante tiene lugar en la superficie de las partículas del suelo y las raíces de las plantas. Un amplio rango de microorganismos de la rizosfera (*Pseudomonas*, *Achromobacter*, *Azospirillum*, *Bacillus*, *Burkholderia*, *Klebsiella*, *Trichoderma*, etc.) pueden promover el crecimiento vegetal por compuestos químicos señalizadores que incluyen auxinas, giberelinas, glicolípidos, y citocininas. Así mismo se ha demostrado que las bacterias endófitas pueden ser fundamentales para la supervivencia de las plantas, pues las ayudan a reducir el ataque de patógenos, insectos y nematodos, debido a que pueden identificar la presencia de estos organismos en la planta de una manera rápida y ayudan en el desencadenamiento del fenómeno de inducción del sistema de resistencia (ISR) de las plantas. Esta actividad es posible por la capacidad de ciertas bacterias de sintetizar sustancias metabólicas como antibióticos y fungicidas, al igual que otros metabolitos secundarios que incluyen compuestos anticarcinogénicos, compuestos volátiles orgánicos, antivirales y agentes inmunosupresores (sustancias que inhiben o previenen la acción del sistema inmune). En los últimos 10 años la Fundación PROINPA, en el área de Manejo Integrado ha venido aislando microorganismos que reduzcan las poblaciones de patógenos de plantas y también ligados a la fertilidad del suelo con el propósito de devolver microorganismos que faciliten la disponibilidad de los nutrientes en el suelo y/o controlen los problemas fitosanitarios. Al presente, se dispone de un cepario de diversos aislamientos que evaluados en laboratorio en forma in vitro, en invernadero y finalmente en campo han permitido seleccionar aislamientos que inhiben el desarrollo de enfermedades causadas por hongos de suelo y del nematodo causante del “rosario” (*Nacobbus aberrans*) y del nematodo quiste de la papa (*Globodera* spp.), que además favorecieron el crecimiento de las plantas.

PRIMERA APARICIÓN DE *Meloidogyne paranaensis* EN LA PRINCIPAL REGIÓN PRODUCTORA DE CAFÉ DE BRASIL Y UN NUEVO HOSPEDERO (First occurrence of *Meloidogyne paranaensis* in the main coffee producing region of Brazil and new host)

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La especie de nematodo *Meloidogyne paranaensis* (MP) presenta gran diseminación en los estados brasileños de Paraná y San Pablo, donde contribuyó para la disminución de la producción cafetera. A pesar de MP no haber sido aún encontrada en el Sur del estado de Minas Gerais (MG), donde se concentra el 25% de la producción cafetera brasileña, esa especie fue constatada en el año 2003 en la región Oeste de ese estado (municipio de Piumhi), a pocos kilómetros de la frontera con la región Sur de MG. Sin embargo, en 2013, muestras de raíces de cafetal del municipio de Coqueiral de esa misma región, presentaron descamación de las raíces gruesas donde las hembras fueron encontradas envueltas por tejido cortical. En análisis electroforético de esas hembras se constató la presencia de MP. En esa finca cafetera infestada, plántulas nuevas mueren pocos meses después del trasplante. Dentro de los hospederos de MP, se constató en soja, tomate y *Oxalis corniculata*. Ahora se incluye lechuga como una nueva hospedera. En ensayos en invernadero, la reproducción (huevos/gramo de raíz) de MP inoculado en lechuga cressa, romana y lisa, fue de 4 a 11% de aquella en tomate. La facilidad de MP en encontrar nuevos hospederos puede haber sido la causa principal de la grande diseminación en los estados mencionados y coloca en riesgo las grandes plantaciones cafeteras de Minas Gerais. Apoyo financiero: Capes, CNPq y Fapemig.

COMPARATIVE ANALYSIS OF MITOCHONDRIAL GENOME SEQUENCES OF ROOT-KNOT NEMATODES (Análisis comparativo de secuencias del genoma mitocondrial de nematodos agalladores)

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Mitochondria are endosymbiotic bacteria in charge of oxidative phosphorylation and other essential biochemical functions within the eukaryotic cell. The animal mitochondrial genome (mtDNA) is typically non-recombining and presents regions that evolve at markedly different rates. As a consequence, rapidly-evolving regions of the mtDNA are well suited to differentiating morphologically similar species. We characterized mitochondrial genome sequences from two species of root-knot nematodes: *Meloidogyne incognita* (~18 kb) and

M. hapla (~16 kb). Mitochondrial sequences were mined from complete genome projects in Genbank and were analyzed regarding protein-coding genes, rRNAs and tRNAs. We studied the codon usage, substitution rates and evolution of seven genes for each species; *cox1*, *cox2*, *cytb*, *nd1*, *nd3*, *nd4* and *nd5* from *M. hapla*, and *cox1*, *cox2*, *cox3*, *cytb*, *nd1*, *nd3*, and *nd4* from *M. incognita*. The nucleotide composition of the partial mtDNAs was A/T-biased, with an overall A/T content of 80.3% in *M. hapla* and 81.8% in *M. incognita*. The similarity between coding regions of *M. incognita* and *M. hapla* was 72-82%. We also identified indels within coding sequences. These findings are valuable for developing new molecular markers for taxonomic purposes at the species level in the genus *Meloidogyne*.

NEMATOFAUNA ASOCIADA A CULTIVOS DE HORTENSIA (*Hydrangea*) EN EL VALLE DE SAN NICOLÁS, ANTIOQUIA, COLOMBIA (Nematofauna associated to hydrangea (*Hydrangea*) plantations in the Valley of San Nicolás, Antioquia, Colombia)

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La actividad floricultora colombiana está siendo impulsada hacia la diversificación de la agricultura y la generación de divisas para el país, se estima una superficie cercana 380 hectáreas de Hortensia para exportación. La producción de esta flor se ve afectada por patógenos que alteran su rendimiento y calidad, como *Botrytis*, *Oidium*, *Alternaria*, bacteria, virus, entre otros. Puede afirmarse que son pocas las plantas que carecen de nemátodos parásitos, se calcula que afectan aproximadamente un 10% de los cultivos. Si bien, en Colombia no se conocen estudios asociados a la nematofauna de cultivos de Hortensia, en Europa se reportan ataques de *D. dipsaci* (Filip), que ocasiona el ensanchamiento de los tallos los cuales se acortan o retuercen; nematodo aun no registrado en Colombia para este cultivo. Con el objeto de generar conocimiento de los nematodos presentes en cultivos comerciales de Hortensia en algunas localidades de los municipios de La Ceja, Abejorral y El Carmen de Viboral, en el Laboratorio de Sanidad Vegetal U.C.O, mediante análisis de plantas en producción y por métodos de extracción tradicional Baermann modificado con bandejas, se ha identificado el endoparásito *Pratylenchus* sp. afectando el desarrollo de las plantas y así su calidad de exportación; los síntomas producidos por estos fitoparásitos desorientan a los agricultores, quienes lo confunden y atribuyen el daño al ocasionado por hongos como *Verticillium* sp., y *Fusarium* sp. Asociados a los suelos también se ha identificado géneros de dudoso parasitismo y de vida libre, entre ellos, *Tylenchus*, *Dorylaimus*, *Plectus* y *Rhabditis*.

UNRAVELING THE INTERACTION BETWEEN RICE AND PARASITIC NEMATODES (Elucidando la interacción entre la planta de arroz y los nematodos fitoparásitos)

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Our research focuses on rice as model plant to analyse the interaction with nematodes at the cellular and molecular level. To get a comprehensive overview of the compatible plant response to nematode infection, mRNA sequencing was performed on rice after nematode infection. Local infected tissue was compared with systemic tissue after infection by the root knot nematode *Meloidogyne graminicola* or the migratory nematode *Hirschmanniella oryzae* and with control tissue of the same developmental stage. One of the results is the downregulation of plant defense genes locally and systemically after root knot nematode infection. We are also studying the role of several plant hormones in the plant's basal defense. For a functional analysis of plant genes that are differentially expressed upon nematode infection, we perform infection experiments on mutants or transgenics with lower or higher expression of that specific plant gene. To get insight in the proteins that are secreted by nematodes into the plant in order to establish a successful infection, a transcriptome analysis was performed on *M. graminicola* preparasitic juveniles and on mixed stage nematodes of *H. oryzae*. One of the strategies is to identify nematode proteins that are capable of suppressing plant defense. In the future we want to extend our analyses to other types of rice nematodes (cyst nematode, stem nematode, white tip nematode).

USO DE SUSTANCIAS VEGETALES PARA EL MANEJO DE *Meloidogyne incognita* EN REMOLACHA. (Use of plant products for management of *Meloidogyne incognita* on beet)

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El nematodo agallador es un grave problema en la explotación económica de la remolacha. El objetivo de este estudio fue evaluar la aplicación de aceite y extracto acuoso de neem (*Azadirachta indica* A. Juss.) y extracto acuoso de pimienta rosa (*Schinus terebinthifolius* Raddi) en las poblaciones de *Meloidogyne incognita* que parasitan la remolacha de mesa. Plántulas de remolacha se trasplantaron a 3 dm³ de sustrato contenido en macetas de polietileno, y posteriormente, 50% de ellas se inocularon con 500 huevos/J2. Después de una semana, las soluciones se aplicaron aceite de neem al 1,0% (v/v) y los extractos acuosos de neem y pimienta a 5,0% (m/v) en una sola aplicación a una dosis de 50 ml por planta, alrededor del cuello. Se evaluó el peso de las hojas frescas (PHF), el peso fresco de las raíces tuberosas (PFR), diámetro de raíz (DR), la población final de nematodos (PF), factor de reproducción (FR) y sólidos solubles (Brix°). El control consistió en las plantas tratadas con la aplicación de agua destilada. El nematodo reduce PFR y DR, pero los extractos acuosos y aceite de neem reduce el PF y FR y se probarán campo.

EVALUACIÓN DE EXTRACTOS ACUOSOS DE PLANTAS PARA EL MANEJO DE *Meloidogyne javanica* PARASITANDO TOMATE (Evaluation of aqueous extracts of plants in management of *Meloidogyne javanica* parasitizing tomato)

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El nemátodo *Meloidogyne javanica* parasita el tomate (*Lycopersicon esculentum*). En presente trabajo tuvo como objetivo gestionar este patógeno con extractos acuosos botánicos. El experimento se realizó en un invernadero en diseño completamente al azar con siete tratamientos y seis repeticiones. Plántulas de tomate cv. Santa Clara fueron cultivadas en macetas con una capacidad de dos litros con suelo de arcilla arenosa, y inoculadas con 2.000 huevos/J2 de *M. javanica*. Para los extractos de ruda (*Ruta graveolens*), citronela (*Cymbopogon winterianus*), me-nadie-puede (*Dieffenbachia picta*), neem (*Azadirachta indica*) y la nuez moscada (*Myristica fragrans*) se mezcló 1 g de hojas secas de cada especie para cada 10 ml de agua destilada. Posteriormente se aplicó 100 ml de los extractos en la región del cuello. Para propósitos de comparación se utilizó 0,6 g/maceta de nematicida Terbufós, em dosis única, y un control con agua destilada. Los tratamientos mostraron lo siguiente FR: extracto de ruda (0,091), nematicida y extracto de nuez moscada (0,272); extracto de me-nadie-puede y citronella (0,363), extracto de neem (0,454). Estos extractos tienen potencial para el manejo de *M. javanica* y debería ser probado en campo.

EFFECTO DE ENMIENDA ORGÁNICA LÍQUIDA SOBRE LAS POBLACIONES DE NEMATODOS NO FITOPATÓGENOS (RHABDITIDOS Y MONONCHIDOS) PRESENTES EN EL CULTIVO DE CAÑA DE AZÚCAR (*Saccharum officinarum*), PIURA-PERÚ (Effect of organic liquid amendment on the populations of non phytopathogenic nematodes (rhabditids and mononchids) in sugarcane plants (*Saccharum officinarum*), Piura-Perú)

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La enmienda orgánica líquida procedente de gallinaza, tiene diferentes efectos sobre los campos de cultivo, que van desde el incremento de las poblaciones de microorganismos benéficos del suelo hasta la mejora en su estructura. El objetivo de la presente investigación fue evaluar el efecto de la enmienda orgánica líquida sobre la densidad poblacional de nematodos no fitopatógenos (Rhabditidos y Mononchidos) presentes en el cultivo de caña de azúcar (*Saccharum officinarum*) en suelos arenosos de Piura – Perú. Para ejecutar el ensayo, se consideró doce tratamientos; ocho en los que se aplicó la enmienda orgánica líquida y cuatro tratamientos testigo (tres testigos absolutos y un testigo comercial formulado a base de Carbofuran, *Paecilomyces lilacinus* y Citoquininas). Las evaluaciones se realizaron durante siete meses, considerándose una evaluación inicial y tres evaluaciones posteriores a la aplicación de la enmienda orgánica líquida. Los resultados muestran que aplicando la enmienda orgánica a 500 L.ha⁻¹ en 3 fracciones se obtuvo un incremento en la población de nematodos no fitopatógenos de 377 juveniles por 100cc. de suelo, mientras que en los tratamientos testigo, se obtuvo un incremento máximo de 105 juveniles por 100cc de suelo. Estos resultados, posiblemente, se deban a los componentes orgánicos de esta enmienda y a su importante carga microbiana (actinomicetes: 1,5 x 10⁴ u.f.c./mL; bacterias: 3,8 x 10⁴ u.f.c./mL;

y hongos: 3,3 propágulos/mL), la cual actualmente sigue en investigación.

***Larix* sp., A POTENT HOST OF PINE WOOD NEMATODE IN SOUTH KOREA (*Larix* sp., un hospedante potente del nematodo de la madera del pino en Corea del Sur)**

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One of the most important forest diseases in East Asia countries is pine wilt disease (PWD). PWD is caused by pine wood nematode (*Bursaphelenchus xylophilus*) which vectored by pine sawyer beetles. In Korea, PWD was first reported in 1988 and it has been spread out all over the countries. The major host is Pine species, such as *Pinus thunbergii*, *P. densiflora*, and *P. koraiensis*. However, recently PWD severely affected Korean pine forest (*P. koraiensis*) in north region of South Korea and a new possibility that PWD can spread to larch forest is suggested. Because most larch forest were adjacent to Korean pine forest and even the insect vector, pine sawyer beetles, emerged from in the dead larch trees. Pathogenicity test of pine wood nematode on 5-year-old larch tree was performed in green house condition. Three different species of nematode, *B. xylophilus*, *B. mucronatus* (European type), and *B. thailandae* were inoculated, and 3-year-old *P. densiflora* used as a positive control species. The nematode inoculation level was 5,000 per tree. Yellowish symptom was started to be shown in larch trees treated by *B. xylophilus* after 2 weeks. Eight weeks later, the mortality rate of larch trees was determined as 100% in *B. xylophilus*, 80% in *B. mucronatus*, and 0% in *B. thailandae* treatment. In the positive control species, *P. densiflora*, 90% mortality rate was observed only in *B. xylophilus* treated seedlings. Otherwise, no symptom was observed in both *B. mucronatus* and *B. thailandae* treated *P. densiflora*. The result informed that *Larix* species is highly susceptible host of pine wood nematode, and also European type *B. mucronatus* is pathogenic to *Larix* sp. Therefore, *Larix* sp. is expected as a potent host of both *B. xylophilus* and *B. mucronatus* in natural forest.

VALORACIÓN DE CEPAS DE *Trichoderma asperellum* COMO POTENCIALES AGENTES DE CONTROL BIOLÓGICO DE *Meloidogyne incognita*. (Valuation of *Trichoderma asperellum* strains as potential biological control agents for *Meloidogyne incognita*)

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Los nematodos formadores de agalla representan plagas importantes para numerosos cultivos en Cuba. *Meloidogyne incognita* es la especie más distribuida y su manejo constituye un reto para los productores, por ello se buscan nuevas alternativas de manejo. El objetivo del este estudio fue determinar las potencialidades de cepas de *Trichoderma asperellum* para el manejo de *M. incognita*. En condiciones de laboratorio (*in vitro*) se evaluaron 6 cepas (Ta25; Ta1; Ta90; Ta78; Ta79 y T13) de *T. asperellum* en cuatro concentraciones y un tratamiento control con agua destilada estéril. Todas las cepas provocaron altos valores de mortalidad en los juveniles de *M. incognita*, sobresaliendo la cepa Ta90 provocó 100% de mortalidad a las 24 horas (concentraciones 25 y 50%). Para el estudio en condiciones semicontroladas (macetas de 1 kg de capacidad), se inocularon 2,5 juveniles por gramo de suelo y a las 72 horas de aplicó Ta90 a razón de 10⁷ UFC por maceta. Los tratamientos fueron: planta sola (testigo absoluto); planta + Ta90; planta +nematodos+ Ta90; planta + nematodo; nematodo + Ta90 (sin planta). Se evaluaron a los 35 días los parámetros. Índice de Agallamiento (IA), juveniles en suelo y número de huevos por sistema radical, altura de la planta, diámetro del tallo, longitud de la raíz, numero de hojas y masa fresca aérea y de raíz. El IA de las plantas no tratadas fue de 3,71; produciéndose ligera disminución en las plantas tratadas con Ta90 (3,57). Se produjeron diferencias significativas en los parámetros de desarrollo de las plantas tratadas con Ta90 en relación con las que no recibieron aplicaciones del hongo, aun en aquellas parasitadas por nematodos.

