The Danger to Norwegian Plant Health from increased Import of Agricultural Commodities

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Abstract

The plant health sitution in Norway is better than in most European countries. The realtively cool growing season, winters with frozen ground over most of the country and low spring temperature slow down the development of insects pests and fungal plant pathogens. Increased import of potatoes, vegetables, fruits and plants for propagation will augument the risk for import and establishment of new pests and diseases of cultivated plants in Norway.

Key words: Plant health, pest risk assessment, entry, establishment, quarantine, phytosanitary measures

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The Danger to Norwegian Plant Health from increased Import of Agricultural Commodities

Contents

SUMMARY

The plant health in Norway is regulated by "Act of 14. March 1964 Relating to Measures to Prevent Plant Diseases and Pests" and regulation under this act. A list of prohibited pests and diseases with 0-tolerance in imported plant consignments contains 7 bacteria, 35 fungi, 20 viruses and phytoplasmas, 34 insects and mites and 9 nematodes.

Due to relatively cool summers and winters with frozen ground over most of the country, the plant health situation in Norway is better than in most European countries. The low spring temperature slows down the development of insect pests and fungal plant pathogens. Also, the climatic conditions during the summer decreases the number of generations for several insect pests and reduces the rate of development of plant diseases. Increased import of potatoes, vegetables, fruits and plants for propagation will augment the risk for import and establishment of new pests and diseases in Norway.

A number of pests and diseases are discussed in some detail. Some examples of potentially serious threats to the plant health situation in Norway are: Karnal bunt of wheat, pine wood nematode, potato leafroll virus, Colorado beetle, potato brown rot, red steele disease of strawberry and tomato spotted wilt virus.

A quantitative study of the pathways of the potato brown rot bacterium *Ralstonia solanacearum* has been made. The results indicate that prevalence infected of infected potato lots in the exporting country is the most crucial component regarding entry of this pathogen through potato export to Norway. Regarding establishment, the intended use of the imported potatoes determines the probability of release of the bacterium into the environment. If released, the study shows that the

brown rot bacterium will be able to establish on the wild hosts *Solanum dulcamara*, a common weed of Southern Norway.

1.0 AGRICULTURE IN NORWAY

Agriculture occupies only about 3 % of the total area of Norway. The arable land amounts to 0.23 ha per capita, which is lower than the world average of 0.26 ha per capita and much lower than the figures of 0.90 ha per capita for New Zealand and 0.73 ha per capita for USA. The Norwegian agricultural production supplies 48 % of the domestic consumption. The average Norwegian farm has 12 ha arable land and the average herd on a dairy farm is 12 cows.

1.1 Climate

The mainland of Norway covers 324 000 km^2, and it is situated between 58° N and 70° N and between 5° E and 32° E. It is a mountainous country with a long coastline, and a maritime climate influenced by the North Atlantic current. The country also has areas in the east with predominately continental climate. The annual average temperature varies from +7.7 °C on the southern and western coast to –3.1 °C in the interior of Finnmark at a lowland site. In the mountains the annual average temperature may be less than -6 °C. The annual precipitation varies from 3575 mm at a lowland site at the western coast to 278 mm in a mountain valley of central Norway. The annual precipitation in the western mountains may be more than 5000 mm.

1.11 Climate in agricultural districts

The main agricultural districts are situated south of 65° N. In Trøndelag, Central Norway, the growing season, defined as more than +5 °C average daily temperature, is from late April to early September in the most favoured districts. In the southeastern rural districts, in the most favourable parts, the growing season is from mid April to late September. On the coast in the southwest the growing season is from early April to mid October.

The average yearly precipitation in agricultural districts in the counties Nord- Trøndelag and Sør-Trøndelag is between 700 mm and 2000 mm. In the major farming districts of southeastern Norway the precipitation is between 500 and 1000 mm. In western and southwestern Norway annual precipitation is between 1000 and 2500 mm in rural districts. All parts of the country receive precipitation throughout the year, but in the western part and in Trøndelag precipitation is heavier during the autumn. In the southeastern part of the country summer precipitation typically occurs as rain showers.

