AARHUS
UNIVERSITET
DCA - NATIONALT CENTER FOR FØDEVARER OG JORDBRUG

Til Landbrugs- og Fiskeristyrelsen

Vedr. bestillingen: 'Risikokategorisering af karantæneskadegørere relevante for planteproduktionen i væksthuse i Danmark'

DCA - Nationalt Center for Fødevarer og Jordbrug

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Specialkonsulent

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Landbrugs- og Fiskeristyrelsen har i bestilling sendt den 28. april 2016 bedt DCA – Nationalt Center for Fødevarer og Jordbrug – om en risikokategorisering af karantæneskadegørere relevante for planteproduktionen i væksthuse i Danmark. Leveringen er opdelt i 3 faser, hvor de to første er leveret, så denne levering afslutter opgaven.

Rapporten er udarbejdet af Adjungeret professor Gabor Lövei og Postdoc Marco Ferrante fra Institut for Agroøkologi.

Besvarelsen er udarbejdet som led i "Aftale mellem Aarhus Universitet og Fødevareministeriet om udførelse af forskningsbaseret myndighedsbetjening m.v. ved Aarhus Universitet, DCA – Nationalt Center for Fødevarer og Jordbrug, 2016-2019".

Venlig hilsen

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Extended information for species constituting very high risk to Denmark from the quarantine pests listed on the EU Plant Health Directive DIR 2000/29 Appendices I/A2, II/A1, II/B, and the EPPO Alert List

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BACKGROUND

On the basis of a previous exercise, each currently EU regulated pest (i.e. those listed in Plant Health Directive DIR 2000/29, Annexes I and II, plus those regulated only by EU emergency measures) and for each pest currently listed on the EPPO Alert list (but excluding invasive alien plants), were categorized as high, medium or low risk to Denmark. This document, after extensive and repeated discussions, was completed in July 2016, and delivered to NaturErhvervstyrelsen.

As outcome, 6 species on Annex I/A2, 18 species on Annex II/A1, 3 species on Annex II/B, and 6+2 species on the EPPO Alert List were classified as constituting "very high risk" for Denmark (Tables 1-4). These ratings are below more extensively justified, with information available in the literature added.

Collectively, these include: 3 bacteria, 20 spp. arthropods, 10 fungi, 5 nematodes, 3 virus/viroids. Although earlier discussions mentioned “about 30 species”, all these were scored very high risk, so I did not leave any of them out.

After revisiting the scoring, and on the basis of detailed information, a few species were judged of lower risk than first noted. These are separately listed at the end of the document. Further, the lost below is grouped by organism type, then alphabetically, not by categories, in order for easier lookup.

BACTERIA

Ralstonia solanacearum (bacterial wilt of potato)

Host range

R. solanacearum has an extremely wide host range, but different pathogenic varieties (races) within the species may show more restricted host ranges, including tomato, tobacco, aubergine, potato, banana, plantain and *Heliconia*. Within the EPPO region, race 3 with a host range including potato, tomato and the weed *Solanum dulcamara*, has potential for spread.

Geographical distribution

Widespread; race 3 was first found to spread in the Mediterranean Basin; further spread occurred in the 1980s and 1990s when irrigation in potato in northern Europe became more common.

Pest significance

R. solanacearum is the most serious pathogen of solanaceous plants and can cause serious losses in temperate regions. The greatest economic losses occur on potato, tobacco and tomato. Regularly intercepted from rhizomes exported for cut flower production in Europe, serious indirect losses can occur when quarantine measures entail restriction movement of, or destruction of plant products.

Means of spread

One of the few plant pathogenic bacteria for which there is evidence of survival in soil and plant residues. Many weeds are alternative hosts that maintain an on-going source of inoculum. Race 3 survived for 2-3 years in Australia under bare fallow or pasture. Spread between countries usually involves vegetative propagating material that carries latent infections or is contaminated with the pathogen.

Phytosanitary importance

R. solanacearum is an EPPO A2 quarantine organism, and is listed by APPPC and IAPSC. The occurrence of different races and strains of the pathogen with varying virulence under different environmental conditions presents a serious danger to European potato and tomato production.

Justification for scoring:

A persistent and serious threat to one of the most important economic and food crops in Denmark, potato. It demonstrates rapid growth, abundant in its native range, has a broad native range, high genetic variability, propagules that can remain viable for more than one year, highly adaptable to different environments, reproduces asexually, and difficult/costly to control.

***Clavibacter michiganensis subsp. michiganensis* (bacterial canker of tomato)**

Host range

The main host is tomato but also naturally infects *Capsicum annuum*, and several wild *Solanum* spp.. A number of solanaceous plants are susceptible on artificial inoculation.

Geographical distribution

World-wide

Pest significance

Since the first report of the disease in the USA in 1910, bacterial canker has spread throughout the world and causes serious losses to both greenhouse and field tomato crops either by killing the young plants or reducing marketable yields.

Means of spread

Seed-transmitted. In the field, can spread from infected plants to nearby plants by water splash, movement of machinery, or by people working when the field is wet. Canker bacteria seem to persist long enough to initiate the disease in the following season on new plantings. Can also survive on volunteer tomato seedlings and alternative host species.

Phytosanitary importance

C. michiganensis subsp. michiganensis is an economically important pathogen that is seed transmitted. It is generally considered of moderate phytosanitary risk due to its worldwide distribution and the availability of seed treatments to reduce seed borne inoculum.

Justification for scoring:

Due to the high spread potential and survival in soil, plus the quick development makes this a permanent threat, especially for the glasshouse industry.

***Erwinia amylovora* (fireblight)**

Host range

Plants in the family Rosaceae; mostly in the subfamily Maloideae (formerly Pomoideae), a few in the Rosoideae and Amygdaloideae. Strains isolated from one host are pathogenic on most other hosts.

Geographical distribution

Originated on wild hosts (presumably *Crataegus*) in the north-eastern USA, Western Europe has been invaded by fire blight in the second half of the 20th century. Wide areas of Europe remain free (in Italy, Spain and the south-east of France).

Pest significance

Currently believed to be of little threat in N Europe, the pathogen can thrive in warm, wet conditions, when severe impacts can occur.

Means of spread

The long distance spread of fire blight is rare, most cases via plants or plant tissues being moved across oceans. Short distance spread is the result of its ability to produce an exudate (bacteria embedded in exopolysaccharides) which is easily transported by wind, rain, insects or birds.

Phytosanitary importance

It is an EPPO A2 quarantine organism with the requirement: 'that host plants should have been grown in areas where *E. amylovora* does not occur or else a place free from *E. amylovora* during the last growing season.' Also of of quarantine concern in Asia, the Pacific, S America and Africa.

Justification for scoring:

The disease has numerous hosts or potential hosts in Denmark, and a warming climate can make this disease a large problem for orchards and the gardening industry. The presence of the disease can also have negative implications for international trade. It is fast growing, highly mobile locally, invasive in its native range, proved invasive outside its native range, reproduces asexually, difficult to identify/detect as a commodity contaminant, difficult/costly to control, and is highly likely to be transported internationally illegally.

NEMATODES
***Ditylenchus dipsaci* (stem and bulb nematode)**

Host

Attacks over 450 different plant species, including many weeds. Of the more than 20 biological races, some have a limited host range. The races that breed on rye, oats and onions seem to be polyphagous and can also infest several other crops.

Geographical distribution

Occurs locally in most temperate areas of the world (Europe and the Mediterranean region, North and South America, northern and southern Africa, Asia and Oceania).

Pest significance

One of the most devastating plant-parasitic nematodes, especially in temperate regions. Without control, it can cause complete failure of host crops such as onions, garlic, cereals, legumes, strawberries and ornamental plants, especially flower bulbs. The impact is made worse because *D. dipsaci* is sometimes associated with other pathogens.

