Résumés des communications et posters présentés lors du XVIIIe Symposium International de la Société Européenne des Nématologistes. Antibes, France, 7-12 septembre 1986.

Abrantes, I. M. de O. & Santos, M. S. N. de A. - *Egg production by* Meloidogyne arenaria *on two host plants.*

A Portuguese population of *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949 race 2 was maintained on tomato cv. Rutgers in the greenhouse. The objective of our investigation was to determine the egg production by *M. arenaria* on two host plants using two procedures. In our experiments tomato cv. Rutgers and balsam (*Impatiens walleriana* Hooket fil.) seedlings were inoculated with 5 000 eggs per plant. The plants were harvested 60 days after inoculation and the eggs were separated from roots by the following two procedures : 1) eggs were collected by dissolving gelatinous matrices in a NaOCl solution at a concentration of either 0.525 %, 1.05 %, 1.31 %, 1.75 % or 2.62 %; 2) eggs were extracted comminuting the cutting roots in a Waring Blender, then shaking the mixture in a NaOCl solution at a concentration of either 0.525 %, 1.05 %, 1.31 %, 1.75 % or 2.62 %. Hatching and infectivity tests were also assessed. The numbers of eggs recovered per root system were lower in balsam than in tomato. The results suggest that greater quantities of eggs were obtained using the second procedure with a solution of 1.05 % or 1.75 % of NaOCl, for tomato and balsam plants, respectively.

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Ainsworth, L. F., Boag, B. & Robertson, W. M. - *The specifity of the nematophagous fungus* Arthrobotrys dasguptae.

Arthrobotrys dasguptae produces detachable adhesive knobs which attach themselves to nematodes which come in contact with them. The efficiency with which this process takes place can be quantified by counting the number of adhesive knobs on the different species of nematode and by correcting for the surface area of the nematode. The result indicated that large numbers of adhesive knobs adhered to *Rotylenchus robustus* and *R. fallorobustus* while slightly fewer were attached to *Criconemoides informis* and *Hemicycliophora conida.* Low numbers were also found on *Tylenchorhynchus dubius, Panagrellus redivivus, Turbatrix aceti, Globodera rostochiensis, G. pallida* and *Longidorus attenuatus.* No adhesive knobs were found on *L. elongatus, L. leptocephalus, L. vineacola, L. goodeyi, Xiphinema diversicaudatum, Trichodorus primitivus, T. velatus, Paratrichodorus pachydermus* or *P. anemones.* On *R. robustus* the number and rate at which adhesive knobs were acquired was greatest at the anterior end of the nematode than along the body or on the tail. Preliminary investigations have suggested that the efficiency with which *A. dasguptae* attach themselves to the different nematode species may be associated with the presence of carbohydrates on the nematode cuticle.

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Alphey, T. J. & Phillips, M. S. - *Integrated control of the potato cyst nematode* Globodera pallida *using low rates of nematicide and partial resistors.*

At the present time there are no potato genotypes which have absolute resistance to the potato cyst nematode (PCN), *Globodera pallida.* Partial resistance to *G. pallida* has been bred into commercial cultivars of potato from *Solanum vernei* and *S. tuberosum* ssp. *andigena* CPC 2802. Field experiments have been undertaken to study the interaction between nematicide and partial resistance with respect to control of PCN and potato yield. In this study potato genotypes with partial resistance derived from *S. vernei* were grown on land infested with *G. pallida* Pa2/3 and treated with low rates of the nematicide aldicarb. The potato genotypes used included clones with estimated resistances ranging from 40 % to 98 %. The nematicide aldicarb was used at the approved rate (33.6 $kg \cdot ha^{-1}$), 0.5 rate, and 0.25 rate. Untreated controls were included. Soil samples were collected per plot at planting and at harvest and the numbers of juveniles g^{-1} soil recorded. The multiplication rates (P_f/P_i) for plots, genotypes, nematicide treatments and the interactions were calculated. The results indicated that for all genotypes, at this site, P_f/P_i values of less than 1 were obtained even with the 0.5 rate of aldicarb. For genotypes with resistances greater than 50 % (12243, 11233, and 12380) the 0.25 rate decreased P_f/P_i below 1. The tolerance of the genotypes varies considerably and were not related to resistances. The yield of 12243 (50 %) resistant was not changed by the use of any one of the rates of nematicide whereas, that for 12380 (98 % resistant) was increased 4-fold by the 0.25 rates of nematicide, 5-fold by the 0.5 rate, and 7-fold by the full approved rate.

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Alphey, T. J. W. & Taylor, C. E. - *Mapping the geographical distribution of the Longidoridae and Trichodoridae for Europe.*

Over the past five years nematologists in several European countries have submitted distribution data, generated from various national surveys and collections, to the Scottish Crop Research Institute (SCRI) for mapping. The SCRI, in its role as coordinator of the European Plant Parasitic Nematode Survey (EPPNS), has developed programs for the computer mapping of nematode distributions for each participating country. To date eleven EPPNS atlases containing data from thirteen countries have been published. During the past year all the submitted national data concerning the distribution of the Longidoridae and Trichodoridae were transferred into a single partitioned file. All site location grid references were converted from the various national grid scales into standard UTM 50 km grid references. In cooperative work with the Department of Geography, University of Dundee, a new

program was produced to draw an outline base map of Europe. From this program individual maps showing the distributions of 63 longidorid and trichodorid species in Europe as a whole have been drawn.

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Ambrogioni, L., Caroppo, S., Gregori, E., Miclaus, N. & Pelagatti, O. - *Nematode population density and biological activity of soil under sugar beet crops and pesticide treatments.*

An evaluation was made of the effects of three consecutive sugar beet crops and of treatments with Terbufos (200 g/ha a.i.) and Pyrazon (5.5 kg/ha a.i.) on the population levels of nematodes and on several soil biota. The data of the last two years were submitted to a factorial statistical analysis. Treatments did not produce significant effects on free-living bacterial feeding and predatory nematodes, but, considering maximum population levels, the density of these nematodes appeared greater, during the second year in the sugar beet treated and untreated plots in comparison with the uncultivated ones. The density of phytoparasitic nematodes was significantly higher ($P = 0.05$) in the untreated sugar beet plots than in the treated ones. The composition of the nematofauna, including about 20 genera with bacterial feeding, predatory, fungal feeding and phytoparasitic species. The most common of which were *Acrobeloides, Panagrolaimus, Rhabditis, Aphelenchoides, Aphelenchus, Helicotylenchus, Paratylenchus, Pratylenchus, Tylenchus* was not sensibly altered by the sugar beet crop or the pesticide treatments. A positive correlation has been observed between the density of bacterial feeding and predatory nematodes and total microbial count, ATP level, phosphatase activity in the soil. Fungi, actinomycetes, green algae and blue-green algae (cyanobacteria) were noticeably reduced by the pesticides (- 49 %, - 39 %, - 58 %, - 74 % respectively) and in the third year the disappearance or the strong reduction of several genera of fungi, green algae and blue-green algae occurred.

Istituto Sperimentale per la Zoologia Agraria, Cascine del Riccio, Firenze, Italy.

Ambrogioni, L. & Marinari-Palmisano, A. - *Ultrastructural examination of syncitium development in roots infected by* Heterodera *and* Globodera *spp.*

Comparative ultrastructural observations on the development of syncytia in susceptible host plants of *Globodera rostochiensis, Heterodera goettingiana, H. schachtii, H. trifolii, H. carotae* showed different responses to the late life stages of the nematodes. In the syncytial cells more or less prominent wall ingrowths were found in association with the growth stage female larvae of the five species examined. In the syncytium induced by *G. rostochiensis* on potato mitochondria were scattered and less numerous in comparison to those induced by other species; the giant cell showed little metabolic activity. At the stage of young female without egg-sac, in syncytia associated with *H. trifolii* on carnation, *H. schachtii* on sugar beet, *H. goettingiana* on pea, pronounced thickening of the wall ingrowths occurred, the density of cytoplasm and the number of organelles increased. In *H. carotae* on carrot the fingerlike thickenings along the cell walls appeared discontinuous. In syncytia associated with *H. trifolii, H. schachtii* and *H. goettingiana* the development of wall ingrowths, the density of cytoplasm and the number of mitochondria reached the maximum at the time of egg-sac formation. In the giant cell induced by *H. carotae* the wall ingrowths appeared weaker in comparison with the other species. Signs of advanced degeneration of the cell were evident at the stage of newly browned cyst in *G. rostochiensis*. On the contrary, at this stage giant cell produced by *H. schachtii, H. goettingiana* and *H. carotae* maintained a condition of activity : although the cytoplasm wass less consistant, the mitochondrial cristal dilated and the plasmalemma barely distinguishable. In conclusion, the cycle of syncytium development may be related to the demand made on the cell by nematodes with and without egg-sac and more or less intensive egg production.

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Antoniou, M.*, & Evans, A. A. F.** - *The effect of temperature on the breaking of diapause in* Meloidogyne naasi.

Meloidogyne naasi, a temperate root-knot nematode attacking cereals, overwinters in the soil as J2, in the egg stage. The hatching behaviour of six populations of *M. naasi*, from Belgium, France, Germany, Wales, New Zealand and USA (California), was studied in the laboratory. Temperature was found to be the main factor influencing the termination of diapause in this species. The general hatching trends were very similar in all populations studied. Spontaneous hatch at temperatures from 0° to 40° was very low, with the exception of the Belgian isolate. In all populations, chilling (temperatures between 0°to 15°), was necessary before eggs could hatch at 20°. The most favourable chilling temperature was 10° for all populations except for the German isolate which hatched best at 5°. Best incubation time varied with population and was found to be 13 to 19 weeks. In all populations studied, there appeared to be a second temperature régime, not previously suggested by experimental or field observations, with a weaker tendency to promote hatch. This tendency appeared after incubation of the eggs in temperatures between 25° and 35° and was much more variable than that obtained after chilling treatment. Chilling interrupted by short periods of warmth (up to 30 minutes) was found to stimulate hatch, while longer periods abolished the chilling effect, and hatch was inhibited. Chilling or warm treatments slowed or stopped embryonation in the eggs, which was resumed normally, as soon as they were transferred to 20°. Egg hatch in *M. naasi* is divided into three phases, each with a different optimum temperature. *(i)* embryonic development (around 20°); *(ii)* chilling requirement (5° to 10°); *(iii)* eclosion (around 20°).

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Arias, M., Navas, A., & Andres, M. F. - X. coxi *complex in Spain.*

X. coxi was reported by Arias (1979) from only one locality in the central region of Spain. Subsequently it has been found at several localities in the central region and La Rioja. Following the study of *X. coxi* by Sturhan (1984) all Spanish specimens have been reviewed ant the presence of two different forms has been detected. The morphometry, ecology and distribution of each population is discussed.

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Baker, G. L. & Holmes, H. M. - *Protracted parasitic development of mermithid parasites of Orthoptera under drought conditions.*

Evidence is presented for the important role of rainfall in stimulating the emergence of replete parasitic juveniles of mermithids from Orthoptera. An episode of parasitism of the wingless grasshopper, *Phaulacridium vittatum* (Sjostedt) by *Hexamermis* sp. and *Amphimermis* sp. under drought conditions is described and contrasted with episodes under conditions of average rainfall. It was found that under drought conditions inhibition of parasite emergence resulted in : (1) extremely protracted parasitic development with the emergence of 75 % of parasites occurring by day 63, compared with day 28 when moisture is not a limiting factor; (2) a low rate of decline of parasitised hosts : over the 4 week period between weeks 5-9 after the onset of the episode, parasitised hosts declined at a rate only 2.4 times that of unparasitised hosts (1/10th the rate of decline under conditions of unimpeded emergence); (3) an increase in the length of parasitic juveniles; at week 5 the length of 28 % of juveniles ex females hosts exceeded the normal range (150-280 mm) and at week 8,62 % exceeded the range; (4) partial moulting within the host. Evidence is presented of declining competition with the host by replete parasitic juveniles : by week 5 parasitised female hosts had resumed vitellogenesis and by week 8, 19 % of parasitised females had ovulated. However, residual competition was evidenced by a smaller clutch size (6 *vs.* 17 eggs for unparasitised females), lack of development of the penultimate oocyte at time of ovulation (1.1 *vs.* 2.5 mm) and a lower mean ovary weight (26 *vs.* 48 mg). The implications of inhibited parasite emergence for determinations of indispensable parasite induced mortality as well as the consequences for parasite productivity are discussed.

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Bakker, J. & Gommers, F. J. - *Genotyping european potato cyst nematode populations with two dimensional gel electrophoresis of total protein extracts.*

Isoelectric focusing of crude nematode homogenates followed by sodium dodecyl sulfate electrophoresis and a sensitive silver stain enables the examination of several hundreds of gene products. Two-dimensional gel electrophoresis (2-DGE) of total protein extracts from adult females of 25 *Globodera pallida* and 19 *G. rostochiensis* populations revealed approximately 350 distinct proteins per population. The overall protein differentiation of *G. pallida* and *G. rostochiensis,* which are morphologically nearly indistinguishable, is remarkable large. The two sibling species were discriminated by 70 % of their polypeptides implicating that they have accumulated protein differences during a time period of millions of years without distinct changes in morphology. Intraspecific genetic distances were relatively small. Conspecific populations shared usually more than 95 % of their proteins. Comparison of 25 *G. pallida* populations revealed 29 variant proteins, which appeared to be the result of one or a few isoelectric point changing amino acid substitutions (IP-variants). Examination of 19 *G. rostochiensis* populations resolved 20 IP-variants. The IP-variants are valuable characters in genotyping European potato cyst nematode populations, because the frequencies of the IP-variant encoding alleles can be estimated in a convenient way. The protein patterns were made by electrophoresing a homogenate of hundred individuals and the allele frequencies were estimated by measuring the proportion of the protein quantities between homologous IP-variants. The allele frequency data showed that the current pathotype scheme is incapable to reflect the genetic diversity of the European potato cyst nematode populations. Various populations classified as identical pathotypes had widely different allele frequencies at several loci. Moreover, the genetic distances within *G. pallida* pathotypes were often larger than between pathotypes. Although the majority of the the IP-variants, and may be all, are not encoded by alleles for (a)virulence, protein variation revealed by 2-DGE is highly informative for interpopulation variation in virulence. In the absence of selection by genes for resistance in Europe, both interpopulation variations in virulence and proteins are predominantly the result of three processes which affect the variation of the entire genome : *i)* the genetic structures of the primary founders introduced from South America, *ii)* random genetic drift and *iii)* gene flow. This directly invokes that the similarities and dissimilarities revealed by the IP-variants are also reflected at (a)virulence loci, including those not resolved yet by current pathotype schemes. It is obvious that 2-DGE data provide means for a rational introduction of genes for resistance. Knowledge of the effectiveness of a gene for resistance in an area is crucial for a successful breeding strategy. However, screening numerous populations in order to assess the proportion of virulent and avirulent populations in an area is laborious and expensive. At present the number of populations tested is arbitrary and depends mainly on the screening capacity. 2-DGE can be a valuable adjunctive tool. The genetic diversity introduced into an area can be investigated by electrophoresing several hundreds of populations. The affinities reveales by 2-DGE can be used as a guidance for a representative survey to assess the effectiveness of any source of resistance to be incorporated in commercial cultivars. Representatives of all groups should be included. How to delineate groups in such a way that they represent useful entities needs further investigation.

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Banck, A. - *Control of* Longidorus elongatus *in strawberries with a soil fumigant.*

The effectiveness of the fumigant Di-Trapex for controlling *Longidorus elongatus* was evaluated in a field trial in southern Sweden. The experiment was started in the autum of 1980 at which time the fumigant was applied to the soil at the standard dosage (400 l/ha) and a slightly lower doage (300 l/ha). Strawberries (cv. Senga Sengana) were planted the following spring. Densities of *L. elongatus* in the topsoil (0-25 cm) and in the subsoil (25-50 cm) were recorded before fumigation and in the crop every spring and autumn for four years thereafter. The mean initial densities, before fumigation, were 61 and 28 *L. elongatus*/250 g soil in the topsoil and in the subsoil respectively. The densities of *L. elongatus* in the control plots increased approximately 5 fold furing the first season. However, they decreased thereafter — densities were 48 and 14 specimens/250 g topsoil and subsoil respectively when the experiment was terminated in the autumn of 1984. This discrease was probably due, in part, to a lack of food. In the treated plots the recorded densities of *L. elongatus* both in the topsoil and in the subsoil declined to zero following fumigation. Apparently, females and juveniles were killed by

the treatment. After the first growing season, however, juveniles were again found at low densities at both levels in the soil suggesting that eggs had survived the fumigation. Females were not found again until the autumn of 1982. Thereafter, the densities increased rapidly and at the end of the experiment they were similar to, or slightly higher than those of the control plots. There was no significant difference between the final nematode densities of the two dosage treatments. At first harvest (second growing season) the plots treated with 300 and 400 l Di-Trapex/ha yielded 40 and 50 % more respectively than the control plots (15 and 16 t/ha compared with 11 t/ha). During the following two years the fumigated plots yielded 80-90 % more than the control plots. Berries from the treated plots were larger and of higher quality than those from the control plots.

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Barooti, S. - *Occurrence of* Bacillus penetrans *as a parasite of nematodes in Iran.*

During a five year survey of plant parasitic nematodes over 600 soil samples were collected throught the country. In only two samples were plant ectoparasitic nematodes observed to be parasitized by bacteria. The bacterium was isolated and identified as *Bacillus penetrans. Bacillus penetrans* Mankau, 1975, previously described as *Duboscqia penetrans* Thorne 1940, is a candidate agent for biocontrol of nematodes. The ability of *B. penetrans* to inhibit nematode reproduction and kill root-knot nematodes, as well as several other pest nematode species has been demonstrated. The distribution of this bacterium was limited to Tehran and Gholpaighan where it was found on *Helicotylenchus pseudorubustus* and *Merlinius microdorus* from the periphery of the roots of weeds and tobacco plants. This is the first report of these nematodes as hosts for *B. penetrans.*

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Baujard, P. - *Écologie des nématodes dans le bassin arachidier du Sénégal.*

Le biotope est caractérisé par l'absence de relief, des sols sableux, l'alternance d'une saison pluvieuse (juillet à octobre) avec une saison sèche (novembre à juin). Les nématodes identifiés se répartissent dans trois ordres regroupant 95 % des espèces présentes : Tylenchida (26 espèces), Rhabditida (22 espèces), Dorylaimida (28 espèces). Les espèces phytoparasites *(Ditylenchus* sp., *Tylenchorhynchus mashhoodi, Neodolichorhynchus gladiolatus, N. sulcatus, Dolichorhynchus elegans, Telotylenchus ventralis, T.* sp., *Trichotylenchus falciformis, Pratylenchus brachyurus, P. loosi, P. sefaensis, Scutellonema cavenessi, Hoplolaimus pararobustus, Helicotylenchus dihystera, Aphasmatylenchus variabilis, Senegalonema sorghi, Heterodera* sp., *Meloidogyne* sp., *Criconemella curvata, Paratylenchus* sp., *Xiphinema* sp., *Longidorus* sp., *Paratrichodorus minor, Trichodorus eburneus)* sont associées aux cultures : *Arachis hypogea, Pennisetum typhoides, Sorghum vulgare, Vigna unguiculata,* jachère. Les espèces végétales présentes et le taux d'humidité du sol influent sur la structure des populations : le mil, le sorgho, le niébé ou les plantes sauvages sont hôtes de ces espèces; *D. elegans, N. sulcatus, T. ventralis* et *S. cavenessi* sont les seules espèces capables de se multiplier sur l'arachide. La plante cultivée conditionne la répartition verticale des nématodes dans le sol pendant la saison sèche; les espèces migrent dans les couches superficielles du sol pour entrer en anhydrobiose, à l'exception de *S. sorghi, Xiphinema* sp., *Longidorus* sp. et les Trichodoridae répartis jusqu'à 50 cm de profondeur. Au laboratoire, la plupart des espèces de tylenchides se développent avec des températures du sol de l'ordre de 35°; *N. gladiolatus, D. elegans, Pratylenchus* spp. et *S. sorghi* sont incapables de se multiplier à des températures supérieures à 30° alors que *H. pararobustus* et *Paratylenchus* sp. ne se multiplient pas à des températures égales ou inférieures à 30°. *S. cavenessi* peut se multiplier toute l'année au laboratoire; son développement exige de fortes températures du sol (35°), et un taux d'humidité du sol élevé; l'hôte sur lequel il a accompli son cycle précédent influe sur ses capacités de multiplication. Au champ, ce nématode est incapable de survivre sans s'alimenter pendant l'hivernage, au cours duquel il se multiplie aux dépens de l'arachide, du mil, du sorgho, du niébé et des plantes sauvages avec des taux de multiplication fonction du taux de population initiale, de la culture pratiquée, du précédent cultural et du taux d'humidité du sol. Pour survivre pendant la saison sèche, il est obligé d'entrer en anhydrobiose, migrant dans les horizons superficiels du sol au fur et à mesure que celui-ci se déssèche. La saison sèche provoque une forte mortalité (50 %), conduisant parfois à annuler la multiplication survenue pendant la saison des pluies.

