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PEST RISK ASSESSMENT ON NEMATODE DISEASES OF ROSES OF INDIA

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An analysis of the risk to rose plants in India from possible introduction of plant parasitic nematodes is done by assembling relevant biological, climatic and commercial information. The risk presented by different exchange propagules is assessed and phytosanitary measures to reduce the risks are proposed. The conclusions of the PRA, based on EPPO guideline No.1, is that nematodes of species not yet reported from India, present a serious risk to the industry. All sorts of exchange of live material should be rooted through quarantine inspection.

Key words : Rose, pest risk analysis, PRA, nematodes, floriculture

Floriculture has become a potential money-spinner for the developing countries. It is a multi million rupee industry in India. The liberalisation of industrial and trade policies in July 1991, paved way for development of export oriented production of cut flowers. The seed policy of 1988 had already made it possible to import planting material of international varieties. Floriculture was included in the export and import policy as one of the areas eligible for setting up exports oriented units (EOU's). Various measures are being taken up at the Government level to support this sector.

More than 140 countries are now involved in floriculture trade. Netherlands is the largest producer and exporter of cut flowers with as much as 63 per cent share of the total world exports. Germany is the largest importer, its share in World Trade being around 37 per cent. The largest consumer of flowers and plants is Norway followed by Switzerland, Denmark, Sweden and Germany. India's share in the export of floriculture products in World market is less than 1 per cent.

The important floriculture crops in the international cut flower trade are rose, camation, chrysanthemum, orchids, tulip, anthurium, lilies, iris and liasanthus. According to a report of Agricultural and Processed Food Products Export Development Authority (APEDA) and National Horticulture Board (NHB), for India the estimated area and production under ornamentals in 1994-95 were 53000 hectares and 4 lakh tonnes respectively. Government of India allows subsidy on airfreight, import duty and customs duty. Units engaged in floriculture are permitted duty free imports. Soft loans at 4-5 percent are available from the NHB.

Pest Risk Assessment

Information was collected in the format of EPPO PRA Guideline No. 1 "Checklist of information required for PRA (OEPP/EPPO, 1993)". Analysis could not be made due to non-availability of basic data.

Part A : Information for PRA

Section 1 : The Organisms (Potential disease causing organism)

List of plant parasitic nematodes reported on roots in rhizosphere of the plants along with

country of occurrence are in Table 1. There are no reports of plant parasitic nematodes on cut flowers or other above ground parts of rose plants.

Table 1. Some important nematode species reported on roses

Pratylenchus crenatus	Nurseries in Poland	Wojtowicz & Sobilo, 1994
P. penetrans	Poland	- do -
P. projectus	Poland	- do -
P. vulnu	Poland	Schneider et al. 1995
P. coffeae	Bulgaria	Katalan & Budurova 1979
P. brachyurus	Pakistan	Saeed *et al.* 1988
P. zeae	Pakistan	Saeed *et al.* 1988
P. penetrans	Belgium	Ann. 1975
P. penetrans	Denmark	Jakobsen 1976
P. vulnus	Denmark	Santo 1974
P. vulnus	Europe	EPPO 1977
P. vulnus	Japan	Hayashi 1976
P. vulnus	Florida, USA	Lehman 1982
P. penetrans "	Florida, USA	
P. vulnus	Italy	Lamberti *et al.* 1987
Meloidogyne hapla	Nurseries in Poland	Wojowicz & Sobilo 1994
M. javanica	Pakistan	Zaina & Maqbool 1995
M. incognita	Pakistan	- do -
M. hapla	Netherland	Ann. 1978
M. incognita	U.P.,India	Hasseb *et al.* 1978
M. hapla	Belgium	Ann. 1975
M. hapla	Denmark	Santo 1974
M. hapla	Japan	Hayashi 1976
M. hapla	Florida, USA	Lehman 1982
Longidorus elongatus	Nurseries in Poland	Wojtowics & Sobilo 1994.
L. alaskaensis	Alaska	Robbins and Brown 1996
L. paralaskaensis	Alaska	- do -
L. bernardi	Alaska	- do -
L. ala	Alaska	- do -
L. macrosoma	Florida, USA	Lehman, 1982
Xiphinema cobbi	U.P. India	Sharma & Saxena 1981
X. indica	U.P. India	- do -
X. basiri	Rajasthan, India	Roy 1980
X. diversicaudatum	Florida, USA	Lehman 1982
X. brevicolle	Florida, USA	Lehman 1982
X. americanum	Pakistan	Saeed *et al.* 1988
Tylenchorhynchus rosei	Pakistan	Zarina & Maqbool 1991
T. microdoratus Bulgaria	Katalan & Budurova 1979	
T. brassicae	U.P., India	hasseb *et al.* 1978
T. annulatus	Pakistan	Saeed *et al.* 1988
T. martini	Pakistan	Saeed *et al.* 1988
T. mashhoodi	Pakistan	Saeed *et al.* 1988
Helicotylenchus sp.	T.N., India	Sundara & Vadivelu 1988
H. verecundus	Pakistan	Zarina & Maqbool 1991
H. shakili	H.P., India	Sultan,1981
H. dihystera	H.P., India	Sultan,1981
H. valecus	H.P., India	Sultan,1981
H. indicus	U.P.,India	Haseeb et al 1978
Rotylenchus gracilidens	Bulgaria	Katalan & Budurova 1979
R. calvus	Bulgaria	- do -
R. reniformis	U.P.,India	Hasseb *et al*, 1978
R. reniformis	Pakistan	Saeed *et al*, 1988
Ditylenchus pumilus	Bulgaria	Katalan & Budurova 1979

