Quarantine Nematodes – European Legislation, Current Status and Prespectives

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Introduction

- Introduction of propagating material and planting material is often mentioned as a source of introduction of pests.
- Carl Linnaeus in 1752 express concerns about the risk of spreading plant pests together with their host, he pointed that beetles could be introduced to England, in seeds from English colonies in North America (Usinger, 1964).
- The exchange of crops and their nematode pests between continents increased dramatically after the European discovery of the Americas. Typically, nematode species were first described from a country that was not their centre of origin.
- PCN was first described as *Heterodera rostochiensis* by Wollenweber (1923) in Germany, although it originated from the Andean regions of South America, but it was not reported here until 29 years later (Wille and Bazan de Segura, 1952). A second species of PCN, *H. pallida*, which also originated in South America, was not described until 1973, in England, by Stone (1973) using a type British population.

Photo: B. Hammmeraas

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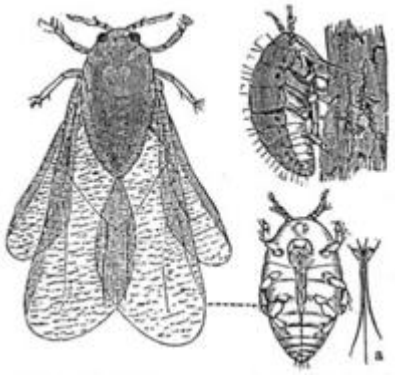
Heterodera rostochiensis described by Wollenweber (1923) in Germany, although it originated from the Andean regions of South America, but it was not reported here until 29 years later (Wille and Bazan de Segura, 1952). A second species of PCN, *H. pallida*, which also originated in South America, was not described until 1973, in England, by Stone (1973) using a type British population.

Introduction

- Jones & Baker (2007) indicated that in Great Britain only 20% of the pathogens of plants found in between 1970 and 2004 can be linked to known imports. many pathogens are thought to have entered with vegetative plant material due to their biology.
- Desprez-Loustau et al. (2009) conclude that in France, 227 alien pathogen species have been introduced since 1800, and many are suspected to have been introduced on living hosts; 178 are considered established, 65% of which are plant pathogens (46% on crop plants, 31% on ornamentals, 22% on forest trees).

International Plant Health

- *Phylloxera vastatrix*, now known as *Viteus vitifoliae*, the pest was carried from North America to Europe, was causing a huge disaster the European wine industry between 1865-1875, brought together representatives form Austria, France, Germany, Italy, Portugal, Spain and Switzerland to discuss what to be done.
- The International Convention on Measures to be taken against *Phylloxera vastatrix* was signed in 1878.
- Countries throughout the world have become more aware within the past few years that prevention of the spread of plant pests can best be accomplished by nations working together.
- This has been the driving force behind the adoption in 1929 of International Convention for the Protection of plants (Ikin, 1990).
- The efforts to expand international cooperation in the management of plant pest threats resulted in the creation of the International Plant Protection Convention (IPPC) in 1951.



http://en.wikipedia.org/wiki/File:Phylloxera_cartoon.png

International Plant Protection Convention (IPPC)

- The IPPC was revised in 1979 and again in 1997. According to the 1997 revision, the purpose of the IPPC is to secure "common and effective action to prevent the spread and introduction of pests of plants and plant products and to promote measures for their control".
- The IPPC is administered through the IPPC Secretariat and the Commission on Phytosanitary Measures (CPM), in cooperation with National Plant Protection Organizations (NPPOs) and Regional Plant Protection Organizations (RPPOs).
- International plant health are governed by relatively few agreements and organizations.
- Principal among which are the Agreement on the Application of Sanitary and Phytosanitary Measures under the World Trade Organization General Agreement on Tariffs and Trade (the World Trade Organisation Agreement on the Application of Sanitary and Phytosanitary Measures (WTO-SPS).
- The IPPC, administered by a Commission on Phytosanitary Measures under the United Nations Food and Agriculture Organization (FAO) and, more recently, the Convention on Biological Diversity (CBD) administered under the United Nations Environment Programme (UNEP).