Means of spread

Spread via seed and contaminated soil is possible. In international trade *D. dipsaci* is liable to be carried on dry seeds and planting material of host plants. In the field the fourth-stage juvenile can withstand desiccation for many years. Desiccation causes some ultrastructural changes. Following a period of desiccation and re-immersion in water, recovery occurs after a delay (lag phase) showing that repairs or restoration of a normal physiological state are necessary before activity can resume. Nematode survival and damage are greater in heavy soils as compared to sandy soils. It can also survive on a number of weeds. Irrigation water and cultivation by contaminated farm tools and machinery are also sources of inoculum dissemination.

Phytosanitary measures

Not uniform in the affected countries. Some consider it a qualitative pest, and only some countries apply official control measures to limit spread, even though EPPO considers it an A2 quarantine pest.

Justification for scoring

With its high economic importance, wide host range, worldwide distribution, difficulty in detecting and control, and non-uniform phytosanitary measures, the risk is high.

***Globodera pallida* (white potato cyst nematode)**

Host

The major hosts of *G. pallida* are potato, tomato and aubergine.

Geographical distribution

The centre of origin of the species is in the Andes Mountains in South America, from where it has spread with the introduction of potatoes to other regions. The present distribution covers temperate zones down to sea level.

Pest significance

Major pests of the potato crop in cool-temperate areas. This situation is, at present, serious because of the lack of commercially available resistent potato cultivars. Up to 80% of the crop can be lost.

Means of spread

Easily dispersed with the movement of seed potato and /or soil, both locally and internationally, via contaminated machinery, animal movement from field to field or human means.

Phytosanitary measures

Phytosanitary measures are vital to integrated pest management schemes, and inspection of seed potato is particularly important to stop the spread of PCN to “clean” areas and countries. The specific EPPO quarantine requirements are that fields in which seed potatoes or rooted plants for export are grown are inspected and must be found free from viable cysts of both species of potato cyst nematode.

Justification for scoring

The high importance of the host plants in Denmark, the difficulty of detecting the eggs and the lack of resistent host plant cultivars makes this a high-risk pest.

***Globodera rostochiensis* (yellow potato cyst nematode)**

Host

The major hosts of *G. rostochiensis* are Solanaceae, in particular potato, tomato and aubergine, and a number of weeds in the same family.

Geographical distribution

Potato cyst nematode is considered to have originated from the Andes region of South America, from where it spread to Europe with potatoes. Today, *G. rostochiensis* is a world wide pest of temperate areas. Distribution is linked to that of the potato crop.

Pest significance

Potato cyst nematodes are major pests of the potato crop in cool-temperate areas. The amount of damage is closely related to the number of nematode eggs per unit of soil. Up to 80% of the crop can be lost.

Means of spread

The cyst adheres to host roots, stolons and tubers and to soil particles during transportation gives rise to new infestations. Cysts are also successfully spread by wind, during storms, flooding, or water runoff.

Phytosanitary measures

Regular soil surveys in areas where they are not yet established and regulations concerning movement of seed potatoes, nursery stock, flower bulbs and soil, nationally as well as internationally. Checking of potato tubers, rooted plants and bulbs from countries where the nematodes occur. Washing of tubers and flower bulbs to remove soil, although it should be noted that cysts can remain embedded in tubers, especially in the eyes.

Justification for scoring

The high importance of the host plants in Denmark and the difficulty of detecting the eggs makes this a high-risk pest.

***Meloidogyne chitwoodi* (Columbia root-knot nematode)**

Host

Wide host range among several plant families, including crop plants and common weed species. Potatoes and tomatoes are good hosts, while barley, maize, oats, sugarbeet, wheat and various Poaceae will maintain the nematode.

Geographical distribution

First described from the Pacific Northwest of the USA in 1980, but not clear whether this is its area of origin. First detected in the EPPO region in the 1980s, in the Netherlands, but a review of old illustrations and old specimens of *Meloidogyne* suggests that it may have occurred earlier. It is possible that has a wider distribution, undetected, in Europe than is currently known.

Pest significance

Reduces the market value of potatoes by causing internal necrosis and external galling. Necrotic spots in 5% of a crop make it commercially unacceptable. Overall yields of tubers are also reduced. This species is considered to be the major nematode pest of potatoes in the Pacific Northwest states of the USA. Effects on other crops are not as marked nor as well documented, but yields of cereals (wheat, barley, oats and maize) significantly reduced.

Means of spread

The most likely method is through the movement of infected or contaminated planting material. The movement of non-host seedling transplants, nursery stock, machinery or other products which are contaminated with infested soil could also result in spread. Infective larvae of this genus persist for more than one year in the absence of host plants. Nematode movement can also be facilitated by contaminated irrigation water.

Phytosanitary measures

EPPO has not yet decided specific quarantine requirements. Measures similar to those for potato cyst nematodes (EPPO/CABI, 1996) would appear relevant.

Justification for scoring

The wide host range, including many of important crop plants in Denmark, the diffficulties in protection and detection make this a high-risk species.

***Meloidogyne fallax* (false Columbia root-knot nematode)**

Host

Mainly recorded on potato, *Scorzonera hispanica* and carrot. Good hosts include *Oenothera erythrosepala*, *Phacelia tanacetifolia*, *Dicentra spectabilis* and *Hemerocallis* cv. Rajah but *M. chitwoodi* reproduces poorly or not at all on these.

Geographical distribution

In Europe, the south-eastern part of the Netherlands, western France and Belgium. Reported from Australia, New Zealand and South Africa.

Pest significance

There is at present no direct information available to show the extent of economic damage caused by *M. fallax*, as it frequently occurs in mixed infestations with *M. chitwoodi* and is supposed to have a pest status similar to that species.

Means of spread

The most likely method is through the movement of infected or contaminated planting material. The movement of non-host seedling transplants, nursery stock, machinery or other products which are contaminated with infested soil could also result in spread. Infective larvae of this genus persist for more than one year in the absence of host plants. Nematode movement can also be facilitated by contaminated irrigation water.

Phytosanitary measures

EPPO has not yet decided specific quarantine requirements. Measures similar to those for potato cyst nematodes (EPPO/CABI, 1996) would appear relevant.

Justification for scoring

Although its status is undecided, it seems prudent to consider this nematode a similar risk as the previous species, for the same reasons.

ARTHROPODS

Agrilus planipennis, (Coleoptera: Buprestidae)

Host

A. planipennis attacks all species of ash (*Fraxinus* spp.) native to Europe or N America.

Geographical distribution

Native to eastern Asia, but spread to North America (USA) and seems to spread westwards through Russia (now outbreaks in the Moscow area). Estimate to arrive to Central Europe in 15-20 y.

Pest significance

Trees attacked by *A. planipennis* are ultimately killed. To date, it is estimated that *A. planipennis* has killed over 30 million trees over the past few years in North America.

Means of spread

Adults are strong fliers and long-distance flights of several km are possible although not frequent. Long-distance dispersal occurs through human-assisted movement of plants and wood products (including wood, wood packing, wood chips and firewood) containing bark strips, moving in local and international trade. Current rate of spread in Europe is 13-41 km/y.

Phytosanitary measures

In the USA and Canada, movement of ash material from infested areas is regulated by federal quarantine regulations. Prohibited material includes ash trees, limbs or cut firewood, ash logs and lumber, uncomposted ash wood chips and bark chips larger than 1 inch in diameter. Current regulations, following the IPPC International Standards for Phytosanitary Measures No. 15, require that solid wood packaging material be heat treated or fumigated prior to export. These measures can only slow down human-assisted dispersal.

Justification for scoring:

Wide availability of host plants, grave consequences of infestation, and a seemingly unstoppable natural spread.

***Anthonomus quadrigibbus* (Coleoptera: Curculionidae)**

Host

A. quadrigibbus is associated with a wide range of plants in the Rosaceae .

Geographical distribution

North America: the most northerly record is from the Grand Prairie region, Alberta; the southernmost is Mexico, Mexico state. Absent in Europe. Conditions in the EPPO region seem suitable for the survival and multiplication of the species including the presence of wild *Crataegus* spp. to support reservoir populations.

Pest significance

Can cause very severe damage to apples, locally inflicting more than 50% crop losses. Records of serious damage to cherries, pears – but most records are ca. 30 y old.