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B'Chir, M. M. - *Histopathological changes induced by* Tylenchulus semipenetrans *in citrus root.*

Slow decline caused by *Tylenchulus semipenetrans* is very common in citrus-growing countries. The cytological mechanism of its action on the host plant and their consequences on fungi infections of citrus root-stocks is not very well known. This work, based on observations of longitudinal sections by light microscopy and transmission electron microscopy (TEM), shows the importance of nematode-induced changes in the nursers sites at the cortical tissue of the root. Each site is formed by 5 to 10 cells which undergo profound modifications : the cytoplasm becomes dense, the nucleus grows in length before forming nuclear vesicles by pleuromitosis, where apparently preferentiel DNA sequences get multiplied. There is also one of two nuclear pleuromitotic vesicles per cell depending on its length. Ultrastructural cell transformations induced by *T. semipenetrans* in host root cortex are spectacular on nucleus, cytoplasm and cell wall level. Special intracellular organelles associed with an intercellular tubules net are described for the first time. The transformed cells loose an important part of its genetic potential and become very sensitive to any metabolic disequilibrium. Considering the extent of the histological changes induced, pathological action of this nematode can be easily understood. The « nurse cells » are highly specialized in view of these transformations. *T. semipenetrans* seems to be one of the most developed plant parasitic nematode. The host quality of the different root-stocks will be then linked to the stability of this equilibrium in the transformed cells. The secondary infection of *Fusarium solani* in association with a *Bacillus pimulus* can break this new equilibrium in cells this causing necrotic lesions at the citrus roots. The succession of *T. semipenetrans, F. solani, B. pimulus* in roots could be one of the citrus blight causes.

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B'Chir, M. M. & Ammar, E. - *Incidence de la succession d'hôtes sensibles et résistants sur l'évolution des caractères bioécologiques des populations de* Meloidogyne *spp.*

Dans les conditions de culture sous abris-serres en Tunisie, *M. javanica,* ne semble avoir qu'une seule génération par an. Elle disparaît sous l'effet de certains traitements, comme l'introduction des variétés résistantes et le traitement au Furadan. Elle présente ainsi des potentialités d'adaptation plus faibles que celles de *M. arenaria* et *M. incognita.* La notion d'apparition de pathotypes agressifs n'est pas liée à la monoculture de variétés résistantes. Ces pathotypes existent dans le génome des populations entretenues sur un hôte sensible. La rotation culturale, utilisant des variétés résistantes et des variétés sensibles, a une incidence sur les caractéristiques bioécologiques des différentes populations de *Meloidogyne,* après cinq années de culture consécutives. Le nombre de générations, la fécondité des femelles et l'importance de la diapause embryonnaire, qui constituent les principaux facteurs déterminant la dynamique des populations de *Meloidogyne,* montrent une variabilité qui dépend du type de succession culturale suivi. Il y a une régulation au niveau de cette dynamique qui assure la multiplication de la population de *Meloidogyne,* permettant son maintien quelles que soient les conditions. La monoculture de tomates, sensibles ou résistantes, augmente l'importance des microorganismes phytopathogènes dans le sol et contribue aussi d'une façon générale, à la diminution du degré d'infestation des *Meloidogyne* dans le sol.

INAT, 43, avenue Charles-Nicolle, Tunis, Tunisie.

Bello, A., Navas, A. & Belart, C. - *Spatial-temporal variation and characteristics of the nematofauna associated with Citrus groves in Spanish Levante.*

The structure of the nematofauna associated with citrus groves in La Plana was studied to determine the environmental factors which characterize it, and to compare faunistic differences with uncultivated relict areas. Initial studies of 450 random samples from 85 sites, recorded 66 species belonging to 33 genera of nematodes of agricultural interest. An additional survey was carried out on seven different soil types, periodically taking samples at two depths and during different seasons. Different methods of multivariant analysis and automatic cartography have been used to infer the spatial-temporal variation of the nematofauna associated with citrus groves, and to identify their ecological relationships. Five different faunistic groups were distinguished, having clear relationships with edaphic characteristics, age and health of the trees, presence of weeds and sampling season.

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Bleve Zacheo, T., Seinhorst, J. W. & Zacheo, G. - *Some details of the structure of the vagina and ovejector of* Longidorus *and* Xiphinema *species.*

In the investigations by Seinhorst and Koslowska (1974) on the structure of the vagina and ovejector of *Longidorus* species several details remained obscure because of the limitations of the light microscope : the number of cells forming the vagina; the organ to which the *dilatores vaginae* belong (vagina or ovejector?); the nature of the so-called " ridge " around the edge of the posterior part of the vaginal connective tissue; and the existence of *directores vaginae.* Electron micrographs of sections of the vagina and ovejector of *Xiphinema index* and *Longidorus apulus* revealed that the vagina (without the sphincter muscles) consisted of four times four cells. The lateral posterior and anterior *dilatores vaginae,* connected to the connective tissue of the vagina and to the skin at the dorsal side of the lateral cords, belong to the ovejector. The sarcoplasm with the nuclei of the anterior and posterior *dilatores* forms part of the ovejector wall. The *directores vaginae* by Seinhorst and Koslowska appeared to consist of the two posterior or anterior dorsal vaginal sphincter muscles, the ends of which are attached to lateral *dilatores vaginae,* thus forming a continuous muscle from one side of the body to the other. The " ridge " described by Seinhorst and Koslowska appeared to be a groove in the outer rim of the dorsal part of the vaginal connective tissue in which a narrow band cells of the ovejector wall are connected to the vaginal connective tissue. It is the only area of fusion between cell walls of the ovejector and the vagina. By this means the vagina can expand easily to form a single cavity with the lumen of the ovejector when an egg is passing.

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Boag, B., Brown, D. J. F. & Topham, P. B. - *Sampling strategies for virus-vector nematodes.*

Investigations into the horizontal distribution of virus-vector nematodes indicated that although many species were found in large numbers to a depth of 40 cm, the optimum depth for collecting soil for the vector species occurring in eastern Scotland was 10-20 cm. The horizontal distribution of *Longidorus elongatus, Xiphinema diversicaudatum, Trichodorus primitivus, T. cylindricus* and *Paratrichodorus pachydermus* was investigated in eleven fields. One hundred and thirty soil samples were collected from an area of approximately 1 ha in each field and analysed using Taylor's Power Law to determine the amount of aggregation. *L. elongatus* and *X. diversicaudatum* had a near random distribution when samples were taken close together (Taylor's Power Law index of aggregation b′ = 1.1 at 5 cm) but between 80 cm and 51 m the b′ value was approximately 1.7. The index of aggregation b′ for trichodorid nematodes varied considerably but was generally larger for samples taken close together (b′ = 2.4 at 5 cm) and at distances above 12.8 m while lower values were recorded at intermediate distances (b′ = 1.4 at 40 cm). The calculation of the sampling coefficient " a " and Taylors Power Law index of aggregation b′ has allowed optimum sampling procedures to be developed for virus-vector nematodes.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Boag, B., Smith, P. & Topham, P. B. - *The development of a national computer identification scheme for plant-parasitic nematodes.*

The increase in the number of plant-parasitic nematodes being described each year has led to the use of computers to assist with their identification. The computers initially used to develop the identification programmes were expensive and this restricted their use. However, rapid advances in computer technology and the marked decrease in their costs have meant

that the computer, digitising platen and visual display unit used for the identification of nematodes in 1981 and which cost approximately £ 10 000 has now been replaced in 1986 by equipment costing approximately £ 2 000. The reduction in cost has meant that more laboratories can afford to purchase these compatable, less expensive computers. It is envisaged that this will, in turn, allow other specialists within these laboratories to contribute information on yet more plant-parasitic nematode genera and by making this information available to other users increase the usefulness of the system.

The information held on computer can be easily upgraded by the specialist in the respective genera and the data speedily made available to other users by transmitting the data direct from one computer to another via the telephone or by sending the information through the post on a floppy disc.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Bossis, M. - *Variabilité intraspécifique d'*Heterodera carotae.

La variabilité intraspécifique d'*Heterodea carotae* a été étudiée sur différents facteurs : pénétration, compétition entre les larves et taux de multiplication. Quatre populations françaises sont comparées : Créances (Manche), Feillens (Ain), Plouhinec (Morbihan), et Soulignonne (Charente-Maritime). Deux types d'essais sont réalisés avec des infestations artificielles. 1) En boîtes de Petri : L'inoculation artificielle de plantules cultivées en boîtes de Petri sur eau gélosée est réalisée avec des doses croissantes de larves (300 larves pour chaque dose) et sur deux lignées de carottes (Nandor et Vilmorin 309PG81). Les taux de pénétration ne diffèrent pas entre les populations. La compétition entre les larves a entraîné des variations de l'indice andrique observé, mais aucune différence n'a été mise en évidence entre les populations. Toutefois, les faibles taux de pénétration observés entraînent une incertitude trop grande sur l'indice andrique réel. En ce qui concerne l'extériorisation des symptômes par la plante, on a noté une différence importante dans l'apparition des racines secondaires au niveau des points de pénétration des nématodes, la population de Plouhinec provoquant les plus fortes émissions, même aux faibles doses d'inoculation. Avec les populations de Feillens et Soulignonne le végétal réagit peu et n'émet pratiquement pas de racines secondaires; la population de Créances est intermédiaire. 2) En pots : une infestation artificielle à 10 larves par gramme de sol est réalisée avec des kystes placés dans des pots de 2 litres de sol stérilisé. Sur chaque pot, on cultive 5 carottes. L'analyse est effectuée 2 mois et demi après le semis sur la totalité des racines et du sol. Les adultes et les larves sont comptés. Les populations se classent dans l'ordre décroissant suivant : celle de Créances a eu numériquement le développement le plus important, significativement différent de celle de Plouhinec, elle-même différente des deux autres populations qui ne diffèrent pas entre elles. Compte tenu des fortes réactions du végétal et du taux de multiplication assez bon, la population de Plouhinec semble la mieux convenir pour des tests de tolérance.

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Boström, S. - *Evolution of lip structures in the Cephalobidae (Rhabditida).*

The free-living soil nematode family Cephalobidae Chitwood & Chitwood, 1934 may, according to some hypotheses, have evolved from *Rhadditis*-like animals (possibly through animals resembling *Panagrolaimus*) by specializations in the anterior structures (cephalic and labial probolae). In forms having simple lips the anteriormost circlet of papillate sensilla is generally positioned apically on the lips, while in those bearing labial appendages the papillae have generally been functionally displace posteriorly. The presence of cephalic and labial probolae in some cephalobids has been questioned, but SEM studies seem to support the idea of probolae being present in mosts. From the cephalobid simple anterior organization, possibly with transitional stages between lips and cephalic and labial probolae in members of the subfamily Cephalobinae, there seem to be several trends in the evolution of the anterior structures of the Cephalobidae : 1) simple cephalic and labial probolae (e.g. *Acrobeloides*); 2) simple cephalic and somewhat complex (bifurcate) labial probolae (e.g. *Acrobelophis*); 3) more complex cephalic and bifurcate labial probolae (e.g. *Cervidellus*); and 4) further complexity in both cephalic and labial probolae (e.g. *Acrobeles*). The rather simple anterior structures of 1) and 2) are more plastic and may have given rise to the more elaborately modified and apparently stable structures of 3) and 4). There seem to be no muscles or sense organs connected with the labial probolae, and their function appears to be purely mechanical. The diverse morphology of the probolae within the family is probably related to environmental conditions and will give selective advantages in different kinds of micro-habitats.

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Bowen, S. A.*, Storey, G. W.* & Evans, K.** - *The contribution of eggs sacs to the population dynamics of* Heterodera cruciferae *and* H. schachtii.

Few of the studies on the population dynamics of cyst-nematodes have attempted to quantify the number of eggs deposited in the gelatinous egg sacs of the female and their contribution to nematode multiplication. This may lead to an underestimation of potential yield losses based upon population densities derived solely from counts of cyst-bound eggs. Both *Heterodera cruciferae* and *H. schachtii* are capable of parasitising oilseed rape in the UK and an experiment is described in which the proportion of eggs that are deposited in egg sacs is measured. The hatching of juveniles from eggs in cysts and egg sacs is compared at different dilutions of oilseed rape root leachate; juveniles require less stimulation and hatch more quickly from eggs in sacs than from those in cysts. The relationship between the hatching of juveniles from cysts and sacs and the osmotic control of hatching, mediated by the trehalose concentration of egg fluid, is discussed. In pot tests juveniles invade the roots of oilseed rape plants both earlier and in larger numbers from egg sacs than from cysts; however, egg sacs are short-lived and do not contribute to invasion after a few months in the soil in the absence of a host crop. It is concluded that egg sacs will not contribute to the persistance of soil populations between host crops but they may increase nematode multiplication and the damage to a crop by allowing second and subsequent generations to develop earlier in the growing season.

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Bridge, J. - Pratylenchus *spp. on tropical crops.*

Pratylenchus spp. are found in almost all tropical soils and often in roots but their relative importance as crop pests is sometimes overlooked or underrated. Certain species are found in some parts of the world but not others and their unusual distribution or dissemination is both scientifically interesting and of economic importance in future agricultural development. The tropical species occuring on a wide range of crops and known to cause damage are *P. coffeae, P. brachyurus, P. zeae, P. indicus, P. goodeyi* and *P. loosi.* Recent surveys have revealed that *P. coffeae* and *P. goodeyi* are the most important nematode root pests of bananas in Papua New Guinea and parts of East Africa respectively. In both cases, they cause the symptoms and extensive root damage normally associated with the burrowing nematode, *Radopholus similis* which, in comparison, is a very minor pest in these areas. *P. coffeae* has also been found as the cause of " dry rot disease " of yam tubers (*Dioscorea* spp.) in the Pacific Islands and is responsible for considerable yield and storage losses. The only other yam-growing area where *P. coffeae* is known to cause dry rot of tubers is the West Indies. *P. zeae* is well documented as a damaging pest of tropical cereals (rice, maize, millet and sorghum), sugarcane and other crops in many countries of the tropics. In the Philippines, it occurred in populations of over 1 000 nematodes/g root on upland rice associated with severe root damage.

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Brown, D. J. F. & Boag, B. - *A study of the distribution and morphometrical variability between populations of* Longidorus vineacola *Sturhan & Weischer, 1964 (Nematoda : Longidoridae).*

Longidorus vineacola, originally described from specimens from the rhizosphere of grapevines at Trier, Federal German Republic, has a sporadic distribution in Europe ranging from Israel in the south to Scotland in the north. Usually it is present in a country as a few isolated populations as reflected in its distribution in the British Isles where it has been found once in northwest England and Ireland and from three Scottish western islands. Due to its potential for damaging crops by its feeding, its occurrence in Scotland and as part of the European Plant Parasitic Nematode Survey specimens from 43 populations from seven European countries were studied at the SCRI. One population from France was identified as *L. paraelongatus* whereas all other 42 populations were considered to be anatomically similar. The characters body length, odontostyle, odontophore, distance from the anterior to the guide ring and length of tail were used from the 43 populations in the preparation of a canonical variate analysis (CVA). Also the morphometrics of four other species most similar to *L. vineacola* namely, *L. apulus, L. attenuatus, L. closelongatus* and *L. cohni* were used in the analysis to compare their similarity to each other and to the populations of *L. vineacola.* Two-dimensional placings of 49 populations from the six species were studied in relation to the first three axis of the CVA based on population females means for the five characters. Although five axis were available for plotting only the first three were used as together they accounted for 91 % of the variance. Six groups of populations were formed each group representing one of the six species. However, three populations of *L. vineacola,* two from The Netherlands and one from Italy, formed outlines which were discrete from one another. When compared with *L. vineacola* paratypes one population from The Netherlands differed by having a shorter body but longer odontostyle and odontophore lengths, a second population differed by having longer odontophore and tail lengths and the Italian population differed by having longer odontostyle, odontophore and anterior to guide ring lengths. The possibility that these three populations should be referred to other species or in part represent new species is being investigated.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Brown, D. J. F. & Boag, B. - *A study of the methods used to extract virus vector nematodes present in Scotland from soil samples for advisory statutory and research purposes.*

Flegg's modification of Cobb's sieving and decanting method (SDM) and Seinhorst's two-flask method (2FM), each with the Baermann funnel (BF) final separation-method, are the principal means used to extract virus vector nematodes from soils in Scotland. A study was made of the various components of these methods and of some of the variables which might affect the final recovery of nematodes i.e. sieve aperture size, filters, temperature, time, etc. The most efficient method for recovering trichodorids was the 2FM which yielded 20 % more nematodes than the most efficient SDM whereas SDM's in which a bank of three 150 µm aperure sieves were used and a single semi-submerged 150 µm sieve were the most efficient for recovering longidorids. Rhe latter method was particularly useful when live specimens were required for research studies. A 95 µm aperture plastic mesh was much more effective than two ply Kleenex tissues for the final separation of longidorids in BF whereas the converse was true with the trichodorids. A final separation time in the BF of 24 h yielded 98 % of the longidorids but only 75 % of the trichodorids, and, after a further 24 h 99 % of the longidorids and 94 % of the trichodorids were recovered. No virus vector nematode were recovered after 72 h. Water temperature between 5 and 30° in the BF did not affect the recovery of longidorids whereas substantially more trichodorids were recovered at 15° than at any other temperature. In a separate study nematodes were dropped in water (500 cm^3) and soil (500 g) in polythene bags from 1, 3, 5 m and 1 m five times. The percentage mortality of trichodorids in soil was 18, 25, 35 and 35 % for each height drop but in water trichodorids were killed (4 %) only when dropped 1 m five times. In soil 13 % of *Longidorus elongatus* were killed when dropped 1 m five times but less than 5 % were killed when dropped 1, 3 and 5 m. The results with *L. elongatus* in water were 0, 4, 20 and 8 % killed when dropped 1, 3, 5 m and 1 m five times. When a column of soil 30 cm × 5.5 cm diam. containing trichodorids was dropped 5 m the numbers of nematodes killed in the top and middle sections was *c.* 20 % whereas *c.* 40 % were killed in the bottom section.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Brown, D. J. F., Robertson, W. M. & Trudgill, D. L. - *Variability in the specific relationship between longidorid nematodes and the viruses they transmit.*

Eleven nepoviruses have been irrefutably shown to be transmitted by longidorid nematodes. Serologically distinct

virus strains often have different nematode species as vectors e.g. a strain of artichoke Italian latent virus from Italy is transmitted by *Longidorus apulus* whereas a strain from Greece is transmitted by *L. fasciatus*. Also in some instances different viruses may be transmitted by the same vector nematode e.g. arabis mosaic (AMV) and strawberry latent ringspot viruses (SLRV) are both transmitted by *Xiphinema diversicaudatum*. This complex situation is indicative of a very specific association existing between the viruses and their respective vectors. Studies of the sites of virus retention within-vector nematodes has confirmed that specific relationships exist but that the relationships may not be consistent between all virus and vector combinations. For example, AMV and SLRV are associated with a thin carbohydrate layer lining the food canal of *X. diversicaudatum* but particles of AMV, unlike SLRV, also are surrounded by carbohydrate-staining material (see Robertson and Henry in these Proceedings). Further evidence suggests that this already complex pattern of specific relationships might be further complicated by the relationship between vector population and isolates of viruses. The percentage of *L. attenuatus* from a population from England which transmitted six isolates of tomato black ring virus from Britain and three isolates from Germany ranged from nil to 78 %, the three German isolates being transmitted only by *c.* 5 % of the individuals. Similarly, AMV and SLRV were transmitted by only *c.* 5 % of *X. diversicaudatum* from populations from France, Italy and Spain whereas 80 % and 30 % from several other populations transmitted AMV and SLRV respectively. The efficiency of a vector to transmit its associated virus is broadly related to its ability to retrain virus e.g. *X. diversicaudatum* which is an efficient vector of AMV and SLRV retains many virus particles within its oesophagus whereas *L. elongatus*, a relatively inefficient vector of raspberry ringspot and tomato black ring viruses, retains many less virus particles. This trend, however, is not consistent as *L. attenuatus* is an efficient vector of tomato black ring virus yet retains, few virus particles and, conversely, *L. macrosoma* is an inefficient vector of raspberry ringspot virus yet retains many virus particles within its odontostyle. Investigation of these anomolies may help to elucidate the specific nature of virus retention in vector nematodes which in turn may result in more efficient or novel ways of controlling nematode transmited virus diseases of crops.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Cadet, P. - *Comparaison des peuplements de nématodes phytoparasites observés sur deux complexes sucriers d'Afrique de l'Ouest.*

Les peuplements de nématodes parasites de la canne à sucre ont été observés périodiquement sur deux périmètres sucriers situés au nord de la Côte d'Ivoire et au sud du Burkina Faso. Ils ont été comparés statistiquement au moyen de l'analyse factorielle des correspondances. On constate que les peuplements d'un pays se distinguent de ceux de l'autre pays à partir des populations de *Hoplolaimus, Xiphinema, Trichodorus* et *Heterodera*. Sur le périmètre du Burkina Faso les parcelles étudiées se différencient également les unes des autres. Les peuplements des repousses conservent généralement les mêmes caractérisques que les cannes de plantation qui précédaient. D'autre part, on observe le regroupement des mesures faites à certain moment du cycle de la plante correspondant à la période d'activité d'un système racinaire particulier de la canne. Cette structure provient plus particulièrement des densités de *Xiphinema* et de *Meloidogyne, Pratylenchus, Hoplolaimus* et *Heterodera* dans les racines de bouture.