Regional Plant Protection Organizations (RPPO)

- In line with the principles of the IPPC, national governments around the world develop their own plant health and quarantine regulations, which are usually enforced by an integral NPPO.
- In accordance with IPPC requirements nine Regional Plant Protection Organizations (RPPO) have been formed.
- NAPPO : North American Plant Protection Organization
- OIRSA : Organismo Internacional Regional de Sanidad Agropecuaria
- CPPC : The FAO carribbean Plant Protection commission
- CIPA : Comite Inter- Americano de Protection Agricola
- CA: Comunidad Andina
- IAPSC : Inter-African Phytosanitary council
- EPPO : European and Mediterranean Plant Protection Organisation
- SEAPPC : Plant Protection committee for the South East Asia and Pacific region
- NEPPC : Near East Plant Protection Commission

Role of RPPOs and NPPOs

- They produce non-binding (i.e. without legal status) recommendations to member countries for harmonizing regulations among their members.
- The main tasks of the National Protection Organizations (NPPOs) are:
- To provide laboratory services for identification of harmful organisms in support of phytosanitary inspections and surveys.
- To provide advice on and interpretation of the scientific aspects of national and international legislation or other regulations.
- To carry out pest risk analyses.
- To provide scientific support, training and advice to other parts of the NPPO during negotiations, or when planning policy or executing initiatives such as surveys or eradication campaigns.
- To advise on the scientific aspects of certification schemes and issue of licences and permits.
- Complementary to these tasks is the need to carry out related research to improve testing or identification procedures, to investigate pest biology where necessary to help in assessing threats and developing effective eradication measures, and to keep up to date with scientific advances in relevant disciplines.

European and Mediterranean Plant Protection Organisation (EPPO)

- EPPO is the oldest of RPPO. Organization (EPPO), established in 1951.
- Over the years, EPPO has fifty member countries in Europe, North Africa and the near East.
- The aims of EPPO are to help its member countries to prevent entry or spread of dangerous pests (plant quarantine).
- The Organization has therefore been given the task of identifying pests which may present a risk, evaluating their risk for the region and making proposals on the phytosanitary measures which can be taken against them (Pest Risk Analysis).
- Information on pests presenting a risk to the EPPO region is required and is collected by the Organization.
- Lists of pests recommended for regulation as quarantine pests (www.eppo.org).
- EPPO List of pests recommended for regulation as quarantine pests:
  - EPPO A1 pests are absent from the EPPO region
  - EPPO A2 pests are locally present in the EPPO region
  - EPPO Alert list for organisms with potential risk for the region

EPPO A1, A2, Alert list and nematodes regulated in some parts of the EPPO region

Family	Genera and species	EPPO List of pests recommended for regulation as quarantine
Meloidogynidae:		
	Meloidogyne chitwoodi	EPPO A2
	Meloidogyne enterolobii	EPPO A2
	Meloidogyne fallax	EPPO A2
	M. ethiopica	EPPO Alert list
Heteroderidae:		
	Globodera rostochiensis	EPPO A2
	Globodera pallida	EPPO A2
	Heterodera glycines	EPPO A2
	Heterodera zeae	EPPO Alert list
	Punctodera chalcoensis	EPPO Alert list
Pratylenchidae:		
	Hirschmanniella spp. (except H. gracilis and H. loofi)	regulated in some parts of the EPPO region
	Nacobbus aberrans	EPPO A1
	Radopholus similis attacking citrus (formerly R. citrophilus)	EPPO A1
	Radopholus similis (not attacking citrus)	EPPO A2
Anguinidae:		
	Ditylenchus dipsaci	EPPO A2
	Ditylenchus destructor	regulated in some parts of the EPPO region
Aphelenchoididae:		
	Aphelenchoides besseyi	EPPO A2
	Bursaphelenchus xylophilus	EPPO A2
Longidoridae:		
	Longidorus diadecturus	regulated in some parts of the EPPO region
	Xiphinema americanum sensu lato	regulated in some parts of the EPPO region
	Xiphinema americanum sensu stricto	EPPO A1
	Xiphinema bricolense	EPPO A1
	Xiphinema californicum	EPPO A1
	Xiphinema rivesi	EPPO A2