Means of spread

The adults are strong fliers and can disperse the species locally. Larvae, pupae or newly emerged adults could be transported in apples, but there are no records of their interception.

Phytosanitary measures

A. quadrigibbus is not currently listed as a quarantine pest, it was considered that measures already recommended for other North American fruit pests would adequately protect against its introduction.

Justification for scoring:

Seeming suitability of climate, wide host range including important crop/fruit plants, and record of serious losses. Uncertain if current pesticide regimes are responsible for recent non-importance, and potentially problematic under low pesticide pressure.

***Anthonomus signatus* (Coleoptera: Curculionidae)**

Host

Strawberries, but *Rubus* spp., *Rosa* spp. and *Vaccinium* spp. are also minor hosts.

Geographical distribution

North America: Canada (Eastern provinces to Ontario), USA (east of the Rocky Mountains: present in north-eastern, south-eastern and south-western areas). Absent in Europe.

Pest significance

Early records of devastating impact on strawberries, later reduced by increased plant vigour.

Means of spread

Adults can fly over small distances. International movement is most likely to occur on planting material.

Phytosanitary measures

A. signatus is likely to be at least as important a pest as *A. rubi*. Temperature development curves show its base temperature to be below 10°C, which is typical of northern European species, and the general pattern of its geographical distribution suggests that it could survive perfectly well in most of Europe. Importing countries should require that the consignment grown in an area free from this pest.

Justification for scoring

Strawberries being a locally very important crop, and the climatic fit to northern climates means this species needs to be watched as potentially high risk.

***Carposina sasakii* (Lepidoptera: Carposinidae)**

Host

C. sasakii occurs on a wide range of cultivated and wild fruits, especially Rosaceae but also other families. It is possible that the published host range to a certain extent confuses *C. sasakii* with *C. niponensis*.

Geographical distribution

The distribution of *C. sasakii* is limited to the temperate Far East, centred on northeastern China and Japan. It is not known to have spread to other areas.

Pest significance

One of the most important pests of pome fruits in the Far East. On apples in Japan, Korea and China, it 'may cause heavy losses if not controlled. In China, recorded as destroying about one-third of the apple crop in Liaoning province. In the Primor'e province of Russia, C. *sasakii* is the most damaging fruit moth, more so than the codling moth, *Cydia pomonella*. Damage to pears can reach 100% in some cases, but apples are less heavily infested (40-100%).

Means of spread

The moth normally flies only short distances. In China, 80% of marked adults dispersed randomly within a radius of 100 m and the furthest distance an adult dispersed was 225 m Larvae can survive for long periods in stored fruits, so imported fruits are the most likely means of entry. C. *sasakii* is found by USDA inspectors almost every year on raw fruit from Japan and Korea.

Phytosanitary measures

Fruits of host plants from the Far East should be subject to strict requirements. All *Chaenomeles, Crataegus, Cydonia, Eriobotrya, Malus, Prunus, Pyrus* and *Ziziphus* plants with roots (especially those with growing medium) should have been grown in an organic medium or growing medium which was treated or tested against C. *sasakii* .

Justification for scoring

Potential to become a major pest of pome fruits if appears in Europe.

***Cydia inopinata* (Lepidoptera: Tortricidae)**

Host

Apples are the main host, but also quinces, pears and various other Pomoideae.

Geographical distribution

Present in Russia and China. Absent in Europe.

Pest significance

Rather similar pest to the pan-European *C. pomonella*. Damage from *C. inopinata* can reach 100% on apples in the area east of Lake Baikal. Little information is available on the situation in China.

Means of spread

Dispersed locally by adult flight. In international trade, it might be carried as larvae in fresh fruit or with planting material carrying fruits. The species has not yet been intercepted in the EPPO region (but trade from infested areas has been minimal).

Phytosanitary measures

A sufficient requirement would be that fruits of *Cydonia*, *Malus* and *Pyrus* from countries where *C. inopinata* occurs should have been found free from the pest. Planting material of these genera should preferably not carry fruits.

Justification for scoring

A realistic threat to the pome fruit industry.

***Cydia prunivora* (Lepidoptera: Tortricidae)**

Host

The main natural host is Crataegus spp., but readily attacks apples, plums and cherries. Recorded on peaches, roses and *Photinia* spp. Larvae may also develop in galls of *Quercus* and *Ulmus*.

Geographical distribution

Indigenous on wild *Crataegus* spp. in eastern North America and has spread onto fruit trees in other parts of North America. In Asia it is only present in China. Absent in Europe.

Pest significance

Since the first reports as a major pest of stone fruits in the USA, it is likely that the pest has considerable potential, particularly if chemical control practices were to be substantially eased.

Means of spread

Can spread within countries by flight but is more likely to move in international trade as larvae in fruits or as pupae in soil accompanying planting material of host species.

Phytosanitary measures

In general, all plants with roots of Crataegus, Malus, Prunus and Rosa coming from a country where the pest occurs, should be free from flowers and fruits and the consignment should have been grown in an organic medium or growing medium which was treated or tested against C. prunivora.

Justification for scoring

A potentially major pest of pome fruit.

***Dendrolimus superans sibiricus* (Lepidoptera: Lasiocampidae)**

Host

Caterpillars feed on many coniferous tree species, with indications of preference for species of larch.

Geographical distribution

Widespread in the coniferous forests of Siberia, northern-east China, northern Mongolia and North Korea. Recent expansion into coniferous forests in the central regions of the European part of Russia.

Pest significance

The most important defoliator of coniferous trees, with outbreaks occur over enormous areas (many thousands of hectares) and often lead to the death of entire forests. Very often followed by outbreaks of wood borers (scolytids, cerambycids and others).

Means of spread

D. superans sibiricus can spread by flight up to 100 km per year. All stages of the life cycle can be transported on plants moving in trade, particularly plants for planting and cut branches (including Christmas trees.

Phytosanitary measures

Added in 2002 to the EPPO A2 action list, and endangered EPPO member countries are thus recommended to regulate it as a quarantine pest. To prevent introduction, plants for planting and cut branches of host plants from the infested areas should be free from soil. Alternatively, such commodities could originate in a pest-free area, be produced in protected houses, or fumigated, or imported during winter. Wood should be debarked or heat-treated, or originate in a pest-free area, or be imported during winter, and isolated bark should be treated to destroy contaminating insects

Justification for scoring

Ample presence of host plants in Denmark, and severe consequences, including gradations.

***Dendroctonus micans* (Coleoptera: Scolytinae)**

Host

Primarily breeds in spruce (*Picea* spp.), but known to attack several other pines, fir and larch.

Geographical distribution

Believed to be native to the conifer forests of Asia. When determining the geographic distribution of this insect it is difficult to establish whether it is native or introduced because of its unique history.It has steadily spread westward over the past 100 years, undoubtedly aided by the increased trade in unprocessed logs. At present, it is found throughout Eurasia and has adapted to a wide range of forest conditions. This insect is now established across most of western Europe from European Russia, west to Belgium and France, south to Turkey, and north to Finland and Sweden. It was discovered in the UK in 1982.

Pest significance

Within its natural range, D. micans is widespread but rare, and few trees are killed. During outbreaks, however, the species is able to destroy entire stands. More severe damage is registered at the edges of its distribution.

Means of spread

The beetles fly only limited distances. A single female is capable of starting a new infestation. The timber trade has been the most important reason for the recent spread of the beetle, and also due to the extensive plantation of spurce outside its natural range in Europe.

Phytosanitary measures

As D. micans lives between the bark and the outer wood of the tree, the removal of bark from all types of wood ensures the absence of the pest. However, caution should be exercised with regard to round wood subjected to the standard debarking process, because small areas of bark remain and can harbour the pest.

Justification for scoring

Plenty of suitable host plants in Denmark, which is near the edge of the distribution range; here the species causes more damage than elsewhere.

***Eutetranychus orientalis* (Arachnida: Acarina: Prostigmata: Tetranychidae)**

Host

Citrus spp. are the main hosts of economic importance, but has a wide range, from almonds to *Ricinus communis*.