AVANCES EN LA INVESTIGACIÓN Y DESARROLLO DE *Pochonia chlamydosporia* COMO PRODUCTO MICROBIANO PARA EL CONTROL DE NEMATODOS ENDOPARÁSITOS EN EL TRÓPICO (Advances in the research and development of *Pochonia chlamydosporia* as a microbial product to control endoparasitic nematodes in the tropics)

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El hongo nematófago *Pochonia chlamydosporia* (Hypocreales, Clavicipitaceae), es uno de los agentes de control microbiano de nematodos endo-parásitos más estudiados. Este hongo se informa como parásito facultativo de huevos de nematodos y moluscos, hiperparásito de otros hongos y saprofito en suelos en diversas regiones del mundo. En la rizosfera, coloniza las raíces de las plantas hospedantes y, recientemente, se informa como endófito facultativo de plantas mono y dicotiledóneas, lo cual amplía sus usos como potencial estimulador del crecimiento de las plantas e inductor de resistencia a enfermedades fungosas. *P. chlamydosporia* presenta una elevada variabilidad intra-específica, por lo que resulta esencial seleccionar biotipos con potencialidades como agentes de control microbiano de nematodos. Solo pocos aislamientos (i.e., *Pc. var. catenulata*, en Cuba, y *Pc. var. chlamydosporia*, en Brasil), se encuentran comercialmente disponibles. Los agentes de control biológico raramente proveen un adecuado control de los nematodos, por lo que requieren ser incorporados con otras medidas. Una estrategia de manejo exitosa requiere de un detallado entendimiento de la interacción entre el nematodo diana, la planta y el agente microbiano. A ello, se agrega un adecuado programa de educación dirigido a extensionistas y productores locales. Se presentan los avances y nuevos retos en el desarrollo y explotación comercial de cepas seleccionadas *P. chlamydosporia* en Cuba y Brasil.

A PHYLOGENETIC ANALYSIS OF *Hoplolaimus stephanus* AND MORPHOLOGICALLY SIMILAR SPECIES (Análisis filogenético de *Hoplolaimus stephanus* y especies morfológicamente similares)

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Hoplolaimus stephanus is a poorly studied ecto-endoparasite of plants, fairly recently described and with few host reports. It is morphologically similar to *H. galeatus*, *H. magnistylus* and *H. concaudajuvencus*, sharing characters such as four incisures in the lateral lines, three esophageal gland nuclei, a hemizonid anterior to the excretory pore, and the presence of abundant males. Considering that the genetic diversity of *H. stephanus* is not well studied, it is possible that *H. stephanus* has wider range of distribution and hosts than reported. In this study, we examined the phylogenetic relationships of *H. stephanus* with morphologically similar species isolated from different hosts and locations in the United States. We used morphology and sequences of the mitochondrial DNA cytochrome oxidase c subunit I (COI) and the internal transcribed spacer 1 (*ITS1*) genes. The phylogenetic analysis of both genes showed clearly separated lineages for *H. stephanus*, *H. magnistylus*, *H. concaudajuvencus*, *H. galeatus* and 2 unidentified clades. New reports are provided for *H. stephanus*, *H. magnistylus* and *H. concaudajuvencus* in different states and hosts in the United States. We provide robust phylogenies of *Hoplolaimus* species of economic importance in the United States using nuclear and mitochondrial genes.

SPATIAL DISTRIBUTION OF RENIFORM NEMATODE *Rotylenchulus reniformis* IN COTTON FIELDS (Distribución espacial del nematodo reniforme *Rotylenchulus reniformis* en algodón)

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Understanding the spatial distribution of reniform nematode in cotton fields is essential for the development of management strategies. Evidence suggesting that soil texture is one of the main factors driving distribution is somewhat contradictory. In this study, we examined the horizontal and vertical distribution of reniform nematode in two cotton fields in South Carolina, and measured potential correlations with soil texture. In the first field, forty samples were collected at random and separated into four depths: 0-15 cm, 15-30 cm, 30-60 cm, and below 60 cm. In the second field, eighty samples were collected representing four zones with different soil electrical conductivity readings and soil texture. Horizontal distribution analysis using the variance/mean ratios showed a significant clustered distribution at planting, mid-season, and harvest. However, a significant neighborhood structure was detected only in the field that was sampled at a finer scale (4 x 4 m) at harvest with patches between 8 and 18 square meters in two of the plots. Vertical distribution data showed the highest numbers of reniform

nematode were found between 15- and 30-cm deep. Kriging analysis was used to predict reniform densities within each field/plot and revealed high levels of spatial variability at the three sampling dates. Correlations between reniform densities and soil texture were not observed. Knowledge of the spatial distribution of reniform nematode can lead to reduction of nematicide use in precision agriculture applications.

MICROBIAL COMMUNITY STRUCTURE AND NEMATODE DIVERSITY IN GLYPHOSATE-RESISTANT SOYBEAN CROPPING SYSTEMS (Estructura de la comunidad microbiana y diversidad de nematodos en sistemas glifosato-resistentes en cultivos de soya)

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Genetically-modified (GM), herbicide-resistant (Roundup Ready: RR) soybean cultivars currently dominate the local soybean market. Since soybean is an important protein source for human and animal use, the use of RR soybean cultivars has increased over time, increasing the use of glyphosate. However, little is known about the effect of glyphosate on nematode and microbial communities. Due to the importance of soil health in agriculture, determining the effect of glyphosate associated with RR crops may lead to a better understanding of long term use on soil health. The aim of this study was to determine microbial community structure and nematode diversity in soil samples from conventional and RR soybean fields in soybean production areas of South Africa compared to that in adjacent natural veld areas. Concurrently results were used to determine whether glyphosate associated with RR soybean cultivars affect these organisms. Microbial community structure was determined by PLFA analyses and nematode diversity, after extracting the nematodes from soil samples with standard methods, was also determined. Preliminary PLFA analyses results indicate a definite difference in community structure between the various localities, however further analyses is required to determine whether differences exist between RR- and conventional soybean samples. Correlations that exist between microbes and nematodes associated with RR and conventional soybean plantings as well as natural veld areas will be discussed.

A COMPARATIVE *IN VITRO* STUDY TO EVALUATE THE EFFECT OF THREE *Bacillus firmus* STRAINS ON THE MOTILITY OF *Meloidogyne incognita* (Estudio comparativo *in vitro* para evaluar el efecto de tres cepas de *Bacillus firmus* sobre la motilidad de *Meloidogyne incognita*)

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Meloidogyne incognita is a plant-parasitic nematode that infects and damages a wide variety of agricultural and horticultural crops world-wide. Research is progressively aimed at investigating control strategies that is more environmentally-friendly, such as biological agents to manage this nematode. Commercially-available formulations containing the bacteria *Bacillus firmus* have been developed and have been reported to be effective in reducing *M. incognita* infections in several crops. The aim of this study was to compare the mode of action and efficacy of three *B. firmus* strains against second-stage juveniles (J2) of *M. incognita* in *in vitro* experiments. Two strains were isolated from commercially-available products, while the other one was obtained from a pure culture. The effect of cell-free water extracts was compared to cell suspensions for all three strains with regard to the paralysis of J2. Results indicated that although all three *B. firmus* strains were successful in reducing J2 motility, such reductions were generally not higher than 40%. Furthermore, no significant difference in the effect of the three strains on the motility of *M. incognita* J2 existed. Cell-free water extracts and cell suspensions gave similar results for J2 motility, indicating an indirect effect of *B. firmus*, possibly through the production of secondary metabolites.

A CRITICAL EVALUATION OF COTTON TOLERANCE TO *Hoplolaimus columbus* (Una evaluación crítica de la tolerancia del algodón a *Hoplolaimus columbus*)

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Selected cotton cultivars were evaluated for tolerance to *Hoplolaimus columbus* in field experiments conducted from 2004 to 2006. Field trials were arranged in a split-plot design that included treatment with four levels of 1, 3-dichloropropene (0.0, 17.0, 34.0, and 51.0 kg a.i./ha) to establish a range of population densities

of *H. columbus*. Six cotton cultivars (early-to-mid maturity: DP444BG/RR SG501BR, ST5242BR; mid-to-late maturity: DP451B/RR, ST5599BR, DP655BRR) were planted as whole plots. Fumigation was effective in suppressing *H. columbus* population densities at mid-season, but not at cotton harvest. Cotton lint yield increased linearly with regard to the rate of fumigant applied. When using linear models, the cultivar × fumigation interaction for cotton lint yield was not significant for the six cultivars evaluated, indicating that tolerance did not occur in this nematode-host combination. One cultivar (ST5242, however, better fit a quadratic response indicating that this cultivar may actually be somewhat tolerant to *H. columbus*.

VALIDACIÓN DE LA TÉCNICA DE MACETA VOLTEADA PARA ENSAYOS DE LABORATORIO EN CONTROL QUÍMICO DE *Globodera* spp. (Validation overturned pot technique for laboratory tests in chemical control of *Globodera* spp)

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La técnica de maceta volteada ha sido utilizada históricamente para el estudio de resistencia de la papa al Nemátodo Dorado de la Papa (*Globodera* spp.). Dado que a través de un corto tiempo, se puede analizar la evolución de las poblaciones de quistes, juveniles y huevos, es que se trató de validar esta técnica para estudios de efectividad de productos nematocidas en el control de *Globodera* en laboratorio, de tal forma de reducir el tiempo de ensayos de validación de químicos, desde 4 a 5 meses que lleva un ensayo de campo a sólo 1,5 meses. De acuerdo a lo anterior, se trabajó con el sistema de maceta volteada de 250 cc, donde se inocularon las macetas con 25 quistes viables de *Globodera rostochiensis* cada una, para luego proceder a las aplicaciones de nematocidas tanto granulares como líquidos y sellar cada maceta hasta cosecha. Estas aplicaciones se realizaron ajustando la dosis de producto y agua a la capacidad de la maceta, según cada tratamiento. Se realizaron las evaluaciones a cosecha, 50 días después de las aplicaciones químicas, una vez que se observó la presencia de quistes maduros en raíces. La extracción de quistes se realizó bajo sistema de Jarra Fenwick para cada maceta del ensayo de manera separada. Se evaluó el índice reproductivo de quistes, juveniles y huevos, encontrándose diferencias estadísticas significativas entre los tratamientos de control a través de formulaciones líquidas, sin embargo, para los formulados granulares no hubo efecto de control.

BÚSQUEDA DE RESISTENCIA GENÉTICA AL NEMATODO DORADO DE LA PAPA (*Globodera* spp.) EN JARDÍN CHILOTE DE PAPA. (Search of genetic resistance to Golden Potato Nematodes (*Globodera* spp) in potato chilote garden)

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El Nemátodo Dorado de la Papa (*Globodera rostochiensis*) es uno de los problemas fitosanitarios más importantes del cultivo de la papa en Chile. Su control se basa en la aplicación de productos químicos y rotaciones de cultivo, sin embargo, durante varias temporadas, la Empresa de semillas KWS, dedicada al mejoramiento genético de papa, con apoyo de la Universidad de La Serena, viene desarrollando estudios tendientes a buscar resistencia genética de líneas de papa a *Globodera* spp., dentro de los programas de mejoramiento genético del cultivo. Es así, como desde el año 2010 a la fecha, se ha trabajado a través del sistema de maceta volteada, en el análisis de resistencia/susceptibilidad de distintos materiales correspondientes a líneas avanzadas de papa y jardín chilote, entre otras. En dichos ensayos, cada unidad experimental ha correspondido a un tubérculo plantado en una maceta de 250 cc conteniendo sustrato de turba y arena, más el inóculo consistente en 25 quistes viables por maceta, con 4 repeticiones por cada línea en estudio. Luego de 58 días post establecimiento, se evalúan las macetas a través de presencia/ausencia de quistes. Se eliminan las líneas que manifiestan presencia de quistes, ya que son susceptibles, y continúan en proceso de estudio aquellas líneas que no presentan quistes, ya que son resistentes.

EFFECT OF *Steirneria rarum* AND ITS SYMBIOTIC BACTERIUM *Xenorhabdus szentirmaii* ON *Nacobbus aberrans* (Efecto de *Steirneria rarum* y su bacteria simbiote *Xenorhabdus szentirmaii* sobre *Nacobbus aberrans*)

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Entomopathogenic nematodes (EPN) (families Steinernematidae and Heterorhabditidae) are used as biological control agents of insect pests. Infective juveniles (IJ) of the nematode carry symbiotic bacteria (SB) in their intestine that kill the host. The EPN-SB complex has been shown to have an antagonistic effect on certain plant-parasitic nematodes. The SB *Xenorhabdus szentirmai* was isolated from an Argentine isolate of *Steinernema rorum*. The nematicidal activity of the SB on second stage juveniles and on hatching of *Nacobbus aberrans* eggs was evaluated *in vitro*. In addition, under controlled conditions the effect of IJ application of the EPN in the soil was analyzed, as well as the effect of the SB and its metabolites on *N. aberrans* in tomato. The results showed that the number of galls and the reproduction factor of the plant-parasitic nematode decreased significantly in the treated plants, both in sterile and non-sterile soil. The results obtained show the promising potential of the NEP-SB complex for the management of *N. aberrans*.

DIVERSIDAD GENÉTICA DE POBLACIONES DEL NEMATODO AGALLADOR (*Meloidogyne* spp.) PROVENIENTES DE PLANTACIONES DE PAPA DEL SUR DE BRASIL. (Genetic diversity of root-knot nematodes (*Meloidogyne* spp.) populations from potato growing areas in southern Brazil)

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El nematodo del nódulo de la raíz es considerado el más patógena del cultivo de la papa causando daños y pérdidas en las diferentes zonas donde es plantada. Considerando la importancia económica del cultivo de la papa en la región Sur de Brasil e la ocurrencia de *Meloidogyne* en el País, el objetivo del presente trabajo fue estudiar la variabilidad genética intra y interespecífica de poblaciones de *Meloidogyne* spp. provenientes de plantaciones de papa del Sur de Brasil. Fueron utilizadas 20 poblaciones de *Meloidogyne* spp. (quince de *M. javanica* con fenotipo esterase (Est) J3, dos de *M. javanica* Est J2a, y una de *M. incognita* Est I2, *M. arenaria* Est. A2 y *M. ethiopica* Est. E3) oriundas de áreas de papa. Estas fueron caracterizadas molecularmente por marcadores PCR-SCAR e RAPD. Posteriormente, cuatro poblaciones de *M. javanica* fueron evaluadas con relación a la agresividad en los cultivos de papa Agata y BRS Clara. De acuerdo al análisis con el marcador PCR-SCAR fueron confirmadas las especies de *Meloidogyne* spp. Cuando se utilizó el marcador RAPD, fue posible observar variabilidad intraespecífica entre las poblaciones de *M. javanica* formando tres grupos por el análisis filogenético. Además, fue observado interacción entre las cuatro poblaciones de *M. javanica* y daños en el sistema radicular, tubérculos y en el factor de reproducción del nematodo. Sin embargo, fue observado mayor agresividad en una población de *M. javanica* J2a y una J3 independientemente de los cultivares de papa evaluados.

IMPROVEMENT OF SOIL QUALITY UNDER UNCONVENTIONAL LEGUMINOUS PLANTS CULTIVATION IN ALAGOINHA, A SEMIARID SITE IN BRAZIL. (Mejora en la calidad del suelo bajo cultivo de plantas leguminosas no convencionales en Alagoinha, un local semiárido en Brasil)

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Aiming to evaluate the improvement of soil quality by using conservationist practices, soil samples were collected at 0.20-0.30-m depth in degraded areas in the municipality of Alagoinha, Pernambuco State, in Brazil semiarid region, in order to characterize local nematofauna. It was used a factorial randomized block design (4 x 5) in which unconventional leguminous plants (chichá, licuri, munguba and moringa) were subjected to five different treatments: 1) coconut powder, hydrogel, chemical fertilizer, organic fertilizer, and coconut powder mulch; 2) coconut powder, chemical fertilizer, organic fertilizer, and coconut powder mulch; 3) coconut powder, hydrogel, chemical fertilizer, organic fertilizer, coconut powder mulch and emergency irrigation; 4) chemical fertilizer, organic fertilizer, coconut powder mulch, and permanent irrigation; and 5) chemical fertilizer and organic fertilizer. The results indicate a high beneficial effect of those leguminous plants on restructuring soil microbiotic balance. *Rhabditidae* dominance and the decrease of plant-parasitic nematodes reveal an initial succession stage on this ecosystem development. These differences may be attributed to greater root density of the unconventional leguminous plants.

ROOT PENETRATION AND REPRODUCTION OF ROOT-KNOT NEMATODES ON

FIVE CUCURBIT CROPS (Penetración y reproducción de nematodos agalladores en cinco cucurbitáceas)

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Cucurbit crops are often cultivated in rotation with Solanaceae in double-cropping systems in several vegetable production areas. Most cucurbits have been described as susceptible to root-knot nematodes but little is known on their relative levels of susceptibility. Because *Meloidogyne* species differ in rates of root invasion and reproductive traits, isolates of *M. arenaria*, *M. incognita* and *M. javanica* were compared on five cucurbit crops in a climate growth chamber. They were zucchini squash cv Amalthee, cucumber cv Dasher II, melon cv Pistolero, pumpkin cv Totanera and watermelon cv Sugar Baby. All cucurbits were susceptible to the three nematode isolates although *M. javanica* showed higher invasion rates, faster development and egg production than *M. arenaria* on the selected cucurbits. Apparent differences among cucurbits were primarily due to root invasion rates and formation of egg masses. Both *Cucumis* species (cucumber and melon) were better hosts for nematode invasion and reproduction than zucchini squash followed by watermelon. Large invasion rates followed by small reproductive traits linked to *M. incognita* were observed on zucchini squash. Reduced invasion rates and eggs mass formation along with delayed early development of the three nematode isolates were consistently shown on watermelon.