The normal air temperature during the peak of summer ranges from below 10 °C to over 17 °C in areas with agricultural production. Between a coastal area and the interior at the same latitude and altitude summer temperature may differ by more than 5 °C. Temperature level is frequently used to

determine the start and end of the growing season. When the passage of 5 °C diurnal mean temperature is used as a criterion in both spring and autumn, the duration of the growing season varies from 220 to 120 days, the latter referring to areas with agriculture in the north and in mountainous regions of south Norway.

The daylength varies regularly with season and latitude. From an equal duration of day and night at the spring equinox, a maximum daylength of about 18h is reached in south Norway, while the daylength reaches 24 hrs at the Arctic Circle and northwards. During the growing season, daylength varies from 14 to 24hrs in spring to 9 to 12 hrs at the end of the growth period. An increase in daylength enhances the rate of phenological development of long-day plants. The long photoperiod stimulates the dry matter production and compensates for a reduction of temperature of several degrees centigrade. Growth cessation of perennial crops is strongly affected by photoperiod. Ecotypes adapted to northern conditions must stop growing at a longer photoperiod than types of southern origin.

1.2 Districts with significant agricultural production

While the majority of the farms in Norway combined plant and animal production until approximately 1950, during the last half of the twentieth century we have seen a significant specialisation in Norwegian farming, both in the best climatic zones and in more marginal districts. In the 1950s and 1960s the majority of the farms in the lowlands of southeast Norway and some districts in Trøndelag terminated their dairy production and became specialised cereal farmers. Some combine cereals with potato and vegetable production.

1.21 Grassland

Grassland covers around 60 % of the agricultural land. Grass production for hay or silage dominates in more marginal areas in the mountain valleys and in humid cost and fjord districts in southwest and central Norway. Previously, dairy farmers also produced cereals and potatoes in all climatic zones where these productions were possible. Today, only hay and silage are produced on the majority of the dairy farms.

1.22 Cereals

Only one quarter of the arable land in Norway can be used for cereals. The main cereal districts are the counties Østfold, Akershus, Hedmark, Oppland, Buskerud and Vestfold in the southeast and Sør-Trøndelag and Nord-Trøndelag counties in central Norway. Barley covers about 50 % of the cereal area, oats around 30 %. The wheat harvest varies with the overwintering of winter wheat, but during the period 1990 - 1999 wheat has been grown on approximately 20 % of the cereal area. Half the wheat production is winter wheat. Winter barley is not cultivated in Norway. From 50 - 70 % of the bread wheat is domestically grown. The protein quality varies from year to year depending on the weather conditions. Therefore, self-sufficiency varies with the precipitation and temperature during ripening and harvest. Norwegian grown cereals meet the demand for carbohydrate animal feed, when it is mixed with imported protein rich grains to produce feed concentrate.

1.23 Potatoes

Potatoes are grown on 18 000 ha, with a production of 454,4 mill Kg in 1993 (Statistics Norway 1994). Commercial potato production is mainly concentrated in districts with intensive cropping, where the potato fields cover a significant part of the arable land. The major potato producing counties are Hedmark, Oppland, Akershus, Østfold, Vestfold, Sør-Trøndelag and Nord-Trøndelag. Scattered commercial potato fields can be found in all agricultural districts including the county of Troms at about 69° North. The domestic production covers about 90 % of the potato demand for consumption and industrial use.

1.24 Vegetables

Also, field cultivation of vegetables occurs in most agricultural districts. The counties Østfold, Hedmark, Oppland, Buskerud, Vestfold, Rogaland and Nord-Trøndelag produce the majority of the domestic demand for onions, carrots and cabbage. During the season and early part of the storage period domestic production covers the markets demand, while some import takes place in the spring before the early crop is harvested.

Production of greenhouse vegetables supplies about half of the domestic consumption for tomato, cucumbers and lettuce.

1.25 Berries

Strawberry production satisfies the domestic demand during the season and some quantities are exported, because the Norwegian crop is harvested later then the major season for fresh strawberries in continental Europe. Raspberry and currants are used domestically during the season. The majority of strawberries, currants and raspberries for industrial purposes are imported.

1.26 Fruit

Apple production covers only 20 % of the domestic consumption. Pear and plums are even less important. Sweet cherry production is increasing, and cherries are exported during the Norwegian season, which follows the season in England and continental Europe.