Geographical distribution

This species has a wide distribution in the Old World but it is not clear which is the country of origin. Currently restricted to warmer parts of Europe.

Pest significance

On citrus, *E. orientalis* is generally regarded as being an important pest.

Means of spread

Spider mites mainly disperse by wind currents and in the field this is probably the main means of dispersal. In international trade, they might be carried on citrus plants. Since the mites do not infest fruits, these only present a risk if accidentally contaminated by the pest or carrying leaf debris.

Phytosanitary measures

Importation of citrus plants is prohibited from most non-Euromediterranean sources because of a variety of EPPO A1 pests. From eastern Mediterranean sources, citrus plants should come from a place of production free from, or treated against.

Justification for scoring

Although currently considered only a pest of citrus, the wider host range indicates a possibly more widespread range of plants on which the species can establish and possibly cause damage. In spite of this, the original scoring is possibly higher than justified.

***Grapholita packardi* (Lepidoptera: Tortricidae)**

Host

The major cultivated hosts are cherries, apples and *Vaccinium* spp. Other cultivated hosts include plums, peaches, roses, pears, *Pyracantha* sp. and quinces. Reported wild hosts include *Crataegus* spp. and *Prunus virginiana*.

Geographical distribution

Indigenous to North America. Absent in Europe.

Pest significance

Fruits of all recorded hosts, except peaches, are known to be attacked, although C. packardi has not been considered a significant pest of either apples or peaches since the early part of the 20th century. C. packardi was considered a major pest of cherries from 1914 to the 1960s, although it was primarily a problem in poorly sprayed orchards.

Means of spread

Could be transported as larvae in raw fruit or as overwintering larvae on host plants, especially nursery stock. The pest has been intercepted by USDA inspectors in fruit imported from Mexico. The adults could be dispersed for short distances by wind.

Phytosanitary measures

Measures taken against *Rhagoletis pomonella* and other North American *Rhagoletis* spp. will be effective against *C. packardi*.

Justification for scoring

On considering details, this can be downgraded from very high risk to medium risk.

***Helicoverpa zea* (Lepidoptera: Noctuidae)**

Host

Polyphagous in feeding habits but it shows a definite preference in North America for young maize cobs and tassels, but more than 100 plant species are recorded as hosts. A feeding preference is shown for flowers and fruits of host plants.

Geographical distribution

Currently confined to the New World, from Canada to Argentina.

Pest significance

In North America it is reported that H. zea is the second most important economic pest species (preceded by codling moth) (Hardwick, 1965), and Fitt (1989) quotes the estimated annual cost of damage by H. zea and H. virescens together on all crops in the USA as more than US$ 1000 million, despite the expenditure of US$ 250 million on insecticide application.

Means of spread

H. zea is a facultative seasonal nocturnal migrant, and adults migrate in response to poor local conditions for reproduction, when weather conditions are suitable. Air-freight transportation of agricultural produce from the New World to Europe is an ever increasing commercial enterprise, especially with vegetables and ornamentals. Almost every year, caterpillars of H. zea are intercepted on this produce in the UK (Seymour, 1978).

Phytosanitary measures

Recommended phytosanitary measures similar to that for *H. armigera*.Iimported propagation material should derive from an area where the species does not occur or from a place of production where the pest has not been detected during the previous 3 months.

Justification for scoring

With a wide range of suitable host plants in Denmark, and the huge potential to spread on other European countries, and the migrating habit, this is clearly a serious threat.

***Ips pini* (Coleoptera: Scolytidae)**

Host

Relatively non-specific, being found on many pine species, also *Picea* sp.

Geographical distribution

Present in North America, absent in Europe.

Pest significance

Like other scolytids, periodically causes loss of wood over extensive areas. Usually infests dead or weakened trees, but at high population densities can kill standing trees. Can lead to secondary infections by other insects or pathogens.

Means of spread

Some bark beetles are strong fliers with the ability to migrate long distances. The most common mode of introduction into new areas is unseasoned sawn wood and wooden rates with bark on them. If wood is barked, there is no possibility of introducing bark beetles.

Phytosanitary measures

EPPO recommends that all countries should prohibit import of plants of conifers from countries where I. pini occurs, and optionally also bark of conifers. If bark is imported, it should be heat-treated or fermented.

Justification for scoring

Favourable conditions exist in Denmark, and once introduced, spread is difficult to avoid.

***Ips hauseri* (Coleoptera: Scolytidae)**

Host

Attacks certain species of *Picea*, *Pinus* and *Larix*.

Geographical distribution

An endemic species of the Tien Shan mountains of China, Kyrgyzstan. Its current distribution is limited by *Picea schrenkiana* forests.

Pest significance

The most important xylophagous pest of its host plant, considered comparable to that of *Ips typographus*.

After introduction of *P. sylvestris*, *P. pallasiana* and *L. sibirica* into Central Asia in the 1930s, it became an important pest of these trees, particularly of *P. sylvestris*.

Means of spread

Natural spread of the pest by adult flight is limited. All life stages of I. hauseri may be easily transported with untreated coniferous (mainly spruce, pine and larch) wood commodities carrying bark, and possibly on cut branches (including Christmas trees).

Phytosanitary measures

*A*dded in 2004 to the EPPO A2 action list of pests recommended for regulation as quarantine pests. Measures used for other Ips spp. would also be suitable for I. hauseri.

Justification for scoring

The widespread presence of *P. sylvestris* in Denmark, and the severe imapct on this species in its current area of distribution.

***Liriomyza huidobrensis* (Diptera: Agromyzidae)**

Host

Highly polyphagous: host plants in 15 families of plants, without a clear preference for any particular family.

Geographical distribution

Originates in Central and South America and was absent from other continents until the 1980s. First detected in Europe in 1987 on glasshouse lettuces. It has since spread considerably in Europe, but particularly significant is the spread in central and eastern Europe where climatic conditions would be expected to deter its presence.

Pest significance

L. huidobrensis is a serious pest of potato, vegetables and ornamental plants in the field and glasshouses in many parts of the world. Damage is caused by larvae mining into leaves and petioles. The photosynthetic ability of the plants is often greatly reduced. In young plants and seedlings, mining may cause considerable delay in plant development, leading to plant loss.

Means of spread

It can be wind-blown into crops from surrounding vegetation/fields; females are stronger fliers than males. There is no information on the natural dispersal of L. huidobrensis.

Phytosanitary measures

All stages are killed within a few weeks by cold storage at 0°C. Newly-laid eggs are the most resistant stage and it is recommended that cuttings of infested ornamental plants be maintained under normal glasshouse conditions for 3-4 days after lifting, to allow eggs to hatch. Subsequent storage of the plants at 0°C for 1-2 weeks should then kill off leaf miner larvae (Webb and Smith, 1970).

Propagating material (except seeds) of capsicum, carnations, celery, chrysanthemums, Cucumis, Gerbera, Gypsophila, lettuces, *Senecio hybridus* and tomatoes from countries where the pests occur must have been inspected at least every month during the previous 3 months and found pest-free. A phytosanitary certificate should be required for cut flowers and for vegetables with leaves.

Justification for scoring

A polyphagous pest with a recent record of fast spread, also into areas where it was not expected due to climatic barriers. Obvious threat to glasshouse as well as outdoor vegetables, flowers and fruit.

***Liriomyza trifolii* (Diptera: Agromyzidae)**

Host

The host range of *L. trifolii* includes over 400 species of plants in 28 families including both ornamental crops (Bogran, 2006) and vegetables (Cheri, 2012). It is now a major pest of the Compositae worldwide.

Geographical distribution

L. trifolii has not yet been reported from many countries where it is actually present. Apparently unable to overwinter in the open in the north European countries. However, the current regulations to prevent entry and spread in non-Mediterranean areas only partially effective.

Pest significance

This species is now the major pest of chrysanthemums in North America; vegetable losses in the USA are also considerable. Also a vector of plant viruses. Damage is caused by larvae mining into leaves and petioles – see details under *L.huidobrensis*.