EU a Single Market and Plant Health Regulations

- The Treaty of Rome, signed in 1957, created the European Economic Community (EEC)
- The emphasis at first was on economic cooperation and free trade between the participants. In the succeeding years the tendency in common parlance to refer to this grouping as the “European Community” (EC) gradually increased, EC regulations began to cover much wider areas than strictly economic activities, and this development gradually accelerated.
- The early stage EC plant health regulation resulted in the directives of 1966–1969 on the marketing of field crop seeds, seed potatoes (66/403/EEC, now replaced), vine reproductive material (68/193/EEC), forestry reproductive material (66/401/EEC), and the control of potato wart disease (69/464/EEC) and of potato cyst nematode (69/465/EEC now amended 2007/33/EC).
- Development of plant health regulations was then resumed between members of the enlarged

EU a Single Market and Plant Health Regulations

- Community, and reached a conclusion in 1976 with agreement on the plant health directive (Council Directive 77/93/EEC).
- This directive established key principles, such as the
  - Transparency of regulations, a common list of quarantine organisms and the right to take emergency action in certain circumstances.
  - The International Phytosanitary Certificate and the rules governing its use still provided the basis for trade in plants and plant products between Member states.
  - In 1993 amendments to Directive 77/93/EEC were introduced, and the use of plant passports was implemented (Ebbels, 2003).
  - Over the years, the number and complexity of amendments and directives associated with Directive 77/93/EEC increased to such an extent that in the year 2000 a consolidated version, Council Directive 2000/29/EC,
  - EU website: http://www.europa.eu

Plant Health Directive, 2000/29/EC

- This Directive replaces and consolidates Directive 77/93/EEC and subsequent amendments.
- This directive is the principal piece of legislation governing plant health regulations within the EU.
- It is based on the principles accepted internationally in the International Plant Protection Convention (IPPC) of the Food and Agriculture Organisation (FAO) and the WTO SPS (sanitary and phytosanitary measures) agreement.
- This Directive lays down measures designed to protect Member States against the introduction of organisms harmful to plants and plant products from other Member States or third countries.
- This Directive also lays down measures designed to protect Member States against the spread of harmful organisms within the European Union (EU).

Plant Health Directive, 2000/29/EC

- Protected zones
- The Directive establishes, at the request of one or more Member States, special protected zones to guard against certain harmful organisms. The reason for this protection is the absence of specified harmful organisms in this zone despite conditions favourable to their development.
- Each zone may cover all or part of the territory of a Member State and must be defined in specific geographic terms and in relation to the harmful organisms concerned
- Amending Directive:

  Council Directive 2002/89/EC of 28 November 2002, 2000/29/EC

  Regulation (EC) No 882/2004

  Council Directive 2009/143/EC

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0029:en:NOT

Legislation Against Plant Parasitic Nematodes

- There is a core of nematode species that are targeted by legislation around the world.
- Nematode pests of potatoes are amongst the most highly regulated because they are readily disseminated in infested tubers or associated soil residues.
- Other cyst forming nematodes *H. glycines* and *H. schachtii* are most commonly regulated by countries.
- The false root-knot nematode, *Nacobbus aberrans*, another major potato pest, is included in the list of regulated pests for many countries
- In general, root-knot nematodes are not regulated as a group because the major economically important species are already widely distributed. However, one increasingly important regulated species is *M. chitwood*i, primarily because it is a serious pest of potato and other economically important crops such as carrot. The burrowing nematode *Radopholus similis* is common on lists of quarantine pests.

Nematodes regulated by 20 or more countries in international quarantine legislation. After (Lehman, 2004)

Nematode species	Crop	Number of countries regulating (in 2000)
Globodera rostochiensis	Potato	106
Apelenchoides besseyi	Rice	70
Ditylenchus dipsaci	Several	58
Radopholus similis/R. citrophilus	Citrus	55
Globodera pallida	Potato	55
Ditylenchus destructor	Potato	53
Heterodera glycines	Soybean	52
Aphelenchoides fragariae	Strawberry and ornamentals	47
Bursaphelenchus xylophilus	Forestry (Pinus)	46
Xiphinema index	Grape	42
Nacobbus aberrans	Potato and Vegetables	38
Xiphinema americanum	Grape	30
Anguina tritici	Cereal (wheat)	24
Heterodera schachtii	Sugarbeet	22
Bursaphelenchus cocophilus	Ornamentals	21