PHENOTYPIC VARIABILITY, BROAD-SENSE HERITABILITY AND VARIANCE COMPONENTS ESTIMATES FOR *Meloidogyne incognita* AND *Pratylenchus brachyurus* RESISTANCE IN BEAN GENOTYPES. (Variabilidad fenotípica, heredabilidad en sentido amplio y estimativas de componentes de varianza para la resistencia de genotipos de frijol a *Meloidogyne incognita* y *Pratylenchus brachyurus*)

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Bean (*Phaseolus vulgaris*) is the main food legume in Americas. Many nematode species infected this crop throughout the world. In Brazil, *Meloidogyne incognita* (Mi) and *Pratylenchus brachyurus* (Pb) are important pathogens on several crops. Management of nematodes in beans has been dependent largely on the use of crop rotation with resistant species and resistant cultivars. Thereby, in this present work we aimed to characterize the host response of 40 selected bean genotypes to Mi and Pb, under greenhouse conditions, based on nematode reproductive factor (RF) and number of nematodes per gram of roots (nem/g). On this basis, we determined also the variance components and broad sense heritability associated to nematodes resistance. Results revealed an important variation in the susceptibility of the cultivars to the nematodes tested. Broad-sense heritability (H^2) calculated for RF values were 95.26 % (Mi) and 96.20 % (Pb), and for nem/g were 94.71 % (Mi) and 90.92 % (Pb). These high H^2 values obtained here reflect the high genetic variability showed by bean genotypes, increasing the possibilities of success in a breeding program.

MANEJO DE *Meloidogyne ethiopica*, UN IMPORTANTE NEMATODO FITOPARÁSITO EN LA AGRICULTURA DE CHILE (Management of *Meloidogyne ethiopica*, a very important plant parasitic nematodes in Chilean agriculture)

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La agresividad de *Meloidogyne ethiopica* con su hospedero es muy elevada, siendo las estrategias de manejo y control aplicables, insuficientes para permitir calidad de plantas y producción. Cuando *Meloidogyne ethiopica* se encuentra presente, debemos enfocarnos en realizar una protección eficiente de las raíces de las plantas, lo que conlleva un análisis integral de la problemática de los nematodos fitoparásitos, que significa desplazar a los nematodos del centro de la problemática, para colocar a las raíces de las plantas en su lugar. Cuando desplazamos el centro de atención desde los nematodos a las raíces de las plantas, la planificación estratégica incorpora nuevas herramientas posibles de aplicar en la defensa de raíces, pasando desde la utilización de productos fumigantes y sustancias que normalmente muestran alta toxicidad, hacia agentes biológicos o extractos de menor toxicidad,

que permiten un equilibrio o convivencia de las plantas y los nematodos fitopatógenos, pero que generalmente para ser eficientes requieren aplicaciones cuidadosas. Cuando buscamos equilibrio de la rizósfera con *M. ethiopica*, necesariamente deben coadyuvar las variables de suelo, desde suelos arenosos a suelos arcillosos, manejos de frecuencias y volúmenes de agua que se aplican a las plantas, productos enraizantes, nematicidas, elicitores o promotores de resistencia y material vegetal con tolerancia al desarrollo de los parásitos.

EVALUATION OF PROTECTIVE EFFECT OF NEMIX C ON *Vitis vinifera* CV CHARDONNAY IN PRODUCTION INFESTED WITH *Meloidogyne ethiopica* IN CASABLANCA VALLEY, CHILE, SEASON 2012-2013 (Evaluación del efecto protector de Nemix C en *Vitis vinifera* cv Chardonnay en la producción infestada con *Meloidogyne ethiopica* en el Valle de Casablanca, Chile, Temporada 2012-2013)

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Meloidogyne ethiopica (WHITEHEAD, 1968) is present and has been causing damage to vines Chardonnay, since its establishment 18 years ago at a vineyard in the Casablanca Valley. Under these conditions, a study was conducted to evaluate the root protective effect caused by NEMIX C applications, biological product consisting of *Bacillus subtilis* and *Bacillus licheniformis*, and registered in other countries, as a product with nematicidal effects and root protector. During a growing season treatments were made with 3 applications of NEMIX C in a dose of 0.75, 1, 1.5 and 2 [K/ha] at 1000 ppm and a chemical control with the nematicide QL Agri35 25L/ha and an absolute control. 2K/ha of Nemix C increased the quality of the root. There was no difference in shoot weight and harvest, presumably might be manifest in the second season of study. As the dose increased, Nemix C increased the depressant effect of *M. ethiopica* populations. On the other hand Nemix C did not affect the populations of non-parasitic nematodes.

NAPHTHOQUINONES – NATURAL NEMATICIDES AGAINST *Meloidogyne hispanica* (Naftoquinonas – nematicidas naturales para el control de *Meloidogyne hispanica*)

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The wide geographical distribution of the polyphagous root-knot nematode *Meloidogyne hispanica* and the diminishing availability of effective nematicides increase the chances of damage in agricultural areas where this nematode is present, and reinforces the need of effective, sustainable and eco-friendly control strategies. Recent studies on the development of “natural” nematicides from plant extracts have shown potential. The aim of this work was to assess the effect of naphthoquinones (1,4-naphthoquinone, juglone and plumbagin), natural products obtained from several plants and from their agro-industrial residues, on *M. hispanica* second-stage juveniles (J2) mortality. Twenty J2 were transferred to glass-staining blocks with 1ml of each compound concentration (500, 250, 150, 100 and 50 ppm), solubilised in Triton X-100 5000 ppm and nematode mortality was monitored during 72 h. Each treatment consisted of five replicates and tap water and Triton X-100 5000 ppm as controls. 100% J2 mortality was achieved after 6, 12 and 48 h at 500 ppm 1,4-naphthoquinone, juglone and plumbagin, respectively; and after 12 and 24 h at 250 ppm 1,4-naphthoquinone and juglone. These phytochemicals have shown potential to be used as natural nematicides in the management of *M. hispanica* and a delivery system will be developed for field application.

EFFECT *IN VITRO* OF TOMATO ROOT DIFFUSATE ON *Pochonia chlamydosporia* GROWTH AND *Meloidogyne incognita* EGG PARASITISM (Efecto *in vitro* del exudado radical del tomate en el crecimiento de *Pochonia chlamydosporia* y en el parasitismo en huevos de *Meloidogyne incognita*)

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Plant species differ in their root diffusates (exudates) and rhizodeposits, which may affect microbial interactions in the rhizosphere. The differential growth of *Pochonia* isolates in the rhizosphere can indicate

the great variation in the ability of *P. chlamydosporia* isolates to use root diffusates saprophytically, and the parasitic ability of the fungus to infect nematode eggs as related to qualitative and/or quantitative differences in nutrients available to support *P. chlamydosporia* growth on roots. The effect on growth and egg parasitism of selected isolates of the fungus was tested in the presence of hydroponic tomato root diffusate. The diffusate was collected at 2, 4 and 6 weeks post-infection, from uninfected and *Meloidogyne incognita* infected plants. Colony growth and conidia production was assessed for two isolates on a solid medium and in a liquid medium, and the percentage of infection of *M. incognita* eggs was recorded. Results of adding diffusate from either nematode-infected or uninfected tomato plants are discussed in relation to the isolates' response to root diffusate collection time, egg parasitism and the saprophyte-parasite switch of the fungus.

AN OVERVIEW *Nacobbus aberrans* IN MEXICO (Revisión de *Nacobbus aberrans* en México)

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El género *Nacobbus* Thorne y Allen, 1944, contiene especies de nematodos endoparásitos sedentarios, endémicos de Norte y Suramérica. Las hembras maduras establecen un sitio permanente de alimentación en las raíces de sus hospedantes, induciendo la formación de agallas. Este género, reportado predominantemente en ambientes secos y semiáridos, y en altitudes altas, posee una alta capacidad reproductiva y una gama de hospedantes que incluye 84 especies cultivadas y no cultivadas pertenecientes a 18 familias botánicas, lo que lo convierte en un patógeno importante y de difícil manejo, debido a que bajo condiciones ambientales favorables una sola hembra puede producir de 37-833 huevecillos. En México, *N. aberrans* se ha encontrado en los estados de Coahuila, Distrito Federal, Guanajuato, Hidalgo, Estado de México, Michoacán, Morelos, Puebla, Oaxaca, San Luis Potosí, Tlaxcala y Zacatecas, asociado principalmente a los cultivos de chile (*Capsicum annum* L.), tomate (*Solanum lycopersicum* L.) y frijol (*Phaseolus vulgaris* L.), en donde causa daños importantes al reducir significativamente su producción. En los siguientes minutos, compartiré con ustedes el avance de *N. aberrans* en la República mexicana, los esfuerzos de investigación que algunos colegas han hecho respecto a su biología, relación planta-hospedante, métodos de combate, intentos de explicar modo de acción de algunas tácticas de combate, así como la interacción de estos conocimientos y su significado en relación a otras contribuciones desarrolladas en otros países en donde *Nacobbus* es de importancia económica.

EVALUACIÓN *IN VITRO* DE TRES CEPAS DE *Pseudomonas protegens* SOBRE JUVENILES DE SEGUNDO ESTADIO DE *Nacobbus aberrans* (*In vitro* evaluation of three strains of *Pseudomonas protegens* on second-stage juveniles of *Nacobbus aberrans*)

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Las rizobacterias se utilizan como agentes de control biológico de nematodos fitófagos perjudiciales. Se ha demostrado que algunas bacterias del género *Pseudomonas* generan metabolitos extracelulares que poseen acción nematocida. En condiciones *in vitro*, se evaluó el efecto de cultivos celulares (suspensión de bacterias y sobrenadante filtrado) de *P. protegens* CHA0 y de dos cepas derivadas (ARQ1, fenotípicamente equivalente a CHA0, y CHA89, un mutante que no produce antibióticos ni proteasas extracelulares) sobre *Nacobbus aberrans*. La experiencia se realizó en cápsulas de Petri; en su interior se colocaron 35 juveniles de segundo estadio del nematodo y se estimó el porcentaje de mortalidad (%M) a las 24 y 48 h. Cada tratamiento se repitió tres veces; como control se utilizó solución fisiológica y medio de cultivo estéril. El %M se incrementó con el tiempo; a las 48 h, las tres suspensiones celulares causaron una mortalidad significativa, alcanzando valores entre 63-69%. En el caso de los sobrenadantes, CHA89 produjo un %M del 40% mientras que para CHA0 y ARQ1 fueron superiores (89 y 92 %, respectivamente). Los resultados sugieren que la acción nematocida de *P. protegens* CHA0 depende, al menos en parte, de sus exotoxinas.

SUSCEPTIBILIDAD *IN VITRO* DE *Meloidogyne incognita* A EXTRACTOS ACUOSOS DE MATERIAL VEGETAL (*In vitro* susceptibility of *Meloidogyne incognita* to aqueous extracts of plants)

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Se evaluó bajo condiciones *in vitro*, el efecto nematicida sobre *M. incognita*, de cuatro extractos acuosos de origen vegetal: a) compost inmaduro de orujo de uva fresco (COUF); b) compost inmaduro de orujo de uva agotado (COUA); c) compost inmaduro de alperujo de oliva (CA) y d) bulbillos de ajo (BA). Los extractos se obtuvieron por molienda, maceración en agua destilada y filtrado. Como testigo químico se empleó fenamifos CS 24% a 2000 ppm y como testigo absoluto, agua destilada. De cada material vegetal se obtuvieron dos extractos con distintas concentraciones, expresadas como peso seco de material vegetal en 100 g de agua (p/p). Se empleó un diseño completamente aleatorizado con cuatro repeticiones por tratamiento. La unidad experimental consistió en una caja de Petri donde se colocaron 30 larvas de segundo estadio de *M. incognita* y se expusieron 72 horas al extracto. Luego se verificó, por movilidad, la supervivencia de los individuos y se calculó el porcentaje de control. Éste resultó superior al 90% para todos los tratamientos; excepto los de orujo de uva agotado, que presentaron valores menores al 74%. Los porcentajes de control obtenidos fueron: CA (10:100) 98,7%; COUF (10:100) 98,2%; BA (25:100) 98%; fenamifos 96,7%; CA (2,5:100) 96,2%; BA (10:100) 94,7% y COUF (5:100) 93,7%. Con menores porcentajes de control, se diferenciaron del resto y entre sí, COUA (20:100) y COUA (5:100) con 63,7% y 53,2% de control, respectivamente.

THE STATUS OF PLANT-PARASITIC NEMATODE COMMUNITIES IN CONVENTIONAL AND GENETICALLY-MODIFIED SOYBEAN FIELDS IN SOUTH AFRICA, WITH SPECIAL REFERENCE TO *Meloidogyne* SPECIES. (Estatus de las comunidades de nematodos fitoparásitos en cultivos de soya convencionales y genéticamente modificados en Sudáfrica, con especial referencia a especies de *Meloidogyne*)

A. Mbatyoti¹, D. Fourie¹, A. Swart² and A.H. Mc Donald¹

¹North-West University, Unit of Environmental Sciences and Management, Private Bag X6001, Potchefstroom, 2520, South Africa; ²National Collection of Nematodes, Biosystematics Division, Agricultural Research Council - Plant Protection Research Institute, Private Bag X134, Queenswood, 0121, South Africa. 24088978@nwu.ac.za

A range of plant-parasitic nematode (PPN) spp. parasitise local soybean (*Glycine max* (L.) Merr.) crops, with *Meloidogyne incognita* and *M. javanica* the predominant spp. This information exists for conventional soybean crops but not for genetically-modified (GM) Roundup Ready (RR) soybean cultivars, which currently constitute more than 65% of the local seed market. Therefore, nematode surveys were conducted during 2012 and 2013 by sampling 11 soybean farms where conventional and RR soybean crops were grown adjacently. Natural vegetation in areas adjacent to soybean fields was also sampled concurrently. In this survey too *Meloidogyne* spp. were generally the predominant PPN, with population levels of up to 104 962/50g roots in conventional and 23 220/50g roots in RR soybean at pod formation. Natural vegetation hosted up to 1 761 *Meloidogyne* spp. eggs and J2/50g grass roots. Other PPN that were associated with both soybean and natural vegetation at smaller population densities than for soybean in the latter were *Criconeimoides* spp., Dorylaimida, Hoplolaimidae and *Pratylenchus* spp.. A variety of fungivores, bacterivores and predators were recorded in the soil samples from both conventional and RR soybean fields, as well as from natural veld.

HOST SUITABILITY OF SOUTH AFRICAN SOYBEAN CULTIVARS TO *Meloidogyne javanica*. (Susceptibilidad de cultivares de soya a *Meloidogyne javanica* en Sudáfrica)

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Soybean (*Glycine max* (L.) Merr.) is an important oilseed crop in South Africa. Its production progressively increases annually. Production is threatened, however, due to plant-parasitic nematodes, in particular root-knot nematodes (*Meloidogyne* spp.) that cause substantial yield losses. These losses could be reduced by using resistant cultivars. No nematicides are registered for use on soybean locally. Twenty-four commercially available soybean cultivars were thus screened for host suitability to *M. javanica* in a greenhouse. Approximately 5 000 eggs and second-stage juveniles (J2) were inoculated on the roots of each soybean seedling 12 days after emergence. Parameters determined 56 days after inoculation (DAI) were: i) egg and J2 numbers/root system, ii) reproduction factor (Rf) and iii) percentage resistance in relation to the most susceptible soybean genotype. Substantial variation existed among the soybean cultivars with regard to all the parameters evaluated. The resistant standard cv. LS 5995 had the lowest number of eggs and J2/root system. In terms of resistance percentages, LS5995 was also indicated as the most resistant cultivar since it only maintained 1% of the nematode population/root system

hosted by Marula, the most susceptible cultivar at the same growth stage. Results from this study showed that none of the of newly-released soybean cultivars have resistance to *M. javanica*.

THE STATUS OF PLANT-PARASITIC NEMATODE COMMUNITIES IN CONVENTIONAL AND GENETICALLY-MODIFIED SOYBEAN FIELDS IN SOUTH AFRICA, WITH SPECIAL REFERENCE TO *Meloidogyne* SPECIES. (Estatus de las comunidades de nematodos fitoparásitos en cultivos de soya convencionales y genéticamente modificados en Sudáfrica, con especial referencia a especies de *Meloidogyne*)

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INTRODUCTION TO NEMATODES, A MULTIMEDIA PRESENTATION FOR TEACHING NEMATOLOGY. (Introducción a los nematodos, una presentación de multimedia para la enseñanza de nematología)

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Teaching in general, and in the plant protection sciences in particular, is a challenging endeavor in the 21st century. A large blackboard and a package of multi-colored chalk have been replaced by a large monitor and a range of multi-media resources. Hardbound textbooks are increasingly being replaced by or supplemented with software bound instructional modules. In order to successfully “engage” students, instructors must come to class armed with seasoned experience in the subject, a keen awareness of the students foundation in science and a genuine enjoyment for the teaching activity. Introduction to Nematodes, a multimedia, multi-platform, multi-layered slide production by E.C. McGawley, C. Overstreet, M.J. Pontif and A.M. Skantar brings this new technology to the teaching of nematology. The presentation, two years in production, is available for free (for educational purposes) download from the websites <nematologists.org>, <ontaweb.org> and <nematode.net>. To date, there have been over 4,000 downloads of this presentation. The nematology community is encouraged to contribute to this ongoing project designed to foster quality instruction in nematology and produce an increased awareness of the importance of nematodes in agriculture.