Means of spread

Adult flies are capable of limited flight. Dispersal over long distances is on planting material of host species. Cut flowers can also present a danger as a means of dispersal.

Phytosanitary measures

Cold treatment is recommended, but not always feasible. Planting material of host plants from countries where the pest occurs must either have been inspected at least every month during the previous 3 months and found free from the pests, or have been treated by a recommended method. A phytosanitary certificate may be required for cut flowers and for vegetables with leaves.

Justification for scoring

A polyphagous pest with potential record of fast spread. Obvious threat to glasshouse as well as outdoor vegetables, flowers and fruit.

***Listronotus bonariensis* (Coleoptera: Curculionidae)**

Host

Lolium spp., but also many other pasture grasses. The potential host range in the EPPO region would be pasture grasses and cereals.

Geographical distribution

Originates in South America and has spread across the Pacific. Absent in Europe.

Pest significance

A serious pest of pastures in New Zealand, and can severely damage pastures, particularly ryegrass. Adult damage per se is said to be insignificant although an adult infestation of 200 per m^2 leads to a large subsequent larval infestation. The high migratory potential of the adults means that pastures of any age can harbour large infestations. Larvae cause severe damage to establishing maize and wheat crops and are an important pest of maize throughout the North Island of New Zealand.

Means of spread

The pest can disperse itself locally by flight. International movement would most probably be with seeds of pasture grasses (introduced into Australia as adults in ryegrass seed), and possibly with other seeds (cereals).

Phytosanitary measures

Restrictions are recommended by EPPO (OEPP/EPPO, 1990) on the importation of seeds of relevant host plants from New Zealand, Australia and South America. A phytosanitary certificate for seeds of Poaceae should be required for countries where *L. bonariensis* occurs.

Justification for scoring

The climatic conditions being suitable, and potential to infest grasses, can cause serious damage, esp. in seed grasses.

***Myiopardalis pardalina* (Diptera: Tephritidae)**

Host

The main host plant is melon, but other cultivated Cucurbitaceae as well as weeds can be attacked.

Geographical distribution

Records are based on old literature indicate that this pest is present in warmer countries of Europe. in Denmark, it can possibly be a problem in glasshouse cucumbers.

Pest significance

Damage is caused by larvae feeding inside the fruit on pulp and seeds. Attacked fruit are generally affected by secondary rots (bacterial and fungal) which render them unfit for consumption (tainted) and unmarketable. Overwinters as pupae in the soil, can survive under snow cover and temperatures slightly below zero.

Means of spread

Adults can fly but there is no data on their flying capacity. Information is generally lacking on the biology of the pest. In particular, the reasons why under certain circumstances *M. pardalina* can emerge as a serious pest and spread rapidly remain unexplained.

Phytosanitary measures

No detailed information found.

Justification for scoring

The ability to survive below 0C and the importance of cucumber as a glasshouse crop. However, this species may not be a threat to outdoor crops in Denmark.

***Pissodes nemorensis* (Coleoptera: Curculionidae)**

Host

A very wide host range of coniferous trees which includes the widespread N American species, but also cedars, Norway spruce, Caribbean pine and Scots pine (*P. sylvestris*).

Geographical distribution

Occurs mainly in the north, centre and east of North America, not in western states or provinces. Present in South Africa. Absent in Europe.

Pest significance

P. nemorensis is of little importance in natural pine stands, due to the lack of suitable breeding materials. However, in Christmas tree plantations, the numerous stumps are ideal for the beetle. As re-afforestation increases, the importance of the weevil is expected to increase. Nursery plants are often badly damaged as adults feed on the bark of seedlings. Besides the direct damage it causes, *P. nemorensis* acts as a vector of *Leptographium procerum*, causing procerum root disease, can be a serious problem of Christmas tree growers.

Means of spread

The natural spread of *Pissodes* spp. is determined by the flight performance of the species which seems to be not more than 100 km. International spread would most probably occur via the shipment of living conifer plants, including Christmas trees.

Phytosanitary measures

To prevent the introduction of life stages of P. nemorensis, EPPO recommends that the importation of plants and cut branches of host species of Picea and Pinus from North America should be prohibited. There is a definite risk that P. nemorensis should enter on conifer wood.

Justification for scoring

Several host plants are widespread in Denmark as landscape trees, forest trees and also the Christmas tree industry is threatened.

***Pissodes strobi* (Coleoptera: Curculionidae)**

Host

Confined to coniferous trees, but most such trees are hosts.

Geographical distribution

North America, inc. Mexico; absent from Europe.

Pest significance

P. strobi is a damaging pest of spruce in Canada and northern USA, especially the European *Picea abies* and the native *P. glauca*. Both wood quantity and quality is affected, can reach 40% of timber products.

Means of spread

The natural spread of Pissodes spp. is determined by the flight performance of the species which seems to be not more than 100 km. International spread would most probably occur via the shipment of living conifer plants, including Christmas trees.

Phytosanitary measures

To prevent the introduction of life stages of *P. strobi*, EPPO recommends that the importation of plants and cut branches of host species of *Picea* and *Pinus* from North America should be prohibited.

Justification for scoring

Several host plants are widespread in Denmark as landscape trees, forest trees and also the Christmas tree industry is threatened.

***Popilia japonica* (Coleoptera: Scarabaeidae)**

Host

Adult *P. japonica* feed on at least 295 species of plants in 79 plant families, including small fruits, tree fruits, vegetable and garden crops, field crops, woody and herbaceous ornamentals, shade trees, various weeds, and many non-economic species.

Geographical distribution

Originates from north-eastern Asia, native in northern Japan and in the Russian Far East. Widely established in the USA. Absent in the EPPO region except for the Azores (Portugal).

Pest significance

P. japonica is the single most destructive insect pest on golf courses, lawns and pastures, and on herbaceous and woody landscape plants in the eastern USA. Damage to tree fruits, small fruits, maize, and soybeans is also significant. In addition, many millions of US dollars, and considerable quantities of pesticides, are also lost trying to limit the beetle's spread by nursery stock and airplanes in North America. The Japanese beetle has never been a major pest in Japan, and has not yet caused extensive damage in the Azores.

Means of spread

The adults disperse locally by flight. Intercepted on agricultural produce, on packaging and on ships and aircraft. Larvae may be transported in soil around the roots of plants for planting.

Phytosanitary measures

Information on this is mostly from the US (where the species is causing serious damage). Control of larvae by various insecticides, airplanes are treated with insecticide if arrive form contaminated areas, and permanent inspection of packages, and other transport means to limit dispersal.

Justification for scoring:

Due to wide host range, suitable climatic conditions, and proven damage potential.

VIRUSES

Beet curly top hybrigeminivirus (Geminiviridae: Hybrigeminivirus)

Host

BCTV has an extremely wide host range, but the economically most important hosts are potatoes, sugarbeet and tomatoes. Species in various families are reported as hosts, including Chenopodiaceae, Solanaceae, Brassicaceae, Violaceae, Geraniaceae, Cucurbitaceae, Caryophyllaceae, Fabaceae, Asteraceae, Linaceae and Apiaceae, among them many weeds: *Atriplex* spp., *Capsella bursa-pastoris*, *Chenopodium* spp., *Datura ferox*, *Polygonum* spp., *Rumex* spp. and *Stellaria media*.

Distribution

BCTV is thought to have originated in the eastern Mediterranean area and to have spread from there to America where it remains to be more widespread than elsewhere.

Pest significance

Recognized causing important damage in Nebraska (USA), and has since caused frequent and often very destructive outbreaks throughout the area to the west of the Rocky Mountains. During the last 20 years in the USA, BCTV isolates have increased in severity. In the EPPO region is not considered a significant pest.

Means of spread

BCTV is moved locally by its insect vectors. Internationally, it may be carried in infected host material, or possibly in the vector.

Phytosanitary measures

Plants with roots are the only plants in question for phytosanitary requirements. Although seedlings of sugarbeet and tomato may be traded, they are less likely to be infected than mature plants.

Justification for scoring

Although in the Old World it seems to be present only in warmer regions, this is not so in the New World, where it causes serious damage. A very wide host range and recent, reported increase in virulence makes is a potential threat to an important crop plant in Denmark.