1.1. Relationship with known quarantine pests

Some important nematode pests associated with rose plants are *Pratylenchus vulnus, P. penetrans, meloidogyne indica, M. hapla, Longidorus* sp., *Xiphinema americanus.* Most of the countries would not import material grown in nursery/field infested with these nematodes. Plants, rootstock, soil adhered to roots or plant debris in the packing material could be carried for the nematode species.

1.2 Methods of identification for inspection purposes

Nematodes are identified and classified, based on morphology and morphometrics measurements. Observations are taken with the help of high power microscopes, using guidance from taxonomic literature. DNA fingerprinting and PCR techniques are now being used to distinguish certain closely related species. Microsatellite dot blot technique is also useful for differentiating species. The modern techniques are available only to few laboratories and have not yet been developed sufficiently to be reliable tool for routine diagnosis.

1.3 Methods for detection

Nematodes are associated with roots and occur in rhizosphere. Some of them are endoparasites; semi endoparasites while others are ectoparasites. For detection of ectoparasites, processing of soil from the rhizosphere could give a fair idea about not only presence or absence but also its population per unit of soil. For detection of endo and emiendo parasitic nematodes roots are either stained or soaked in water for at least 24 hours at 15-20 C. Active nematodes move into the water suspension and could be examined after concentration through sieves. Aerial parts of rose are generally free from nematodes, but thorough washing of stem/budwood cuttings or flowers with water would further ensure and prevent, if any, nematode adhering within aerial parts and flowers. Expertise is required to distinguish plant parasitic nematodes and correct identification.

Section 2 : Biological characteristics of pest and its vectors

2.1 Life Cycle

Immediately after the larva comes out of egg, it tries to locate host plant. All the laral and adult stages feed on cells of the host roots. Endoparasitic nematodes penetrate epithelial and cortical cells; some cells of the stele grow into giant cells/nurse cells to support nematodes. Two genera of plant parasitic nematodes on roses - *Longidorus* sp. and *Xiphinema* sp. are vectors of viral diseases. After continuous feeding, nematodes moult to adult, mate inside or outside - in soil and begin to lay eggs. During this propagative stage of multiplication, the nematode population is composed of males, females and four juvenile stages.

2.2 Dissemination and dispersal

Rose parasitic nematodes are restricted to aquatic environment - i.e. roots and soil. Movements of soil and plants/rooted cuttings from nurseries/fields to new areas assist in dispersal of nematodes. Human activities are known to be the principal route for dispersal over greater distances. *Pratylenchus* sp., *Meloidogyne* sp. and *Tylenchorhynchus* sp. have been intercepted on a number of occasions during international exchange of rooted plants, rootstock or with soil - as contaminant along with plants/packing material.

2.3 Survival under adverse conditions

The nematodes have temperature dependent life cycles and are adapted to survive periods of low moisture (eggs, cysts and other anhydrobiotic stages), low and high temperatures stages. Nematodes inside the plant root are safe and survive for a very long period. Finding differential temperatures to kill nematodes, without injuring its hosts, for salvaging is generally a tedious job.

2.4. Adaptability

Nematodes have remarkable flexibility in its biology. They are able to enter the ecosystem in an area for outside its normal geographic range; adapting to different host species and different climatic conditions. They are known to have different biotypes and races. DNA profiles indicate considerable plasticity in the nematode genome. Populations from different parts of world show small differences in morphology and pathogenicity (biodiversity)

Section 3 : Geographical distribution of pests

Sufficient data is not available for the distribution of nematode species in or outside India. Information is scattered and most of the research papers are on taxonomic identification. Many of the survey reports are indicative of the distribution of Nematologists rather than nematodes themselves.

The overall distribution of nematodes is again host, moisture, temperature, soil type and soil pH dependent. Some species are prevalent in one area while others are dominant in another.

3.1 Area of origin and history of spread

Data is not available and predictions have not been made about origin or spread of nematode pests of roses, though nurseries play an important role in sporadic spread. Inter national/continental movements are through exchange of amterial/human activities.

3.2. Overlap of world distribution of the pests with that of major hosts

Consolidated literature about worldwide distribution of nematode pests of roses is not available. Most of the reported nematodes on roses have very wide host range.

Section 4 : Host plants of the pests

4.1 Host plants reported in areas where the pest now occurs

Most of the nematode pests of roses have very wide host range. Data on full host range/plants reported in the PRA (India) area or where the pest now occurs is not available.