1.27 Ornamentals

Greenhouse production of the more popular ornamentals covers a significant part of the markets need. Domestic growers supply half of the cut roses sold and most of the pot chrysanthemum and poinsettia market. Greenhouses for ornamental production are often located in the districts. Jobs in ornamental production are very popular among housewives and young people.

2.0 THE NORWEGIAN PLANT HEALTH SITUATION

Due to the relatively cool summers and winters with frozen ground over most of the country, the plant health situation in Norway is better than in most European countries. The low temperature during the spring months slows down the development of insect pests and fungal plant pathogens. The relatively cool temperature during the growing season decreases the numbers of generations for insect pests and reduces the rate of development of plant diseases.

However, a number of pests that are currently absent have the potential to develop on domestic crops in Norwegian climate. Increased volume of trade will also enlarge the probability of introduction and establishment of exotic pests and diseases.

2.1 Norwegian plant health regulations

In Norway the first "Plant Protection Act" was implemented in 1916. The Government was given the authority to prohibit import of certain plant pests and diseases. Also, the import of certain plant species, hosts to potentially dangerous diseases and pest, was banned.

In 1955 Norway joined the European Plant Protection Organisation (EPPO) and harmonised the legislation and regulations as much as possible with the EPPO countries.

Today plant health in Norway is regulated by "Act of 14. March 1964 Relating to Measures to Prevent Plant Diseases and Pests" and regulations under this act. The current "Regulations relating to the import of plants and parts of plants, etc. to Norway" was revised 10. September 1998. There are, in addition, statues for individual diseases and pests. (Enclosure 1).

The Regulations contains an A-list of pests and diseases with 0-tolerance in imported plant consignments. The list includes 7 bacteria, 35 fungi, 20 virus and phytoplasma -like organisms, 34 insects and mites and 9 nematodes.

Table 1. List of bacteria, fungi, viruses and phytoplasma, insects and mites and nematodes whose import into Norway are prohibited according to "Regulations relating to the import of plants and parts of plants into Norway" laid down by the Ministry of Agriculture, September 10th 1998. The scientific names have been updated and some of the most common synonyms are listed.

Pest and diseases	Common synonym	Hosts
Bacteria		
Clavibacter michiganense subsp. *sepedonicus*	*Corynebacterium sepedonicum*	Potato
Clavibacter michiganense subsp. *michiganensis*	*Corynebacterium michiganense*	Tomato
Erwinia amylovora		Pomoidae
Erwinia chrysanthemi pv. *chrysanthemi*		Chrysanthemum
Erwinia chrysanthemi pv. *dianthicola*		Carnation
Pseudomonas caryophylli		Carnation
Ralstonia solanacearum	*Pseudomonas solanacearum*	Potato, vegetables
Fungi		
**) Angisorus solani*		Potato
**) Atropellis* spp		Pine
**) Ceratocystis fagacearum*		Oak
Ceratocystis ulmi		Elm, *Zelkova* spp.
**) Cercospora pini-densiflorae*		Pine
**) Chrysomyxa arctostaphyli*		Spruce
**) Cronartium* spp. (non-European)		Oak, pine
**) Dibotryon morbosum*		*Prunus* spp.
Elytroderma deformans		Pine
**) Endocronartium harknessii*	*Cronartium harnessii*	Pine
Endothia parasitica		Chestnut, oak
**) Guignardia laricina*		Larch
**) Gymnosporangium* spp. (non-European)		Junipers, Pomoidae
**) Hamaspora longissima*		Rubus
**) Melampsora farlowii*		Tsuga
**) Melampsora medusa*		Conifers, poplar
**) Mycosphaerella laricileptolepis*		Larch
**) Mycosphaerella popolorum*		Poplar
Ophiostoma spp.		Oak
**) Peridermium kurilense*		Pine
**) Phellinus weirii*	*Poria weirii*	Conifers
Phialophora cinerescens		Carnation
**) Phoma andina*		Potato
**) Phyllosticta solitaria*		Apple
Phytophthora fragariae var. *fragariae*		Strawberry
Phytophthora fragariae var. *rubi*		Raspberry
Puccinia horiana		Chrysanthemum
Puccinia pelarogonii-zonalis		Zonal geranium
**) Puccinia piettieriana*		Potato
Scirrhia acicola		Conifers
Sclerotium cepiviorum		Onion
**) Septoria lycopersici var. malagutii*		Potato
Synchytrium endobioticum		Potato
**) Tilletia indica*		Wheat
Uromyces transversalis		Gladiolus
Viruses and phytoplasma		
Apple proliferation phytoplasma	Aplle proliferation (MLO)	Apple