CAN WE LINK THE DIFFERENT PATHOTYPES OF THE GOLDEN CYST NEMATODE *Globodera rostochiensis* TO GENOTYPE USING SINGLE NUCLEOTIDE POLYMORPHISM (SNP) MARKERS? (Podemos vincular los diferentes patotipos del nematodo dorado de la papa *Globodera rostochiensis* al genotipo utilizando marcadores de polimorfismo de nucleótido simple)

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The golden nematode (GN), *Globodera rostochiensis*, is a serious pest of potato. The species has co-

evolved with its host in South America and has developed a high level of specialization. The consequences of its adaptation make this nematode very difficult to control. The ability of some populations to multiply on different potato genotypes has led to the current classification scheme of pathotypes. However, this system is not based on genetic characteristics and does not directly reflect genetic diversity. Single nucleotide polymorphisms (SNPs) are genetic markers that are abundant and widespread across the genome. Recently, genotyping-by-sequencing (GBS) protocols were developed based on high-throughput, next-generation sequencing of genomic subsets targeted by restriction enzymes. This approach was shown suitable for population studies and trait mapping in diverse organisms at low cost. Here, we present the genotypes of 26 worldwide GN populations representing the five known pathotypes. More than a thousand SNP loci of high quality and good coverage usable for population and association studies were identified. The global population structure was found to be very strong, separating the tested populations into two genetic clusters. The pathotypes Ro3, Ro4 and Ro5 were closely related and could be easily distinguished from Ro1 and Ro2 with several unique SNP markers. Although the GBS pipeline (UNEAK) was efficient at highlighting major differences between genotypes (e.g. homozygote vs. heterozygote), it lacked depth to reveal more subtle variations. Quantitative analyses of allele frequencies are presently underway to refine our current GN population structure and to unveil new associations between SNPs and pathotypes.

***Pochonia chlamydosporia* VAR. *mexicana*, A NEW VARIETY OF *Pochonia chlamydosporia* FOR THE MANAGEMENT OF *Meloidogyne* SPP. IN MEXICO (*Pochonia chlamydosporia* var. *mexicana* una nueva variedad de *P. chlamydosporia* para el manejo de *Meloidogyne* spp. en México)**

M.G. Medina-Canales¹, A.V. Rodríguez-Tovar¹, G. Zúñiga¹, R.H. Manzanilla-López², A. Tovar-Soto¹

¹Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, Col. Santo Tomás, Del. Miguel Hidalgo, CP. 11340, México D.F., Mexico; ²Department of AgroEcology, Rothamsted Research, Harpenden, Herts, AL5 2JQ, UK. magameca@yahoo.com.mx

Three new 'putative' *P. chlamydosporia* isolates (Pcp2, Pcp21 and Pcp31) were selected from a total of 105 fungal isolates that were screened from samples of nematode infested soils planted with vegetable crops in Puebla's Tepeaca Valley (Mexico). The new isolates were characterized by morphometrics, SEM and molecular tools. Amplification of the ITS region revealed a 650bp amplicon, which was used in a maximum likelihood phylogenetic inference analysis. Comparison of GenBank sequences against the Mexican isolates sequences and tree topology analysis showed three different groups: *Pochonia*, *Metharhizium* and *Epichloe*. The nucleotide identity value showed 83.6% of similarity between the Mexican isolates and the reference sequences. In addition, test using specific primers for the two known varieties of the fungus (*P. c.* var. *chlamydosporia* and *P. c.* var. *catenulata*), RFLP on the ITS product, the phylogenetic inference and the molecular test for detection of *P. chlamydosporia* vcp1 gene, revealed that all three Mexican isolates belong to a new variety named *Pochonia chlamydosporia* var. *mexicana*. All native Mexican isolates produced $>1 \times 10^6$ chlamydospores/50g of substrate of which more than 80% were viable, and they were capable of colonizing >80% of the rhizosphere. Egg parasitism was different among isolates: >60% for *M. incognita* and *M. arenaria* eggs while *M. hapla* egg parasitism was <60%. Isolates Pcp2 and Pcp21 were identified as potential biological control agents of *Meloidogyne* spp. to be tested in future greenhouse and field tests.

PROSPECCIÓN Y DISTRIBUCIÓN GEOGRÁFICA DE *Meloidogyne* spp. (Goeldi) EN CULTIVOS DE PAPA UBICADOS EN EL SUR DE CHILE. (Survey and geographic distribution of *Meloidogyne* spp. on potato in southern Chile)

I. Moreno-Lehuedé and O. Acevedo-Pardo

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Desde la implementación de la técnica de PCR en la red de laboratorios de nematología del Servicio Agrícola y Ganadero, para la determinación de especies de nematodos fitopatógenos, se ha logrado la identificación de nuevas especies, insospechadas en el territorio nacional. Las prospecciones específicas realizadas en tubérculos de papa fueron realizadas en predios ubicados en la zona Sur de Chile, localizados entre los paralelos 38 al 42° de Latitud Sur, que comprenden las Regiones de: Bio-Bio, Araucanía, Los Ríos y Los Lagos, se identificó a las especies *Meloidogyne fallax*, *Meloidogyne chitwoodi* y en algunos casos mezclas de estas dos especies. De un total de 331 focos reportados en el área prospectada, un 58 % con 191 focos correspondió a *M. fallax*, un 29 % con 97 focos correspondió a *M. chitwoodi* y un 13% con 43 focos correspondió a mezclas de ambas especies. Las identificaciones están asociadas principalmente a tubérculos de papa y a la maleza *Senecio sylvaticum*, constituyendo esta última un nuevo hospedante para la especie *M. fallax*. Se analiza la distribución de las plagas

en el territorio nacional, superficie infestada y la posible implementación de medidas de contención de las plagas y/o la producción de papa en predios libres de plagas.

ACTUALIZACIÓN DE NEMATODOS FITOPARÁSITOS ASOCIADOS AL CULTIVO DE PAPA (*Solanum tuberosum* subsp. *tuberosum*) EN CHILE Y SU IMPLICANCIA EN LAS REGULACIONES CUARENTENARIAS (Update of plant parasitic nematodes associated to potato (*Solanum tuberosum* subsp. *tuberosum*) in Chile and implications on quarantine regulations)

I. Moreno-Lehuedé

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El Programa Nacional de la Sanidad de la Papa (PNSP), que se lleva a cabo en todas las regiones de Chile, ha permitido actualizar nuevas distribuciones y nuevas determinaciones asociadas a este rubro. Las identificaciones de mayor importancia cuarentenaria se han producido en la zona austral del país, donde se ha establecido *Globodera rostochiensis* en la región de Los Lagos y de Los Ríos. Entre las especies de *Pratylenchus* asociadas a papa se encuentran: *P. penetrans*, *P. thornei*; *P. brachyurus*, las cuales se encuentran distribuidas en diferentes regiones del país. *Ditylenchus destructor* se localiza de preferencia en la Región de Aysén. Las especies de *Meloidogyne* determinadas son: *M. incognita* y *M. hapla* y en menor incidencia *M. javanica* y *M. arenaria*. Lo más significativo ha sido la identificación de las especies *M. chitwoodi* y *M. fallax* en el año 2012, en la zona sur de país. Los Dorylaimidos están representados por *Paratrichodorus* spp. y en asociación con Tobacco rattle virus (TRV) en la Región de Los Lagos, en bajas poblaciones. No obstante las prospecciones específicas, también han indicado la ausencia de *Nacobbus aberrans* sensu lato, *Ditylenchus dipsaci* sensu lato y *Rotylenchulus reniformis* en cultivos de papa en las regiones australes del país. Se analizan los aspectos cuarentenarios de las plagas, su incidencia con los países importadores y las regulaciones con el comercio internacional de los tubérculos de papa.

POPULATION DYNAMICS OF *Meloidogyne* SPP. ON ASPARAGUS (*Asparagus officinalis*) AND SUGARCANE (*Saccharum officinarum*) CROPS IN PERU (Dinámica poblacional de *Meloidogyne* spp. en cultivo de espárrago (*Asparagus officinalis*) y caña de azúcar (*Saccharum officinarum*), en Perú)

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The population dynamics of *Meloidogyne* spp. was investigated in crops of asparagus (*Asparagus officinalis*) and sugarcane (*Saccharum officinarum*) in three farms in district Virú, La Libertad, in Northern Peru. These farms were naturally infested with *Meloidogyne*. Between May 2011 and March 2012, five replicate samples were periodically taken from the rhizosphere of asparagus cv. UC-157 F1 in a parcel located at Huancaco. The samplings continued after the end of the asparagus crop, when seven samplings were performed on planted sugarcane cv. H71-4992 introduced as rotation in the same parcel. Similarly, between December 2010 and May 2012, 14 samplings from asparagus cv. UC-157 F1 were carried out in a parcel located at Duna Pur Pur. Further 16 samplings were carried out in the same period on asparagus cv. Ida Lea in a parcel located at San José. In the different samplings, the densities of *Meloidogyne* second stage juveniles (J2) ranged between 0-64 nematodes/100 cm³ soil on asparagus, and 0-659 J2/100 cm³ soil on sugarcane (mean sampling densities were 7-16 J2/100 cm³ soil on asparagus and 2-140 J2/100 cm³ soil on sugarcane). The highest densities were observed in older plants, and sugarcane cv. H71-4992 allowed higher *Meloidogyne* spp. multiplication rates than asparagus cv. UC-157 F1.

GREEN AMENDMENT WITH *Tagetes minuta* ON SUPPRESSION OF *Meloidogyne incognita* POPULATIONS ON *Asparagus officinalis* (El abono verde con *Tagetes minuta* en el control de poblaciones de *Meloidogyne incognita* en cultivo de *Asparagus officinalis*)

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The effect of green amendment with *Tagetes minuta* on suppression of *Meloidogyne incognita* populations on *Asparagus officinalis* cv. UC-157 F1 was evaluated in pots under greenhouse conditions. Chopped fresh foliage of *T. minuta* was incorporated in the soil (sterile soil and sand 1:1) at concentrations of 10% and 20%

(v/v). Control pots received no amendment. Each treatment had six replicates (pots). An asparagus seedling was planted in each pot, and one week later the seedlings were inoculated with 1,500 eggs of *M. incognita*. Nematode populations, multiplication rate (MR), gall index (GI), and dry weight of foliage and roots were evaluated 62 days after inoculation. *M. incognita* did not multiply (MR <1; GI <1) on asparagus grown in the soil amended with *T. minuta* at 10% and 20%; no statistical difference ($P > 0.05$) in means was founded between these treatments, but those of the control showed significant differences ($P < 0.001$). Dry foliage and dry root weights of the plants grown in the soil amended at 10% were higher than those of plants from the treatment at 20% ($P < 0.001$). The foliage of *T. minuta* incorporated at 10% and 20% in the soil of asparagus plants suppressed the populations of *M. incognita*, and the plant development was better in the soil amended at 10%.

SPATIAL AND SEASONAL DISTRIBUTION OF *Meloidogyne incognita* IN A PIURA, PERÚ VINEYARD (Distribución espacial y estacional de *Meloidogyne incognita* en un viñedo de la región Piura, Perú)

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The spatial and seasonal distribution of *Meloidogyne incognita* was studied for a period of 11 months on Harmony and Freedom rootstocks on a commercial vineyard located in the valley of Cieneguillo, Piura region, Peru. Significant population levels of *M. incognita* were distributed both in the row and between rows of plants to 60 cm deep and 80 cm horizontal distance in both rootstocks, the distribution of the nematode also parallels the root density. The largest nematode population levels occurred during the summer and gradually decreased in the other seasons. Unlike root density decreased from summer to fall and increased significantly from fall to winter and spring. The coefficient of variation in the *M. incognita* populations sampling when sampling is reduced within 40 and 60 cm of the trunk bot in the row and between plants rows.

NEMATODOS DEL GÉNERO *Paratylenchus* ASOCIADOS A HUERTOS DE DURAZNERO EN EL VALLE DE ACONCAGUA, REGIÓN DE VALPARAÍSO CHILE. (Nematodes of the genus *Paratylenchus* associated with peach plantations in the Valley of Aconcagua, Region of Valparaiso, Chile)

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Durante el año 2009, se realizó un muestreo en un huerto de duraznero *Prunus persica* L. Batsch, cv Ross Peach de 9 años, ubicado en la Provincia de San Felipe, tomando muestras en cada estación, con la intención de detectar la posible presencia de *Paratylenchus prunii* Sharma, Sharma y Khan, no reportado en Chile. La metodología utilizada para la extracción de formas móviles, se realizó mediante el método de Christie-Perry más embudos de Baermann. Se estudiaron las características fenotípicas de 19 hembras adultas, usando el compendio taxonómico ESSER, 1992, basándose principalmente en la característica del largo del estilete, (menor de 40 μ m), concluyendo que todas las especies analizadas correspondieran al género *Paratylenchus*. Con la morfometría utilizada, no se evidenció similitud de las especies con *Paratylenchus prunii*, sin embargo, con la metodología cladística se logró contribuir con la actualización en la diversidad de especies de este género en Chile, determinando en más de un 90% la presencia de las siguientes especies: *P. projectus*, *P. neonanus*, *P. baldaccii*, *P. ciccaronei*, *P. nanus*, *P. amblycephalus*.

EFFECT OF NEEM CAKE ON GREEN PEPPER DEVELOPMENT IN NEMATODE-INFESTED SOIL IN IRRIGATED PLOTS IN ALLUVIAL VALLEY OF THE BRAZILIAN SEMIARID. (Efecto de pasta de neem en desarrollo del pimiento verde bajo suelo infestado por nematodos en parcelas de regadío en valle aluvial semiárido brasileño)

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The experiment was carried out in a family farming area in the municipality of Pesqueira in the Brazilian

semiarid region, aiming to evaluate the effect of neem cake on plant development and nematode population density in a plot cultivated with green pepper (*Capsicum annuum*). Two grids with 49 points (8 x 8 m), representing a total area of 6272 m² with 98 points, were taken to carry out the experiment. Neem cake was amended one month after green pepper planting and soil samples were collected immediately before sowing and 45 days after neem amendment at the 0.20-0.40-m depth in order to perform nematological analysis. Nematode community was identified and population density evaluated through covariance analysis. Biometric evaluations were carried out through measures of plant stalk diameter and plant height. Neem cake amendment improved plant development, occurring higher population density of the families Criconeematidae and Rhabditidae and decrease of the genus *Trichodorus* and *Paratrichodorus* on treated plots.

SPATIAL VARIABILITY OF *Meloidogyne* spp. IN THE SOIL OF SUGARCANE AREAS IN THE COASTAL MESA IN NORTHEASTERN BRAZIL. (Variabilidad espacial de *Meloidogyne* spp. en el suelo de caña de azúcar en la meseta costera del Noreste de Brasil)

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The aim of this research was to evaluate the spatial variability of *Meloidogyne* spp. in sugarcane areas on coastal tableland, under rainfed conditions and irrigation of the Northern coast of Pernambuco. Two areas and four periods of the sugarcane cultivation were selected, renewing, four, nine and fourteen months after plantation. In the study area, 36 soil samples were collected with 5.00 × 5.00 m spacing, 0.10 – 0.25 m deep. The data were analyzed using classic statistics and geostatistics tools. Geo-statistical analyses showed that *Meloidogyne* spp. exhibited spatial variability and the experimental semivariograms were fitted to spherical models. The study areas presented strong degree of spatial dependence. The contour maps showed that in irrigated area *Meloidogyne* spp. was distributed uniformly across the area, and also in the fourth months after plantation, the nematode was distributed over the field. On the other hand, under rainfed conditions *Meloidogyne* spp. was scattering across the field during the sugarcane cultivation.

SURVEY AND MAPPING OF PLANT PARASITIC NEMATODE OCCURENCE IN GRASS SEEDS IN BRAZIL (Prospección y mapeo de la incidencia de nematodos fitoparásitos en semillas de gramíneas en Brasil)

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Phytonematode species can infect seeds making it more difficult the commercialization internationally. This study was carried out with the objectives of identify, quantify and map of species of phytonematodes in samples of forage grasses in Brazil. Samples of 500 lots of forage grasses were taken at the plant of Indústria e Comércio de Sementes Matsuda Ltda and sent to the Nematology Laboratory of EPAMIG-URETP. The nematodes were extracted from aliquots of 10 g of each sample by the technique of centrifugal flotation in sugar solution with kaolin. The population was estimated with the aid of a photonic microscope and a Peters Slide. This study observed that the largest lot had its origin regions of Minas Gerais State with 130 lots, São Paulo with 122 lots and Bahia with 96 lots. The major occurrences of nematodes were registers in Baianópolis and Correntina-BA; Rio Verde and Serranópolis-GO; Camapuã-MS. The smallest incidence were registers in São Desidério and Correntina-BA; Santo Anastácio e Mirante do Paranapanema-SP; São Sebastião do Paraíso-MG. *Aphelenchoides* spp. were the most found in the samples.