4.2 Host plants growing in PRA area (i.e. India)

Data is not availale on weeds, crop rotation, alternate crops, and mixed crops, grown along with roses and their pests. The area under rose cultivation is wide spread and native crops grown in the area are not studied. The reported nematode pests are known to have very wide host range.

Section 5 : Potential of the pest for establishment in the PRA area

5.1 Climatic conditions for pest development

The optimal conditions for the pest development are the same as required for the host/rose development and survival. There are optimum temperature and moisture conditions for the host and pest multiplication, therefore extent of damage on roses depends upon climatic conditions of the area..

5.2. Data on climatic conditions in PRA area

India being a big country has got all types of climates, starting from temperate in the north, to tropical, subtropical and xerophytic in the west. Rose pests, coming along with host or otherwise from other countries could easily accommodate themselves in rose growing areas.

Section 6 : Control of the pests

6.1. Control measures

Growing of rootstock in pest free area is important and desirable wherever the material is for movement. Fumigation, hot water treatments and pesticidial dip/spray treatments are being used as a precautionary measure for plants, rooted cuttings, cut flowers under exchange.

6.2. Records of eradication of the pest

There is no record of any successful eradication programme from a field/region. Populations have been managed below threshold level for *Pratylenchus* sp. under glass house/nurseries by steaming soil and using nematode free rootstocks. Plants/rooted cuttings could be salvaged for exchange through hot water and nematicidal treatments.

Section 7 : Transport of the pest

7.1. Methods of natural spread elsewhere in the world

Natural but slow spread of nematodes occurs

through movement of soil, rooted plants from fields/nurseries, wind storms, irrigation canals and through farm machinery. Nematodes on their own can move, a few inches in a year. Long distance movements are through the man.

7.2. Pattern of international trade in the major host plants of the pest

Most of the international trade and exchange of germplasm for improving quality, takes place through cut flowers, but wood/stem cuttings which in general does not impose threat of nematode spread along with it. Additional precautions could be taken to wash stem cuttings with running water at the place of origin and packing them in pest/soil free material.

To some extent material exchanged for commercial use are either grafted plants or rootstocks. These could carry nematodes. In no case soil should be allowed to come along with the exchanged material. Plants exchanged as far as possible, should have been grown on a disease/pests free nursery. Suitable treatments are advised for salvaging at the point of export and verification of the same at the country of import. Still there are chances of escape of few pests especially from a bulk consignment.

7.3 Records of interception of the pest

Important nematode pests - *Pratylenchus* sp., *Tylenchorhynchus* sp. and *Meloidogyne* sp. have been intercepted along with international shipments of roses. The nematodes are known to survive in roots for at least a year in dominant stage and could therefore survive shipment to any destination from any source.

7.4 Records of movement of the pest not associated with host plants

Apart from movement of nematode pests along with plants and rooted cuttings, there are reports of movement of live nematodes along with non-hosts, in soil clods and damp packing material.

7.5 Specific pathways for movement of the pests to the PRA area

Nematode pests reported on roses are of very wide host range, so it is not necessary that they should enter in the PRA area through rose germplasm/commercial material. All the exchanged planting material should be thoroughly examined to confirm pest free movement of plants/seeds.

Section 8 : Economic impact of the pest

8.1 Recorded economic impact

Rose is an important ornamental crop of India. Cut flowers are in great demand in national and international market. Nematodes are known to not only reduce yield but also have drastic effect on their quality. Quality/size of the cut flowers makes a big difference on economy of the crop. Therefore all precautions and measures should be taken to reduce the chances of entry of a new nematode (pest) species through imported consignment or through infested nurseries.

8.2 Estimated effect of the presence of the pest on exported commodities

Cost fetched in the international market would be drastically reduced for the cut flowers as their size and quality goes down. Export of plants because of quarantine reasons and plant products (cut flowers) because of quality will not be possible once the pests (nematodes) get introduced in the nurseries/fields. Although treatments are available but no country would prefer to risk their own flower production/industry by importing plants from diseased regions/nurseries, as 100% control (eradication)is seldom achieved.

8.3 Costs and side effects of control measures

There are no side effects of salvaging treatments if proper time and temperature combinations is used for curing plants/planting material of roses through hot water treatment. Cost involved is negligible.

CONCLUSIONS

From the assessment of the information available, potential nematodes -

Pratylenchus vulnus, P. projectus and Meloidogyne hapla, pose a threat to roses in Indian subcontinent. There are two pathways for the nematodes to enter, firstly through introduction of infested plants/root stock of roses or any other host plant and secondly by contamination of soil clods mixed with seeds/packing material. Conditions are favourable for establishment of the nematodes as appropriate host plants roses, ornamental and fruit crops are widely grown with favourable climatic factors.

Inter population mating and development of hybrids of other rose parasitic nematodes already present in our country are possible (Riga *et al.* 1992). Such hybrids may alter pathogenicity traits and survival strategies.

Exchange of rose plants and rootstock involves a great risk from nematode pest. Cut flowers and stem cuttings are comparatively risk free. Therefore as far as possible exchange of germplasm should be through stem cuttings while international trade should be restricted to cut flowers only.

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