Chrysanthemum stem necrosis virus (Bunyaviridae: Tospovirus)

Host

Chrysanthemum, but also gerbera and tomato.

Distribution

Seems endemic in Brazil. Outbreaks occurred in the Netherlands (1994/1995), Slovenia (2001/2002) and UK (2002), but the virus is no longer found in those countries.

Pest significance

In Brazil, it is expanding since 1997 but information on pest significance is lacking. Potentially important for the glasshouse industry.

Means of spread

CSNV is transmitted only by its thrips vectors between plants, fields or glasshouses. Could be disseminated over long distances in cuttings and other vegetative plants for planting.

Phytosanitary measures

CSNV was added to the EPPO A1 action list in 2003, and EPPO member countries are thus recommended to regulate it as a quarantine pest. So far, there are no specific phytosanitary measures to protect against the introduction of CSNV into the EPPO region. Tomato plants from outside the European and Mediterranean area are prohibited entry, as Solanaceae, into the EU (EU, 2000). Freedom from thrips vectors is also a requirement, and because these thrips are polyphagous, freedom from them could be required for plants for planting of any herbaceous plant species from countries where CSNV occurs.

Justification for scoring

A potentially important pest for glasshouses, but with high uncertainty, mainly due to lack of information.

Hosta virus X (Potexvirus)

Host

Hosta spp. (*Hosta* spp. are popular herbaceous perennial plants with more than 7000 varieties, and widely cultivated due to their diversity in leaf shape and colour patterns. There is a great diversity of cultivars presenting different levels of susceptibility to the virus (susceptible, tolerant, or immune).

Distribution

Reportred from Central, Western and Southern Europe, China, N America, and New Zealand. Because HVX can be easily spread by infected planting material and is mechanically transmissible, its distribution is probably wider than which is recorded in the literature.

Pest significance

Difficult to find figures. As is the case for other viruses, the control of the disease is difficult and essentially based on the use of resistant cultivars and of prophylactic measures to minimize the possibility of mechanical transmission of HVX.

Means of spread

As HVX is sap-transmissible, it is easily transmitted during vegetative plant propagation. Hostas can also be propagated by seeds.

Phytosanitary measures

Based on cultivar resistance.

Justification for scoring

A somewhat uncertain impact but once introduced, a substantial risk to glasshouse ornamental growers.

FUNGI

***Alternaria mali* (Dothideomycetes: Pleosporaceae)**

Host

The main host is apples, both cultivated (*Malus pumila*) and wild (*M. sylvestris*). *A. alternata*, the related non-specific secondary parasite, has a very wide host range, including many plant families.

Geographical distribution

A. mali has been recorded in only a limited number of countries, while *A. alternate* is extremely widespread, having been recorded on *Malus* and *Pyrus* in most parts of the world. There is some uncertainty about the species identity of the damage records. Widespread in Asia, limited distribution in N America, Chile, Australia. The only European record is from the former Yugoslavia.

Pest significance

A. alternate is, in Europe, a minor fruit-rotting fungus on apples, affecting only fruits which are already damaged, *A. mali* is both a leaf and a fruit disease in Asia. It can infect up to 85% of leaves on susceptible cultivars.

Means of spread

Spread by means of conidia and its dispersal is particularly favoured by rainfall. However, this natural dispersal is only local. Internationally, possibilities for spread are fairly limited. The fungus is not liable to be carried on dormant planting material (without leaves). It could be carried in fruits but, since infection occurs on the young fruit, it is relatively unlikely that infected fruits would be harvested and traded.

Phytosanitary measures

Any planting material of Malus imported from countries where A. mali occurs should be in dormancy, and not carry any leaves or plant debris. Fruits from these countries should be free from symptoms and of good commercial quality.

Justification for scoring

A wide range of host plants available, its spread is difficult to prevent once established, and its effect will be very visible due to the widespread distribution of host plants in Denmark.

***Apiosporina morbosa* (Ascomycetes: Dothideales)**

Host

The principal host is plums (*Prunus domestica*); but the potential host range extends to *Prunus* spp. generally. Wild species occur widely and could be a potential reservoir of the pest.

Geographical distribution

Indigenous in Canada and USA. Absent from the EPPO region.

Pest significance

In North America, A. morbosa can be serious in plums. Destructive outbreaks of usually occur in small home orchards where no control is practised.

Means of spread

Under natural conditions, A. morbosa spreads readily by ascospore dispersal within orchards. In international trade is liable to be carried on infected plants for planting.

Phytosanitary measures

Plants for planting of *Prunus* from Canada and USA should come from a place of production intensively treated (by chemical treaments or pruning) against *A. morbosa*, and found free during the last two growing seasons.

Justification for scoring

As *Prunus* spp. in general are more important in Europe, inc. Denmark than in N America, and there are more wild hosts avaiable, the potential to cause serious damage, especially to home fruit trees and orchards is high.

***Atropellis piniphila, A. pinicola* (Ascomycetes: Helotiales)**

Host

A. piniphila: main host is *Pinus contorta*, but can also attack other American *Pinus* spp.

A. pinicola: also P. contorta, but also several species that are widely present in Europe as forest trees.

Geographical distribution

Both species are N American, and currently restricted there, with *A. piniphila* more widely reported.

Pest significance

A. piniphila causes a serious canker of P. contorta , particularly in trees 5-25 years old in overcrowded, pure stands. A. pinicola is important on P. contorta on which it can cause extensive branch and stem cankers leading to malformation and consequent lowering of wood quality. It is seldom important on other pines, and generally never sufficiently severe to cause tree death.

Means of spread

Under natural conditions, *Atropellis* spp. spread by ascospore dispersal within pine stands. In international trade, logs with the bark attached may contain ascospores or traces of mycelium, as may cankers on younger branches and twigs of growing material.

Phytosanitary measures

Prohibition of import of bark of *Pinus* from North America. If wood of Pinus is imported from North America, the consignment must have been debarked or kiln-dried.

Justification for scoring

Although with uncertainty, both species can have visible impact on host pines, and cause damage by reduced growth.

***Mycosphaerella dearnessii* (Capnodiales: Mycosphaerellaceae)**

Host

All pine species are potential hosts.

Geographical distribution

The anamorph has a global distribution. Compared to this, the teleomorph is reported less frequently and appears not to play an important role in the disease epidemiology.

Pest significance

In North America, *M. dearnessii* is an important pine foliage disease, particularly of *P. palustris* in south-eastern USA, causing severe growth checks to seedlings and young trees.

Means of spread

Conidiospores are only produced under moist conditions and exude from acervulus in a mucilaginous, olive-green, wedge-shaped spore mass. Conidia are dispersed over short distances (from tree to tree) by rain splash. The conidia are spread over longer distances by wind-driven water. During rain, dew formation or fog, ascospores were discharged from the fruit bodies and windblown within and beyond the immediate locality. Conidia can also be spread by insects or on forestry equipment.

Phytosanitary measures

Planting material of *Pinus* should come from an area free from *M. dearnessii*, and in addition that the place of production should have been found free.

Justification for scoring

As we have data on damage to pines, and all pine species are potential hosts, the pathogen has the demosntrated potential to infect many needle-leaved trees all over Denmark.

***Phytophthora fragariae* (Oomycetes: Peronosporales)**

Host

The principal host of var. fragariae is cultivated strawberries (*Fragaria x ananassa*). Only one other host, loganberries (*Rubus* hybrid), has been found naturally infected. For *P. fragariae var. rubi*, cultivated raspberries (*Rubus idaeus*) are the principal host, but hybrid berries such as loganberries and tayberries have been found naturally infected.

Geographical distribution

Both varieties are widely distributed in Europe, also in Denmark. Also in many other countries of the world, inc. N America, Oceania, and Asia.

Pest significance

Phytophthora fragariae var. fragariae

Red core is a cause of serious economic loss wherever it occurs, although it is generally most severe in cool, wet regions.