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Caruhel, P. - *Une méthode simple et rapide pour la recherche de nouvelles molécules à activité nématicide.*

Les produits à tester sont inclus dans une mince couche de gélose (en boîtes de Petri) sur laquelle des larves de *Ditylenchus dipsaci* doivent se mouvoir avant de contaminer des graines d'une plante sensible (luzerne). Pendant toute la durée du test, une observation du comportement des nématodes au contact du milieu traité est possible. La méthode utilisée permet donc de déterminer l'activité globale (par le calcul du taux de contamination obtenue) et de fournir, à un stade précoce dans l'étude d'une nouvelle matière active, quelques éléments concernant son mode d'action. Ce test, rapide et sûr, est de plus, adapté à une utilisation sur une grande échelle (plusieurs milliers de molécules par an).

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Castillo, P., Peña, R., Gómez Barcina, A. & Jiménez Millán, F. - *Distribution and biometric characteristics of* Paractinolaimus microdentatus *(Thorne, 1939) Meyl, 1957 in the sierra of Cazorla, Jaen (Spain).*

A montly sampling of different plant communities on a mountain in the Cordilleras Betic (Prebetic zone), identified an important population of nematodes belonging to the superfamily Actinolaimoidea Thorne, 1967. They have been identified as *Paractinolaimus microdentatus* (Thorne, 1939) Meyl, 1957. This corroborates its presence in Spain, where it was found for the first time in North (Monreal y Campoy, 1982) associated with two different beech forests. In our survey the species was found in different plant communities in a zone with wet soil, caused mainly by many small winter streams and in which *Fraximus angustifolia* and *Jynx* sp. were predominant. This paper presents the first study in Spain of the biometric characteristics of this species, contributing new data for some characteristics and modifying the range of measurements for others. A camera lucida was used to measure a large number of nematodes from which the averages of the characteristics, standard derivations and the range of the measurements were derived. The results confirm a high intraspecific variability between specimens from a single population of nematodes, as occurs in different populations of this same species in south Africa (Vinciguerra & Heyns, 1984). We have also been able to confirm that this species is closely associated with wet ecosystems, and that in the monthly sampling the highest population levels (25-70 worms/150 cm^3 soil) were found in June, July and August — probably as a result of the high soil moisture in the spring in 1985 in this zone. During the rest of the year the population declined markedly as in all other plant communities where the species has been found.

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Cayrol, J. C., Frankowski, J. P. & Boyera, J. - *Comparaison de l'effet stimulant de huit nématodes libres sur l'activité prédatrice de deux espèces d'*Arthrobotrys.

On sait que les nématodes libres peuvent induire la formation des organes de capture chez les champignons prédateurs. Il a été démontré que cette action inductrice résulte d'une relation complexe entre les nématodes et leurs bactéries associées. Nous avons comparé l'effet stimulant de huit nématodes libres sur deux espèces d'*Arthrobotrys (A. irregularis* et *A. musiformis).* Cet effet stimulant a été apprécié d'après la quantité de larves de *Meloidogyne* piégées par les champignons, stimulés ou non par les nématodes libres. Les résultats indiquent que la réponse à l'effet stimulant est moins nette chez *A. musiformis* que chez *A. irregularis.* Il apparaît par ailleurs que deux nématodes s'avèrent particulièrement stimulants : *Cephalobus parvus* et *Diplogaster* sp. Des études sont actuellement développées en vue de préciser la nature des relations nématodes/bactéries responsables de cet effet inducteur.

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Cook, R. - *Selection of white clover for resistance to stem nematode.*

Selection of white clover *(Trifolium repens)* for resistance to stem nematode *(Ditylenchus dipsaci)* is justified as part of the assessment of nematode effects on grassland. The persistence and yield stability of white clover in grass leys can be adversely affected by stem nematode. More than 30 cultivars, accessions and genepools of white clover have been assessed for stem nematode reaction : all have some susceptible plants. However, there are differences between varieties in the proportion of plants expressing symptoms of susceptibility. These differences can be distinguished in varieties naturally infected in the field. However such tests are not reliable. Symptom development depends upon *i)* successful invasion; *ii)* plant growth rate and *iii)* inherent (genotypic) susceptibility. Under field conditions plants with larger leaves, erect petioles and fewer, bigger stolons often escape infection. At times of fast growth even infested plants may show no symptoms. Damage and symptoms are most prominent when clover growth is slow, at lower temperatures in spring and autumn. The effects of inoculations in controlled conditions have been tested. Seedlings, inoculated at the cotyledon stage, may express symptoms initially before ultimately becoming nematode free. This reaction is also observed when red clover *(T. pratense)* and lucerne *(Medicago sativa)* are inoculated with white clover race of stem nematode. Inoculation of buds of young plants (with the first trifoliate leaf expanded) or of stolon tips, has been used to identify varietal differences. Susceptibility is not intrinsically related to plant size character : cultivars with relatively few (25 %) plants susceptible are found in both large and small leaved types. Conservely some cultivars of each type have up to 75 % susceptible plants.

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Cooke, D. A. - *Controlling docking disorder.*

Docking disorder is the name given in England to damage to sugar-beet seedlings caused by the ectoparasitic nematodes *Trichodorus, Paratrichodorus* and/or *Longidorus.* It is almost entirely restricted to light, sandy soils and is most serious following wet springs when about 10 % of the national crop is affected. Soil-applied granular pesticides were first used on a wide scale in the British sugar-beet crop in 1974. Their use increased steadily, so that by 1985 about half of the national crop was treated. Only about a quarter of this use was specifically to control Docking disorder — the remainder was intended to control arthropod seedling pests, the aphids which transmit yellowing viruses or unspecified pests (as a general insurance). The materials approved for Docking disorder control are aldicarb (Temik or Sentry), oxamyl (Vydate), carbofuran (Yaltox), carbosulfan (Marshal) and benfuracarb (Oncol); two other materials are approved for use against arthropod pests only — thiofonax (Dacamox) and bendiocarb (Garvox). In 1985, of the 204 000 ha of sugar beet sown in England, 106 000 ha were treated with granular soil-applied pesticides. About 27 000 ha were treated principally to control Docking disorder and the preferred material for this use was aldicarb. Although yields have been greatly improved by pesticides in areas at risk from nematode damage, some symptoms may still occur in treated fields. One reason for this is the leaching of aldicarb which follows periods of excessive rainfall. Simulated leaching and degradation rates agree well with those measured in field experiments, and can help to explain the relatively poor control of damage which sometimes occurs. Experiments in 1985 on two fields at risk from Docking disorder compared all of the granular pesticides cleared for use on sugar beet in England. At both sites a wet spring resulted in severe damage in untreated plots (mean root yield 43.4 t/ha). Large yield increases followed the use of all materials approved for differences between products. Smaller yield increases followed the use of materials not approved for nematode control.

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Coomans, A., Verschuren, D. & Vanderhaeghen, R. - *Traumatic insemination and the demanian system in* Oncholaimus oxyuris *Ditlevsen (Nematoda : Oncholaimidae).*

Observations on living specimens confirm the hypothesis of traumatic insemination in *O. oxyuris* formulated by Chabaud *et al.* (1983). In this species copulation frequency is usually rather low although it can be enhanced by a temperature shock. Females are seized in their posterior body region by the male's tail and their cuticle punctured by the spicules. Initially the male injects a glandular substance (probably formed by the accessory gland) which flows through the body cavity towards the main duct of the demanian system, thus forming an interstitial channel (the so called terminal duct). The male then ejaculates and the sperm follows the secretion through the interstitial channel, reaching the main duct, where it aggregates around the uvette. From there the spermatozoa are moved to the uterus through the *ductus uterinus.* After the sperm has passed from the interstitial channel to the main duct, the channel collapses and its wall becomes highly folded. With each copulation, a new copulation pore and interstitial channel are formed, and therefore the " terminal duct(s) " and " terminal pore(s) " are not pre-existing structures. After withdrawal of the spicules, a " wound plug " temporarily seals the pore. If a second copulation follows shortly after the first, when the sperm of the first insemination has not yet reached the uterus, the sperm is probably evacuated to the intestine through the *ductus entericus* and the *osmosium.* Traumatic

insemination may occur in many more *Oncholaimus* species, where the phenomenon is linked with the demanian system. Why the latter system may be equally well developed in some apparently parthenogenetic species has still to be investigated and shows that the demanian system remains an interesting subject for further study.

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Davy de Virville, J.* & Person-Dedryver, F..** - *Action d'*Heterodera avenae *sur l'intensité respiratoire et la croissance de diverses Triticinées résistantes ou tolérantes au parasite.*

L'activité métabolique des racines de diverses Triticinées *(Triticum aestivum, Aegilops ventricosa)* présentant différents niveaux de résistance ou de tolérance à *Heterodera avenae* a été établie grâce à la mesure de certains paramètres caractéristiques tels que l'accroissement du poids de matière sèche et l'intensité respiratoire des tissus. Ces mesures ont été effectuées au cours des 18 premiers jours de croissance des plantules mises à germer en boîte de Petri sur milieu gélosé; les modifications de la croissance racinaire occasionnée par la présence du parasite ont également été relevées. Chez les plantules témoins des lignées les plus résistantes, les résultats traduisent une vitesse plus faible de l'élongation et de la croissance pondérale des racines. Par contre chez toutes les lignées, l'intensité respiratoire des tissus est comparable. Pour les plantules infectées, on observe un arrêt important de l'élongation auquel correspond une inhibition de l'intensité respiratoire des tissus chez les lignées les plus résistantes. Inversement, chez celles possédant un faible niveau de résistance, on peut observer une stimulation de l'intensité respiratoire (rapportée au gramme de matière sèche) qui survient au moment où de nombreuses petites racines se développent à partir du point d'infection. Ces différences peuvent être observées indépendamment du niveau de tolérance des différentes lignées. Chez les plantules témoins, ce caractère de tolérance semble plutôt se traduire par l'existence d'une vitesse d'élongation et de synthèses pondérales plus importantes que chez les autres lignées. Pour les plantules infectées, le caractère de tolérance semble correspondre à une moins grande altération du système racinaire dont la croissance est en particulier moins ralentie. L'ensemble de ces résultats permet ainsi d'envisager de pouvoir tester rapidement le caractère de tolérance ou de résistance de différentes triticinées.

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Dellaert, L. M. W. - *Resistance to the potato cyst nematode* (Globodera ssp.) *: resistant types and mechanism.*

To develop a strategy for breeding potato varieties with durable resistance to *Globodera* ssp. information about resistance types and mechanisms in different resistant genotypes is very important. Up till now the main sources for resistance breeding to potato cyst nematode in the Netherlands were resistant genotypes from *Solanum tuberosum* ssp. *andiga* and *S. vernei.* However, when grown on large scale, the resistance from potato cultivars bred from these sources, broke down after three to four cultivations on the same plot. Besides, when grown on infested soils, the yield reduction due to potato cyst nematode infection is often comparable to the reduction observed in susceptible varieties. Therefore, the present research at the Foundation of Agricultural Plant Breeding SVP concentrates on the development of progenitors with pathotype non-specific durable resistance combined with tolerance. A search for new sources of resistance has been carried out. In 1983, 1984 and 1985 about 800 accessions of the potato collection of the German-Netherlands Braunschweig Genetic Resources Centre (BGRC) were tested for resistance to *G. pallida* or *G. rostochiensis.* In nine accessions, resistant genotypes were selected with resistance to *G. pallida* virulence groups Pa-2 and Pa-3 as well as to *G. rostochiensis* virulence groups Ro_1, Ro_2, Ro_3, Ro_4 and Ro_5. In five of these accessions all genotypes with resistance to *G. pallida* were resistant to *G. rostochiensis* as well. The selection of resistant genotypes has been based on the average number of cysts per plant. Only genotypes with a multiplication rate less than one are selected. Between these genotypes differences in larvae penetration, development rate, ratio between male and female adult nematodes and the average number of eggs per cyst is observed. Resistant genotypes are crossed with susceptible *S. tuberosum* genotypes to study the heritability of the components of the resistance. Most of the " resistant " accessions of the BGRD collection segregated in suceptible and resistant genotypes to one *Globodera* ssp. virulence group. Genotypes with resistance to one virulence group often were susceptible to other virulence groups, indicating that the resistance is based on genes participating in a gene-for-gene relationship. Only four accessions of *Solanum spegazzinii* (2x) and *S. vernei* (2x) were selected with resistant genotypes that dit not segragate and showed a high level of resistance to all virulence groups of *Globodera.* Changes in cell structure in roots of resistant potatoes parasitized by *Globodera* ssp. have been studied in different cultivars. In cultivars with resistance to *Globodera rostochiensis* Ro_1 (from *S. tuberosum* ssp. *andigena*), a hypersensitive reaction in the cells surrounding the nematode was observed. In cultivars with *G. pallida* Pa2 resistance (from VTN-62-33-3) or Pa2 + Pa3 (from *S. vernei*) also a hypersensitive raction is observed. In the genotypes studied much more cells were affected as in the *G. rostochiensis* resistant genotypes.

Foundation agric. Plant Breeding, SVP, Postbus 117, 6700 AC Wageningen, Nederland.

Den Nijs, H. J. M. F. - *Possibilities to control potato cyst-nematodes by growing species-specific resistant potato varieties.*

To control the potato cyst-nematodes *Globodera rostochiensis* and *G. pallida,* an integrated pest management program is carried out in the Nerthelands. In this sheme cumulative resistant potato varieties are very important. New pathotypes however limit the use of the resistant cultivars, therefore control depends largely on chemicals. The aim of this project is to investigate whether the nematode populations can be manipulated in such a way that the emergence of new pathotypes will down or be suppressed. The hypothesis is that the reproduction of *G. pallida* is less in competition with *G. rostochiensis.* Therefore the increase in frequency of *G. pallida* virulent pathotypes will be delayed when species-specific resistant potato varieties are grown in alternation. Two clones from the Plant Breeding Institude, Cambridge, with resistance to Pa1, Pa2 and Pa3 and with a multiplication rate equally to that on the susceptible variety were selected for the experiments. The relationship between initial (Pi) and final (Pf)

densities for both species on these clones were all according to the equation $Pf = a(1 - q^{Pi}) - 1$ ng. Besides a CPC2802 clone from the Scottish Crop Research Institute, which turned out to be resistant to both species, the variety Elhana, only resistant to *G. rostochiensis*, and the susceptible variety Bintje were used. Pot experiments were set up in which initial densities and species ratio's of *Globodera* were varied. Data are collected on the multiplication of the *Globodera* species in the different mixed populations on these species-specific resistant varieties. Electrophoretic techniques are being used for this. Results will be available in the next year. Additional work will be : *i)* estimation of the spatial distribution of both species in the field; *ii)* field experiments; *iii)* computer modelling.

Institute for Plant Protection, P.O. Box 9060, 6700 GW Wageningen, Nederland.

Dickson, D. W. & Hewlett, T. E. - *Vertical migration of* Meloidogyne arenaria *in soil columns in the field.*

Polyvinylchloride (PVC) columns 45, 60, 90, and 120 cm long × 12.7 cm internal diameter were packed with pasteurized soil and buried vertically in a field naturally infested with *Meloidogyne arenaria* race 1. A 15 cm long × 12.7 cm diameter PVC root chamber with the top and bottom covered by plexiglass (15 cm × 15 cm × 0.3 cm) and nylon monofilament screen cloth (15 µm openings), respectively, was glued and taped to each column and filled with pasteurized soil. A single bare root tomato seedling was transplanted into the root chamber through a 1.5 cm hole in the flat plexiglass covering. A duplicate of each tube was placed in the field and replicated four times. Fifteen to 20 egg masses of a greenhouse culture of *M. arenaria* race 1 were placed at the bottom of duplicate tubes. Clay saucers were used to seal the bottom of control tubes. Juveniles of the field population migrated at the rate of 2 to 4 cm per day. They moved a distance of 45 or 120 cm and induced galls on the tomato seedling in 13 and 29 days, respectively. In every case the inoculated juveniles induced a greater number of galls than did the field population.

Univ. Florida, Dept. Entomol & Nematol., Gainesville, FL 32611, USA.

Duncan, L. W. & Noling, J. W. - *The relationship between citrus tree health and* Tylenchulus semipenetrans *infestation level.*

Tylenchulus semipenetrans infestation levels and feeder root abundance on one hundred mature Valencia orange trees growing on sour orange rootstocks were measured monthly during a fall period of root flush (net root increase) activity. The natural logarithm of feeder root weight was directly proportional ($p = 0.01$) to a visual, quantitative estimate of tree vigor. Female *T. semipenetrans* per gram feeder root varied by observation period but not by feeder root abundance. Juvenile *T. semipenetrans* per gram feeder root and monthly net increase of feeder root weight/sample were inversely related ($p = 0.01$) to feeder root abundance. These observations suggest that the proportion of young feeder roots in a root system increases with declining tree health which may enhance nematode infestation levels by permitting higher fecundity and higher subsequent damage to young roots.

University of Florida, IFAS, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850, U.S.A.

Eriksson, K. B. & Banck, A. - *Distribution of virus vector nematodes in Sweden and their significance in plant disease.*

Data on the distribution of virus vector nematodes in Sweden were collected from nation-wide faunistic surveys of arable land and natural biotopes, including samples from potato and sugarbeet fields, onion and strawberry fields, and from nurseries (including forest nurseries). First records date from the beginning of the 1960s, but most of the information is from the last 10-15 years. The following species have been identified : *Paratrichodorus pachydermus, P. teres, Trichodorus primitivus, T. similis, T. sparsus, Longidorus elongatus, L. leptocephalus* and *Xiphinema diversicaudatum.* However, there are also other species, whose identity has yet to be confirmed. *P. Pachydermus* was the most prevalent and widespread species, followed by *T. primitivus*, while *P. teres* and *T. sparsus* were recovered only occasionally. The trichodorids, which often occur in mixtures of species, are typically found on lighter soils with good water-retention capacities. Of special interest was the presence of trichodorid species, sometimes in fairly high densities, in 22 out of 26 forest nurseries. The trichodorids also appeared frequently in nurseries for horticultural plants. *Longidorus elongatus* was the most common *Longidorus* species; *L. leptocephalus* has been identified from three localities only. The *Xiphinema* records, six in total, were all *X. Diversicaudatum*, three of which were collected from below 30 cm depth. The virus vector nematodes are recorded mostly from Southern Sweden. There are very few records north of latitude 60° N. The trichodorids and *L. elongatus* have been associated with crop damage, as root ectoparasites of onion and strawberries, and as virus vectors. Records of nematode-transmitted viruses in Sweden include sporadic reports of tomato black ring virus, tomato ringspot virus, arabis mosaic, and pea early browning virus, and more frequently tobacco rattle virus (TRV). As vectors of TRV the trichodorids are implicated in spraing in potatoes, a disease which seems to be increasing in frequency and is therefore a matter of concern in commercial potato production. This is not mitigated by our recent finding that potato mop-top virus is also part of the spraing syndrome. Repeated sampling in a potato field revealed high trichodorid densities of viruliferous nematodes to a depth of 40 cm. The trichodorid populations were of higher densities during May-July than later in the autumn. On the contrary TRV incidence was more frequent towards the end of the growing season. The significance of this will be discussed in relation to control measures, migration of the nematodes in the soil profile, and with respect to the nematodes as a possible " virus reservoir " through the winter.

Swedish University of Agricultural Sciences, Department of Plant and Forest Protection, Box 7044, 750 07 Uppsala, Sweden.

Ferris, V. R. & Ferris, J. M. - *Two dimensional protein patterns in* Heterodera avenae.