Barley stripe mosaic virus		Cereals
*) Cherry rasp leaf virus (American)		Cherry
Chrysanthemum stunt viroid		Chrysanthemum
*) Elm phloem necrosis phytoplasma	Elm phloem necrosis (MLO)	Elm
*) Peach mosaic virus (American)		Peach
Pear decline phytoplasma	Pear decline (MLO)	Pear
*) Plum line pattern virus (American)		Plum
Plum pox virus	Sharka virus	*Prunus* spp.
Potato leaf roll virus		Potato
Potato spindle tuber viroid		Potato
*) Potato viruses and phytoplasmas (outside-Europe), incl. Non-European strains		Potato
*) Raspberry leaf curl virus (American)		*Rubus* spp.
Rubus stunt phytoplasma	Rubus stunt (MLO)	*Rubus* spp.
Stolbur phytoplasma	Stolbur (MLO)	Solanaceae
*) Strawberry latent C virus		Strawberry
Strawberry vein-banding virus		Strawberry
*) Strawberry witches broom phytoplasma	Strawberry witches broom (MLO)	Strawberry
Strawberry yellow edge virus		Strawberry
Tomato spotted wilt virus		Polyphagous
Insects and mites		
**) Acleris variana*	*Teras variana ,Peronea var., Peronea angusana*	Conifers
**) Amauromyza maculosa*	*Agromyza guaranitica, Phytobia guaranitica*	Chrysanthemum, polyphagous
**) Blitopertha orientalis*	*Anomala orientalis*	Polyphagous
Cacoecimorpha pronubana	*Tortix pronubana Cacoecia pronubana*	Carnation, polyphagous
**) Conotrachelus nenuphar*		*Prunus* spp.
**) Cydia prunivora*	*Grapholita prunivora, Enarmonia prunivora Laspeyresia prunivora*	Apple, cherry
Diarthronomya chrysanthemi	*Diarthronomyia chrysanthemi Ahlb. = Rhopalomyia chrysanthemi*	Chrysanthemum
Epichoristodes acerbella	*Tubula acerbella E. ionephela*	Carnation, chrysanthemum
Eriosoma lanigerum		Fruit trees, deciduous trees, shrubs
Helicoverpa armigera	*Heliothis armigera Chloridea armigera*	Ornamental plants
**) Hylurgopinus rufipes*		Elm
Hyphatria cunea		Deciduous trees
Ips amitinus	*Tomicus amitinus Ips duplicatus*	Conifers
Leptinotarsa decemlineata	*Chrysomela decemlineata Doryphora decemlineata Polygramma decemlineata*	Potato
Liriomyza trifolii	*Liriomyza alliovora*	Chrysanthemum, polyphagous
**) Liriomyza huidobrensis*	*Agromyza huidobrensis Liriomyza cucumifoliae L. langei, L. Dianthi*	Chrysanthemum, polyphagous
**) Liriomyza sativa*	*Liriomyza pullata, L. Canomarginis L. minutiseta*	Chrysanthemum, polypagous
Opogona sacchari	*Alucita sacchari,*	Ornamental plants