Phytophthora fragariae var. rubi

The fungus causes an extremely serious disease which can result in complete loss of a raspberry plantation, as large areas are completely killed. Damage is most severe after wet winters.

Means of spread

Both varieties of the fungus can spread in surface or drainage water, and this can be important for local spread. However, the most important means of spread is in planting material of strawberry or raspberry.

Phytosanitary measures

Phytophthora fragariae var. fragariae

Plants for planting of strawberries should have had root samples examined for P. fragariae, and that they and their mother plants should have been subjected to a growing-season inspection.

Phytophthora fragariae var. rubi

Too recent to have attracted the same amount of controlling legislation as the very similar red core disease of strawberry, although the losses which the disease can cause makes the need for such legislation pressing.

Justification for scoring

A major threat to soft Rosaceae fruit industry, with damage records in Europe.

***Ceratocystis platani* (Microascales: Ceratocystidaceae)**

Host

Platanus spp. are the only hosts.

Geographical distribution

The organism was introduced from the USA to several Southern European ports at the end of the Second World War and spread rapidly in Italy (Panconesi, 1981) and more slowly in France (Vigouroux, 1979a). The rate of spread in France seems to have accelerated in recent years.

Pest significance

In the eastern USA, before 1950, canker stain attacked3.8% of the trees, and up to 80% in some towns. In south-east France, C. platani has caused serious losses to shade trees. In Italy, the fungus invaded the north of the country in a few years and killed many trees, especially in young row plantings.

Means of spread

The pathogen is spread by entering wounds on the tree or through root anastomoses between neighbouring trees. The reproductive organs of the pathogen can be spread by rain, hail, wind, etc. and by animals (man, insects, small rodents, birds, etc.); conidia are also borne along in water currents. The agent mainly responsible for the spread of the disease is man, because the pathogen may be spread during pruning operations if tools that have been used on a diseased tree are then used on a healthy one. The most likely means of international spread is by trade in unknown infected plants.

Phytosanitary measures

Because the disease is mainly spread by human activity, it is feasible to limit the spread by clean propagation and production methods (Smith, 1985). Planting material should be obtained from regions where the disease does not occur.

Justification for scoring

A seemingly unstoppable spread in Europe, and a warming weather means that once appears in Denmark, noticeable landscape changes happen, especially in cities.

***Mycosphaerella chrysanthemi* (Mycosphaerellales: Mycosphaerellaceae)**

Host

Chrysanthemum (daisy).

Geographical distribution

Area of origin not known with certainy; widely present in Europe, N America, and Asian and African countreies; Oceania.

Pest significance

Of little importance until the late 1940s until the intensification of chrysanthemum flower and pot plant production. The increasing intensification of chrysanthemum production, with all-the- year-round cultivars, mist benches, use of dark covers, etc., favours spread and development of the disease.

Means of spread

D. ligulicola has a relatively low dispersal potential on its own, but can be transmitted by infected cuttings, plants and flowers of chrysanthemums. Earth attached to roots can also be a source of inoculum. The fact that the disease is recorded in California shows that it will persist even in areas with apparently unfavourable climatic conditions.

Phytosanitary measures

The fungus can develop under a wide range of conditions and, once established, is both difficult and costly to eradicate. In countries where the disease occurs, growing-season inspections should be carried out, especially during rooting of cuttings, but also on mother plants and at flowering. Rooted or unrooted cuttings should come from rooting beds or plants, respectively, which were found free from *D. ligulicula* during the last growing season

Justification for scoring

Potentially important pathogen for the glasshouse/flower industry.

***Puccinia horiana* (Pucciniales: Pucciniaceae)**

Host

Chrysanthemums.

Geographical distribution

Originated in Japan and has spread to other Far Eastern countries, to South Africa, and from there to Europe. *P. horiana* is mostly a greenhouse pest in more temperate areas.

Pest significance

P. horiana is now a feared and serious disease in nurseries, frequently causing complete loss of glasshouse chrysanthemum crops.

Means of spread

An autoecious rust. The disease is normally carried on infected cuttings and plants (including cut flowers) of glasshouse chrysanthemums. There are reports that dispersal by wind can occur over distances of 700 m and more but, because the basidiospores are very sensitive to desiccation at less than 90% RH, long-distance spread would only be likely during very wet periods. Natural spread is hence unlikely over long distances; it is limited even between glasshouses (or else it would never have been possible to contain the disease at all).

The ability of the fungus to overwinter outdoors is unknown.

Phytosanitary measures

EPPO recommends (OEPP/EPPO, 1990) that planting material of chrysanthemums should come from a place of production regularly inspected and found free of disease for 3 months beforehand. The fungus should also be absent from the immediate vicinity of the place of production. For cut flowers, visual inspection is sufficient. Veenenbos (1984) outlined the pre-export inspection and control system used to provide this guarantee in the Netherlands. Such systems are now viewed in that country as less and less acceptable from an environmental standpoint, because they depend heavily on intensive use of plant protection products and also interfere with biological control systems in glasshouses. For the few countries where the disease is still absent, these arguments tend to support continued exclusion.

Justification for scoring

“Now a feared and serious disease in nurseries, frequently causing complete loss of glasshouse chrysanthemum crops” – this is enough to suggest that as a major threat to the Danish flower industry.

***Entoleuca mammata* , hypoxilon canker (Xylariales: Xylariaceae)**

Host

Aspen (*Populus* spp.), salix and rowan, although it is likely that isolates are genus-specific.

Geographical distribution

Originally North American, introduced to Europe probably centuries ago, where it is widely present.

Pest significance

Means of spread

Can be vectored by several beetles, but mainly by ascospores and conidia.

Phytosanitary measures

Measures are lacking due to lack of understanding of the disease mechanisms.

Justification for scoring

As a pathogen of several common trees in the Danish countryside, this pathogen may have, if it arrives, a major impact on landscapes, including urban parks.

Note: there is surprisingly little published informatin available about this pathogen.

***Heterobasidion annosum* sensu lato (Russulales: Bondarzewiaceae)**

Host

A wide range of Northern Hemisphere conifers, less commonly broadleaved trees and other woody plants, and rarely non-woody plants.

Geographical distribution

Probably eastern and southern Asia but some doubts exist that early records may, in fact, represent other species of Heterobasidion that may occur in this region.

Pest significance

Root rot fungi that spread vegetatively via root contact and grafts, forming distinct disease centres in the tree stand. In large stumps the fungus can remain alive and infectious for decades after felling and thus forms a threat for the next conifer generation.

Means of spread

Viable, airborne spores have been found 300 km from the nearest source. Conidia may also have some role in the aerial dispersal.

Phytosanitary measures

In healthy and slightly diseased stands in risky areas it is important to prevent infection by spores. This is done by performing cuttings during the seasons (cold winter or hot summer) when the risk of spore infection is low or absent. Little can be done to control the fungus in diseased stands. Heterobasidion infection can be cleared from a site by cultivating a rotation of a resistant tree species.

Justification for scoring

Propensity for long-distance dispersal of spores, presence of a wide range of hosts, and difficulty to control the pathogen.

Species of lower risk than at the first scoring

***Ophiomyia kwansonis* (Diptera: Agromyzidae)**

Host

Larvae feed on *Hemerocallis* spp. (including *Hemerocallis fulva, H. lilioasphodelus*).

Geographical distribution

O. kwansonis originates from Asia. It seems rather widespread now n the USA, and established, after successful overwintering, in Slovenia.

Pest significance

Larvae feed on Hemerocallis leaves, mining up and down between the leaf surfaces, leaving obvious silver tunnels. No plant mortality has been reported but severe mining strongly disfigures daylilies which are grown for ornamental purposes.

Means of spread

Adults can fly but no details are available on their flying capacities. Over long distances, movement of infested plants is probably an important pathway. In addition, Hemerocallis spp. with their numerous cultivars are quite popular in gardening and it is likely that amateurs are actively exchanging or trading planting material. Plants are often multiplied vegetatively and sold bare-rooted with 1 or 2 crowns including short green leafy parts which could carry eggs, larvae or pupae. Seeds are not likely to be a pathway.