Two-dimensional (2-D) protein patterns were compared for five isolates of cereal cyst nematode (*H. avenae* Woll.) from Sweden, supplied by A. Ireholm. Sources, pathotypes, and strains (Swedish nomenclature) of the isolates were as follows : 1) Ask, pathotype Ha 11; 2) Nässja, pathotype Ha 12; 3) Våxtorp, " Våxtorp " pathotype; 4) Hjelmsäter, " West " Gotland strain; 5) Etelhem, " East " Gotland strain. All isolates were increased in growth chambers on the susceptible barley (*Hordeum vulgare* L.) " Varde ". Root zone temperatures were maintained at 10° for the first two weeks, followed by an increase to 20° for the remainder of the growth

period. Proteins for analysis were obtained from samples comprised of 30 young (white cyst stage) female nematodes picked from roots and cleaned by water rinses prior to homogenization in 0.2 M sodium borate at pH 9. After centrifugation followed by dialysis of the supernatant, the proteins were labeled *in vitro* by reductive methylation with formaldehyde and sodium [^{3}H] borohydride. Proteins from the different isolates were paired for electrophoresis in a variety of possible combinations during repeated runs for each isolate. The pH gradient of the first dimension was measured using 1-cm segments of the isoelectric focusing gels; and molecular weight standards were run in the second dimension with the nematode proteins. Proteins and polypeptides (located on gels by fluorography) with identical electrophoretic properties were assumed to be identical. Protein patterns for isolates 1 (Ask) and 2 (Nässja) were very similar, although a few unique protein spots were present in the pattern for each. The 2-D protein pattern of isolate 3 (Våxtorp) was also similar to the patterns of 1 and 2, but differed more than the patterns of isolates 1 and 2 differed from each other. One prominent spot present in isolate 2, but missing in isolate 1, was present in the Våxtorp isolate. The 2-D protein patterns for isolates 4 (Hjelmsäter) and 5 (Etelhem) had many similarities to each other, and some differences as well. The patterns of these two isolates (4 and 5) were very different from the patterns of the other three isolates, although some commonalities existed among all five isolates.

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Fleming, C., Marks, R. J. & Turner, S. J. - *The identification of cyst-nematodes using agarose isoelectric focusing and silver staining.*

A major problem faced by nematologists involved in extensive statutory soil sampling programmes is the identification of the large numbers of cyst-nematodes commonly detected in field samples. Such samples may contain mixtures of relatively harmless cyst-nematodes (e.g. *Punctodera punctata*) and serious pests such as *Globodera rostochiensis, G. pallida* and *Heterodera avenae.* Identification of large numbers of cyst-nematodes using classical cyst and juvenile morphometric characters can be time consuming and labour intensive. The use of agarose isoelectric focusing in conjunction with a silver staining technique was used to examine the General proteins from a range of *Globodera, Heterodera* and *Punctodera* cyst-nematodes. The sensitive silver stain permitted very small amounts of nematode protein to be visualized and, along with the short running time required for agarose isoelectric focusing, facilitated the rapid identification of large numbers of cyst-nematode species from statutory soil samples. Silver stain banding patterns obtained for both species of PCN were quantitatively and qualitatively different from general protein patterns obtained after Coomassie Brilliant Blue staining (Fleming & Marks 1983). However, as with Coomassie, the banding patterns were quite distinct for each species and could be used to distinguish between the two forms. General protein patterns for *P. punctata* were also found to be distinct and a number of bands could be used to separate this species from *G. rostochiensis* and *G. pallida.* Examination of the electropherograms for a range of *Heterodera* species *(H. schachtii; H. humuli; H. carotae; H. avenae; H. mani)* revealed species specific banding patterns which permitted the rapid identification of these nematodes. Work on the quantitative aspects of this silver stain and its application to estimating nematode numbers is currently under investigation but preliminary work indicates as few as 10-20 juveniles could be detected i.e. silver staining was 20 to 30 times more sensitive than Coomassie Brilliant Blue staining.

Department of Agriculture, Nematology Laboratory, Felden, Mill Road, Newtownabbey, Co. Antrim, BT 36 7ED, UK.

Forrest, J. M. S. & Robertson, W. M. - *The nature and possible function of saccharide residues on the head region of juveniles of potato cyst nematodes.*

Four or five sugars have been found on the surface of juveniles of PCN and the amount present varies between individuals and some pathotypes. These substances are of nematode origin, being present only in small quantities on unhatched juveniles, but increasing on juveniles hatched from surface-sterilized eggs. They are at least partly glycoprotein. Treatment with sodium hypochlorite for short periods abolishes lectinbinding, and treated juveniles lose the ability to invade the host plant. This suggests a role for the amphids in host finding and/or selection of a site on the root surface.

Scottish Crop Research Institute, Invergowrie, Dundee, DD2 5DA, U.K.

Forrest, J. M. S. & Trudgill, D. L. - *The emergence of juveniles of potato cyst nematode from the roots of resistant plants.*

Juveniles of *G. rostochiensis* R_01 emerge in large numbers from plants derived from *S. tuberosum* spp. *andigena* CPC 1673 (H_1) and *S. vernei* whereas those of *G. pallida* leave *S. vernei* and *S. tuberosum* ssp. *andigena* CPC 2802. Emigrants are subsequently unable to re-invade susceptible potatoes. Changes in surface-labelling by lectins and the structure of the amphidial exudate are described.

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Geraert, E. - *The use of the female reproductive system in the classification of the Tylenchida (Nematoda).*

The part of the uterus where the egg shell is formed has been called crustaformeria. The number of cells is apparently constant for a given species and the arrangement has been described as cells in three rows (tricolumella), cells in four rows (quadricolumella), in multiple rows or not in rows. From a comparative study of several genera it appears that the major subdivisions of the Tylenchida can be sustained by this difference in arrangement and, in particular, that the difference tricolumella-quadricolumella is helpful in elucidating some problems within the Tylenchoidea.

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Gomes-Carneiro, R. & Cayrol, J. C. - *Étude de l'utilisation de cinq doses du champignon* Paecilomyces lilacinus *(Thom.) Sanson, 1974, dans la lutte biologique contre* Meloidogyne arenaria *(Neal, 1889) Chitwood, 1949.*

Dans un essai conduit en serre, on a testé l'efficacité de cinq doses (0,01 g, 0,1 g, 1 g, 10 g et 100 g/m^2) d'une poudre de

spores de *P. lilacinus* (10^{11} conidies/g) contre une très forte infestation de *M. arenaria*. L'expérience a été suivie pendant onze mois : trois générations de *M. arenaria* sur trois cultures successives de tomates, cv. St Pierre. On a observé que les nombres de propagules dans le sol suivent toujours l'ordre des dosages initiaux et diminuent progressivement avec le temps. On peut même déterminer une équivalence dose/durée. Les dosages 1, 10 et 100 g/m^2 ont réduit de façon significative la population de *M. arenaria* dans les deuxième et troisième générations et leurs effets sont significativement différents entre eux et par rapport aux témoins, sans champignon. Les doses 0,01 et 0,1 g/m^2 sont complètement inefficaces et comparables aux témoins sans champignon. Le nombre de pontes infestées par *P. lilacinus*, ainsi que le nombre d'œufs parasités s'accroissent avec la dose de champignon dans les trois générations. Entre ces deux nombres apparaît une corrélation linéaire étroite, significative à 1 %. L'augmentation effective du niveau d'infestation des plantes par *M. arenaria* et la diminution du pourcentage de pontes infestées à la troisième génération, même dans les forts dosages (10 et 100 g/m^2) peuvent être expliqués par la réduction progressive du nombre de germes du champignon dans le sol. Le pouvoir parasitaire de *P. lilacinus* décroît en effet corrélativement avec le nombre de spores par gramme de sol et avec le temps. D'une façon générale, le contrôle effectif du nématode est assuré quand le champignon est présent en grandes quantités dans le sol, aux environs de 10^4 à 10^5 conidies par gramme. La décroissance avec le temps du champignon dans le sol jusqu'à un seuil au-dessous de son niveau de contrôle constitue donc un problème quand on envisage son utilisation comme agent de lutte biologique.

INRA, Station de Recherches de Nématologie et de Génétique Moléculaire des Invertébrés, B.P. 2078, 06606 Antibes, France.

Gommers, F. J. & Bakker, J. - *Mode of action of α-terthienyl* in vitro *and* in vivo.

The compound α-terthienyl from *Tagetes* species was described as a nematicidal principle from the roots, together with the biogenetically related 5-(3-buten-1-ynyl)-2,2'-dithienyl. Thus a chemical base was given to the suppressing effects of growing marigolds on populations of endoparasitic nematodes such as *Pratylenchus penetrans*. Toxicity of α-terthienyl *in vitro* has been shown to depend on type II photodynamic action. The compound, if excited by near ultra violet light, — transfers its excitation energy to molecular oxygen which is than activated to the toxic singlet state. When α-terthienyl is kept in the dark or is mixed with soil, where light is absent, the compound is completely devoid of nematicidal activity. The intruiging question which remains to be solved wether or not α-terthienyl and related compounds are involved in the killing effects on endoparasitic nematodes of growing *Tagetes* roots in the soil and therefore in the dark. A model will be presented, based on enzymatic excitation of α-terthienyl, explaining the mode of action of these compounds in the living roots of *Tagetes*.

Department of Nematology, Binnenhaven 10, Wageningen, Netherlands.

Gonzalvez Fernández, E., Pérez, J. A., García, O., Vázquez, R., Fernández, M., Jiménez, E. Mola, G. - *Distribution and incidence of parasitic nematodes associated with guava* (Psidium guajava *L.) crop in Cuba.*

From 1977 to 1982, sixty-seven guava orchards in different provinces were sampled by taking roots and soil from the plant rhizospheres at three points and at depths from 5 to 30 cm. The nematodes were extracted from the soil by means of sieves plus Baermann's funnels and from the roots using a blender and sieves, additionally, roots were observed under the stereo-microscope for root-knot nematodes. Seventy species belonging to 20 genera of phytoparasitic nematodes were detected. *Meloidogyne, Helicotylenchus, Pratylenchus* and *Xiphinema* were the most widely distributed genera in the crop. Damage was most frequently associated with *Meloidogyne incognita, M. arenaria, M. hapla, Pratylenchus brachyurus* and *P. neglectus*. The *Meloidogyne* species caused severe destruction of the root system, galling and tumors on all types of roots, as well as aerial wilt symptoms, foliar discoloration, premature leaffall, yield losses and occasionally death of the plants. The aerial symptons were accentuated under adverse environmental conditions. *Pratylenchus* spp. were found associated with short longitudinal necrotic lesions on secondary roots. In 5-7 years old plantations on soils rich in clay, the largest larval populations of *Meloidogyne incognita* were found at distances of 75-135 cm from the basis of trunks and at a depth of 30 cm. In some regions seven species of nematodes were found to be parasitized by *Bacillus penetrans*.

Centro Nacional de Sanidad, 150 No 2125, E/. 21 A y 25 Reparto Siboney, C. Habaña, Cuba.

Gooch, P. S. - *Plant nematology in the European USSR : a literature analysis from the CAB data base.*

Work on Plant Nematology in the European USSR over the period 1973-1985 is analyzed in terms of the literature recorded in the database of the Commonwealth Agricultural Bureaux. Tabulations of crops and aspects of nematode interaction with them, such as biology, life control and economic loss are used in an attempt to identify some of the trends in research in plant nematology in this part of the USSR and to emphasize the contribution of Russian nematologists.

Commonwealth Institute of Parasitology, 395 A Hatfield Rd., St. Albans, Herts AL5 3EU, UK.

Grandison, G. S. - *Root knot nematode on kiwifruit in New Zealand.*

The most important nematode pathogenic to kiwifruit throughout the world is the root knot nematode. (*Meloidogyne arenaria* in Australia, Brazil, Italy; *M. hapla* in Australia, Chili, France, Italy, New Zealand; *M. incognita* in Australia, Chili, USA; *M. javanica* in Australia, Italy). In New Zealand, if all conditions of cultivation are optimum in the field, such as moisture, drainage, nutrition, soil conditions and shelter from wind, the growth of plants may not be affected by nematode infection. But if any one of these cultural conditions is inadequate, control of root knot, nematode may be necessary to maintain high production of kiwifruit. Only clean, healthy nematode-free nursery plants should be planted. If control is necessary, a bare root of dormant plants in 0.1 % a.i. phenamiphos for 1 hour gives virtually complete control. In established orchards a total of 10 kg a.i./ha of either oxamyl or phenamiphos in three split applications in November, December and February (in N.Z. conditions) will give adequate control. To date there are no known rootstocks of *Actinidia* sp. resistant to *M. hapla*. Use of mycorrhizal fungi

may be an acceptable control practice since this technique was highly successful in controlling *M. incognita* on tamarillo *(Cyphomandra betacea).* Use of nematode resistant legumes as inter-row crops is another possible control measure which is being investigated.

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Griffin, G. D.*, Gray, F. A., Johnson, D. A.*** - *The effect of* Meloidogyne hapla *on* Phytophthora *root rot of alfalfa.*

Phytophthora root rot of alafalfa, incited by *Phytophthora megasperma* f. sp. *medicaginis,* is found associated with the northern root-knot nematode, *Meloidogyne hapla,* in areas of alfalfa decline in the western United States of America. In view of this, a study was conducted to determine the interaction between *M. hapla* and *P. megasperma* f. sp. *medicaginis* on " Deseret " alfalfa, susceptible to *M. hapla* and *P. megasperma;* Apollo II' alfalfa, susceptible to *M. hapla* and resistant to *P. megasperma;* and " Nevada Syn XX" alfalfa, susceptible to *P. megasperma* and resistant to *M. hapla.* There was a synergistic interaction between *M. hapla* and *P. megasperma* on Deseret and Apollo II alfalfas, and plant mortality and plant growth suppression were significantly increased when inoculation with *M. hapla* preceded that of *P. megasperma.* Mortality rates of Apollo II from *M. hapla, P. megasperma, M. hapla* plus *P. megasperma,* and untreated control were 8, 0, 25, and 0 %, respectively. This corresponded to 25, 3, 58, and 0 % mortality for Deseret, respectively. *M. hapla* did not increase the susceptibility of Nevada Syn XX to *P. megasperma,* and *P. megasperma* did not reduce the resistance of Nevada Syn XX to *M. hapla.* Soil type affected the nematode-fungus interaction on Deseret alfalfa; the greatest mortality rate and growth suppression occurred in clay soil.

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Heijbroek, W. - *Multiplication of beet cyst nematodes* (Heterodera schachtii *and* Heterodera trifolii *f. sp.* betae) *on resistant sugar beets and cruciferous green manure crops.*

Diploïd sugar beets homozygous for resistance to *Heterodera schachtii* have been developed out of monosomic addition lines originating from *Beta procumbens.* These diploïd resistant plants can be used as pollinators, since the male transmission of resistance has been increased to nearly 100 %. Although single cysts are formed on the roots, the population of *H. Schachtii* will be decreased and a clear correlation between Pf and Pi could not be detected. Yellow beet cyst nematodes *(H. trifolii* f. sp. *betae)* multiplied rapidly on resistant diploïds and no differences in susceptibility as compared to commercial varieties was found. On the contrary the source *B. procumbens* still showed considerable resistance to yellow beet cyst nematodes; during the selection procedure some genes for resistance might have been lost probably. The degree of resistance was often correlated with the number of hypersensitivity reactions, estimated by counting necrotic spots. However, in some of the resistant material the hypersensitivity reaction was much less, probably caused by wilting tolerant material being used as pollinators. Both beet cyst nematodes showed a density dependent multiplication on partially resistant fodder radish varieties, the content of the freshly formed cysts being reduced. Under optimal conditions the multiplication factor will be more than in fallow land at initial densities below circa 1 000 larvae per plant. In one highly resistant variety these effects were not detected. With respect to resistant mustard varieties similar relations were established as in fodder radish varieties, but no reduction of the content of the freshly formed cyst was detected, as compared to susceptible standards. In resistant mustard varieties many cysts were formed on a very small number of susceptible plants.

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Heinicke, D. - *Experience in the control of* Heterodera schachtii *using nematode resistant green manuring crops.*

Since 1980 field studies have been carried out in Lower Saxony in reference to the reduction of the population of *H. schachtii* using resistant green manuring (gm) two related factors seem to be important in the effect of gm : the sowing time and in connection to this the soil temperature. As a result of the late grain harvest and the subsequent need of straw and stubble cleaning (tilling the straw into the earth) the sowing occurs relatively late in the year. Despite the development of the plants a single cultivation is unsatisfacting in the control of *H. schachtii.* Over some years the reduction achieved in population was 20 % using fallow ground or *Phacelia* as control and 50 % using resistant gm. The average yield of sugar beet was 560 dt/ha less than the control. A significant surplus was realized following the introduction of resistant gm. As expected, the nematode population increased significantly after sugar beet growing. Despite increased reproduction after following resistant. The overall effect was a light reduction in population increase. The average population increase occuring between drilling and harvesting sugar beet was six-fold following *Phacelia,* five-fold after oil radish (Pegletta, Nemex) and three-fold after mustard (Maxi, Emergo). The considerable variation in these results suggest interactions between population hights, different soil conditions and years. Despite the effects of the three year sugar beet rotation the use of resistant gm reduces the nematode population slightly or keeps it steady.

Pflanzenschutzamt, Wunstorfer Landstr. 9, 3000 Hannover 91, B.R.D.

Heinicke, D.*, Ohms, J. P. & Schultz, S.*.** - *Species and pathotype identification of the potato cyst nematodes* (Globodera rostochiensis *and* G. pallida) *by micro-2D-electrophoresis of single cysts.*

Proteins extracted from single cysts of the potato cyst nematodes *Globodera rostochiensis* and *G. pallida* are separated by micro-2D-electrophoresis (IEF (Servalyt pH 4-6 and 3-10 mixtures) in polyacrylamides gels containing urea xSDS-PAGE in 15 % polyacrylamide gels) into three groups. These are classified as " unspecific spots ", " specific spots " and " pathotype specific spots ". The species differ in five main spots. Compared to the species " specific spots " the " pathotype specific spots " are weak. Furthermore, some of them are localized close together in the electrophoretic pattern (pH 4.5-5.0 IEF; R_f 0.5-0.6 SDS-PAGE). While the pathotypes Ro1-Ro5 differ from each other in one to three

spots, those of Pa2 and Pa3 differ in the pattern of only one group of spots. Among the five pathotypes of *G. rostochiensis* only Ro5 reveals a spot of relatively high intensity which is shifted to a higher pH compared to the other spots. Unfortunately, unlike species not all populations can be defined, as the pathotypes are not always distinct. For identification purposes newly formed large full cysts are needed.

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Hooper, D. J. - *The use of the scanning electron microscope in the taxonomy of* Aphelenchoides *species.*

The scanning electron microscope (SEM) has proved very useful in determining some of the basic features used in the identification of species of *Aphelenchoides.* Many species within this group have a similar face pattern which includes a distinct labial disc and a head region that is finely annulated; occasionally the labial disc is absent and one population has been found in which the head region is without a labial disc or annulation. The number of incisures on the lateral fiels, although not always readily resolved with the light microscope, is usually distinct when viewed with the SEM but considerable variation occurs within populations and this may be due partly to the fixation/processing technique used. The female tail may have a simple, plain, terminal mucro but in some populations small cuticular projections are often present which give the tail a fuzzy appearance when viewed with the light microscope. The paired spicules of the males can be dissected out and their structure examined in detail with the SEM. The differences in spicule shape between populations are enhanced. The pattern of cuticular thickening on the inner surface of the spicules differs considerably from that on the outer surface and sometimes shows features that are characteristic for a particular species.

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Ivezić, M. & Šamota, D. - *Seasonal variation and distribution of the genus* Xiphinema *in vineyards of Savonija and Baranja.*

The investigation was made to determine the seasonal variation and distribution of species of the genus *Xiphinema* in vineyards of northeastern Yugoslavia. The investigation, carried out over a period of three years, showed that the two species *Xiphinema vuittenezi* Luc *et al.*, 1964 and *Xiphinema pachtaicum* (Tulaganov, 1938) Kirjanova, 1951, occurred frequently to a depth of 150 cm in our vineyards. *X. vuittenezi* was most numerous as larval stages, at all sampling depths between spring and winter. Similarly, *X. pachtaicum* was found at all depths, mainly as larval stages, but with the highest populations between autumn and spring.

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Jacobs, P. J. F.*, Heyns, J.*, Coomans, A. & Loots, G. C.***** - *Ultrastructure of the pharyngeal region in Longidoridae.*

A comparative electron microscopy study of the genera *Longidorus, Longidoroides, Paralongidorus* and *Xiphinema* revealed the presence of flanges at the posterior part of the odontophore in all these genera. However, in *Xiphinema* they are well developed with anchor-shaped apexes, while they are variously developed. This indicates that a reduction of the flanges has occured inside the longidoridae. The presence of four pairs of stylet retractor muscles in *Xiphinema vanderlindei* is a new record for the family and considered to be a primitive condition. It adds further weight to the hypothesis that *Xiphinema* represents the oldest genus of the Longidoridae.