USO DE SUSTANCIAS VEGETALES EN GESTIÓN DE *Meloidogyne incognita* EN LA REMOLACHA. (Vegetable substance use in management of *Meloidogyne incognita* in the beet)

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El nematodo es un grave problema en la explotación económica de la remolacha. El objetivo de este estudio fue evaluar la aplicación de aceite y extracto acuoso de neem (*Azadirachta indica* A. Juss.) y extracto acuoso de pimienta rosa (*Schinus terebinthifolius* Raddi) en las poblaciones de *Meloidogyne incognita* parasitan la remolacha de mesa. Plántulas de remolacha se trasplantaron a 3 dm³ de sustrato contenido en macetas de polietileno, y posteriormente, 50% de ellas se inocularon con 500 ovos/J2. Después de una semana, las soluciones se aplicaron aceite de neem al 1,0% (v/v) y los extractos acuosos de neem y pimienta a 5,0% (m/v) en una sola aplicación a una dosis de 50 ml por planta, al rededor del cuello. Se evaluó el peso de las hojas frescas (PHF), el peso fresco de las raíces tuberosas (PFR), diámetro de raíz (DR), la población final de nematodos (PF), factor de reproducción (FR) y sólidos solubles (Brix°). El control consistió en las plantas tratadas con la aplicación de agua destilada. El nematodo reduce PFR y DR, pero los extractos acuosos y aceite de neem reduce el PF y FR y se probarán campo.

EVALUACIÓN DE EXTRACTOS ACUOSOS DE PLANTAS EN MANEJO DE *Meloidogyne javanica* PARASITANDO TOMATE (Evaluation of aqueous extracts of plants in management of *Meloidogyne javanica* parasitizing tomato)

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El nemátodo *Meloidogyne javanica* parasita el tomate (*Lycopersicon esculentum*). El presente trabajo tuvo como objetivo gestionar este patógeno con extractos acuosos botánicos. El experimento se realizó en un invernadero en diseño completamente al azar con siete tratamientos y seis repeticiones. Plántulas de tomate cv. Santa Clara fueron cultivadas en macetas con una capacidad de dos litros con suelo de arcilla arenosa, y inoculadas con 2.000 huevos/J2 de *M. javanica*. Para los extractos de ruda (*Ruta graveolens*), citronela (*Cymbopogon winterianus*), me-nadie-puede (*Dieffenbachia picta*), neem (*Azadirachta indica*) y la nuez moscada (*Myristica fragrans*) se mezcló 1 g de hojas secas de cada especie para cada 10 ml de agua destilada. Posteriormente se aplicó 100 ml de los extractos en la región del cuello. Para propósitos de comparación se utilizó 0,6 g/maceta de nematicida Terbufós, en dosis única, y un control con agua destilada. Los tratamientos mostraron lo siguiente FR: extracto de ruda (0,091), nematicida y extracto de nuez moscada (0,272); extracto de me-nadie-puede y citronella (0.363), extracto de neem (0.454). Estos extractos tienen potencial para el manejo de *M. javanica* y debería ser probado en campo.

THE ROLE OF EXTENSION NEMATOLOGY IN THE UNITED STATES (El papel de la extensión en la nematología en los Estados Unidos)

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The role of Extension in the United States has been to develop practical applications of research knowledge and provide instructions and demonstrations of existing or improved practices in agriculture. Extension was formalized in the United States in 1914 with the Smith-Lever Act to establish partnerships between the agricultural colleges and the U.S. Department of Agriculture. Much of the early work with Extension nematology was conducted by teaching/research faculty of the land grant universities. These early nematologists conducted research/demonstration programs and developed extension publications that outlined some of the problems associated with nematodes and offered some management options such as crop rotations. The development of nematicides in the 1940s was instrumental in convincing producers of just how serious plant-parasitic nematodes were to agriculture. Until the 1950s, most producers were not college educated and had little exposure to science-based farming practices. Currently, many producers are much more educated and involved in large farming operations. Although producers still receive information about nematodes from demonstrations, producer meetings, local extension agents, fact sheets and bulletins, producers now rely on additional methods including the internet, electronic newsletters, blogs, podcasts, and other types of social media. Extension nematology is constantly evolving in order to keep up with the latest technologies and management options as well as changing how extension nematologists reach their clientele.

PRIMER REPORTE DE *Meloidogyne chitwoodi* Y *M. fallax* EN CHILE, IDENTIFICACIÓN MEDIANTE TAXONOMÍA TRADICIONAL Y MARCADORES MOLECULARES. (First report of *Meloidogyne chitwoodi* and *M. fallax* in Chile, identification based on traditional taxonomy and

molecular markers)

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En Chile en el año 2010, el laboratorio de Biotecnología del Servicio Agrícola y Ganadero implementó la técnica PCR para la identificación de nematodos cuarentenarios del género *Meloidogyne*. Se analizaron muestras de tubérculos de papa captadas del Programa Nacional de Sanidad de la Papa (PNSP), con sintomatología de nematodo agallador, provenientes de la zona sur de Chile (40° latitud sur). Se extrajo las hembras y masas de huevos desde los tubérculos para realizar el análisis de PCR utilizando partidores generales y especie específicos, resultando amplificaciones positivas para *M. fallax*. Para la verificación del diagnóstico se realizó la secuenciación del producto amplificado y su subsecuente comparación en GenBank. Las observaciones y mediciones taxonómicas confirman los resultados obtenidos por las técnicas moleculares. Se realizó una prospección específica en las regiones con cultivos de papa especialmente de la zona sur del país encontrándose además la especie *M. chitwoodi*. Ambos diagnósticos se enviaron a un laboratorio de referencia extranjero para su confirmación. La determinación de *M. fallax* constituye el primer reporte de este nematodo a nivel continental.

WHAT DOES IT TAKE TO ADD A NEW TOOL TO THE TOOL BOX? (QUÉ SE NECESITA PARA AÑADIR UNA NUEVA HERRAMIENTA A LA CAJA DE HERRAMIENTAS?)

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The following process has been highly simplified with the purpose of illustrating a long and complex process from development to sales of a conventional plant protection product. The story begins when a farmer encounters a challenge that compromises the health of his crop. First, the problem must be accurately identify, a potential product must be selected (screen >100,000 potential candidates to select one for submission), an initial formulation developed and efficacy testing initiated to determine the interim Directions For Use (DFU's). Second, registrants must demonstrate that the product can be safely used and will not result in any unreasonable adverse effects to humans and the environment. In this stage, residue, toxicology, environmental, ecotoxicology and metabolism studies are conducted on the active ingredient and DFU's are finalized. Simultaneously, the synthesis process and formulation are optimized. All the scientific data are incorporated into a risk assessment to ensure safe use and regulatory compliance. Third, with a positive result, the registrant assembles the dossier according to regulatory agency requirements and company regulatory strategies (register in one country, one region, or globally). The review and approval process can take 2 or more years. Finally, in the USA, either at dossier submission or after registration, companies must apply for state regulatory approvals, where they plan to sell, distribute or use the product. The state registration process can take from 1-18 additional months. Only then will the farmers/end-users be able to add a new plant protection tool to their toolbox. In the USA, this process is estimated to cost approximately 250 million dollars or more.

EVALUACIÓN DE *Bacillus subtilis* Y *Bacillus licheniformis*, PRODUCTO COMERCIAL NEMIX C® COMO PROTECTOR DE RAÍCES DE TOMATE INOCULADAS CON HUEVOS Y JUVENILES DE *Meloidogyne ethiopica*, EN CONDICIONES DE INVERNADERO (Evaluation of *Bacillus subtilis* and *Bacillus licheniformis*, Nemix C® commercial product as tomato root protector inoculated with *Meloidogyne ethiopica* eggs and juveniles in greenhouse conditions)

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Se evaluó el efecto protector de raíces de NEMIX C® desde 50 ppm a 2000 ppm contra 500 huevos y juveniles de *M. ethiopica*, en plantas de tomate en condiciones de invernadero. Se realizaron tratamientos en que NEMIX C® se aplicó antes y otros en que se aplicó después de la infestación con *M. ethiopica*. La protección de raíces se dio tanto en tratamientos con aplicaciones previas al inóculo como en posteriores, incrementándose con el aumento de concentración de NEMIX C. Todos los tratamientos de NEMIX C® aplicados previo al inóculo de *M. ethiopica* tuvieron baja nodulación, y entre los tratamientos aplicados con posterioridad al inóculo la concentración alta de producto obtuvo mejor calidad de raíces. Las bacterias aplicadas antes de la infestación de *M.*

ethiopica, les permite establecerse y consolidarse en raíces, rizósfera y suelo, lo que posibilita buenos resultados de protección de raíces a menores concentraciones de producto y cuando los cultivos ya están infestados con *M. ethiopica*, las bacterias *B. subtilis* y *B. licheniformis* deben ser aplicadas a concentraciones mayores a 1000 ppm, para poder apreciar efectos de disminución de nódulos radicales.

DETECCIÓN E IDENTIFICACIÓN DEL NEMATODO DORADO DE LA PAPA *Globodera rostochiensis* (Wollenweber) EN LA REGIÓN DE LOS LAGOS, CHILE (Detection and identification of Golden Cyst nematode *Globodera rostochiensis* in the Lakes Region of Chile)

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Chile posee una superficie cultivada de 53.689 hectáreas de papa de las cuales 32.587 hectáreas se encuentran localizadas en la zona sur del país, en el área comprendida entre la provincia de Arauco, Región del Bío-Bío y la Región de Magallanes y Antártica Chilena (38 a 56° Lat. Sur), declaradas por el SAG área libre de plagas cuarentenarias de la papa dentro de las cuales se encuentran *Globodera rostochiensis* y *Globodera pallida*. La Región de Los Lagos es la principal zona productora de tubérculo de semilla de papa. En 2012 se recibieron muestras procedentes de la prospección específica para detección de nematodo dorado, procedentes de la Comuna de LLanquihue del Programa Nacional de la Papa del SAG, resultando positivas a *G. rostochiensis*, mediante taxonomía tradicional de quistes y estados juveniles. Para su confirmación y siguiendo las pautas NIMF 27 FAO/2006 se utilizó análisis molecular mediante PCR con partidores específicos. Esta es la primera identificación de este nematodo en el área Libre de plagas cuarentenarias de la papa. En este trabajo se presentan los resultados de los análisis de laboratorio, de muestras de suelos de cultivos de papas captadas en actividades de vigilancia y fiscalización en las temporadas 2011-2012 en la Región de Los Lagos.

NEMATODE HOST SUITABILITY AND OCCURRENCE IN FOREST SPECIES SEEDLINGS USED IN THE AGROSILVOPASTURE SYSTEM (Ocorrência e Hospedabilidade de Nematoides em Mudanças de Espécies Florestais Utilizadas no Sistema Agrossilvipastoril)

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The aim of this work was to survey nematode in forest species used in the Agricultural-Forest Integration System (AFIS), as well to evaluate the host suitability of 15 forest species to *Pratylenchus brachyurus*. To do this, 58 seedlings were collected from nurseries and tembawang (managed forests), all of them in the Minas Gerais State. From 58 seedlings, 56 (96.55%) of them were infested with phytonematodes. The nematodes found, as well its respective occurrence percentages, are as follow: *Ditylenchus* sp. – 37 samples (63.79%), *Aphelenchoides* sp. – 33 samples (58.89%), *Helicotylenchus* sp. – 27 samples (46.55%), *Pratylenchus* sp. – 19 samples (32.75%), *Aphelenchus* sp. – 11 samples (18.96%), *Meloidogyne* sp. – 4 samples (6.89%), *Mesocriconema* sp. – 2 samples (3.44%), *Trichodorus* sp. – 1 sample (1.72%) and *Tylenchus* sp. – 1 sample (1.72%). The results indicated that commercially important phytonematodes used in the AFIS, like *Meloidogyne* sp. and *Pratylenchus* sp. were found in forestry seedlings traded to be part of this system. The host suitability test was done in an EPAMIG greenhouse, Uberaba, MG. The experimental design used was the randomized blocks with five replications, being inoculated 600 nematodes per plant. All forestry species evaluated in this experiment multiplied *P. brachyurus*.

EVALUACIÓN DE LAS POTENCIALIDADES DE PRODUCTOS NATURALES DE ORIGEN BOTÁNICO EN EL MANEJO DE *Meloidogyne incognita* (Evaluation of the potential of plant products in the management of *Meloidogyne incognita*)

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Los nematodos fitoparásitos del género *Meloidogyne* constituyen plagas importantes de diversos cultivos en Cuba. Aunque se han desarrollado diferentes tácticas para su manejo, el complejo medio donde estos se desarrollan, el suelo, impone retos que demandan continuar las investigaciones para dotar a los productores de un arsenal mayor de alternativas. Este trabajo tuvo como objetivo determinar el efecto de diferentes extractos,

obtenidos de plantas presentes en Cuba, sobre larvas de *Meloidogyne incognita* (Kofoid y White) Chitwood. Los extractos se obtuvieron por decocción y maceración secuencial con disolventes orgánicos de polaridad creciente. La evaluación *in vitro* de los extractos de maíz (*Zea mays*), girasol (*Helianthus annuus*), titonia (*Tithonia diversifolia*), platanillo de Cuba (*Piper aduncum* subsp. *ossanum*) y noni (*Morinda citrifolia*) a concentraciones de 0,25 y 0,50% se realizó en condiciones de laboratorio. Se emplearon como testigos, placas donde los juveniles se colocaron en agua destilada y otras con DMSO. Los Juveniles de segundo estadio (J2) se obtuvieron a partir de huevos incubados en tamices colocados en vidrios con agua destilada a temperatura de 28°C durante 72 horas. Los extractos de maíz, titonia y noni produjeron 100% de mortalidad en larvas de *M. incognita*, en los de girasol se registraron valores entre 29,49 y 98,68%; mientras los de platanillo provocaron solo hasta un 81%. Los extractos que produjeron mortalidad en los juveniles continuarán en estudio para determinar sus potencialidades para su empleo en el manejo de nematodo en campo.

EFFECT OF VETIVER GRASS (*Chrysopogon zizanioides*) ROOT EXUDATES ON THE BIOLOGY AND REPRODUCTION OF *Meloidogyne javanica* (Efecto de exudados de raíz de vetiver (*Chrysopogon zizanioides*) sobre la biología de *Meloidogyne javanica*)

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Meloidogyne spp. are one of the economically most important plant-parasitic nematode groups that damage agricultural and horticultural crops worldwide. Due to the progressive withdrawal of synthetic nematicides from world markets, various plant-derived products with nematicidal/nematostatic characteristics have been studied. The effect of various Vetiver root extract concentrations (25, 50, 75 and 100%) on the biology and reproduction of *M. javanica* was thus determined by means of *in vitro* and *in vivo* experiments. The 50 to 100% exudate concentrations reduced the motility of J2 significantly from 48 h after the onset of the trial onwards compared to the tap water control. In terms of reproduction, no significant differences were evident for the number of egg masses as well as eggs and second-stage juveniles (J2)/root system 56 days after J2 that were exposed to the Vetiver root extracts were inoculated on roots of tomato seedlings. Results from this study suggested that although Vetiver root exudates inhibited the mobility of J2, the latter were able to recover when removed from the exudates and they ultimately reproduced in tomato roots. Follow-up studies using extracts from more Vetiver plants, identification and refining of the chemicals that cause J2 immobility and field testing of such products are envisioned since this may render an alternative and environmentally safe product for future use to manage *Meloidogyne* spp.

IN VITRO AND IN VIVO EVALUATION OF A BIOLOGICAL SOIL CULTURE AS A POTENTIAL ORGANIC CONTROL AGENT FOR ROOT-KNOT NEMATODES (Evaluación *in vitro* e *in vivo* de un cultivo biológico de suelo como potencial agente de control de nematodos agalladores)

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Extensive research efforts are underway to identify novel agents for the management of *Meloidogyne* spp. that parasitise and damage a range of agricultural and horticultural crops. The effect of various concentrations (2.5%, 3%, 4% and 5%) of a soil-derived organic and biological compound, Soil BioMuti (SBM), was thus investigated on the biology and reproduction of *M. javanica* and *M. incognita* in separate *in vitro* and *in vivo* experiments. All the SBM concentrations, both for the filtered and non-filtered products, reduced the motility of J2 significantly from 3 h after the onset of the trial until 24 h of exposure compared to the tap water control. No significant differences were evident for the number of egg masses/root system 30 days after J2 exposed to the SBM concentrations were inoculated on roots of susceptible tomato seedlings. Results from this study thus suggested that SBM has inhibiting effects on the mobility of *Meloidogyne* spp. J2, but that they still retain the ability to reproduction. Follow-up studies will be conducted to identify the causing biological agents and/or their secondary metabolites to understand the mechanism of this product in terms of its adverse effect on root-knot nematodes. Field testing of such products is also envisioned since this may shed more light on the mechanism of the causing agents that could render an alternative and environmentally safe product for future use to manage root-knot nematodes.