Phytosanitary measures

None suggesed, as a UK risk assessment concluded that the species is transient, i.e. cannot establish.

Justification for scoring

Probably of possible importance but only for a segment of glasshouse growers, so the risk of this species is now downgraded.

***Strauzia longipennis* (Diptera: Tephritidae)**

Host

The primary host is sunflower, but also lives on other *Helianthus* species, and on species of the Asteraceae family, including several invasive weed species, *Ageratina altissima* (white snakeroot), *Ambrosia trifida* (giant ragweed).

Geographical distribution

Widespread in its native range of the USA and Canada; now also present in Germany.

Pest significance

Larvae of *S. longipennis* bore tunnels in the pith of sunflower stalks. Depending on the number of larvae, injury may vary from a short tunnel to complete destruction of the pith. Large infestations can weaken the stalk and eventually lead to plant breakage.

Means of spread

Plants for planting, cut flowers of host plant species, soil and growing medium (no data is available to evaluate the possibility that tubers of *H. tuberosus* with adhering soil could transport the pest).

Phytosanitary measures

None.

Justification for scoring

This is another species on the alert list that is probably less of a risk than originally considered.

***Mycosphaerella pini* (Ascomycetes: Dothideales)**

Host

Mainly a disease of the genus *Pinus*. Pinus species vary in their susceptibility.

Geographical distribution

Global, most widespread in countries that grow susceptible pine species out of their native habitat on a commercial scale (e.g. Chile, New Zealand).

Pest significance

M. pini causes loss to timber production in susceptible species through reduction in growth rate following defoliation.

Means of spread

Airborne conidia are released and dispersed by rain splash for short distances. The spread of blight over long distances is not understood, but it is likely that wind, cloud and diseased materials (e.g. nursery stock) are possible transfer mechanisms. Both teleomorphic and anamorphic forms were found infecting an 8- to 10-year-old *P. mugo* stand in Germany in 1983. The probable cause of infection is the introduction of diseased *P. nigra* from a neighbouring country.

Phytosanitary measures

EPPO recommends that planting material of *Pinus* should come from an area free from M. dearnessii, and in addition that the place of production should have been found free.

Justification for scoring

The risk from this species has probably been overrated. Essentially a subtropical fungus.

This species was removed from the Alert List

***Aproceros leucopoda* (Hymenoptera: Argidae)**

Host

An oliphagous pest of elm trees (*Ulmus* spp.).

Geographical distribution

Sporadic recent records form various Europena countries, from east to west, north to south. In Asia, China, Japan, and the Russian Far East.

Pest significance

By feeding actively on elm leaves, larvae of *A. leucopoda* can cause severe defoliation of elm trees both in urban areas, along roadsides and in forests. Repeated defoliation weakens the tree.

Means of spread

Probably introduced from East Asia into Europe with elm plants used in horticulture or forestry. Natural spread is by adult females, which are strong fliers. The spread in Europe from 2003 to 2014 has been 45 - 90 km/y. Passive dispersal by traffic is also to be expected, since spread is observed along roads and highways.

Phytosanitary measures

None known against specifically this species.

Justification for scoring

Presence of species in W Europe, plenty of host plants available (although decreased density due to elm disease), serious impact in cities and over the Danish landscape can be expected. However, - see below – this is now taken off the alert list.

Added in 2011 – Deleted in 2015

Reasons for deletion:

Aproceros leucopoda has been included in EPPO Alert List for more than 3 years and during this period no particular international action was requested by the EPPO member countries. The Panel on Quarantine Pests for Forestry and the Panel on Phytosanitary Measures agreed that it could be deleted. In 2015, it was therefore considered that sufficient alert has been given and the pest was deleted from the Alert List.

Table 1. The ranked scores of pests listed on the EU Plant Health Directive DIR 2000/29, Annex I/A2. Species were grouped by taxon; within taxon, they are alphabetically arranged.

Species	Taxon	Probability in DK of			Negative impact in DK	Risk	Score	Uncertainty	Uncert score	Final score	Weighted score 2	Verbal score
		Establishment	Spread	E&S								
Popillia japonica	Arthropod	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Ralstonia solanacearum	Bacterium	High	High	High	High	High	4	Low	4	16	12	Very high
Globodera pallida	Nematode	High	High	High	High	High	4	Medium	4	16	12	Very high
Globodera rostochiensis	Nematode	High	High	High	High	High	4	Low	4	16	12	Very high
Meloidogyne chitwoodi	Nematode	High	High	High	High	High	4	Medium	4	16	12	Very high
Meloidogyne fallax	Nematode	High	High	High	Medium	High	4	Low	4	16	12	Very high

Table 2. The revised ranked scores of pests listed on the EU Plant Health Directive DIR 2000/29, Annex II/A1. Species were grouped by taxon; within taxon, they are alphabetically arranged.

Species	Taxon	Probability in DK of		E&S	Negative impact in DK	Risk	Score	Uncer-tainty	Uncert score	Final score	Weighted score 2	Verbal score
		Establish-ment	Spread									
Agrilus planipennis	Arthropod	Medium	High	High	High	High	4	Low	4	16	12	Very high
Anthonomus quadrigibbus	Arthropod	High	High	High	High	High	4	Medium	4	16	12	Very high
Anthonomus signatus	Arthropod	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Carposina sasakii	Arthropod	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Cydia inopinata	Arthropod	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Cydia packardi	Arthropod	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Cydia prunivora	Arthropod	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Ips pini	Arthropod	Medium	High	High	Medium	High	4	Medium	4	16	12	Very high
Listronotus bonariensis	Arthropod	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Pissodes nemorensis	Arthropod	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Pissodes strobi	Arthropod	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Alternaria mali	Fungus	Medium	High	High	Medium	High	4	Medium	4	16	12	Very high
Apiosporina morbosa	Fungus	Medium	High	High	Medium	High	4	Medium	4	16	12	Very high
Atropellis pinicola	Fungus	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Atropellis piniphila	Fungus	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Mycosphaerella dearnessii	Fungus	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Beet curly top virus	virus/viroid	High	Medium	High	High	High	4	Medium	4	16	12	Very high
Chrysanthemum stem necrosis virus	virus/viroid	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high

Table 3. The ranked scores of pests listed on the EU Plant Health Directive DIR 2000/29, Annex II/B. Species were grouped by taxon; within taxon, they are alphabetically arranged.

Species	Taxon	Probability in DK of			Negative impact in DK	Risk	Score	Uncer-tainty	Uncert score	Final score	Weighted score 2	Verbal score
		Establish-ment	Spread	E&S								
*Dendroctonus micans**	arthropod	High	High	High	Medium	High	4	Low	4	16	12	Very high
*Erwinia amylovora**	bacterium	High	High	High	Medium	High	4	Low	4	16	12	Very high
Entoleuca mammata	fungus	High	High	High	High	High	4	Low	4	16	12	Very high

* Present/detected in Denmark

Table 4. The ranked scores of pests on the EPPO Alert List and recently added species. Species were grouped by taxon; within taxon, they are alphabetically arranged.

Species	Taxon	Entry date	Probability in DK of			Neg. impact	Risk	Score	Uncer-tainty	Uncert score	Final score	Weighted score 2	Verbal score
			Establish-ment	Spread	E&S								
Aproceros leucopoda	Arthropod	2011-09	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Myiopardalis pardalina	Arthropod	2013-06	Medium	Medium	Medium	High	High	4	Medium	4	16	12	Very high
Ophiomyia kwansonis	Arthropod	2013-01	High	Medium	High	Medium	High	4	Medium	4	16	12	Very high
Strauzia longipennis	Arthropod	2011-02	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Heterobasidion irregulare	Fungus	2013-10	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Hosta virus X	Virus	2013-08	High	High	High	Medium	High	4	Medium	4	16	12	Very high
Additional species													
Dendrolimus superans	Arthropod		High	High	High	Medium	High	4	Medium	4	16	12	Very high
Ips hauseri	Arthropod		High	Medium	High	Medium	High	4	Medium	4	16	12	Very high