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Janssen, R. - *Genetic studies on potato cyst nematodes.*

The diapause of potato cyst nematodes was bypassed by avoiding dessication of the cysts. Larvae were artificially hatched by cutting the cysts in halves and subsequent incubation in potato root diffusate. Approximately 40 % of the cyst contents hatched. These treatments had no influence on viability and fertility as ascertained by rearing nematodes in pots and on roots of sprouts grown on water-aggar in Petri dishes (Mugniery, 1982). With the artificial hatching procedure it is possible to produce 5-6 generations a year in Petri dishes and 3-5 generations in pots. Artificially hatching considerably accelerates genetic studies on pathotypes of potato cyst nematodes. Controlled matings were made by fertilizing single females on roots of potato sprouts on water-agar in Petri dishes with one male. Thus several inbred lines of *G. rostochiensis* were obtained with 100 % virulent individuals for the differential *Solanum tuberosum* ssp. *andigena.*

Department of Nematology, Binnenhaven 10, Wageningen, Netherlands.

Kozlowska, J. & Dmowska, E. - *The influence of semi-liquid manure on soil nematode communities.*

The aim of this work was to study the effect of semi-liquid manure (s.l.m.) on communities of soil nematodes. S.l.m. was applied at various doses equivalent to those commonly used as fertilizer and similar to that generated as waste by swine producers. The studies were carried out on arabal land and in a greenhouse. The results obtained from field investigations showed that applications of s.l.m. at fertilizer rates caused an increase of number of nematodes, particularly true saprobionts, although no important change in the composition of the community was observed. However, a change in the number of nematodes and in the composition of their community was caused by higher rates of s.l.m. At sites where the dose was so high that plants were killed, nematodes were very numerous but the communities were taxonomicaly very poor. At these sites as many as 34 800 individuals in 500 g of soil were found composed only of true saprobionts of which 90 % were *Rhabditis.* Smaller changes were observed in a field treated with intermediate doses of s.l.m. Results from a greenhouse experiment have confirmed those obtained from field investigations concerning the changes in nematodes communities by various doses of s.l.m. Moreover, it has

indicated that these changes are short lived and after application of s.l.m. revert relatively quickly.

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Kruger, J. C. de W. - *New data on the morphology and arrangement of spines in the uteri of some* Xiphinema *species.*

The spiniform structure (spines) in the uteri of the type material of *Xiphinema coomansi* Kruger & Heyns, 1986, *X. ingens* Luc & Dalmasso, 1963, *X. loteni* Heyns, 1986, *X. malagasi* Luc, 1973. *X. mammatum* Siddiqi, 1979, *X. michelluci* Siddiqi, 1979, *X. rarum* Heyns, 1979 and *X. spinuterus* Luc, 1973, and specimens of two yet undescribed species of this genus from South Africa, were studied on a comparative basis. The investigation made new data available concerning the specific morphology and arrangement of these peculiar uterine structure, that could eventually shed light on there specific function. Observations made from this study seen to indicate that the following three divergent kinds of uterine spines could readily be distinguished in *Xiphinema : i)* spines attached by means of a relatively smooth base to the uterine wall with *X. spinuterus* as an example; *ii)* spines attached by means of a centrally-situated projection in the corners of a " network " in the uterine wall with *X. michelluci* as an example; *iii)* spines attached by means of a forked base to the uterine wall with *X. mammatum* as an example. It is concluded from the study that nematologists should, for the sake of accuracy, be encouraged to distinguish between these three kinds of uterine spines in *Xiphinema* and to let this be reflected in routine description and illustrations.

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Kurppa, S. - *Distribution of* Pratylenchus *spp. in Finnish agricultural soil.*

During the survey conducted in 1978-1980 *Pratylenchus* spp. were found in 50 % of the samples from arable areas and 40 % of the samples from horticultural nurseries. The major species in arable soils was *P. crenatus* and in gardens and nurseries *P. penetrans. Pratylenchus* nematodes were most abundant in strawberry fields. 70 % of the samples from strawberry fields were infested and in 5 fields more than 200 specimens per 200 grams of soil were found. Other *Pratylenchus* species identified were *P. pratensis, P. fallax* and *P. convallariae.* Associations between *Pratylenchus* spp. and root decaying fungi e.g. *Fusarium* spp., *Gnomonia* spp., *Cylindrocarpon* spp. and *Coniothyrium* spp. have been studied.

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Leach, L.*, Gahan, P.* & Trudgill, D. L.** - *Mechanisms controlling nematode development.*

To learn more about the control of moulting and development in nematodes the relationship between feeding, growth and moulting in *Goodeyus ulmi* was studied in relation to changes in ultrastructure and to the secretion of hormones by nerves. These studies showed that *G. ulmi,* a nematode that can be cultured readily on fungi, required 108 days/degr. above a threshold temperature for development of 1.3° for its complete lifecycle. At 20° juveniles in the fourth stage fed for 29 h before commencing to moult but that they would still moult after feeding for 23 h. Immediately prior to moulting there was an intensive build-up of mitochondria, golgi bodies and glycogen granules in muscle cells underlying the hypodermis, along with the appearance of extensive membrane structures in the lateral cords. Cytochemical and immunocytochemical investigations showed that the classical neurotransmitters acetylcholine, serotonin and α amino butryic acid were present at specific sites in the nervous system. In addition sites of neuropeptide production, such as adrenocorticotrophic hormone and FMRF-amide which might be involved in the control of development, were also found.

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Magnusson, C. - *Effects of the beet cyst nematode and a wilt fungus on winter rape.*

Seedlings of winter rape, *Brassica napus* var. *oleifera* (cv. Brink), were planted in pots containing 1 000 cm^3 sandy soil infested with beet cyst nematodes, *Heterodera schachtii* Schmidt, with initial population densities (Pi) of 0.25, 1, 2, 5, 10, 50, 100 and 190 nematodes/cm^3. In one treatment the distal third of the seedling root was cut off before planting. The following day half of the experiment was inoculated with the wilt fungus, *Verticillium dahliae* Kleb. at a density of 38 × 10^6 microconidia per pot. The experiment was run for 54 weeks in growth chambers with air temperatures of 9-17° (11 weeks), 2-6° (24 weeks), and 11-17° (19 weeks). Temperatures and light-periods simulated the conditions of southern Sweden. The nematodes increased in all treatments except at Pi = 50, 100 and 190 nematodes/cm^3. The number of early leaves, plant dry weights and seed yields were significantly reduced at Pi = 0.25-5 nematodes/cm^3. Pi-levels of 5 nematodes/cm^3 reduced seed numbers by 49 % and seed dry weights and root dry weights by 35 %. Effects on the 1 000 seed weight were not recorded except for a significant increase at Pi = 5 nematodes/cm^3 and in the treatment with cut roots. In the absence of nematodes, *V. dahliae* significantly reduced the seed number by 30 % and the number of early leaves was also affected. The effect of nematode-fungus combinations were mostly additive and significant growth reductions were frequently recorded at lower Pi-levels compared to treatments with only nematodes. Wilt symptoms were occasionally observed, but were difficult to distinguish from normal symptoms of senescense. The only recorded significant reduction in shoot height was 13 % and occured at Pi = 190 nematodes/cm^3 in the presence of the fungus. The strongest synergistic nematode-fungus interaction was recorded in root weights with a 60 % reduction at Pi = 5 nematodes/cm^3. Weaker synergistic interactions were noted in top dry weights with a 27 % reduction at Pi-levels of 10, 50 and 190 nematodes/cm^3. A weak synergistic interaction was also observed in seed dry weights with 22 % reduction at the low Pi-level of 0.25 nematodes/cm^3. The fact that the common nematode field densities of 0.25-5 ind./cm^3 caused heavy reductions in seed yield without noticeable decreases in shoot height deserves more attention. *H. schachtii* should not be underestimated as a pathogen of oil seed rape based solely on above-ground symptoms. The absence of clear wilt symptoms in the cut-root treatment indicated a too-low inoculum density of the fungus. This, however, did not

prevent the occurrence of synergistic nematode-fungus interactions in vital plant parameters. The possibility of interactions between *H. schachtii* and *V. dahliae* deserves further attention in connection with the *Verticillium*-wilt of oil seed rape.

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Magnusson, M. L. & Eweida, M. - *Identification of* Globodera rostochiensis *and* G. pallida *by ELISA.*

Identification of the potato cyst nematodes, *Globodera rostochiensis* and *G. Pallida*, and their pathotypes is laborious and time consuming. Serological methods to detect and identify plant viruses and bacteria are well established in plant pathology. The aim of the present study was to evaluate the possibility of identifying cyst nematodes, and eventually their pathotypes using the ELISA-method based on polyclonal antibodies. Antiserum was produced by injecting proteins from cysts of a Swedish *G. rostochiensis* Ro1-population into a rabbit. The antiserum detected Ro1-populations from Sweden and Finland, but a Swedish *G. pallida* population reacted negatively. Somme Finnish populations, not pathotyped in biotests, reacted negatively, while some other Finnish populations resembled the Ro1-results in the ELISA-tests. Morphometrics of juveniles and cysts of all the Finnish populations fit that of *G. rostochiensis*, although some overlapping was found. The use of ELISA as a tool for distinguishing potato cyst nematodes and their pathotypes might prove valuable. However, to identify all the known pathotypes (or virulence groups) may prove difficult, as the pathotypes are separated using test plants with oligo- or polygenic resistance, and the genetic background of the pathotypes is not always known. A combination of electrophoretical and serological methods to increase the sensitivity for detecting closely related nematode species and pathotypes may prove useful.

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Marks, J. & Turner, S. I. - *The effect of microwave radiation and sodium hypochlorite on the viability of potato cyst nematodes.*

Previous published investigations of chemical, physical and electrically mediated methods for nematode disinfestation have reported reductions in nematode numbers or viability, but with associated adverse effects on host plants. The present studies identified the tolerance levels of small batches of unsprouted potato tubers to microwave radiation (2 450 MHz and up to 1.2 kw) and, within that limit, the effect of microwave radiation in reducing the viability of potato cyst nematode (PCN). Dry cysts of PCN were resistant to microwave radiation, the results indicating that effective treatment of cysts with microwaves must be associated with the presence of moisture films, rather than juvenile hydration, since presoak times of 1 min. to 16 h did not alter susceptibility. The viability of wetted cysts of PCN, however, can be significantly affected by power × time products which have minimum adverse affects on the subsequent growth habit of tubers. With microwave radiation an appropriate power × time product will be dependent upon the mass of tubers treated. Treatment of PCN with a range of concentrations of sodium hypochlorite severely reduced PCN Viability within the tolerance limit of tubers, so confirming previous studies by Wood and Foot (1975) and Sarakoski (1977). Although hypochlorite treatment was limited to a 30-min. soak, after which cysts were thoroughly washed in distilled water, hatch in potato root diffusate continued to be effected for the duration of the experiment. The failure of any juvenile development to result from hypochlorite treated cysts indicates that although juveniles may be able to hatch from cysts after hypochlorite treatment at a range of concentrations, hatched juveniles are subsequently unable to either invade or develop within the root systems of potato plants. Within the tolerance levels of tubers, microwave radiation alone failed to produce a complete reduction in potato cyst nematode viability, as measured by the occurrence of some juvenile development in roots and the subsequent production of a new generation of cysts on potatoes. A reassessment of the suitability of sodium hypochlorite treatment in potato producing regions would be justified following the proven control of PCN on contaminated tubers and the known effective surface sterilization by sodium hypochlorite of tuber borne pathogens. However, microwave radiation alone would not, from these experiments, appear to add significantly to, or be likely to serve as an effective alternative to, this approach.

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McKenzie, M. M. & Mabbott, T. W. - *Freedom from potato cyst nematode in seed potato exports from Scotland.*

Under the Potato Cyst Eelworm (Great-Britain) Order, 1973, seed potatoes in Scotland may only be grown on land which has been tested for the presence of PCN. Other statutory provisions relating to PCN establish minimum rotations acceptable for seed potato crops — 5 years freedom from potatoes for basic seed and 7 years for pre-basic. These regulations ensure that seed potatoes are produced on land in which PCN is below detectable level. Further tests are carried out by root examination during inspection of the growing crops. Most importing countries of seed potatoes have a nil tolerance for PCN and some require post harvest or consignment testing in addition to the pre-crop soil test and the growing crop inspection. Over 3 years, c. 11 600 consignments have been examined by DAFS for PCN. Less than 2 % have been found to be infested, mostly with single cysts. As a potato crop during growth may multiply a light infestation by 10 fold or even by 40 fold, the results give re-assurance on the efficacy of the pre-crop soil tests. An important factor in the export of seed potatoes is freedom from soil. A minimum of soil ensures that there is less chance of the presence of cysts. Under DAFS regulations, the maximum soil tolerance is 0.5 % by weight, and consignments are expected to come well within this tolerance. For certain countries a tighter standard is operated. An analysis of samples from consignments showed that 95 % had less than 0.1 % soil by weight. Removal of soil had been achieved by brushing or riddling, but it is appreciated that, especially in a wet season, mechanical removal of soil may result in an increased incidence of mechanical damage and soft rot diseases.

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Meyer, A. J. - *Spatial and seasonal distribution of nematode parasites associated with peach orchards in South Africa.*

Six important species of nematode parasites of the roots of peaches were identified as *Scutellonema brachyurum, Pratylenchus neglectus, Meloidogyne javanica, Xiphinema brevicolle, Paratrichodorus christiei* and *Criconemella xenoplax.* The numbers of these nematodes that occur at different horizontal distances from the stem of trees and in the different (vertical) strata of the soil profile were followed through the four seasons of the year. Each species followed a different pattern of distribution and generalization is difficult. *Criconemella xenoplax* maintained highest numbers close to the trunk, suggesting a preference for undisturbed soil. The other species followed root distribution more closely.

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Mohammad, H. Y. & Hague, N. G. M. - *The effect of carbofuran and oxamyl on the invasion and development of* Meloidogyne graminicola *and* Heterodera sacchari.

The effectiveness of oxamyl and carbofuran on the invasion and development of *Meloidogyne graminicola* and *Heterodera sacchari* in *Echinocloa colonum* was studied in pots under glasshouse conditions. Both oxamyl and carbofuran reduced the number of nematodes in roots but oxamyl was more effective against both species than carbofuran. Studies on invasion and development indicated that greater numbers of *M. graminicola* were found inside the roots compared to *H. sacchari.* Carbofuran was more effective against *H. sacchari* than *M. graminicola* which may be explained by the juveniles of *M. graminicola* invading roots faster than those of *H. sacchari.*

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Mousa, E. M. & Hague, N. G. M. - *Studies on the association between the root-knot nematode* Meloidogyne incognita *and* Fusarium oxysporum *f. sp.* glycines *on soybean.*

Two soybean cultivars, Coll, resistant to *Fusarium* wilt but susceptible to the root-knot nematode and Ware, resistant to both the fungus and the nematode were exposed to both *F. oxysporun* f. sp. *glycines* and *Meloidogyne incognita* to investigate the association. Vascular occlusion by gels and tyloses represent a major mechanism of resistance to *Fusarium* infection on soybean. Large amounts of fungus and fewer occluded vessels were found in the vascular tissues of the wilt-resistant cultivar Coll inoculated with both pathogens simultaneously and there was severe wilt and vascular discolouration. Root knot nematodes developed rapidly and produced more females and egg masses in Coll compared to the cultivar Ware. In Coll, giant cells were found in the xylem paranchyma, pith and occasionnally in xylem vessels were heavily invaded by the fungal elements. In both cultivars there was a significant increase in the number of males in plants exposed to the fungus and the number of females was significantly decreased : the sex ratio was therefore markedly influenced in gall tissue.

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Mugniery, D. - *Hybridations interspécifiques chez les* Globodera *des Solanacées.*

L'hybridation est utilisée pour préciser le statut des espèces de *Globodera* (hors *G. tabacum*) inféodées aux Solanacées. Les espèces étudiées sont *G. rostochiensis* (GR), *G. pallida* (GP), *G. virginiae* (GV), *G. solanacearum* (GS) et " *G. mexicana* " (GM). Les femelles vierges sont obtenues par élevage d'une seule larve sur tomate cultivée sur eau gélosée en boîte de Petri. L'hybridation est réalisée en déposant un mâle de l'espèce choisie auprès d'une femelle. Les croisements sont effectués dans les deux sens. Pour tous les croisements, on obtient sans difficultés une F1. Toutes les larves F1 écloses sont déposées sur racine de tomate et/ou de pomme de terre cultivées comme précédemment. Des F2 abondantes sont obtenues, exclusivement sur tomate, pour les croisements GV × GS, GS × GV, GS × GM, GP × GM. Le croisement GM × GP donne quelques rares femelles. Les hybrides F1 GM × GS ne dépassent pas le stade L2. Aucun croisement dont l'un des parents est GR ne donne de F2. Le développement des hybrides GV × GS, GS × GV, GS × GM s'effectue à vitesse normale : 15 jours à 20°. Le développement des hybrides GP × GM et GM × GP est lent : 4 semaines à 20°. Pour tous les autres croisements qui n'ont donné que des mâles, le développement est très lent : 6 semaines à 20°. Ces mâles ont été déposés sur femelles vierges GR, GP, GV, GS, GM. Aucun mâles provenant d'un parent GR ne donne de descendance. Ceux provenant des combinaisons GP, GV, GS, GM donnent des descendances avec les femelles GP, GV, GS, GM. Ces résultats montrent que : *i) G. rostochiensis* est une espèce valide très largement séparée de toutes les autres. *ii) G. virginiae* et *G. solanacearum* doivent être considérés comme une seule et même espèce. *iii)* " *G. mexicana* " correspond à un groupe intermédiaire entre *G. pallida* et *G. virginae-solanacearum.* Son statut spécifique ne peut pas être clairement défini. Il sera intéressant de savoir si cette population peut servir de pont génétique entre *G. pallida* et *G. virginiae-solanacearum.*

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Müller, J., Agadr, S. & Rumpenhorst, H. J. - *Testing* Heterodera schachtii *populations for pathotypes by electrophoresis and biotest techniques.*

Heterodera schachtii resistant varieties are not available in sugar beet and consequently, in contrast to *Globodera* species, pathotypes are not differentiated in *H. schachtii.* However, as resistant cruciferous plants are now grown frequently in Germany, pathotypes may be selected by this crop. Using electrophoretic and biotest methods, we investigated soil samples from 92 locations for the presence of *H. schachtii* pathotypes. Isoelectric focusing of cyst protein followed by silver staining for general protein pattern did not differentiate between *H. schachii* populations. The reaction for unspecific esterases revealed three different groups of populations. The phosphoglucomutase zymograms differentiated more, but there was no correlation with the results obtained with unspecific esterases. The population dynamics of *H. schachtii* from all 92 locations was also investigated in a bioassay. Resistant mustard (*Sinapis alba* " Maxi ") was grown continuously on all soils for three years by resowing 12 times during this period. According to the accumulative temperature, the nematode theoretically could complete about 20 generations. From all soils nematode population densities

were determined at regular intervals. All populations declined to very low levels, none exceeding three eggs per gram of soil at the end of the experiment. No population was able to overcome the resistance of the mustard variety used. So pathotypes of *H. schachtii* were not present in the soils examined. The distinguishing bands found in some populations by electrophoresis do not indicate the existence of pathotypes, as they are not correlated with nematode pathogenicity.

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Navas, A., Bello, A. & Arias, M. - *Potential distribution of the Longidoridae in continental Spain.*

To determine the dispersal mechanisms, biogeographical characteristics and the optimum conditions for the most prevalent species of the family Longidoridae in Continental Spain, was first necessary to define areas of distribution within the great biogeographical diversity of the Iberian Peninsula. To establish the potential distribution of these nematodes the records of the family in Spain, their relationships with environmental factors of the most representative ecosystems, the associated vegetation and their distributions in Europe have to be taken into account. The potential distributions of *L. attenuatus, L. caespiticola, X. brevicolle, X. diversicaudatum, X. index, X. italiae, X. pachtaicum* and *X. turcicum* have been defined, but those of *L. profundorum, X. sahelense* and *X. vuittenezi* have not yet been determined.