	Tinea subcervinella	
Phthorimaea operculella	*Gnorimoschema operculella*	Potato
**) Pissodes* spp. (non-European species)		Conifers
**) Popillia japonica*		Polyphagous
**) Premnotrypes* spp.		Potato (tubers)
Quadraspidiotus perniciosus	*Aspiditous perniciosus* *Comstockaspis perniciosa* *Diaspidiotus perniciosus*	Fruit trees, deciduous trees, shrubs
Rhagoletis cerasi		Cherry
**) Scolytidae (*non-European species)		Conifers
Scolytus laevis	*Eccoptogaster laevis*	Elm, *Zelkova* spp.
Scolytus multistriatus	*Eccoptogaster multistriatus*	Elm, *Zelkova* spp.
Scolytus scolytus	*Eccoptogaster destruktor*	Elm, *Zelkova* spp.
**) Spodoptera litura*	*Prodenia litura*	Ornamental plants, polyphagous
Spodoptera littoralis	*Hadena littoralis*	Ornamental plants, polyphagous
Steneotarsonemus pallidus fragariae		Cyclamen
Thomasiniana ribis	*Thomasia ribis*	*Ribes* spp.
Thrips palmi	*Thrips leucadophilus,* *T. gossypicola,* *Chloethrips aureus*	Polyphagous
**) Trypetidae* (non-European species)		Fruit
Nematodes		
Bursaphelenchus xylophilus	*Aphelenchoides xylophilus*	Conifers
x) Ditylenchus destructor		Potato, etc.
x) Ditylenchus dipsaci		Onion, ets.
Globodera pallida	*Heterodera pallida*	Potato (soil)
Globodera rostochiensis	*Heterodera rostochiensis*	Potato (soil)
x) Meloidogyne spp.		Greenhouse plants, polyphagous
**) Nacobbus aberrans*	*Angu illulina aberrans* *N. batatiformis* *N. serendipiticus* *N. serendipiticus bolivianus*	Potato (soil) Polyhagous (roots, soil) Greenhouse plants
x) Radopholus similis	*Tylenchus similes*	Ornamental plants, polyphagous
Xiphinema americanum sensu lato	*Tylencholimus americanus*	Polyphagous (roots, soil)

x) Applies only to plants for cultivation and propagation
*) Organisms that occur outside Europe (=European Plant Protection Organization A1 list common to all member countries).

2.2 Consequences of an introduction

Introduction of one or several of the plant pests on the current A-list may have dramatic economic consequences for Norwegian agriculture. Increase in pesticide application during an eradication campaign or a permanent increase in pesticide use in case of a permanent establishment of a new pest can be the result. For the individual farmer or gardener the extra expenditure may reduce the profit in his production. Also, the extra use of chemical pesticides may increase the risk for residues in the produce and augment the environmental hazard related to pesticide application. Norwegian exports, such as seed plant exports, depend on a good plant health situation which may also be destroyed by introduction of new non-indigenous pests.

2.3 Increase in international trade

Increase in international trade increases the risk for import of quarantine pests and diseases. Fortunately, because pest populations increase only in the presence of a suitable environment and a susceptible host plant, exotic pests most often fail to become established when introduced into a new region. Although the probability of successful establishment is low, the large number of pest and disease propagules occasionally arriving in import commodities, some successful establishment of foreign pests will occur.

3.0 INTERNATIONAL ORGANISATIONS

Norway is a member of organisations with conflicting interests. Plant protection organisations have been established to prevent the spread of plant pests and diseases. Free trade organisations seek to promote trade in agricultural commodities. The increase in trade of plants and plant produce augments the risks for spread and introduction of exotic pests.

3.1 Plant Protection Organisations

Since 1955, Norway is a member of the International Plant Protection Convention (IPPC), an office within FAO. IPPC also is the umbrella organisation for the regional plant protection organisations, for which the European Plant Protection Organisation (EPPO) covers the countries of Western,

Central and Eastern Europe and the Mediterranean region. Similarly there are regional organisations for North America, Central and South America, Africa and Asia.

IPPC and EPPO have joint interest in protecting plant health in member countries. Recently, there has been some discussion among members related to the revision of the IPPC. Some exporting countries will strengthen the role of IPPC and reduce the importance of the regional organisations. Most countries in Europe have taken the view that EPPO is important for the plant health status in all member countries. Also, the national interests of Norway are best served with a strong EPPO.

3.2 World Trade Organisation

The World Trade Organisation (WTO) included agricultural commodities in the Uruguay round. A major goal for WTO is to eliminate barriers to free trade. There are several examples where individual countries and regional plant protection organisations have hindered free trade by establishing lists of prohibited plant pests and diseases.

3.3 The Agreement on the Application of Sanitary and Phytosanitary Measures

One important result of the Uruguay Round of Multilateral Trade Negotiations was the 1993 Agreement on the Application of Sanitary and Phytosanitary Measures (SPS). The SPS agreement applies to all sanitary and phytosanitary measures which may affect international trade. Some important points related to phytosanitary measures are the following.