DYNAMICS OF NEMATODE DIVERSITY AND SOUNDS ASSOCIATED WITH MSU KBS LONG-TERM ECOLOGICAL RESEARCH PROGRAM (Dinámica de la diversidad de nematodos y sonidos asociados con el programa de investigación ecológica a largo plazo de Michigan State University Kellogg Biological Station)

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A Long Term Ecological Research Program (LTER) was established in 1988, at the Michigan State University, Kellogg Biological Station to study the ecology of diverse agricultural and native ecosystems. It is designed to compare three agricultural systems (no-till, bio-based and conventional) with two old-field successions and two forest systems. The objective of this contribution is to evaluate nematode and sound diversity- dynamics. A greater richness of taxa were detected in 2007-2008, compared to 1991 (Freckman and Ettema). The 1991, canonical discriminant analysis separated the agricultural and succession systems. Similar results were observed in 2007-2008. In 2007, detectable taxon diversity and population density was significantly less in September than in December. This was probably the result of an extended period of low soil moisture. Taxon diversity, population densities and soil moisture were similar in December 2007 and September 2008. Taxa richness in the forest and early-succession systems was greater than detected in the agricultural systems. The forest and early-succession had a greater diversity of bacterial feeding taxa than the agricultural systems. The forest system had the greatest diversity of herbivores, but at low population densities. Acoustical signatures of the forest, successional and agricultural systems were vastly different and exhibited distinct diurnal patterns. The studies indicate that natural and managed ecosystem disturbances impacted the temporal dynamics of nematode and sound diversity-dynamics.

IDENTIFICACIÓN MORFOLÓGICA Y MOLECULAR DE *Xiphinema brevicollum* ASOCIADO A *Citrus sinensis* EN ISLA DE PASCUA, CHILE (Morphological and molecular identification of *Xiphinema brevicollum* associated to *Citrus sinensis* in Easter Island, Chile)

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Durante el año 2012 se realizó una prospección en Isla de Pascua, distante a más de 3.500 kilómetros de Chile continental. Asociado a *Citrus sinensis* se encontraron ejemplares del grupo *Xiphinema americanum*. Se estudiaron los caracteres morfológicos y morfométricos de la población y los especímenes fueron identificados como *X. brevicollum*. Además de realizar taxonomía tradicional se realizó un análisis molecular de las bacterias endosimbiontes, pertenecientes al phylum Verrucomicrobia, asociadas a esta especie. La región secuenciada fue 16S rDNA. Las secuencias fueron comparadas con datos de Genbank y sujetas a análisis filogenético. Los resultados mostraron que las secuencias estudiadas presentaron un 99% de identidad nucleotídica con *Candidatus Xiphinematobacter brevicolli*, bacteria simbiote específica de *Xiphinema brevicollum*, identificando y confirmando los especímenes estudiados como dicha especie. Este nematodo se encuentra ausente del territorio continental pero fue reportado en la isla en el año 1979, sin embargo no se había realizado su identificación a través de herramientas moleculares.

REACTION OF PASSION FRUIT GENOTYPES TO THE COMPLEX *Meloidogyne incognita* AND *Fusarium solani* (Reacción de genotipos de maracujá al complejo *Meloidogyne incognita* y *Fusarium solani*)

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The interaction between *Meloidogyne* and *Fusarium* is responsible major for losses in passion fruit plants. The study was aimed at evaluating the reaction of genotypes of *Passiflora* spp. to *Meloidogyne incognita* race 3 (*Mi*)-*Fusarium solani* (*Fs*) complex. The assay was carried out in a greenhouse at Janaúba city, MG State (Brazil) using RBD in the factorial arrangement: 10 genotypes (BRS-SC, M-19-UFV, *P. alata*, *P. nitida*, *P. giberti*, *P. setacea*, *P. mucronata*, *P. murifolia*, *P. cincinnata*, *P. ligularis*) x 3 treatments (*Mi*, *Mi* + *Fs*, *Fs*). After 180 days of planting the reaction to *Mi* was determined by RF (Pf/Pi) and to *Fs* by lesions size in roots and stems. According

to the criteria of Oostenbrink, BRS-SC, M-19-UFV. *P. alata* and *P. cincinnata* behaved as resistant and *P. giberti* as susceptible. According to Taylor and Sasser, BRS-SC, M-19-UFV, *P. alata*, *P. cincinnata* and *P. giberti* behaved as resistant, moderately resistant, moderately susceptible and susceptible, respectively. Lower percentage of plants with symptoms of *Fs* was found in *P. mucronata*, *P. nitida*, *P. setacea*, *P. cincinnata* and M-19-UFV. In the presence of both pathogens, M-19-UFV, *P. alata* and *P. nitida* were those with larger lesion. In the presence of *Fs*, BRS-SC, *P. alata*, *P. cincinnata* and *P. ligularis* showed the largest lesions.

NEMATODES OF ECONOMIC IMPORTANCE FOR PEANUT PRODUCTION IN THE SOUTHEASTERN UNITED STATES OF AMERICA (Nematodos de importancia económica en la producción del maní en el sureste de los Estados Unidos de América)

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The peanut (*Arachis hypogaea*) is a good host to a great variety of phytopathogenic nematodes causing damage on the root system, the fruit bearing carpophore (peg), and the subterranean fruit (pod). In the southeastern United States, the principal economically important nematodes are: *Belonolaimus longicaudatus* (sting), *Meloidogyne* spp. (root-knot), *Pratylenchus brachyurus* (root-lesion), and *Criconemella ornata* (ring). *M. arenaria* and *M. hapla* are the root-knot nematode species of importance with the first being predominantly the most damaging. Yield losses by *M. arenaria* to susceptible peanut in continuous culture can be typically ≥ 100 kgs/ha per year. Losses are aggravated by concurrent incidence of the nematode and the southern stem rot fungus *Sclerotium rolfsii* or several peg and pod rot fungi (PPF). *M. hapla* is associated with cooler more temperate areas and is particularly damaging in association with *Cylindrocladium crotalariae* and other soil-borne PPF. Root-lesion nematode is a migratory endoparasite destroying cortex tissue resulting in large lesions. It is the quintessential component of the pod-rot complex involving inter alia *Fusarium solani* and *Pythium myriotylum*. Losses in yield and quality are high when present significant numbers ($>100/g$ root). The sting nematode is confined typically to soils with $> 84\%$ sand and is most common in Florida limiting peanut production; unlike root-knot and root-lesion nematodes it is strictly an ectoparasite and causes tiny lesions on the tap root while destroying most of the other roots. Management of nematode problems in today is based mainly in adopting cropping systems suppressive of these pathogens. A good example are rotations of the legume with cotton (*Gossypium hirsutum*) with a winter cover of either rye (*Secale cereale*) or ryegrass (*Lolium perenne*).

NEMATICIDAL PROPERTIES OF COMMON NATURALLY OCCURRING ALDEHYDES USED IN THE FOOD AND COSMETIC INDUSTRIES (Propiedades nematocidas de aldehídos naturales comunes utilizados en las industrias alimentarias y cosméticas)

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The nematocidal properties of common naturally occurring aldehydes was studied with greenhouse and microplot experiments. Compounds for the study were all approved for use in the food and cosmetic industries. Among lineal saturated aldehydes in the C2-C10 range only those with C6-C10 exhibited significant control of *Meloidogyne arenaria*. This was for juveniles populations in soil and in the roots of ‘Crookneck’ squash (*Cucurbita pepo*). These aldehydes were hexanal, heptanal, octanal, nonanal and decanal. Among aromatic aldehyde those in the benzaldehyde group demonstrated the greatest nematocidal properties. These included: p-anisaldehyde, benzaldehyde, cuminaldehyde, and salicylaldehyde. Benzaldehyde, the most economical and practical of all the nematocidal aldehydes studied, was chosen for development. The activity of benzaldehyde was significantly enhanced when combined with pre-plant applications of urea [high N], corn cob meal [high C], or with combinations of both materials. These combination treatments reduced populations of *M. arenaria* and other phytopathogenic nematodes [PPN] while increasing numbers of non-parasitic species. The combinations offer the possibility of controlling PPN and providing plant nutrients with ecologically sound compositions.

EFICACIA DE NEMATODOS ENTOMOPATÓGENOS EN EL MANEJO DE *Dysmicoccus brevipennis* EN EL CULTIVO DE *Hedychium coronarium*. (Effectiveness of entomopathogenic nematodes for management of *Dysmicoccus brevipennis* in *Hedychium coronarium* crop)

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La mariposa (*Hedychium coronarium* K.), es considerada en Cuba la Flor Nacional y se cultiva en zonas urbanas y periurbanas para la obtención de flores de corte. En áreas de cultivo de La Habana, donde está prohibido el uso de plaguicidas químicos, una plaga de chinches harinosas (*Dysmicoccus brevipennis*) provocó severas afectaciones y por ello se efectuaron ensayos con productos biológicos. El objetivo del estudio fue determinar la eficacia de aplicaciones de *Heterorhabditis bacteriophora* cepa HC1 en el manejo de las poblaciones de la plaga. Se ejecutaron pruebas in vitro, condiciones semicontroladas y campo. En las dos últimas condiciones se evaluaron tres dosis (1; 1,5 y 2 x 10⁵ juveniles infectivos.m⁻²) y se valoraron los niveles poblacionales de la plaga por tratamiento. En condiciones semicontroladas se determinaron además la masa fresca de tallos y rizomas. Se produjo 100% de mortalidad en los estadios de chinches a las 72 h en los experimentos in vitro. Los tratamientos en macetas que recibieron nematodos exhibieron las menores poblaciones de chinches y difirieron significativamente del testigo, y los menores valores poblacionales se produjeron con la dosis mayor. En condiciones de campo se produjo una disminución de la población inicial, de unos 100 a 150 individuos por plantón, a una media de 9,6 individuos (a los quince días de la aplicación), disminuyendo a valores no apreciables 45 días después de la aplicación de nematodos entomopatógenos. Los productores de la zona adoptaron el uso de nematodos en el manejo de la plaga de forma sistemática.

EXPRESSION OF *Meloidogyne incognita* RESISTANCE GENES INDUCED BY ENDOPHYTIC *Pochonia chlamydosporia* IN TOMATO (Expresión de genes de resistencia a *Meloidogyne incognita* inducidos por *Pochonia chlamydosporia* endofítico en tomate)

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Endophytic fungi are an active component of the natural soil microflora associated to plant parasitic nematodes and have potentials to regulate their populations through different mechanisms. *Pochonia chlamydosporia* is a biocontrol agent of root-knot nematodes (RKN) that can also act as an endophyte in roots of both mono- and dicotyledons. In order to explore the transcriptomic landscape in the *P. chlamydosporia* - tomato interaction, we applied a global transcriptional profile analysis to roots of a local tomato variety (cv Regina). The plants were maintained in flasks with sterile vermiculite for three weeks at 26°C with a 16 hours photoperiod. The fungus was inoculated with three agar blocks per flasks. Uninoculated plants were used as controls. RNAs of roots and *P. chlamydosporia* were extracted and sequenced through an Illumina HiSeq next generation sequencing (NGS) method. Results showed that *P. chlamydosporia* induced, among others, the expression of 213 transcripts related to plant defense response. Up regulated transcripts included members of the disease resistance gene family encoding nucleotide-binding site leucine-rich repeats (NBS-LRR), proteins like coiled-coil (CC) motifs CC-NBS-LRR, TIR-NBS-LRR and BED FINGER-NBS-LRR. In particular, 17 transcripts encoding proteins belonged to the CC-NBS-LRR (CNLs) subfamily, whose products contain the amino-terminal domain (CC) motifs and are involved in pathogens recognition. Other genes induced by *P. chlamydosporia* in tomato included the NAC (for NAM, ATAF and CUC) protein family of transcription factors, also involved in plant-nematode interactions. NGS data showed that the expression levels of *cc-nsb-lrr* genes increased from 2 up to 7.3 folds in tomato roots during their interactions with the fungus. Induced resistance is a fundamental mechanism for disease control. In particular, the *Mi* gene that confers RKN resistance through PRF and MI proteins holds several structural motifs including NBS and a carboxy-terminal LRR region. Studies are in progress to understand the implications of *P. chlamydosporia* in expression of these genes for RKN management, and their occurrence and role in local tomato accessions.

BIOLOGÍA, PATOGENICIDAD Y MULTIPLICACIÓN DE UN AISLAMIENTO NATIVO DEL NEMATODO ENTOMOPATÓGENO *Heterorhabditis bacteriophora* PROVENIENTE DE HUERTAS DE CULTIVO ORGÁNICO EN ARGENTINA (Biology, pathogenicity and multiplication of a native isolate of entomopathogenic nematode *Heterorhabditis bacteriophora* from organic garden, in Argentina)

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Los nemátodos entomopatógenos pertenecientes a la familia Heterorhabditidae son parásitos letales para insectos, principalmente los que viven en el suelo. Son producidos masivamente in vivo o *in vitro* y comercializados como agentes de control biológico. El coleóptero *Tenebrio molitor* se ha sugerido como un insecto modelo alternativo para la producción de entomonemátodos, debido al alto contenido de proteína de las larvas. En este trabajo se evaluó la biología, producción y patogenicidad de una cepa de *Heterorhabditis bacteriophora*, aislada en la localidad de Villa Elisa, Bs. As, Argentina, en larvas de *T. molitor*. Larvas del último estadio (n = 10) fueron expuestas a los juveniles infectivos del nemátodo (500:1 JI/H). La mortalidad se registró diariamente. Los insectos muertos fueron disectados para corroborar el parasitismo y determinar la etapa de desarrollo de los nemátodos. Algunos de los cadáveres fueron colocados en trampa de White para la recuperación de los JI. *Heterorhabditis bacteriophora* produjo entre el 77% y 80% de mortalidad, entre las 48 y 72 horas post-infección. Hembras hermafroditas se observaron a partir del día 4 post-infección y las anfimíticas a partir del día 8, donde se registraron machos y hembras. Los JI comenzaron a emerger de los cadáveres parasitados entre los días 11 a 21 post-infección y continuaron hasta los días 30 a 32. La producción de JI varió entre 3.000 y 37.500 por larva hospedadora. Sobre la base de estos resultados, *H. bacteriophora* fue seleccionado como potencial agente de control biológico, principalmente para la reducción de coleópteros plaga de cultivos de frutilla en Argentina.

COFFEE PLANT SELECTION IN AN AREA INFESTED BY *Meloidogyne paranaensis* (Selección de plantas de café en un área infestada con *Meloidogyne paranaensis*)

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The aim of this study was to evaluate *Meloidogyne paranaensis* parasitism and the agronomic behavior of *Coffea arabica* genotypes to identify resistant materials in a naturally infested area in the municipality of Piumhi, state of Minas Gerais, Brazil. In a randomized block design, 44 genotypes were planted in 2009 with three replications and plots composed of seven plants. After the first crop, 26 plants were selected from genotypes 6 (MG 0294-1 R1), 16 (MG 0179-1 R1), 28 (MG 0179-3 R1), 29 (MG 0185-1 R2) and 44 (MG 1184-1 R1) as well as the susceptible controls Catuaí Amarelo IAC 62 and Mundo Novo IAC 379-19, and the cultivar IPR 100 which is resistant to *M. paranaensis*. Canopy diameter, vigor, yield in liters of "field coffee" ("café da roça" - coffee at all stages of maturity), height, grain size and the nematode population/g of roots were analyzed in the SAS program. The genotypes 16 (MG 0179-1 R1) and 28 (MG 0179-3 R1) had better agronomic behavior and, according to plant yield and nematode population, genotypes 16 and 28 were characterized as resistant and tolerant, respectively, while 44 was susceptible to *M. paranaensis*. The population of this nematode in the roots of genotype 16 was the same as in the resistant material IPR-100, while the grain size of genotype 28 was greater than all the others. We concluded that plants of genotype 16 are resistant and should advance in coffee plant genetic breeding studies for the purpose of selecting *M. paranaensis* resistant cultivars.

INDUÇÃO DE RESISTÊNCIA NO MANEJO INTEGRADO DE *Pratylenchus brachyurus* NA CULTURA DE CANA-DE-AÇÚCAR (Induced Resistance on Integrated Management of *Pratylenchus brachyurus* on Sugarcane)

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A linha de pesquisa voltada para o uso de agentes indutores de resistência a nematoides tem sido explorada, na busca de novos agentes e do entendimento dos fenômenos que ocorrem durante o processo. Acibenzolar-S-Metil (ASM) vem sendo aplicado em diversas espécies de plantas como indutor químico de resistência a patógenos. ASM é considerado um dos mais potentes ativadores sintéticos da resistência sistêmica induzida, retardando o desenvolvimento de vários fitopatógenos em cana-de-açúcar. O presente trabalho tem por objetivo avaliar o efeito do indutor de resistência acibenzolar-S-metil (ASM) no manejo de *Pratylenchus brachyurus* na cultura da cana-de-açúcar. O ensaio foi conduzido sob condições de casa de vegetação utilizando-se como planta

hospedeira a variedade de cana-de-açúcar RB867515. Utilizou-se o delineamento inteiramente casualizado em esquema fatorial 4 x 2, com cinco repetições. Os tratamentos foram compostos pela combinação entre quatro doses de ASM (0; 10; 20 e 40g i.a./100L) e duas formas de aplicação do produto (pulverização na parte aérea e no solo). Aos 7, 14, 21 e 28 dias após a inoculação foram feitas as aplicações do ASM. O ASM quando aplicado na parte aérea reduziu a densidade populacional de *P. brachyurus* na dose de 40 g i.a./100L.