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Nickle, W. R. - *The pine wood nematode in the United States.*

Though the Pine Wood Nematode (PWN) has been found to be a contributing factor to the pine with disease of the Japanese red pine during stress periods in the forests of Japan, it has not been found to be a primary pest in the major lumber producing pines of the southeast and far western parts of the US. None of the other 45 species of *Bursaphelenchus* are considered plant parasitic as all the rest feed on fungi and are associates of bark beetles and other insects. It is limited in the US to stressed hard pines, such as : scotch, red, Japanese black, Austrian, and larch which are used as ornamentals or in plantations for shelter belts and for other purposes. The PWN is vectored in the US mainly by the cerambycid pine sawyer beetle, *Monochamus carolinensis.* These beetles are usually saprophytic wood borers, laying eggs on recently dead or cut logs containing bark. The normal way that nematodes enter the wood is by oviposition on these logs. It is important to know that over 80 % of the PWN findings in the USA are under saprophytic conditions and the rest are found mainly on decadent or stressed trees. Some of these are found saprophytically in tops, logs, blow down, chips, bark beetle and spruce budworm damaged, drought stressed, off-site plantations, and other trees killed by other reasons and oviposited on by the vector wood boring beetle. The main type of damage in the US is that found is decadent scotch pine plantations used as shelter belts in the Illinois-Missouri area under stress from recent drought conditions. Here, the beetle feeds on the leader of the tree and the nematodes which are deposited on the weakened tree are able to survive and reproduce at a high level which requires temperatures of 30° and warm evening temperatures in the summer. Workers in Minnesota are hard pressed to find PWN trees on which to base experiments and work mainly with cut logs. Dr. Mamiya feels that the summer and evening temperatures are too low in Minnesota for optimum reproduction of the nematode in enough numbers to kill even a stressed tree. We now find PWN living saprophytically on blue stain fungi in southern pine and northern spruce and fir wood chips which are important in export for paper production in Scandinavia. This nematode did not kill these trees. They were cut for lumber and for chips. We know there is, of course, a similar nematode in France, Canada, and in Russia. So, what is the risk of such a situation to the Scandinavian forests and other European forests? We find no vector insects on this woodchip pile. In fact, the only insects we find are a few flies. This would indicate that, in my opinion, PWN in wood chips may be a dead end in Scandinavia because the disease cycle is broken as the vector is not present. Also, I feel it is too cold especially the night temperatures in the summer for proper development of PWN in Scandinavia. However, I would not import PWN-infected scotch pine logs from Illinois with vector beetles and nematodes into the South of France or Italy near stressed Scotch pine trees or logs. Perhaps you should ban the beetle vector instead of the PWN. This is what we did in the US with the Japanese vector.

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Nishizawa, T. - *On a strain of* Pasteuria penetrans *parasitic to cyst nematodes.*

Discovery of an isolate of *Pasteuria penetrans* (= *Duboscqia p.; Bacillus p.*), parasitic to cyst nematodes, from a field population of the upland rice cyst nematode, *Heterodera elachista,* was reported in 1984. A similar isolate of the hyperparasite was also detected in Nov. 1984, from a field where soybean has been cropped sussessively and " decline phenomenon " of the soybean cyst nematode, *H. glycines,* had been observed. This was an experimental field of Tochigi Agricultural Experiment Station which has been used for screening cyst nematode resistance of soybean breeding lines. Results of the nematode survey were as follows : mean number of larvae detected from soil by Baermann's funnel technique was 0.3/20 g; 100 % of larvae infected with spores; number of cysts isolated from soil by a decanting and sieving technique was 8.5/100 g wet soil; and percentage of diseased cysts (cadaver filled with millions of spores) — 82,4 %. Figures obtained from chloropicrin treated areas of the same field were : 20.0, 33.0 %, 157.5, and 5.1 % respectively. The nematode-suppressive nature of the spore-infested soil from the abovementioned field and bactericidal effect of chloropicrin against this hyperparasite were ascertained by pot experiments in which soybean cyst nematode was used as host. Mean number of spores extracted per infected female was 437 500. No differences were observed in morphology of host specificity of the spores from the isolate from *H. elachista* and the isolate from *H. glycines.* Diameters of the spherical endospore and enveloping crescent-shaped sporangea of both isolates were about 2.0 µm and 5.3 µm, respectively, and as far as tested. No parasitism of nematodes, except cyst nematodes, *Heterodera* and *Globodera,* have yet been found for either isolate. Effect of the *H. glycines* isolate on a population of potato cyst nematode, *G. rostochiensis,* was examined in a

replicated pot test by mixing the nematode infested soil in a ratio of 2 : 1 (v/v) with the spore-infested soil. Steam-sterilized spore-infested soil was used in control pots. The nematode population in the hyperparasite inoculated pots, examined after one cropping period of potato, was less than 50 % of that of the control pots, and 54 % of the larvae examined from the inoculated soils were infected with the spores. The effectiveness of leached water from the spore-infested soil as an inoculum was proved in a microplot experiment.

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Oostendorp, M. & Sikora, R. A. - *Utilization of antagonistic rhizobacteria as a seed treatment for the biological control of* Heterodera schachtii *in sugar bet.*

290 bacterial isolates from the rhizosphere of field-grown sugar beet were tested for their ability to protect the plant from *Heterodera schachtii* - attack. The bacteria were inoculated by dipping untreated seeds in bacterial suspensions adjusted to a density that gave approx. 2×10^{-7} colony forming units (cfu) per seed. Eight isolates significantly ($p = 5$ %) reduced nematode penetration 40 to 70 % in non-sterilized soil in replicated greenhouse tests. The antagonistic properties of the isolates were not related to production of antibiotics. Under field conditions antagonistic potency of the bacteria was often reduced, nevertheless, a 75 % reduction ($p = 5$ %) in nematode penetration could be achieved with one isolate. This isolate was identified as *Pseudomonas fluorescens*. Yield increases of up to 39 % were obtained with three other isolates. Greenhouse trials with two isolates showed that soil moisture is an important factor governing the efficacy of bacterial seed treatments. In moist soil at 80 % water capacity, a bacterial inoculum of approx. 6×10^7 cfu/seed caused a 83 to 86 % reduction in nematode penetration ($p = 5$ %). At 40 % water capacity an inoculum of approx. 1.5×10^8 was necessary to produce the same effect.

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Orion, D.*, Loots, G. C. & Orion, T.***** - *Histolytical activity of* Meloidogyne *gelatinous matrix.*

The effect of root-knot nematode gelatinous matrix (GM) on the host tissue was studied on monoxenic cultures of *Meloidogyne incognita* reared on excised tomato roots. Fifteen to 30 days following innoculation galled roots were sampled at 3 days intervals, fixed and processed for histological observations utilizing the conventional paraffin method. Twenty-one to twenty-four days after innoculation GM secretion began, forming a small cavity adjacent to the posterior end of the female nematode. At the contact area of the GM and the host cells, fragments of cell walls were observed. At a further distance from the GM front line, the host cell walls were somewhat thicker than other parenchymal cells within the gall, suggesting activity due to diffusants originating from the GM. Twenty-seven to 30 days after innoculation more cell walls were found to have been dissolved by the GM to form a large cavity or canal which reached the surface of the gall. The eggs embedded in the GM were pushed through the canal to the external environnement. Observation of fleshy banana roots infested with *M. javanica* also revealed large cavities — sometimes larger than the volume of a swollen female — that were formed in a similar pattern to the above. This study suggests an enzymatic activity of cellulolytic or lignolytic nature exerted by the root-knot nematodes GM.

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Perry, R. N. - *A novel hatching biossay for cyst nematodes using fluorescence microscopy.*

Knowledge of the initial stages of the hatching sequence has led to the development of a novel hatching bioassay technique. Eggshell permeability changes and juvenile water uptake induced by hatching agents such as PRD allow the passage of selected fluorochromes through the eggshell to stain the unhatched juvenile. Using fluorescence microscopy, the uptake of certain fluorochromes by unhatched juveniles treated with hatching and non-hatching agents on a comparative basis was examined. The percentage of juveniles stained after 24 h exposure to the experimental solutions correlated closely with the results of routine hatching tests. Routine hatching bioassays are time consuming and require large numbers of cysts. Their replacement by a test taking only hours to complete and using free egg is desirable and this work indicates that a hatching bioassay using fluorescence microscopy is feasible.

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Person-Dedryver, F. - *Variations of development of* Meloidogyne naasi *Franklin on different grasses.*

Differences in the host status of grass species against *M. naasi* have been studied in outdoor experiments made on infested soils. The highest numbers of females and eggs of *M. naasi* were found after 3.5 months on cultures of italian ryegrasses produced. The host quality of perennial or hybrid ryegrasses were similar and better than those found within the tested varieties of tall fescue and cocksfoot grasses — bad hosts of *M. naasi*. Variation in the host status of these different grass species may be the consequence of the death of the nematode in roots at the J2 stage or the result of their re-emergence into the soil. These differences in rates of development of *M. naasi* between the ryegrass species remained unchanged after 18 months of culture — the italian ryegrasses were always the best hosts for the nematode. Only maxima, concerning the numbers of females or eggs per grams of root, were observed in autumn indicating the development of the second annual generation of *M. naasi* on ryegrasses.

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Phillips, M. S. & Trudgill, D. L. - *The multiplication rate of different population densities of* Globodera pallida *on potato clones with different degrees of tolerance and resistance.*

The multiplication rates of different population densities of *Globodera pallida* on potato clones with different levels of

resistance derived from *Solanum vernei* was assessed in field plots. The rate of multiplication decreased as the initial population density increased and was least on the most resistant clone. As the initial density progressively increased the final population density on the less tolerant clones reached a maximum and then decreased. However, on the most tolerant clone the final population density increased over the whole range of initial densities from 2 to 165 eggs/g^{-1} soil. Yield on the least tolerant clone was decreased by 87 % whereas on the most tolerant the decrease was only 20 %.

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Plowright, R. - *The interaction of* Aphelenchoides besseyi *and* Meloidogyne graminicola *on rice cultivar IR36.*

A. besseyi, the causal agent of white tip, infests rice in a range of environments from upland to deep water. It has been widely dispersed in seed and now occurs in most rice growing areas. The rice root-knot nematode *M. graminicola* has a more limited distribution but is of increasing importance and also occurs in upland and flooded conditions. Concomitant populations of these species have been reported from India and Bangladesh, and indicate a need to examine the interaction of these nematodes on rice. In flooded conditions in a glasshouse, rice cv IR36 was tolerant of an infestation of *A. besseyi* alone and despite a reduction in root weight of 66 %, the seed yield of rice was not affected. However, when infested by both *A. besseyi* and *M. graminicola*, the roots were damaged to the same degree but, in addition, seed yield was reduced by 55 %. *M. graminicola* alone did not affect root weight or seed yield. IR36 was relatively resistant to *A besseyi*. However, when infested by *M. graminicola*, IR36 was as susceptible as the susceptible cv BR1 which was severely damaged by *A. besseyi* alone. The presence of *M. graminicola* increased the numbers of *A. besseyi* in both true and sessile seed. *A. besseyi* did not affect the susceptibility of IR36 to *M. graminicola*. These observations complicate the selection of resistance to *A. besseyi* in the field and may help to explain why *A. besseyi* does not always produce disease symptoms in the field, despite its common occurrence. The presence of *A. besseyi* in sessile seed indicates rice chaff as an important means of nematode dispersal.

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Racke, J. & Sikora, R. A. - *Influence of rhizobacteria on* Globodera pallida *early root infection and* Erwinia carotovora *tuber soft rot of potato.*

Bacteria isolated from the potato rhizosphere were screened for their ability to reduce *Globodera pallida* early root infection, *Erwinia carotovora* soft rot and for their effects on plant growth. Solutions containing pure cultures of rhizobacteria were sprayed onto potato seed pieces which were then planted into a nonsterilized sandy loam soil previously inoculated with *G. pallida* eggs or cysts. Of 144 bacteria tested, two isolates reduced nematode penetration 86 % ($p = 5$ %), when compared to the untreated controls. The level of antagonism fluctuated greatly and was strongly influenced by the number of colony forming units applied per seed piece. The level of control could not be increased in tests with sterilized soil or by the addition of large amounts of organic matter. Plant growth increases of up to 80 % were obtained with a number of isolates. Rhizobacteria that reduced early root infection had a wide range of affects on plant growth, varying from suppression to stimulation. Simultaneous inoculation of potato tubers with rhizobacteria and *E. carotovora* had either no effect on soft rot or significantly increased disease intensity. The effective use of rhizobacteria as a potato tuber treatment for biological control requires the thorough testing of interactions with other soil-borne disease organisms associated with the crop to detect possible negative side-effects.

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Reddigari, S. R., Hussey, R. S., Jansma, P. L. & Premachandran, D. - *Collagens of cuticles of second-stage juveniles and adult females of* Meloidogyne incognita.

Cuticles isolated from second-stage juveniles (J2) and adult females of *Meloidogyne incognita* were purified by treatment with 1 % sodium dodecyl sulfate (SDS). The three zones, cortical, median, and basal, of the J2 cuticle differed in their solubility in the sulfhydryl reducing agent β-mercaptoethanol (BME). Examination of treated cuticles by transmission electron microscopy revealed that proteins in the cortical and median zones were partially soluble in BME, whereas proteins in the basal zone were the least soluble. The BME-soluble proteins from the J2 cuticle were separated into 12 bands by SDS-polyacrylamide gel electrophoresis and characterized as collagens based on their sensitivity to collagenase and amino acid composition. The adult cuticle consisted of two zones, cortical and basal, which were dissolved extensively by BME. The basal zone was completely solubilized and only a fibrous network remained in the cortical zone. The BME-soluble proteins from the adult cuticle were separated by electrophoresis into nine bands one of which constituted > 55 % of the total BME-soluble proteins. All bands were characterized as collagens. Several significant differences occured between the BME-soluble proteins of J2 and adult female cuticles. J2 cuticle contained considerably more glycine residues than the adult female cuticle (40 % compared to 31 %). Quantities of several other amino acid residues differed between the collagens isolated from J2 and adult female cuticles. Collagens from the J2 cuticle also contained glycoproteins which were absent from the adult female cuticle. Polyclonal antibodies were produced against the major collagen in the adult female cuticle. Immunogold labelling revealed that this collagen was distributed throughout the cortical and basal zones of the adult female cuticle and only present in the J2 cuticle at a low level.

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Reis, L. G. L.*, Sequeira, O. A. de & Silva, C. A. O.** - *Phytoparasitic nematodes in Portuguese hop gardens.*

A survey on the occurrence of plant parasitic nematodes is being carried out in Braga and Bragança hop growing areas to investigate the role of phytoparasitic nematodes on the abnormal growth of hop vines observed in some fields. A total of 54 soil and root samples were taken in fourteen hop gardens,

from areas with stunted hop vines and from areas with vigorous plants. Soil samples were collected from around roots to a depth of 30-35 cm and processed by the centrifugal-flotation technique. Additionally, roots collected at the same depth, were cut into small pieces and incubated in water containing 1 % H_2O_2 for 48 h. Phytoparasitic nematodes belonging to thirteen genera were identified, *viz. Pratylenchus crenatus* (61 % of the samples), *Helicotylenchus* (61 %), *Rotylenchus robustus* (48 %), *Ditylenchus destructor* (39 %), *Xiphinema* (35 %), *Tylenchorhynchus s.l.* (31 %), *Trichodorus s.l.* (15 %), *Paratylenchus* (11 %), *Ditylenchus* sp. (6 %), *Aphelenchoides* (6 %), *Globodera* (6 %), *Heterodera* (4 %), *Meloidogyne* (2 %), *Rotylenchus* sp. (2 %) and *Criconemoides s.l.* (2 %). *P. crenatus, D. destructor* and *Helicotylenchus* sp. were the most frequent endoparasitic nematodes recovered from roots. No correlation was found between the occurrence of phytoparasitic nematodes and the damaged areas.

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Rey, J. M., Andres, M. F. & Arias, M. - *A method for identification of species of the genus* Longidorus *by automatic means.*

A computer program to assist in the identification of species of the genus *Longidorus* is proposed. The program utilizes an index that measures the probability that an element is common to both the unknown and reference specimens. The program is easy to edit in a personal computer and is simple to use. Furthermore, it can be extented to include any other genus. The computer output gives the taxonomist five alternatives from which he can choose one, or he can create a new species, or extend the range of those already described.

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Richardson, P. N. & Hughes, J. C. - *Use of the nematode* Heterorhabditis heliothidis *to control mushroom cecidomyiid flies (Diptera : Cecidomyiidae).*

In the United Kingdom three species of cecidomyiid flies *Heteropeza pygmaea, Mycophila speyeri* and *M. barnesi* are regarded as important pests of cultivated mushrooms *(Agaricus bisporus).* Cecidomyiids are unusual pests. Their larvae, which are obligate mycelial feeders, are capable of reproduction by " paedogenesis " and adult flies are uncommon. Populations as high as 300 000 larvae per m^2 have been recorded, but even moderate infestations depress yield and cause mushroom spoilage. Cecids are remarkably resistant to insecticides; growers currently depend on vigilant hygiène and effective sterilisation of spent crops to restrict outbreaks. In laboratory trials larvae of the nematodes *Heterorhabditis heliothidis* or *Steirnernema feltiae* agriotos (= *Neoaplectana carpocapsae*) were applied to beakers of compost infested with *H. pygmaea.* Counts of the numbers of cecids surviving at weekly intervals after treatment showed that *H. heliothidis* was the more effective parasite. Cecidomyiid pupae were particularly susceptible to invasion by nematodes. In field trials, trays of commercially-prepared compost were used to study the potential of *H. heliothidis* for biological control in the presence or absence of two commonly-used insecticides, diazinon and diflubenzuron (" Dimilin "). The numbers of nematodes extracted from samples of casing decreased throughout the eight-week post-treatment period. Although the lowest numbers of nematodes were extracted from trays containing insecticides the best cecid control was achieved when both types of control were used together. Incidence of cecid-contamination was highest when insecticides alone were applied (10.7 % of mushrooms were contaminated). Contamination was halved in trays treated with *H. heliothidis* and reduced to 2 % when nematodes and insecticides were both used. Trials with *M. speyeri* and with mushroom phorid and sciarid flies, have shown that these important pests are also susceptible to parasitism by rhabditid nematodes. Integrated fly control strategies are now being developed for the UK mushroom industry.

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Rivoal, R. - *Rythmes d'éclosion des deux écotypes d'*Heterodera avenae *en France : conséquences du transfert dans des situations climatiques distinctes et influence de la température.*

H. avenae, espèce monovoltine, présente deux schémas d'activité selon la localisation de ses populations. Si l'éclosion est hivernale en Australie méridionale, en climat de type méditerranéen, elle se produit plutôt au printemps en Europe septentrionale. Ces deux modes d'activité se retrouvent en France pour deux populations géographiques distinctes. La population méridionale de Villasavary (Aude) présente une éclosion essentiellement hivernale alors que la population septentrionale de Nuisement-sur-Coole (Marne) libère la plus grande partie de ses larves au printemps. Différentes expérimentations menées au laboratoire et en conditions naturelles ont mis en évidence le rôle important de la température sur l'éclosion des larves de ces deux populations, qualifiées d'écotypes depuis 1981, dont l'activité est soumise à l'induction ou à la levée de processus de repos physiologiques assimilés à deux types de diapause. On a cherché à préciser l'influence de la température sur le déterminisme de l'éclosion de ces deux écotypes en comparant, pendant deux années consécutives, leurs rythmes d'activité dans leur région d'origine ainsi qu'en situations géographiques opposées ou intermédiaires, distinctes au point de vue thermique. A cet effet, 14 kystes néoformés des deux écotypes sont immergés dans des tubes placés eux-mêmes à 20 cm de profondeur dans un sol enherbé à Castelnaudary, Rennes et Châlons-sur-Marne. Les rythmes d'activité de ces écotypes sont appréhendés aussi bien en fonction des pourcentages cumulés de larves écloses que de la distribution bimensuelle des kystes présentant au moins une larve en éclosion. Le transfert ne modifie pas fondamentalement les rythmes d'éclosion des deux écotypes d'*H. avenae.* Quelle que soit la localisation géographique, le premier cycle d'éclosion de l'écotype méridional débute après un délai d'au moins 4 mois qui confirme l'existence d'une diapause (obligatoire) chez les larves néoformées contenues dans les kystes. Il cesse plus tardivement à Châlons-sur-Marne, ce qui démontre l'influence du relèvement de la température au-dessus de 10° sur l'interruption des sorties larvaires. Cette inhibition se poursuit jusqu'à l'automne suivant, mais elle est levée par des conditions (délai et température) moins strictes que celles constatées chez les larves néonates. L'activité de l'écotype septentrional ne débute réellement qu'après exposition aux basses températures hivernales qui lève la diapause estivo-

automnale (facultative), précédemment décrite. Le relèvement de la température au-dessus de 15° est déterminant pour l'arrêt de ce premier cycle d'éclosion. Dans sa région d'origine, le déclenchement du second cycle de l'écotype septentrional paraît lié à une simple levée de dormance dès que la température descend en dessous de 15°. Le transfert de cet écotype à Castelnaudary semble par contre induire un phénomène d'inhibition plus complexe qui nécessite, pour être levé, une exposition plus longue aux basses températures. On a également constaté que la mortalité des larves à l'intérieur des kystes est significativement accentuée dans la situation expérimentale la plus méridionale (Castelnaudary) à cause vraisemblablement des températures estivales très élevées qui paraissent être particulièrement préjudiciables à l'écotype septentrional.