Plant Parasitic Nematodes - Pest Risk Analysis (PRA)

- Phytosanitary measures must be justified by a PRA as described in the International Standards for Phytosanitary Measures (ISPM) “Guidelines for Pest Risk Analysis” and “Pest Risk Analysis for Quarantine Pests”, including Analysis of Environmental Risks. All current ISPMs are published on the IPPC home website at www.ippc.int.
- The IPPC ISPM on Pest Risk Analysis (PRA) includes a scientific evaluation of biological and economic evidence to determine whether a pest should be regulated (pest risk assessment) and the strength of any phytosanitary measures to be taken against it (pest risk management).
- PRA can be initiated for a variety of reasons, such as if a particular pest is intercepted at points of entry, a new pest risk is identified by scientific research or a pathway other than a commodity import (e.g. natural spread, international mail, garbage) is identified.
- One of the crucial steps in a PRA is the determination of whether or not the pest or pests of concern meet the definition of a “quarantine pest”.

Quarantine pest

- An organism can only be considered a quarantine pest for a particular country if it is not present in that country or of limited distribution and under official control.
  - Official control of regulated pests must aim at eradication or containment and not merely a reduction or suppression of population levels.
  - The official control program must be implemented on a national scale.

WTO-SPS/IPPC principles that should be followed when deciding whether or not to allow importation of a commodity

- There are several important WTO-SPS/IPPC principles
- The first of these principles is that of "minimal impact", also known as "least restrictive measures", which states that measures must not restrict trade more than that required to achieve the appropriate level of protection for the importing country.
- The principle of "equivalence" means that an importing country must recognize that different phytosanitary measures can potentially be used to achieve their appropriate level of protection.
- The WTO-SPS principle of "non-discrimination" states that importing countries should not discriminate between countries that have the same phytosanitary status.
- Finally, the principle of "transparency" requires countries to provide information regarding their risk analysis procedures, including the technical information justifying why certain phytosanitary measures were selected.
- These key principles, and decisions based on scientific evidence through risk analysis, provide a more predictable, transparent and fair trading system.

Future Challenges for the Control of Regulated Nematodes

- Today the main challenges facing NPPOs is to target inspections to consignments with high risk to the agricultural industry in their countries.
- It is necessary to have actualized statistic data as this will provide information on the volume and fluctuation of various types of trade, the problems encountered and the association of problems with particular sources, areas or suppliers, to determine priorities for targeting inspections and monitoring. The same information is important in performing a PRA.
- In current years organic farming and the use of integrated pest management programmes, combined with the loss of many chemical products used to control nematodes, means that another future challenge is to develop a better understanding of the biology of plant parasitic nematodes, so that as many cultural measures as possible can be used to suppress them at their source. Such measures might include, increasing the interval between susceptible crops to reduce the rate of multiplication of pest species.
- In addition, the growing desire to use plant waste for composting, presents an additional risk unless appropriate measures are taken to secure complete sanitation.

Future Challenges for Advisers and Researchers

- Expert scientific support is essential for a country or region to provide an adequate plant health service.
- A good cooperation between the regulatory agencies, crop consultants, farmers and growers is essential for success in all kinds of phytosanitary programmes.
- The increasingly declining skills in classical identification and diagnosis in nematology is evident.
- At the same time there are increasing demands to formalize quality procedures in laboratories, leading to the production of identification protocols that provide guidance for international agreement.
- For more than a century the identification of plant parasitic nematodes has been dependent on recording and quantifying morphological key-features.
- Important tools for morphological identification are original descriptions and reference material in slide collections.
- The international decline of taxonomic skills, and the lack of resources for competence-building, maintenance and expansion of collections will threaten the basis of identification of regulated nematodes.