PHOTOSYNTHETIC PIGMENTS AND COMPATIBLE SOLUTES IN THREE SUGAR CANE VARIETIES SUBJECTED TO WATER STRESS ASSOCIATED TO ROOT-KNOT NEMATODE. (Pigmentos fotosintéticos y solutos compatibles en tres variedades de caña de azúcar sometidas a estrés de agua asociadas al nematodo agallador)

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It was aimed to evaluate photosynthetic pigments concentration and organic solutes in sugar cane plants subjected to water stress and nematode infestation. Sugar cane seedlings were inoculated with 30,000 eggs of *Meloidogyne incognita*, and 5 days after inoculation, it was performed treatments differentiation under a factorial completely randomized design: 3 (varieties: RB72454, RB867515 e RB92579) × 2 (water stress: 100% FC and 40% FC) × 2 (level of infestation: with and without nematode). Evaluations were carried out 45 days after water stress. RB72454 presented higher carotenoids quantity and chlorophyll content among all treatments, except for 40% FC without nematode, whereas RB867515 presented an increase in chlorophyll b as treatment severity increased. Soluble carbohydrate decreased as water content decreased in leaves. Carbohydrate concentration brought about interaction among all studied factors, increasing its concentration significantly in nearly all plants inoculated with nematodes. Protein content decreased in leaves and roots of plants under nematode infestation, as well as on those under water stress.

DEFENSE RESPONSES IN TOMATO AND ARABIDOPSIS AGAINST ROOT-KNOT NEMATODE, INITIATED BY AN ENDOPHYTIC *Fusarium oxysporum* (Respuesta de defensa en tomate contra el nematodo agallador, iniciada por *Fusarium oxysporum* endofítico)

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Fusarium oxysporum is a well-known global soil inhabiting fungus. Although being saprophytically competent and infamous for the identified plant-pathogens, many isolates can be encountered that colonize plants without causing disease symptoms. Some of these endophytic isolates have shown to be beneficial for plants. Isolate Fo162 can systemically repress the infection of both sedentary and burrowing nematodes in various plant species, like tomato and banana. Although the exact mode of action is currently poorly understood, split-root experiments and synchronized infection studies indicate that the fungus enhances certain systemic plant defense responses, affecting both penetration and overall development of the nematode. Genome array studies in tomato show that the endophyte can modify the plant gene expression profile more dramatically when compared to applying methyl jasmonate or salicylic acid, which are known for eliciting induced systemic resistance (ISR) or systemic acquired resistance (SAR), respectively. In Arabidopsis too Fo162 can develop endophytically and systemically reduce infection by the sedentary root-knot nematode, *Meloidogyne incognita*. By using both tomato and the model plant Arabidopsis, the characterization of the molecular mechanisms involved in the endophyte-induced resistance against nematodes can be accelerated.

RESPONSE OF SUGARCANE VARIETIES TO *Meloidogyne incognita* PARASITISM (Respuesta de variedades de caña de azúcar al parasitismo de *Meloidogyne incognita*)

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Sugarcane is an important crop in Northeastern Brazil and the root-knot nematodes, especially *Meloidogyne*

incognita, is one of the most virulent pathogen damaging this crop. This work had as objective evaluating the sugarcane varieties RB92579, RB863129 and RB867515 in response to nematode parasitism. Thirty days old seedlings from RB varieties, and the variety SP813250 used as susceptible control, were inoculated with 0, 5000, 10000 and 20000 eggs and/or second stage juveniles of *M. incognita* in a completely randomized design under greenhouse. Evaluations, carried out 90 days after inoculation, based on plant height, shoot and root biomass, stalk diameter, eggs number per plant and reproduction factor. Although all varieties were susceptible to the *M. incognita*, RB863129 and RB 867515 were more tolerant to the nematode.

BIOTECHNOLOGICAL APPLICATIONS FOR PHYTONEMATODE CONTROL: NATURAL AND ENGINEERED RESISTANCE (Aplicaciones biotecnológicas para el control de nematodos: resistencia natural y mediante ingeniería)

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Phytopathogens like root-knot nematodes (*Meloidogyne* spp.) cause serious damage to hundreds of crop species, especially commodities as soybean and cotton. Economic losses caused by this pathogen reach billions of dollars annually. Our group has approached nematode control in two manners: (i) understanding the non-compatible interaction of resistant plants and nematodes and, (ii) engineering crop species aiming nematode resistance, via RNA interference (RNAi). Initially (firstly), studies were carried out on soybean line PI595099, known to be resistant against specific strains and races of nematode species. The 454 technology has been applied to explore the common aspects of resistance during *Meloidogyne javanica* parasitism and resistance. We noticed that hormone, carbohydrate metabolism and stress related genes were consistently expressed at high levels in infected roots. Noteworthy genes included those encoding glycosyltransferases, peroxidases, auxin-responsive proteins and gibberellin-regulated genes. Data analysis suggest key roles of glycosyltransferases, auxins and components of gibberellin signal transduction, biosynthesis and deactivation pathways in the resistance reaction and their participation in jasmonate signaling and redox homeostasis in mediating aspects of plant growth and responses to biotic stress. Data on approach (ii) using RNAi technique to knock-down essential *Meloidogyne incognita* genes and disrupt the nematode's life-cycle as a manner to control the parasite. We have knocked-down a serine (*Mi-ser-1*) and a cysteine protease (*Mi-cpl-1*), isocitrate lyase, and a heat shock protein (*hsp90*). Tobacco lines were generated expressing dsRNA for all genes and nematodes that infected transgenic plants produced a reduced number of eggs. Quantitative PCR analysis confirmed a reduction in transcripts for all genes tested. Finally, we generated soybean transgenic lines expressing dsRNA for *M. incognita* Splicing Factor under control of a soybean promoter (UceS8.3), in which data demonstrated a reduction in infection ratio of nearly 90%. The results presented here provide an important source of information to better understand plant-nematode interaction and to develop new strategies and tools for nematode control.

EVALUATION AND VERIFICATION OF RESISTANCE IN *Capsicum* VARIETIES AND *Amaranthus* SPECIES TO THE ROOT-KNOT NEMATODES *Meloidogyne incognita* RACE 2 AND *Meloidogyne javanica* IN SOUTH AFRICA (Evaluación y verificación de la resistencia en variedades de *Capsicum* y *Amaranthus* al nematodo *Meloidogyne incognita* raza 2 y *M. javanica* en Sudáfrica)

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The host suitability of twenty local available *Capsicum* varieties and ten *Amaranthus* species were evaluated in separate greenhouse studies for resistance to *Meloidogyne incognita* race 2 and *Meloidogyne javanica*, respectively. Substantial variation existed among the vegetable varieties and species in the greenhouse screening with regard to resistance to the respective root-knot nematode species. None of the *Amaranthus* species and *Capsicum* varieties showed resistance to *M. javanica*. *M. incognita* race 2 resistance was observed in *Amaranthus* species 'Local 33' and *Capsicum* variety 'Tobasco' in the greenhouse trials. *M. incognita* race 2 resistance identified in *Capsicum* variety 'Tobasco' and *Amaranthus* species 'Local 33' during the latter study was subsequently verified in follow-up micro plot trials using different initial population (Pi) densities together with a susceptible *Capsicum* variety 'Paprika' and *Amaranthus* species 'Bosbok Thepe'. Reproduction factor values were used as main criterion to evaluate for resistance. In the micro plot trial, 'Tobasco' showed resistance

at the lower levels of inoculation but did not maintain the resistance at higher levels. These results indicate that 'Tobasco' is susceptible to high nematode numbers. The *Amaranthus* species 'Local 33' showed resistance at all inoculation levels indicating a high level of resistance to this nematode species. The need exists for more frequent and extensive screenings of the various vegetable genotypes in order to provide resource-poor producers with better options for improved and sustainable yields.

HOST SUITABILITY AND RESPONSE OF SPINACH AND SWISS CHARD VARIETIES TO THE ROOT-KNOT NEMATODES *Meloidogyne incognita* RACE 2 AND *Meloidogyne javanica* IN SOUTH AFRICA (Susceptibilidad y respuesta de variedades de espinaca y carda suiza al nematodo *Meloidogyne incognita* raza 2 y *Meloidogyne javanica* en Sudáfrica)

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Seven Swiss chard and three spinach varieties were evaluated for their host suitability to *Meloidogyne incognita* race 2 and *Meloidogyne javanica* in separate greenhouse trials during 2011. Randomised complete block designs were used in all respective trials with 8 replicates for each variety. Root-knot nematode eggs and second juvenile stage (J2) was used as inoculum. Nematode inoculation of the plants was performed at 42 days after planting. Each plant was inoculated with 1000 eggs and J2 of the two root-knot nematode species. Plants were removed 56 days after inoculation. Eggs and J2 were extracted from each root system and were counted. Reproduction factors (Rf-values), egg laying females (ELF), number of eggs and J2 per root system and per gram of roots were calculated. Nematode data were submitted to analysis of variance. The Rf-values was used a main criterion to select for resistance because it provide a basic measurement of the nematode reproduction potential. Although substantial variation existed among the ten varieties screened to the two root-knot nematode species, none of them can be regarded as resistant because the all had Rf-valued of >1. All varieties maintained fairly high numbers of eggs and J2 per root system as well as per gram of roots. From the results it is clear that none of the varieties can be classified as resistant or immune to the two root-knot nematode species because they all had Rf-values >1. This indicated that they are all susceptible to these two root-knot nematode species.

NEMATODOS FITOPARÁSITOS ASOCIADOS A BANANO *Musa* spp. EN ISLA DE PASCUA, CHILE. (Plant parasitic nematodes associated to *Musa* spp. in Easter Island)

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Isla de Pascua se encuentra ubicada a más de 3.500 kilómetros de Chile continental, por lo que presenta particularidades climáticas, edáficas y nematológicas respecto del continente. En el año 2012 el Servicio Agrícola y Ganadero realizó una prospección general de acuerdo al programa de vigilancia agrícola nacional. Dentro de las determinaciones relevantes se detectó asociado a *Musa* spp. se detectó presencia de *Radopholus similis*, *Xiphinema americanum* s.l., *Meloidogyne javanica* y *Helicotylenchus erythrinae*. Tanto *R. similis* como *H. erythrinae* no se han detectado en Chile continental. La identificación de *R. similis* se realizó por taxonomía tradicional, validando el primer reporte realizado por el autor.

REAÇÃO DE CULTIVARES DE SOJA A *Meloidogyne incognita* RAÇA 3 (Reaction of soybean cultivars to *Meloidogyne incognita* race 3)

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O objetivo deste estudo foi avaliar a reação de 27 cultivares de soja indicadas para a Região Central do Brasil ao nematoide *Meloidogyne incognita*, raça 3. O experimento foi conduzido em condição de casa de vegetação, em delineamento inteiramente casualizado, com 27 tratamentos e seis repetições. As plantas foram mantidas em copos plásticos com capacidade para 400 mL de substrato autoclavado (solo + areia) e foram inoculadas artificialmente com uma suspensão de 2000 ovos e J2 de *M. incognita* treze dias após o plantio. As avaliações foram realizadas sessenta dias após a inoculação (DAI), determinando-se a densidade populacional do nematoide nas raízes e o fator de reprodução (FR). As densidades populacionais variaram de 399 até 11.167 ovos e J2 de

M. incognita e o FR variou de 0,06 até 1,49. Com os resultados obtidos conclui-se que as cultivares NS 7476, NS 7490, NA 8015 RR, NA 7255 RR, NA 7620 RR, BRSGO Graciosa, P98Y70, CD 237 RR, P98Y51 e UFU Milionária apresentaram comportamento de cultivares resistentes, pois tiveram FR <1 e se assemelharam aos padrões de resistência utilizados (BRSGO 8860 RR e BRSGO Paraíso). As cultivares TMG 1288 RR e NA 7337 RR comportaram-se como suscetíveis apresentando FR > 1, igualando ao padrão de suscetibilidade BRSGO Santa Cruz.

HISTOPATOLOGÍA DE RAÍCES DE PAPA ANDINA PARASITADAS POR *Nacobbus aberrans* (Histopathology of Andean potato roots parasitized by *Nacobbus aberrans*)

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En la región andina de las provincias de Jujuy y Salta (Argentina), *Nacobbus aberrans* posee una amplia dispersión. Se analizaron las alteraciones inducidas por el nematodo en dos variedades de papa andina (*Solanum tuberosum* subsp. *andigenum*): “Ojo de Señorita” y “Colorada”, provenientes de Yavi (Jujuy) y Santa Victoria (Salta), respectivamente. Trozos de raíces se fijaron en FAA y procesaron según técnicas convencionales. Se observó hiperplasia celular en el cilindro central; parte del tejido hiperplásico constituía los sincitios e incorporaban células del xilema. Los sitios de alimentación estaban adyacentes a los tejidos vasculares y se conformaban por numerosas células (más de 30 por plano de corte). En “Ojo de Señorita”, el tamaño de las células variaba de acuerdo a su ubicación (180 a 60 μm desde el interior a la periferia del sincitio) mientras que en “Colorada”, independiente del lugar que ocupaban, fueron de menor tamaño (aproximadamente 70 μm). El citoplasma era denso, con abundante cantidad de vacuolas secundarias y núcleos hipertróficos. “Ojo de Señorita” presentó raíces laterales con sincitios en su interior. Si bien *N. aberrans* se estableció eficientemente en ambas variedades, las características histológicas indican que “Ojo de Señorita” es la más susceptible.

BIODESINFECCIÓN DEL SUELO Y USO DE *Pochonia chlamydosporia* EN EL MANEJO DE *Meloidogyne arenaria* EN GUAYABO (Soil bioinfection and use of *Pochonia chlamydosporia* in management of *Meloidogyne arenaria* on guava)

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En México se cultivan alrededor de 21 mil hectáreas de guayaba, siendo los nematodos agalladores (*Meloidogyne incognita*, *M. arenaria* y *M. javanica*) uno de los principales problemas fitopatológicos controlándose básicamente mediante diferentes nematicidas causando un fuerte impacto ambiental. De esta manera el objetivo de la investigación fue implementar un manejo alternativo para el control de estos organismos, mediante la biodesinfección del y el incremento de la población y actividad de la biota del suelo. Los materiales utilizados fueron la gallinaza, vermicomposta y alfalfa molida, mas una cepa nativa de la zona de investigación del hongo *Pochonia chlamydosporia*. La cepa fue previamente utilizada en pruebas *in vitro*, evaluando el parasitismo de huevecillos, posteriormente se incorporó en combinación con las enmiendas orgánicas, a una concentración de 5.0×10^8 UFC. Se realizaron evaluaciones mensuales de las poblaciones de nematodos agalladores (J2) y de vida libre, además se midió el área foliar de 24 hojas de cada árbol correspondiente a cada tratamiento. El mejor resultado fue que con los tratamientos con vermicomposta y la gallinaza en combinación con *P. chlamydosporia*, redujeron la población inicial de 611 juveniles de *M. arenaria* a 76 y 133 individuos respectivamente en 300 g de suelo; previo a la aplicación de estos tratamientos el índice de agallamiento correspondía a 5 (escala de 1 a 10), con el 50% de las raíces infestadas, con agallamiento en las raíces principales y con un sistema radicular reducido. Al finalizar el ciclo de producción, en los mejores tratamientos, se encontraron raíces jóvenes con un índice de agallamiento de 2 y presencia de pequeñas agallas. El tratamiento con Alfalfa molida en combinación con *Pochonia chlamydosporia* arrojaron los datos con mayor área foliar (672.2 cm^2) seguido por la Vermicomposta mas el hongo (660.5 cm^2).

PRODUCCIÓN EN MEDIO LÍQUIDO DE DE AISLAMIENOS NATIVOS DE NEMATÓDOS ENTOMOPATÓGENOS, *Steinernema unicornium* (QU-N85) y *S. feltiae* (QU-N21) (Liquid medium production of native nematodes, *Steinernema unicornium* (QU-N85) and *S. feltiae* (QU-N21))

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Los nemátodos entomopatógenos (Neps) son un efectivo método de control biológico de plagas de insectos, sobretudo en lugares crípticos o el suelo. A pesar de su efectividad, la producción de los Neps es clave para mantener su potencial biológico. En esta investigación se utilizaron diferentes combinaciones de medios líquidos, para evaluar productividad de dos aislamientos nativos: *Steinernema unicornium* (QU-N85) y *S. feltiae* (QU-N21), provenientes de la colección microbiana de INIA, y caracterizados por su patogenicidad en *Naupactus xanthographus*. De ambos nemátodos se aislaron sus bacterias simbioses en medio agar NBTA (Akhurst, 1980), verificando su estado en Fase I. El primer medio se basó en Islas-López *et al.* (2005) o Medio MA10, pero reemplazando la miel de Agave por melaza en igual concentración; pH final 7,5 y aireación 2,5 l/min, lográndose un incremento de 20 veces para QU-N21. Posteriormente, se evaluó un medio de: 200g/l de homogeneizado de riñón de cerdo y 30 g/l de melaza, pH 7,0; flujo de aire 2,5 l/min e incubación a 15-18°C. Los resultados para QU-N21, muestran que a los 19 días se alcanza la máxima concentración de 35.000 Neps/ml. Para el aislamiento QU-N85, la cinética de crecimiento sigue la misma tendencia, alcanzándose valores cercanos 30.000 Neps/ml en 20 días. Estos Neps fueron evaluados, posteriormente, en invernadero, donde no hubo diferencias estadísticas en mortalidad de larvas de *N. xanthographus* cuando se utilizaron Neps producidos en medio líquido o aquellos de larvas de *Galleria mellonella*, ratificando que el medio no cambió la capacidad de parasitismo y patogenicidad.