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Robertson, W. M. & Henry, C. E. - *Carbohydrates at sites of virus retention in* Xiphinema, Longidorus *and trichodorid nematodes.*

Nematode vectors of plant viruses have a very specific relationship with the viruses they transmit. Carbohydrate moieties are known to act as receptors for several viruses of vertebrates. Electron histochemistry of virus-vector nematodes has shown that carbohydrates are present at the sites of virus retention within the feeding appparatus. A comparison of *Xiphinema diversicaudatum* which had fed on plants infected with arabis mosaic (AMV) or strawberry latent ringspot (SLRV) viruses showed differences in the carbohydrate straining at the sites where the virus was retained. Particles of AMV were associated with a thin carbohydrate layer lining the food canal and were also surrounded with carbohydrate-staining material. Particles of SLRV were associated with a carbohydrate layer lining the food canal. The particles did not stain for carbohydrate. These findings will be compared with carbohydrates localised at the sites of retention in *Longidorus* and trichodorid nematodes.

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Robinson, A. F. - *A method for generating linear gradients of dissolved gases in nematode behavior experiments.*

A versatile method was developed for maintaining linear gradients of dissolved gases in semi-solid gels during nematode behavior experiments. Continuous observations of nematodes and rapid changes in gaseous conditions could be made without physically disturbing nematode suspensions. The technique consisted of suspending nematodes within a 1-mm thick film of agar or agarose within a 2 × 3 × 50 mm channel inside a transparent acrylic chamber. A dissolved gas gradient in the gel along the length of the channel was achieved through equilibrium with a standing gas gradient within a 2-3 mm thick atmosphère (*ca.* 0.5 cm^3 total volume) directly above the gel. The standing gas gradient resulted from equal continuous flows of dissimilar gas mixtures across the two ends of the channel. The speed, linearity, stability, and reproducibility of gradient achievement were evaluated as follows. Gel was substituted by a strip of filter paper that was saturated with a pH indicator solution, 0.1 % thymol blue in 0.6 NaOH. By filling the chamber with air containing known concentrations of CO_2, the color of the pH indicator could be changed reversibly within 15 minutes from blue to green to yellow. Micrographs (32X) were taken of the filter paper with color slide film (Ektachrome 100) and examined with a visual spectraphotometer. Ratios of absorbance peaks of the micrographs at 448 and 655 nm were essentially independant of camera shutter speed and indicator thickness and were functionally relatable to known atmospheric CO_2 concentrations between 0 and 30 %. The spectraphotometric procedure was used to verify gradient linearity and to test for sensitivity to alterations in flow rates and chamber design.

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Robinson, M. P.* & Jepson, S. B.** - *Routine biochemical identification of* Meloidogyne *species using isoelectric focussing.*

Not all *Meloidogyne* species are easily identified using morphological characters alone, because of the necessity to utilise different life history stages and several different characters in combination, some of these with substantial intraspecific variation. Isoelectric focussing has been used successfully to characterise other groups of nematodes at both species and population level. This technique is being modified and developed for simple routine identification of all agriculturally important *Meloidogyne* species (*M. arenaria, M. hapla, M. incognita, M. javanica, M. chiwoodi, M. graminicola, M. naasi, M. exigua, M. acronea, M. oryzae, M. artiella, M. decalineata, M. coffeicola, M. brevicauda,* etc.), known races and populations.

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Roca, F. - *Revision of the atlas of plant parasitic nematodes of Italy.*

Soil amples collected in various regions of Italy during the period 1982-1985 showed the presence of some *Longidorus* and *Xiphinema* species not previously reported in the atlas of plant parasitic nematodes of Italy. *Longidorus aetnaeus* Roca *et al.*, 1986 was found in the National park of Circeo, Latina, in the rhizosphere of *Juniperus* sp. and at Monte Minardo (Sicily) on the slope of Mount Etna in the rhizosphere of *Querçus ilex* L. *Xiphinema barense* Lamberti *et al.*, 1986 was found at Modugno, Bari in the rhizosphere of *Rubus fruticosus* L. An undescribed *Xiphinema* sp. was found at Bracciano, Roma on pasture. Additionally, *X. diversicaudatum* was found in association with *L. juvenilis* Dalmasso, 1969 in the rhizosphere of peach at Carinola, Caserta.

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Roessner, J. - *Parasitism of* Globodera rostochiensis *by nematophagous fungi.*

A number of nematophagous fungi which strongly reduce *Heterodera* populations have been found during the last 10-15 years. With a few exceptions, the influence of fungal

parasites on *Globodera* spp. has not been studied as intensively and antagonists of practical importance have not been found. Our research programme was based on the hypothesis that natural antagonists of *Globodera* increase in fields under potato monoculture. The experiments were conducted in field microplots that had been in constant potato production for the past 20 years and which were infected with *G. rostochiensis*. Normal growth of the susceptible potato cv. Grata was observed after 10-15 years during which a high degree of nematode damage occurred. Furthermore, a strong reduction in the number of newly produced cysts was observed in earlier years. To determine the reason for PCN decline, cysts from the microplots were analysed for the presence of nematophagous fungi in the autumn of 1983. Less than 5 % of the eggs and juveniles placed on water agar were parasitized. However, in July and August 1984 higher levels of parasitism were detected in new, completely intact cysts taken from root surface. Microscopic analysis of the fungal contents of 200 cysts showed that 15 % of cysts were not parasitized, 15 % were completely parasitized and that 70 % had varying levels of infection. Pure cultures of fungi isolated from individual eggs were established. Two isolates of *Fusarium oxysporum* Schlecht and one each of *Cladosporium herbarum* (Pers. : Fr.). Link and *Preussia* sp. were identified and used for experimental purposes. The identifications were made by Centraal-bureau voor Schimmelcultures in Baarn (Netherlands). In a number of experiments only a low level of parasitism was detected when developed eggs were placed singly on the plates. Parasitism was greater when cysts were used intact or pearced with a needle and the best results were obtained when cysts were cut in half. The frowth and spread of the fungi were considerably enhanced by the presence of mucilage between the eggs. This could explain the higher levels of young egg infection found in mature females and yellow cysts compared to that in older cysts. Second stage juveniles in the eggs were seldom parasitized. Initial results indicated that combinations of fungi were more effective. The level of parasitism varied with time, indicating that the " physiological state " of the cysts may have been affected by growing conditions in the greenhouse. *C. herbarum* was the most effective antagonist in the laboratory experiments on agar. 1985 : the results from the laboratory experiments on egg parasitism could not be repeated in pot experiments using sterilized soil inoculated with the fungi as a mycelial suspension, or in the field with fungi on grain. There were no indications of female parasitism in other trials conducted under outdoor conditions. In addition there was a marked decrease in the level of antagonism in the microplot. 1986 : the level of antagonism in similar experiments was much higher. Biotic and abiotic factors may directly of indirectly affect fungal antagonism. Although conditions in certain years may be disadvantageous for fungal infectivity, the only overall effect observed in the last 5-6 years appears to be a slowing-down in the rate parasitism.

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Sampedro, J., Pérez, J., Fowler, V., Gandarilla, H., Acosta, O., Lorenzo, E., Basterrechea, M., García, I., O'Connors, B., Fernández, E., García, O. - *Parasitic nematodes associated with coffee crops.*

From 1981 to 1984, the high- and lowland coffee growing areas in Cuba were sampled for nematodes by taking roots and soil from the plant rhizosphere at depths from 5 to 30 cm. The roots were examined under the stereo-microscope for root-knot nematodes and then processed by blending and sieving. The nematodes were recovered from the soil by meams of sieves and a Baermann's funnel. Fifty nine species of phytoparasitic nematodes, belonging to 32 genera of the Tylenchida and Dorylaimida were detected. The most widely distributed parasitic nematode species belonged to the genera *Meloidogyne, Rotylenchulus, Helicotylenchus* and *Pratylenchus,* but the most severe attacks were observed only in the presence of root-knot and lesion nematodes. The damage caused by *Meloidogyne* spp. was characterized by the destruction of the root system and the production of tumors, galls and craks at the trunk base. The aerial parts showed symptoms of dwarfing and premature leaf-fall and moreover, the depopulation of the plantations became sparse and there was a decrease in the production potential. *Meloidogyne exigua* was not detected in the sampled areas.

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Santos, M. S. N. de A.*, Abrantes, I. M. de O.* & Taveira Pereira, M. -** *Variability in reproduction of two populations of* Meloidogyne javanica *on four cultivars of pepper.*

Variability in the reproduction of two populations (18 and 21) of *Meloidogyne javanica,* from Portugal, on the pepper cultivars Bola, California Wonder, Morrones and Yolo Wonder was studied in this investigation. The experiments were carried out in a growth chamber with air temperatures ranging from 19 to 29°. The numbers of galls, egg masses and eggs were recorded 60 days after the plants had been inoculated with 5 000 eggs of each population per cultivar. Population 18 produced no galls or egg masses on Bola, few galls and egg masses on Yolo Wonder and moderate numbers on California Wonder. Population 21 produced few galls and egg masses on Bola and Yolo Wonder and moderate numbers on California Wonder. The reproductive rate (final egg count/initial inoculum density) was greater than 1 on California Wonder. The two populations produced no galls or egg masses on Morrones.

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Sarah, J. L. - *Influence of* Pratylenchus brachyurus *on the growth and development of pineapple in the Ivory Coast.*

In the Ivory Coast the growth and the development of pineapple are strongly affected by *Pratylenchus brachyurus* parasitizing roots. The relationship has been clarified through an experiment where soil inoculum was modulated by preplant EDB fumigation treatment (10 rates varying from 0 to 256 l/ha). The results confirm the very high virulence of *P. brachyurus* on pineapple, under ivoirian ecological conditions. No patent tolerance threshold could be detected. If one exists it is lower than the limit of detectability of the infestation (1-2 nematodes/dm^3 soil) and below 5 per gram of root during the cycle crop. On the other hand, plant damage could be more severe than that observed in the untreated plot (where the infestation reach 2 000 per gram of root) if the infestation was higher, or the climatic conditions more favourable. The plant weight at the time of flower induction treatment (FIT, 30 weeks after planting) was very well correlated with the

infestation level during the vegetative growth ($r^2 = 0.934$). The increase of weight from FIT to harvest (22 to 25 weeks) was due mainly to fruit and crown growth. Fruit weight varied from 600 to 1 250 g between the different treatments. This increase was realted to *i)* the number of fruitlets (elementary fruits), determinated during flower initiation; this parameter was well correlated to vegetative growth ($r^2 = 0.823$) and consequently to the earlier levels of root infestation; *ii)* the weight of fruitlets affected by vegetative growth ($r^2 = 0.824$). The crown weight varied from 150 to 220 g and it was strongly correlated to late infestation ($r^2 = 0.725$). In summary, earlier infestation reduced plant growth and fruit potentiality and late infestation lead to a decrease in the efficiency of fruit filling and crown growth. The results are in addition to the well known action to the production and growth of suckers after harvest. They emphasize the need for the continuous control of *P. brachyurus* during the total crop growth period. This cannot be achieved with chemical control (fumigation + systemic compounds) which would be uneconomical and cause negative interactions with the plant (physiological disruptions and risk of residues in the fruit). Decreasing the soil inoculum to below the detectable level by adequate crop rotation is one of the possible solutions.

IRFA/CIRAD, 01 B.P. 1740, Abidjan 01, Côte d'Ivoire.

Schans, J. - *Dynamic simulation of interactions between potato crop growth and potato cyst-nematodes.*

An explanatory model is constructed to simulate the population dynamics and the host-parasite interactions of *Globodera rostochiensis* and *G. pallida*. The model describes the pathosystem in terms of state, rate and driving variables (Ward *et al.*, 1985). Parameters and input relations are obtained from published data. The model consists of four sub-models. The first sub-model simulates the water-balance and temperature of the soil to a depth of 100 cm, as a function of rainfall, evapotranspiration and air temperature. The second sub-model simulates potato crop growth as a function of temperature, irradiation and soil moisture. A detailed analysis of root growth and root density in the soil profile is included. The third sub-model simulates the population dynamics of the nematodes as a function of soil temperature, soil moisture and potato root growth. The fourth sub-model simulates host-parasite interactions. It consists of nematode effects on growth and functioning of roots and the various resistance and tolerance mechanisms of plants. The state-variable approach as presented here has considerable advantages over descriptive modelling techniques (e.g. Jones & Perry, 1978; Seinhost, 1965), which use empirical relations between an initial and a final situation. The state-variable approach allows understanding of the system by analysis of basic processes. Although many relations are still unknown, the present model indicates the importance of missing knowledge and reveals priorities for future research.

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Schlang, J. - *Studies on the spatial distribution of* Heterodera schachtii.

The spatial distribution and dispersion of *H. schachtii* was studied in a sugar beet rotation. The number of nematodes (eggs and juveniles/100 ml soil) were determinated after barley, a resistant intercrop and after sugar beet. The systematic sampling grid was composed of ~ 100, 25 m^2 plots. From each plot a 300 ml subsample, form a 31 composite soil sample comprising 25 cores, was examined. The nematode dispersion showed no significant deviation from a Log-Normal-Distribution, as verified by a Chi^2-Test. After barley a χ^2 -of 7.39 $p < 12.59$, after the resistant intercrop a χ^2-of 7.64 $p < 14.07$ and after sugar beet a χ^2-value of 6.87 $p < 9.49$ was found. The parameters of the Log-Normal-Distribution (barley $\bar{x} = 2.75 \pm$ s.c. $= 0.38$; intercrop $\bar{x} = 2.57 \pm$ s.c. $= 0.42$; sugar beet $\bar{x} = 3.41 \pm$ s.c. $= 0.26$) indicate the dynamic of the *H. schachtii* population in close relation to the field crop. The range of 0.2 log. units was suitable to classified the population densities between 100 and 8 000 eggs juveniles/100 ml soil in ten or twelve classes. Simulated sampling strategies for *H. schachtii* dispersed according to a Log-Normal-Distribution is developed.

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Schots, A.*, Bakker, J., Egberts, E.* & Gommers, F. J.**.** - *Monoclonal antibodies against potato cyst-nematodes.*

The potato cyst nematodes *Globodera rostochiensis* and *G. pallida* are difficult to discriminate by morphological observations. A thorough analysis of nematode egg homogenates by one and two dimensional polyacrylamide gel electrophoresis revealed various species proteins. A number of species specific proteins were isolated by a heat treatment and centrifugation. These thermostable species specific proteins had slightly different molecular weights and isoelectric points. Protease peptide digests demonstrated that the species specific proteins contain identical as well as dissimilar peptides. Therefore, it is not surprising that we have found extensive cross-reactivity in rabbit antisera prepared against either of the species specific proteins. The problems associated with conventional antisera were overcome with the hybridoma technique. Splenocytes from mice hyper-immunised with species specific protein preparations were fused with mouse myeloma cells, following essentially the method of Koehlen and Milstein. Among the many hybridomas producing antibodies that reach equally well with both species, a number have been found to reach exclusively with a species specific protein of *G. pallida*. The suitability of these monoclonal antibodies for a rapid and reliable identification essay is presently being investigated.

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Sohlenius, B., Boström, S. & Sandor, A. - *Abundance, biomass and contribution to nitrogen flux of nematodes in arable soil.*

Nematodes were part of a study on the role of organisms in the circulation and transformation of carbon and nitrogen in an agroecosystem. The experimental field situated in central Sweden, was cultivated for five years with the crops : barley [with (B120) and without (B0) nitrogen fertilizer], grass (GL) and lucerne (LL). The highest diversity of nematodes was found in GL, which differed in many respects from the other treatments. In the perennial systems some taxa fluctuated strongly, while in the annual systems, they remained relatively

stable throughout the experiment. The perennial crops had on an average higher nematode densities (GL 8.7 × 10^6 m^{-2}) and LL 9.8 × 10^6 m^{-2} than the annual crops (B0 5.6 × 10^6 m^{-2} and B120 6.8 × 10^6 m^{-2}). The nematode biomass was 0.8 g fw m^{-2} in the annual and 1.4 g fw m^{-2} in the perennial crops. Root production appeared to influence total nematode density. Plant feeders were most abundant in LL, while fungal feeders and omnivore/predators were most abundant in GL. Bacterial feeders were relatively more abundant than fungal feeders in B120 and LL. Metabolic activity of the field populations was estimated from literature values. It was assessed that for respiration the nematodes used between 4 l O_2m^{-2} yr^{-1} and 7 l O_2m^{-2} yr^{-1}. The corresponding amount of carbon liberated as CO_2 was about 0.9 % of carbon input to the system. Among multicellular soil animals, nematodes and earthworms contributed most to faunal respiration (25-40 % each). It was assessed, with rough assumptions on energy allocation budgets, that the nematodes consumed 190-370 kg dw ha^{-1} yr^{-1} which corresponds to 7-13 kg nitrogen. This amounts to 4-7 % of net mineralization. The relative contribution by nematodes to C and N fluxes was larger in the annual than in the perennial crops.

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Soomro, M. & Hague, N. G. M. - *The effect of* Meloidogyne graminicola *on the root growth of rice and* Echinochloa colonum.

The effect of the rice root-knot nematode *M. graminicola* on root morphology and growth of rice (cv. Jaya) and the grass *E. colonum* was investigated. Invasion by juveniles reduced total root length and the length of axes and laterals in both hosts. The number of axes (nodal) in infested rice roots was increased by the nematode invasion. On infested roots of boths hosts, the laterals grew in clusters and appeared earlier than in the uninfested plants. Up to 11.6 % of laterals in rice and up to 27.3 % of laterals in *E. colonum* were growing on the actual galls formed by nematode invasion. The total number of juveniles and females was greater in *E. colonum* roots than in rice, but the number of nematodes cm^{-1} and gm^{-1} was less in *E. colonum* after 20 days; early in the growth of the hosts the effects were reversed.

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Støen, M. - Aphelenchoides blastophthorus *damage to strawberry.*

Strawberry plants from the national certification scheme have from time to time been forwarded to us for examination for bud and leaf nematodes. *Aphelenchoides blastophthorus* was recognized for the first time in 1972 (det. : D. J. Hooper). The plants showed symptons similar to those of *A. fragariae* which is found distributed throughout the country. Subsequently, *A. blastophthorus* has been diagnosed in a few fields situated with the reception of one, on the western coast. In a 0.15 ha field at Hjeltnes approximately 1 % of the plants showed severe symptons by the end of the first growing season, and by the following July the attack had increased to 5-17 % of the plants. Only *A. blastophthorus* was found and these were then cultured on callus tissue in the nematode bank at Uppsala, Sweden. A greenhouse experiment was set up in December 1984 in which strawberry plants cv S. Sengana, were inoculated with 100 nem/plant. Temp. was maintained at 20°, and supplementary artificial light provided. A moist atmosphere was maintained by a humidifier, which periodically wetted the leaves. After 4 months the plants were examined.

	Nos. plant inoculated	Nos. plant attacked
A. blastophthorus from callus	24	20
A. fragariae from callus	8	8
A. fragariae from field	8	7
Control	8 (not inoc.)	0

Symptoms considered to be caused by nematodes were : petioles shortened and tapered, and/or laminae asymmetrically reduced in size, or absent, or if present dark green and leathery. *A. fragariae* from the field caused more severe deformations than the other two inocula. The final numbers of *A. blastophthorus* varied greatly — mean 1 450 nem./plant, max. 9 000 nem./plant.

The Norwegian Plant Protection Institute, 1432 Åβs-NLH, Norway.

Storey, G. W.* & Evans, K..** - *Interactions between* Globodera pallida *and* Verticillium dahliae *and their effect on the tolerance of three potato cultivars.*

Variations in the responses of potato cultivars to invasion by potato cyst nematodes during field trials may partly be attributed to interactions between the nematodes and other pathogens such as the wilt fungus *Verticillium dahliae.* In field and pot experiments potato cultivar " Pentland Javelin " showed little evidence of attack by *V. dahliae* whether or not nematodes were present. In comparison " Maris Peer " was little affected by the fungus in the absence of potato cyst nematode but exhibited typical wilting and unilateral chlorosis when nematodes were present; " Maris Anchor " had severe symptoms even in the absence of nematodes. Histopathological studies showed that when *Globodera pallida* and *V. dahliae* were inoculated together on roots grown in agar culture the amount of fungus penetrating the roots was greater than when *V. dahliae* was added alone; the distance from the root tip over which the fungus colonised the stele also increased. A delay between the addition of the nematode and the fungus resulted in less *V. dahliae* entering the stele. In all cultivars the fungus colonised phloem in addition to xylem vessels. " Pentland Javelin " roots are large and robust with a quickly maturing stele, so presenting considerable barriers to invading hyphae. " Maris Peer " and " Maris Anchor " roots are thinner with fewer cell layers. " Maris Anchor " has a tetrarch xylen compared with the pentarch arrangement in the other two cultivars. Each cultivar produced lignitubers in apposition to penetrating hyphae; the nematodes invasion channel allows the hyphae to bypass this defence mechanism. " Maris Anchor " and " Maris Peer " each have a lignified hypodermis and both produce a lignified hypersensitive response whrn invaded by nematodes. This response spreads through surrounding tissues effectively sealing off portions of the root to penetrating hyphae. It is concluded that in simultaneous infections *G. pallida* facilitates the entry of *V. dahliae* to the vascular tissues of potato roots but that a prior invasion by nematodes may increase the plants resistance to the fungus.