Future Challenges for Advisers and Researchers

- In order to fill this gap molecular tools have been developed to assist the morphological identification. Such tools include electrophoresis and polymerase chain reaction (PCR).
- They are especially important where morphological identification is particularly difficult or where only immature specimens have been intercepted. However, it is often not realized that the development of such techniques as reliable, routine methods for use as quarantine identification tools requires additional intensive research.
- Today diagnostic protocols are only developed for a restricted range of species, thus still necessitating a preliminary, provisional identification by a morphological specialist.

Future Challenges for Advisers and Researchers

- Analytical methods examining the genetic make-up of organisms are being continually refined and adapted to develop new phylogenetic models that are becoming an integral part of nematode systematics (De Ley and Blaxter, 2002), and the associated technological equipment, though expensive, is becoming a familiar equipment of most diagnostic laboratories.
- Despite great advances in the use of molecular methods for the identification of diseases, especially viruses, their development as identification tools for nematodes has been relatively slow.
- Of the species listed in EU legislation, reliable protocols have currently only been developed for *B. xylophilus*, *G. pallida*, *G. rostochiensis*, *M. chitwoodi* and *M. fallax*.

Future Challenges for Advisers and Researchers

- Even as molecular tools can be used by personnel with no nematological skills, possible requirements in phytosanitary legislation to produce rapid morphological evidence will be difficult in the light of the declining competence in classical morphology among nematologists.
- Not recognizing the possible limitations in existing molecular techniques could in some cases result in over- or under regulation of pest organisms. At present the protocols for regulated species do not distinguish unregulated or native species of the genera that occur in the countries where interceptions or outbreaks may occur. For example protocols for PCN do not include *G. achilleae*, cyst nematode occurring in several European countries.
- PCN cysts will register as negative with such methods if eggs are absent, thus perhaps giving a false impression of the situation with regard to the status of the pest in a particular consignment.
- Therefore, the role of experienced diagnosticians and taxonomists in nematode identification remains a vital one.

Science of nematology versus legislation

- Phytosanitary legislation requires clarity and consistency to avoid misinterpretation.
- The names of regulated plant parasitic nematodes need to be as firmly established as possible.
- This, requires awareness of the fact that some species might be subject to many taxonomic changes, and that there may exist many synonyms in the legislation of some countries; this needs to be recognized to avoid confusion and allow for the correct phytosanitary action to be taken.

Science of nematology versus legislation

- An example of this is the controversy is *Radopholus citrophilus* and *R. similis*, which are both listed in European legislation.
- *R. similis* was thought to consist of different pathotypes but Huettel et al., (1984) concluded that the banana race and the citrus race were distinct species; the name *R. similis* was restricted to the banana race, and the citrus race was described as *R. citrophilus*.
- Later, Kaplan et. al, (1997) synonymized *R. citrophilus* with *R. similis*; Valette et. al., (1998) proposed *R. citrophilus* as a junior synonym of *R. similis*, although Siddiqi (2000) proposed it as a subspecies of *R. similis*, and Elbadri et al., (2002), using molecular techniques, demonstrated marked intraspecific variation in various isolates of *R. similis*.
- This continuing taxonomic uncertainty has caused confusion for quarantine officers and specialists involved in PRA work, due to the uncertainty on the actual host lists of *R. similis*.

Challenges for laboratories involved in Plant parasitic nematode diagnostics

- International standards for phytosanitary measures for plant parasitic nematode diagnostics are becoming increasingly important.
- But their adaptation in some areas, such as the identification of species, which entails the use of judgment by experts rather than the output from machines, has proved a difficult philosophy for accreditation schemes to embrace.
- In addition, the variability of resources available in individual laboratories means a range of protocols has to be included.
- Nevertheless, selected protocols are slowly achieving international status.

Challenges for laboratories involved in Plant parasitic nematode diagnostics

- The combination of scarce scientific resources and the cost of providing prescribed levels and speed of delivery have led some countries to negotiate contracts for science services with those countries that possess the ability to deliver.
- Inevitably, this will lead to centres of expertise serving a community in a particular geographical location or region.
- At the same time this may have economic advantages, it should not discourage the broad development of essential identification and diagnostic expertise that is vital for the whole basis of phytosanitary work.
- The decline in taxonomic expertise requires networks to take advantage of scarce skills at short notice and to develop standardized protocols that are increasingly being demanded internationally

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