FORMULACIONES DE AISLAMIENTOS CHILENOS DE LOS NEMÁTODOS ENTOMOPATÓGENOS *Steinernema unicornium* y *S. feltiae* (Formulations of Chilean isolates of entomopathogenic nematodes *Steinernema unicornum* and *S. feltiae*)

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La colección Chilena de nemátodos entomopatógenos (Neps) existentes en INIA, incluye dos especies nativas de *Steinernema unicornium* (QU-N85) y *S. feltiae* (QU-N21), que han sido caracterizadas por producir parasitismo y patogenicidad en el Burrito de la vid: *Naupactus xanthographus*. Con el objeto de asegurar mayor sobrevivencia y capacidad de parasitismo de estos nemátodos, junto con facilitar la aplicación de campo, se desarrollaron tres tipos de formulaciones: gránulos, gel hidrosoluble y mezcla arcillosa. Cada una de éstas contenían una concentración de 10^5 JI ml⁻¹, producidos en larvas de *Galleria mellonella*, y almacenadas en frío (15-18°C) hasta su uso. Las viabilidad de los JI, para ambas especies, mostraron que las formulaciones almacenadas por 6 meses, presentaron una viabilidad mayor ($P < 0,05$) al de una suspensión acuosa utilizada como testigo. Para QU-N85, las viabilidades fueron de 77,2; 74,4 y 66,8% para los gránulos, gel y mezcla arcillosa, respectivamente, contra un 46,8% del testigo. En el caso de N21, los valores fueron de 78; 80 y 72,4% comparado con 48,6% del testigo. Como parámetro de calidad, se determinó la capacidad de parasitismo de los Neps, expresado como mortalidad en larvas de *Galleria*. Todos los formulados alcanzaron un 100%, comparado con 80% para QU-N21 y 68% para QU-N85 en suspensión acuosa. Los ensayos en maceta mostraron que no hubo diferencias ($P < 0,05$) en mortalidad de larvas de *N. xanthographus* con Neps formulados o aplicados en solución acuosa, lo que ratifica que las formulaciones ensayadas mantienen la capacidad de parasitismo y efectividad de los Neps.

TERVIGO, A NEW NEMATICIDE FROM SYNGENTA: CONTROL RESULTS AND YIELD IN VINEYARDS, TABLE GRAPES, AND TOMATOES (Tervigo, nuevo nematocida de Syngenta: resultados de control y productividad en cultivos de viñas, uva de mesa y tomates)

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Nematodes have become a problem in several crops, affecting yield, quality and profitability of farmers. For that reason, different control methods are used during the cropping period looking for diminish yield losses. In general, chemical methods are those that showed the highest efficacy in the field. Today, new market requirements and the search for sustainability, impose a new challenge to the farmers and to the industry of agrochemicals: reduce the impact to the environment during the food production process. Is in this area that Syngenta has been working on a reliable solution for nematodes control, with lower levels of toxicity and that allows production of fruits free of residues. Tervigo is a chemical nematocida of natural origin, derived from a soil microorganism

Streptomyces avermitilis and specially formulated for soil applications. During seasons 2011, 2012 and 2013 different field trials were conducted in vineyards, table grapes and tomatoes, with the aim of test the efficacy of Tervigo in control of the main nematodes species that colonize this crop and specially to measure the impact in final yield. Results showed an increase in yields of 26, 32 and 11% for vineyards, tale grapes and tomatoes respectively.

THE EFFECTS OF CROPGUARD® ON THE MOTILITY, ULTRASTRUCTURE AND RESPIRATION OF TWO *Meloidogyne* SPECIES (Los Efectos de CropGuard® en la movilidad, ultraestructura y respiración de dos especies de *Meloidogyne*)

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The progressive withdrawal of Class I nematicides from world markets necessitates investigation and exploitation of environmentally-friendlier products with nematocidal/nematostatic properties. Scientific, baseline knowledge about the biology, ultrastructure and physiology of *Meloidogyne* spp. pertaining to the mode of action of CropGuard®, with furfural as the active ingredient (a.i.), is lacking. The product was evaluated over time (1, 24, 48, 72 and 96 hr) for its effects on *M. incognita* and *M. javanica* J2 motility, ultrastructure and specific oxygen consumption rate (MO₂). Four CropGuard® concentrations (0.01, 0.1, 1 and 10%) and a tap-water control were used for all experiments. All four product concentrations significantly inhibited the movement of J2 of both *Meloidogyne* spp. Scanning electronmicroscopy (SEM) results indicated that J2 suspended in the CropGuard® concentrations did not cause any visible damage to their cuticle surfaces, but that their lateral line structures showed a “sunken” appearance. The MO₂ measurements confirmed that the respiratory physiology of J2 were adversely affected and supported motility studies that showed a similar trend with regard to the adverse effect on the biology of these organisms. Partial respiratory recuperation of only *M. incognita* J2 occurred when transferred to sterile tap water after being suspended in the lowest (0.01% and 0.1%) CropGuard® concentrations. The necessary magnetic stirring during MO₂ measurements does not affect the oxygen consumption rates during a 20 minute stir for 5000 individuals in the respiration chamber. The MO₂ stays at a constant rate (30.2 micromole O₂ hr⁻¹ g⁻¹) at 25°C with speeds starting from 25 rpm up to 1000 rpm.

EXPLOITATION AND CHARACTERIZATION OF RESISTANCE TO THE ROOT-KNOT NEMATODE *Meloidogyne incognita* IN SOYBEAN (Explotación y caracterización de la resistencia al nematodo agallador *Meloidogyne incognita* en soja)

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Production of soybean, an important oilseed crop in South Africa, is increasing due to a rising demand for protein-rich food. Parasitism by the root-knot nematode *Meloidogyne incognita*, however, damages the crop in local production areas. The use of host plant resistance is a useful and cost-effective tool for optimization of soybean yield in nematode infested areas. The peroxidase and lipoxygenase activities of five soybean [*Glycine max* (L.) Merr] cultivars, LS5995, GCI 7, Dundee, Egret and LS6248R, were evaluated to determine resistance to *M. incognita* race 2. Half of the seedlings of each of the five cultivars evaluated were inoculated with approximately 5,000 24-hr-old, hatched second-stage juveniles (J2), while the other half seedlings were not inoculated. J2 infection induced activities of both enzymes at higher levels in resistant soybean cultivars such as LS5995 and GCI 7 compared to lower levels in susceptible cultivars such as LS6248R, Dundee and Egret. Results obtained indicated that measurement of peroxidase and lipoxygenase activity in soybean cultivars could be used as cost-effective and quick methods to identify *Meloidogyne* spp.-resistance in local cultivars. Such an intervention can play a significant role in soybean breeding programs and add value to sustainable production of the crop.

THE HOST STATUS OF SOUTH AFRICAN SOYBEAN CULTIVARS TO *Meloidogyne incognita* (Susceptibilidad de cultivares de soja sudafricanos a *Meloidogyne incognita*)

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The host suitability of 24 local soybean cultivars (cvs.) was determined for *Meloidogyne incognita* in greenhouse experiments. Root systems of each seedling were each inoculated with approximately 5,000 *M. incognita* juveniles (J2) and eggs. Nematode reproduction was determined 56 days after inoculation (DAI) by using the following parameters: egg and J2 counts per root system, reproduction factors (Rf) and the percentage resistance exhibited by each of the cultivars tested compared to the most susceptible cv. included. Histopathology investigations were also done to determine the mechanism of resistance involved. Substantial variation existed between the 24 cultivars with regard to all parameters evaluated. The resistant standard cv. LS5995 had the lowest values for all parameters with giant cells being non-optimal for nematode development and reproduction. PHB 95 Y40 had intermediate values for all nematode parameters evaluated, while LS 6248R had the highest values and was classified as highly susceptible. Giant cell development in the latter cv. confirmed its host status. The data obtained gives new insight to the resistance of the genotypes tested which can be used for crop rotation purposes or resistance breeding.

SPATIAL DEPENDENCE BETWEEN NEMATODE COMMUNITY AND SOIL TEXTURE IN GUAVA IRRIGATED PLOTS IN ALLUVIAL VALLEY OF THE BRAZILIAN SEMIARID (Dependencia espacial entre comunidad de nematodos y textura del suelo en la Guayaba en parcelas de regadío en valle aluvial del semiárido brasileño)

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There are no studies about nematode spatial distribution in guava, particularly in Alluvial Valley of the Brazilian Semi-arid, there by becomes essential characterizing the tropic community and verifying their spatial distribution, it is also important to studying the relationship with soil texture to better understand the nematode distribution pattern. The study was carried out in an alluvial area located in an irrigated communal farm (Nossa Senhora do Rosario), in the municipality of Pesqueira, Pernambuco State, Brazil. In the study area, 64 soil samples were collected with 10.00 × 10.00 m spacing, 0.25 – 0.35 m deep. Nematodes were classified according to feeding habits in five trophic groups plant-parasitic, bacteriphage, fungivores, predators and omnivores. The data were analyzed using geostatistics tools. The trophic group plant-parasitic were the most abundant in area followed by bacterivores, omnivores, fungivores and predators. Geo-statistical analyses showed spatial dependence for trophic groups and soil texture of the alluvial valley. The contour maps showed that fungivores were distributed over the area and were influenced by sand fractions.

SPATIAL VARIABILITY OF ENDOPARASITIC NEMATODES IN GUAVA IRRIGATED PLOTS IN ALLUVIAL VALLEY OF THE BRAZILIAN SEMIARID (Variabilidade espacial de nematodos endoparasitas en guayaba en parcelas de regadío en valle aluvial del semiárido brasileño)

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The Brazilian production of fruit farming has been increasing due to the country's relevant economic position in the international market. In spite of that, its production is frequently affected by plant-parasite nematodes. Research initiative has been carried out applying geostatistical tools to monitor areas with high risk of nematode infestation, thus aiding to a proper management of these areas. Therefore, this work aimed to analyze the spatial variability of plant-endoparasites nematodes, gravimetric soil water content and electrical conductivity in Neosol cultivated with guava. The study was carried out in an alluvial area located in an irrigated communal farm (Nossa Senhora do Rosario), in the municipality of Pesqueira, Pernambuco State, Brazil. In the study area, 64 soil samples were collected with 10.00 × 10.00 m spacing, 0.25 – 0.35 m deep. Geo-statistical analyses showed that *Meloidogyne* spp., gravimetric soil water content and electrical conductivity exhibited spatial variability and the experimental semivariograms were fitted to exponential, spherical and spherical models, respectively. On the other hand, *Pratylenchus* spp. exhibited pure nugget effect. *Meloidogyne* spp. and electrical conductivity presented strong degree of spatial dependence.

POPULATION DYNAMICS OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH BENTGRASS PUTTING GREENS IN OKLAHOMA (Dinámica poblacional de nematodos fitoparásitos asociados con campos de golf en Oklahoma)

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Plant-parasitic nematodes are common pathogens of creeping bentgrass (*Agrostis stolonifera* L.) grown in high sand content golf putting greens. The recent removal of the last effective nematicide for use on putting greens and warmer than normal regional weather conditions have led to significant challenges for turfgrass managers in Oklahoma and surrounding regions. Nematode surveys of Oklahoma putting greens were conducted in 2000 and again in 2011. In 2000, seven genera were identified and the total percentage of greens infested by a specific nematode ranged from 6 to 59 percent. In 2011, eight genera were identified and the total percentage infested by a particular nematode ranged from 11 to 90 percent. *Mesocriconema* spp. was the most prevalent in both studies. Nematode populations were monitored yearlong in several locations and trends varied. This monitoring revealed populations increased in the autumn when temperature favored bentgrass root growth, which is important to plant survival during periods of heat stress. These results suggest nematode infestations are becoming more common in Oklahoma and that bentgrass management programs may be impacted by nematode activity during periods of cooler weather.

EFFECT OF COMMERCE SILT LOAM SOIL TEXTURE ON POPULATION DEVELOPMENT OF *Rotylenchulus reniformis* (Efecto de la textura de suelo Commerce franco limosa en el desarrollo de las poblaciones de *Rotylenchulus reniformis*)

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Two fields with mainly Commerce silt loam soil were utilized to determine the effects of this soil type on *Rotylenchulus reniformis* reproduction on cotton during one growing season. The two fields were located in Northeast Louisiana and had *R. reniformis* as the predominant nematode. These fields were divided into five different zones according to electrical conductivity (EC_e) data previously collected with a Veris 3100 EC_a soil mapping implement. Treatments consisted of treated (1,3-dichloropropene at 28.1 l/ha) and untreated rows (12 rows wide) running through the entire length of each field with four replications. Sample sites were selected based on EC_e values and georeferenced in the field by using a Trimble Juno handheld GPS receiver and a Farm Works SiteMate Pro program. At each sampling site, soil samples were collected at planting and after harvest to access the nematode population in both fields. Also, a single core (15.2 cm diameter) was taken at each of the sampling sites at planting in 15.2 cm increments until 61 cm and assessed for nematode populations and soil texture. The nematode populations of treated and untreated areas did not differ from each other in either field. Across the fields, sample sites with clay contents ranging from 10 to 20% had higher nematode populations. The highest populations of *R. reniformis* were found in the lower depths (30.5 to 61 cm) in both fields. Populations of the nematode were negatively correlated with clay content in both fields.

CURRENT STATE OF KNOWLEDGE OF *Globodera ellingtonae*: A NEW CYST NEMATODE SPECIES (Estado actual del conocimiento de *Globodera ellingtonae*: una nueva especie de nematodo quiste)

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Potato cyst nematodes (*Globodera rostochiensis* and *G. pallida*) are strictly regulated pathogens of potato in the United States and many other countries. In 2006, *G. pallida* was discovered for the first time in the United States, resulting in major disruptions in U.S. potato trade for several years. In 2008, the discovery of an atypical *Globodera* population in Oregon during resultant mandated surveys exposed an additional potential risk to the industry. This atypical *Globodera* is now known as *Globodera ellingtonae*. Over the past three years, we have conducted research to begin to understand the biology and pathogenicity to potato of this nematode. *Globodera*

ellingtonae hatched readily when eggs were exposed to potato and tomato root diffusate with 70% of egg hatch occurring within 3 days of exposure. Both potato and tomato are host to this nematode. When a range of potato varieties were evaluated for host status to *G. ellingtonae*, potato varieties containing the gene conferring resistance to *G. rostochiensis* pathotype Ro1 were also resistant to *G. ellingtonae*. *Globodera ellingtonae* research efforts are ongoing and additional information on developmental biology, non-chemical management strategies, and pathogenicity to Russett Burbank and Desiree potatoes will be presented. As of this writing, *G. ellingtonae* is not a regulated pathogen.

THE FUTURE OF NEMATICIDES FOR AGROCHEMICAL COMPANIES. (El futuro de los nematocidas para las compañías agroquímicas)

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The world of nematode control is in a process of change, where the use of highly toxic products is leading to less aggressive nematocides of which you want to control also being less aggressive with other soil organisms and overall environmental. FMC wants to stay in the world of nematocide control and market environmentally friendly products, among other things, and permanently is adjusting its planning policy changes to develop friendly and shortly will start commercialization of the state of art on a biological control which refers to Nemix C. FMC's was born in 1883 when John Bean created an insecticide spray pump to combat scale, an infestation that was ravaging California's orchards. FMC Corporation is a global, diversified chemical company serving agricultural, industrial, and environmental and consumer markets with innovative solutions, applications and quality products maintaining leading market positions. Agricultural Products FMC focused insecticide portfolio with leading positions in several chemistries. With carbofuran being world number insecticide nematocide. Insecticides sales represent 48% global sales mix on agricultural products. Rapidly growing herbicide portfolio targeting niche uses and difficult to control weeds Herbicides represents 43% of sales followed by fungicides 9%. The product is a biological compound applied to the ground that performs as a biofilm that protects the roots creating a physical and chemical barrier surrounding the roots, Better nutrients absorption, is a root enhancer.

DIVERSITY AND OCCURRENCE OF PLANT PATHOGENIC NEMATODES GOLF COURSE TURFGRASSES IN NORTH AND SOUTH CAROLINA, USA (Diversidad e incidencia de nematodos patógenos en césped de campos de golf en el norte y sur de Carolina en Estados Unidos de América)

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One hundred and eleven golf courses from North and South Carolina were surveyed for plant-parasitic nematodes. A remarkably high diversity of 24 nematode species belonging to 19 genera were detected. Of those, 23 species were found in SC, 19 species in NC, and 18 species were detected in both states. *Helicotylenchus dihystera*, *Mesocriconema xenoplax*, *Hoplolaimus galeatus*, *Tylenchorhynchus claytoni*, *Belonolaimus longicaudatus*, *Meloidogyne graminis* and *Paratrichodorus minor* were the most prevalent and abundant species in golf course turfgrasses in both states. Twelve species in the United States, 12 in SC and 10 in NC, were new records of plant-parasitic nematodes in turfgrasses. In addition, in 2011, a population of *Trichodorus obtusus* was found infecting a stand of zoysiagrass in Hampton County, SC, representing a new report of this nematode for SC. Subsequent pathogenicity trials with *T. obtusus* showed reduction in root biomass of zoysia and increased root biomass with treatments of abamectin or abamectin and azoxystrobin.