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Sturhan, D. - *Influence of heavy metals and other elements on soil nematodes.*

In a microplot trial at the Biologische Bundesanstalt in Berlin-Dahlem, which was begun in 1975, the influence of heavy metals and some other elements on the soil nematode fauna was studied in 1985. Twelve elements, Be, Cd, Hg, Sn, Pb, V, Cr, Ni, Se, F, Br and As, were applied to the soil at two different concentrations. In general, the total number of nematodes was not markedly reduced in contaminated soils exept at the high vanadium concentration where a remarkable reduction was evident. However, there were considerable differences in reaction of several nematode taxa to certain noxious elements. Whereas the nematode species or higher taxonomic groups present in the experimental soil were obviously not affected or only slightly influenced by tin, lead, mercury, bromine and beryllium, certain nematode taxa were completely absent in soil with high concentrations of cadmium, nickel, chromium and selenium. Fluorine and vanadium appeared to be toxic to certain nematodes even at the lower concentration; criconematids, certain dolichodorids, trichodorids, plectids and mononchids seemed to be especially susceptible. *Trichodorus primitivus* was affected by seven of the twelve elements, *Anaplectus granulosus* and *Scutylenchus tartuensis* by four, *Criconemoides informis* by at least three and *Pratylenchus* spp. by two; however, numbers of *Aphelenchoides* spp. and *Aphelenchus avenae* were not markedly reduced in any of the contaminated soils. Related species such as *Tylenchorhynchus dubius, Scutylenchus tartuensis* und *Merlinius microdorus* reacted differently to the same elements. For some nematodes a considerable increase in population density was observed in soil contaminated with certain elements. The studies revealed that the soil nematode fauna can be affected by heavy metals and other elements, that certain nematode taxa may be especially susceptible and that different nematode taxa may react to particular elements in different ways. Nematodes may be suitable as bioindicators for certain environmental chemicals.

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Swart, A. & Heyns, J. - *Comparative morphology of the stylet of some species of Longidoridae by means of the scanning electron microscope.*

The stylets of several South African species of *Longidorus, Longidoroides, Paralongidorus* and *Xiphinema* were dissected from fresh specimens, and prepared for examination under SEM. The technique used to excise the feeding apparatus is basically the same as that described by Eisenback (1982) for removing stylets of males of root-knot nematodes, the main modification being the replacement of 45 % lactic acid by 1 % sodium hypocloride. Details of the technique used to prepare the stylets for examination, as well as some of the micrographs obtained, are shown in the poster. It was found that scanning electron microscopy of the odontostyle and especially the junction with the odontophore as well as of the flanges of the odontophore, revealed some details not seen under the light microscope. The three-dimensional image obtained, especially of the flanges, is very illuminating and supplementary to the information obtained under TEM. Differences observed between genera, and also between species within the same genus, leaves no doubt about the value of this method. It is planned to expand this study to include as many Longidoridae species as possible, and it is anticipated that this will contribute towards our knowledge of the interrelationships within this group.

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Tiilikkala, K. - *The life cycle of potato cyst nematode in Finland.*

Development of PCN *(Globodera rostochiensis)* populations was studied in field plots in 1981-1984. Susceptible potato (cv Bintje) was planted on the 25th May every year and was cultivated by normal farming practice. The different life cycle stages were monitored in weekly samples and correlated to accumulated day-degrees above a base temperature of 4.4°. The first migrating larvae were found 2-3 weeks before planting : at that time the soil temperature at a depth of 10 cm was 4-5°. The peak emergence occurred 1 to 3 weeks after planting, with soil temperatures exceeding 16°. Free-living larvae could be found from the beginning of May to September. Invasion of roots started at soil temperature of 10° 1-3 weeks after planting and peaked at 16°. The first males and females were found on the roots 33 days after planting potatoes and the first new eggs and larvae 40 and 63 days after planting, respectively. The whole life cycle required 765 ± 34 day/degrees, of which 104 ± 11 day/degrees were accumulated before planting. The number of larvae remaining in the cysts reached its minimum when the heat-sum of the growth season was 640 ± 89 day/degrees. In Finland PCN is well adapted to low soil temperature in spring and is able to develop in the entire potato growing area near to the polar circle. Comparison with other European populations should be made to determine if genetical differences exist. Early harvesting can be used as apart of an integrated control programme. Calculation of heat accumulation is a useful tool for timing the population development during one season. For quantitative and long-term forecast, simulation models are needed to optimize the control strategy.

Agricultural Research Centre, Departement of Pest Investigation, 31600 Jokioinen, Finland.

Turner, S. J. - *The status of virulent populations of potato cyst nematodes* (Globodera pallida).

Virulent strains of potato cyst-nematode populations *(Globodera pallida)* have been selected on potato hybrids derived from the wild potato *Solanum vernei.* These virulent populations can be identified from their original field population by an increased reproductive ability on *S. vernei*-hybrids; they are, however, unable to maintain similar reproductive rates on other *G. pallida*-resistant potatoes, e.g. *S. sanctae-rosae, S. multidissectum, S. tuberosum* ssp. *andigena.* Initial comparisons between selected and unselected populations by isoelectric focusing techniques have demonstrated that, in a number of cases, selection of virulent strains has resulted in a reduction in the amount of electrophoretically detectable genetic variation. Such losses may be associated with reduced general fitness of the selected population. Since these virulent populations can now be identified as distinct, their general fitness and stability under natural field conditions is being assessed in order to supplement pest management advice for *G. pallida.* The implications of such studies will be discussed.

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Valdeolivas, A. & Romero, M. D. - *Morphometric and biological study of British pathotype 3 of* Heterodera avenae *in Spain.*

A morphometrical and biological study was made of two populations of *Heterodera avenae* from two cereal growing areas of Spain (one in the province of Toledo - Region Central, the other one in the province of Teruel). The morphology of the first population fits the descriptions of *H. avenae,* whereas the second is similar to that described as British pathotype 3 (or Götland strain) and probably has to be considered as a different species. Morphologically, British pathotype 3 differs from *H. avenae* having light browh coloured cysts (compared with thc dark brown cysts of *H. avenae*); thc presence of an underbridge, thick in the centre and finer and sometimes bifurcate in the extremes; and smaller and less prominent bullae. A comparative study of measurements using the Student's test has been made on an average of 100 speciments (50 for the females). Significant differences have been found for most of the parameters studied. As for the biology, important differences have not been found between the two populations from two geographical areas. In both populations the life-cycle is of the mediterranean pattern, but the various stages appear a little later in the population from Teruel.

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Vovlas, N. - *Parasitism of* Trophotylenchulus obscurus *on coffee.*

Trophotylenchulus obscurus (Colbran, 1961) Cohn & Kaplan, 1983 is a widespread pest of coffee (*Coffea arabica* L.) in Sao Tome, West Africa. The nematode has semiendoparasitic habits and induces the formation of dark capsule-like structures which protude from the root surface. These capsules protect the different life stages of the nematode attached to the roots. Histological examination of coffee roots infected with mature females indicated they had established a permanent feeding site in a single cortical cell. This single nurse cell was the same size as adjacent cells, but had dense cytoplasm and an enlarged nucleus and prominent nucleolus. A large vacuole was observed in senescent nurse cells. The single nurse cell of *T. obscurus* was similar to those of *Trophotylenchulus floridensis* and *Tylenchulus semipenetrans* which form, in clusters, in the root stele and cortex, respectively.

Istituto Nematologia Agraria, via Amendola 165/A, 70126 Bari, Italy.

Vrain, T. C. & Daubeny, H. A. - *Resistance of* Rubus idaeus *and related genotypes to* Pratylenchus penetrans.

The root lesion nematode, *Pratylenchus penetrans,* is the major limiting factor of raspberry production in the Pacific Northwest. The host status of twenty one genotypes of red raspberry *(Rubus idaeus)* and related Rubus species to the root lesion nematode was determined in greenhouse trials and a microplot trial. The different genotypes supported significantly different levels of nematode reproduction. The most resistant genotypes were a seedling of the North american red raspberry, *Rubus idaeus strigosus* and a seedling of *R. crataegifolius,* an eastern asiatic spesies. " Nootka ", developped in the Pacific Northwest, was the most resistant of the cultivars tested, while " Chilcotin " and " Glen clova " were the most susceptible. The growth parameters measured were not affected by the nematodes in any of the trials.

Agric. Canada Res. Statn, 6660 NW Marine Drive, Vancouver BC, VGT 1X2, Canada.

Wahab, A. E., Metwally, A. M. & El-Naga, A. - *Observations on the biology of* Androlaelaps (A.) Kifli *M. & I. (Acarina : Laelapidae) a predator on nematodes.*

Biology, of the predacious mite, *Androlaelaps (A.) Kifli* was studied. The predator seemed to be capable of feeding on the nematode *Panagrolaimus rigidus* and the immature stages of thc acarid mites, *Tyrophagus putrescentiae* and *Caloglyphus rizoglyphoides.* However, *P. rigidus* was the preferred host on which the highest fecundity of the predator was recorded.

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Webster, J. M. - *Interactions of nematodes in their parasitosphere and roots in their rhizosphere causing crop loss.*

High quality crop yields can be achieved if we improve our management of the organisms in the plant rhizosphere and the physico-chemical factors in the crop plant environment. Agronomic practice should better facilitate the optimization of these biotic and abiotic factors rather than skew them for short-term crop increase. Multiple parasite associations and/or disease complexes are the norm in field situations. Hence, *Meloidogyne javanica* will predispose tomato plants that are resistant to *Fusarium oxysporum* f.sp. *lycopersici* and they develop wilt disease the fungal hyphae of which destroy the *Meloidogyne*-induced giant cells and so inhibit further root-knot development. Root secretions from such pathogen infected plants change quantitatively and qualitatively which in turn influences the attractiveness of the roots to organisms in the rhizosphere. In particular, endomycorrhizae may develop less well and lead to a diminished crop yield though supplemental phosphorus may ameliorate this change. These changing factors influence the overall parasitosphere of *Meloidogyne* within the plant. The nematode parasite itself modifies water and nutrient uptake and probably transpiration by the plant host and this, in turn, influences tissue development and physiological processes. Chorophyll production and photosynthesis is diminished and plant fibre and seed production is slowed. Although supplemental potassium nitrate may temporarily help the plant overcome these deficiencies the structural changes in the plant caused by heavy parasitism are sometimes difficult to overcome, especially in young plants, and consequently the full benefit of mycorrhizal associates may not occur.

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Whitehead, A. G. - *Problems in integrated control of cyst and stem nematodes.*

Good control of cyst- or stem nematodes may be achieved by integrated management programmes involving the rotation of host and non-host crops, the use of resistant and tolerant cultivars, the use of nematicides and when feasible, biological

or other novel approaches. Populations of the potato cyst-nematode, *Globodera rostochiensis,* can be greatly reduced by the use of resistant potatoes bred from *Solanum tuberosum andigena* or the use of an effective nematicide or both, combined with several years of non-host crops. However, the current widespread, often frequent use of potatoes resistant to *G. rostochiensis* alone, increases *G. pallida,* which can be more difficult to control. Resistance to *G. pallida* is incomplete in most currently available clones or cultivars bred from *S. vernei* or *S. tuberosum andigena* although it may be improved by additional resistance genes from *S. multidissectum* or *S. sanctae-rosae.* Cultivars resistant to *G. pallida* may be intolerant of attack, necessitating the use of a nematicide when they are grown in infested land, and the quality and yield of the tubers may be inferior to susceptible cultivars. In organic soils, *G. pallida* is controlled less by aldicarb or oxamyl than is *G. rostochiensis,* perhaps because of an extended period of hatching of the second-stage juveniles of *G. pallida.* The beet cyst-nematode, *Heterodera schachtii,* which is becoming more prevalent in some parts of Europe, can be controlled by four or five years of non-host crops and in Britain by oximecarbamate nematicides, especially aldicarb. The cost of treating the soil can be greatly reduced by incorporating the granules in widely spaced bands of soil 15 cm wide × 15 cm deep, into which the beet seeds are sown, using a Vertical Band-Reciprocating Harrow technique. Crop rotation is of limited value in the control of stem nematodes, *Ditylenchus dipsaci,* and resistance bred into red clover and lucerne cultivars may be incomplete. In annual crops such as onions and field beans the nematode may be controlled adequately by applying aldicarb or carbofuran to the seed furrows at sowing and in the perennial forage legumes, lucerne and white clover, some success has been obtained with combined seed furrow and foliar treatments.

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Wojtowicz, M. R. & Szczygiel, A. - *Occurrence and pathogencity of* Scutellonema brachyurum, *Andrássy 1958, on sprenger asparagus* (Asparagus sprengeri *Rgl.) and the effect of systemic nematicides on populations of the nematode.*

In Poland sprenger asparagus is cultivated in greenhouses. Its decorative twigs make it one of the most popular plants for use in bouquet compositions. 271 soil samples from sprenger asparagus cultivations were examined in 1978-1983. 86 % of samples were infected by *Scutellonema brachyurum.* The density of the population depended up on the age of the cultivation. In five year old and older cultivations the density of the nematodes exceeded 5 000 per 100 cm^3 of soil, while in younger cultivations it ranged from 0 to 100. Experiments on the pathogencity of *Scutellonema brachyurum* were carried out on sprenger asparagus seedlings grown on two different soils. One soil was poorly nourished (1 part of field soil + 1 part of sand) while the other was standard soil for sprenger asparagus cultivation (2 parts of field soil + 1 part of peat + 1 part of manure). Pathogenicity was estimated 5 months after the soil had been inoculated with nematodes. Initial populations greater than 800 nematodes in 100 cm^3 of poor soil reduced the weight of plants by about 50 % in comparison to that of healthy plants. The same population reduced the weight of plants growing in standard soil by 10 %. The systemic nematicides Furadan 5 G, Mocap 10 G, Nemacur 5 G, Nemafos 10 G, Temik 10 G and Vydate 10 G applied at 0.6-1.2 g.a.i./m^2 in two doses retarded the development of the nematode populations. Single application did not significantly affect the number of nematodes. Changes in the number of nematodes were most noticeable on plots treated with Temik 10 G.

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Wright, D. J. - *Mode of action of nematicides.*

Nematicides are generally classified as fumigants or non-fumigants although a more useful division in terms of their modes of action would be into compounds with an essentially reversible or an essentially irreversible effect on nematodes. Compounds with a reversible action include all the current commercial non fumigant nematicides (organophosphates and carbamates) and the putative nematicides, the avermectins. All of these compounds are neuroactive. The former impairing cholinergic transmission (by inhibiting acetylcholinesterase) at the nematode neuromuscular junction and probably at interneuronal synapses in chemosensory organs such as the amphids. The latter seemingly increasing chloride ion channel conductance at GABA-mediated synapses both centrally and at neuromuscular junctions in nematodes. At present, the only nematicides with an " irreversible " action on nematodes are fumigants (halogenated aliphatic hydrocarbons and methylisothiocyanate [MIT] liberators); compounds which probably have a less specific mode of action than neuroactive pesticides. However, there is no reason why non-fumigant nematicides with a specific but irreversible mode of action could not be developped provided suitable screens are available. Suitable target systems may include microtubule assembly, fertilization, egg shell formation (chitin biosynthesis), collagen biosynthesis, moulting, and lipid metabolism.

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Wyss, U.*, Zunke, U.* & Inst. Wiss. Film** - Heterodera schachtii *(Nematoda). Behaviour inside roots (rape).* [Film E 2904 der Encyclopedia Cinematographica].

See : *Revue Nématol.* 9 (2) : 153-165 (1986).

**Institut für Phytopathologie, Universität Kiel, BRD* and ***Institut für den wissenschaftlichen Film, Göttingen, BRD.*

Zacheo, G. & Bleve-Zacheo, T. - *The biochemical basis of resistance and susceptibility to* Meloidogyne incognita *on tomato cultivars.*

In plant tissues the enzyme superoxide dismutase (SOD) catalyses the conversion of the superoxide anion (O_2^- to H_2O and O_2. In the roots of susceptible tomato cultivars infested with *Meloidogyne incognita* there was a relative increase in SOD and a reduction in O_2^- compared to that in resistant cultivars where there was a decrease of SOD and an increase of O_2^-. In resistant cultivars increasing the *M. incognita* inoculum led to a corresponding increase in O_2^-, related to the number of necrotic loci caused by nematode invasion. In resistant cultivars invasion is not followed by nematode development and reproduction. The O_2^- probably is involved in the hypersensitive reaction of the root tissues, which results

in the death of cells and necroses of the tissues. The O_2^- radical production was determined by extracellular cytochrome a reduction. The addition of NAD(P)H increased the cytochrome c reduction, indicating the presence of NAD(P)H oxidases which are also involved in O_2^- production. However, the relationship with nematode activity/plant resistance is not yet known.

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Zoon, F. C. - *On the relative involvement of nematodes and other soil factors in the decline of* Hippophaë rhamnoides *L. in the Netherlands.*

Sea buckthorn, *Hippophaë rhamnoides* L., forms pioneer scrubs on coastal sand dunes and grows well on newly overblown or excavated sites. On more stable dunes growth and vegetative rejuvenation gradually decrease and sooner or later this shrub species disappears. Growth in nutrient-poor habitats like coastal sand dunes is favoured by the formation of nitrogen-fixing actinorhizal nodules and VA-mycorrhiza. Plant parasitic nematodes, *Longidorus* sp. and *Tylenchorhynchus microphasmis* Loof, and other soil biotic factors have been shown to be involved in the suppression of root growth and nodulation and were suggested as playing a role in the succession of *H. rhamnoides* vegetations. Since this conclusion was founded on only one location the present study was extended to include other sand dune areas on the Dutch coast. From a listing of soil factors and *Hippophaë* vitality from 23 locations it appeared that *T. microphasmis* and *Macroposthonia xenoplax* were very common under *H. rhamnoides* in dry sand dune areas. *Longidorus* spp. were found primarily in the calcareous inner dunes of Voorne and Schouwen under less vigorous scrubs whereas *Trichodorus* and *Helicotylenchus* spp. were most numerous in moist dune slacks. Except for *Rotylenchus* spp. trends between nematode population densities and vitality of *H. rhamnoides* were negative. A bioassay of the growth of *Hippophaë*-seedlings using soils from the different localities and including treatments with oxamyl and gamma-sterilization was made. Overall the oxamyl treatment resulted in significantly more nodules and less chlorosis in comparison to the control. Sterilization, accompanied by Frankia-inoculation, resulted in a significantly greater production of biomass than either oxamyl or the control. These results indicate the importance of nematodes and other biotic soil factors in the decline of *H. rhamnoides* on most locations along the Dutch coast.

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Zunke, U. - *Feeding behaviour of* Pratylenchus penetrans *in roots.*

Pratylenchus penetrans is an important parasite of agricultural crops. However, little is known about the feeding behaviour of this nematode species because of the difficulty of observing nematodes inside roots. A video system has recently been developed with a video camera equipped with a 1" Newvicon pickup tube and a video recorder 10 MHz resolution, both converted to 875 lines/50 Hz to overcome this problem. A special feature of this system is the contrast enhancement of images produced by differential interference contrast techniques, that allows *in vivo* observations of nematode behaviour and plant reaction previously obscured by the thickness of the root. The following aspects of the feeding behaviour are demonstrated : *i)* invasion and migration; *ii)* short time feeding (up to some minutes); *iii)* long time feeding (up to several hours); *iv)* ultrastructure of parasitized cortex cells and of nematode; *v)* egg-laying and defaccation. Rupture of cell walls during migration is caused by co-ordinated stylet thrusts, forming a slit. Food uptake is always from a small zone of aggregated cytoplasm around the inserted stylet-tip (short and long time feeding). Hypertrophy of the nucleus occurs only during long time feeding. Egg-laying usually happens after a long time feeding phase. Defaecation occurs at rather regular intervals (few minutes) during feeding.

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