The SPS gives the member states the right to take sanitary and phytosanitary measures necessary for protection of plant health, provided that such measures are not in conflict with the agreement.

Plant protection methods shall be based on scientific principles and should not be maintained without sufficient scientific evidence.

Phytosanitary measures should not arbitrarily or unjustifiably discriminate between member states where identical or similar conditions prevail, and they shall not constitute a disguised restriction on international trade.

If there is scientific justification members may introduce or maintain phytosanitary measures resulting in a higher level of protection than international standards, guidelines or recommendations.

Members shall accept the phytosanitary measures of other members as equivalent, even if those measures differ from those used by other members trading in the product.

Members shall ensure that phytosanitary measures are based on assessment of the risk to plant health, taking into account risk assessment techniques developed by the relevant international organisations.

In the assessment of risk, members shall take into account available scientific evidence relevant processes and production methods, relevant inspection, sampling and testing methods, prevalence of specific diseases and pests, existence of pest free areas, relevant ecological and environmental conditions, and quarantine and other treatment.

4.0 THE PEST RISK ANALYSIS

The pest risk analysis (PRA) is an important concept in the SPS agreement of the Uruguay round.

The stages of the PRA are Initiation, Pest Risk Assessment, Pest Risk Management, and Pest Risk Communication. The Ministry of Agriculture or the Plant Health Administration will initiate the PRA, while research institutes normally will develop the Pest Risk Assessment, the scientific part of the PRA.

In Norway, the Agricultural Inspection Service has initiated several PRAs, where the Norwegian Crop Research Institute has developed the Pest Risk Assessment.

4.1 The Pest Risk Assessment

Generally, risk analysis is motivated by the presence of uncertainty. The objective of a risk assessment in a plant health context is to provide a complete systematic description of the pathogen and its relevant characteristics and compare these to the properties of the area of potential

establishment. A description of potential pathways in which the plant pest could enter the area under study should also be included. The Pest Risk Assessment serves as a scientific basis for management of plant health problems and it is an open document, which may be studied and challenged by exporting countries.

Experience from plant health risk-analysis reports published so far, has increased the demand on such analysis to be quantitative. One reason is that one has experienced criticism in direction of subjectivity even resulting in counter reports.

An introduction of a plant pest is defined by FAO as entry of a pest resulting in its establishment (FAO, 1990; revised FAO, 1996).

The multitude of pathways on which a pathogen could enter a country has forced, at least quantitative risk assessments for introduction, to be limited to a specific pathway to make it treatable for such kind of analysis. This has lead to the concept of "country-commodity specific risk assessment". A Quantitative Risk Assessment attempts to describe, in numbers, not only quantities like constants and natural variation, but also the current degree of uncertainty due to lack of knowledge.

4.2 Risk Assessment for introduction of a new plant pest to Norway, an example

At the Norwegian Crop Research Institute (NCRI), Rafoss (1999B) has studied the introduction of the brown rot bacterium of potato, *Ralstonia solanacearum*, to Norway through import of potatoes. Briefly described, the following was identified as important components in a risk model for this pest: 1) proportion of export lots infected, 2) prevalence or fraction infected of infected lots, 3) testing, 4) probability of release into environment, 5) probability of finding host plant, 6) probability of successful infection and 7) potential area of natural spread.

Results show that prevalence infected of potato lots infected with *R. solanacearum* is the most crucial component regarding *entry* of this bacterium to Norway through potato imports. The reason for this component to turn out as important, is the official EU-interim method for testing latent infections of brown rot (Anonymous, 1997), applied in EU countries infested with *R. solanacearum*. The test itself is approximately 100% effective, but the sampling procedure is sensitive to low levels of prevalence, in the way that there is a high risk that zero infected tubers will be sampled for testing from low prevalence lots and an infected lot will pass the test.
Regarding *establishment*, the intended use of the imported potatoes is important for the question of where and whether release of bacteria into the environment will occur. Our results show that if *R. solanacearum* is released into Norwegian environments, it will be able to establish. Its most important wild host plant, *Solanum dulcamara* is described as a common wild weed of Southern Norway (Lid & Lid, 1994). Scientific recordings of this plant are presented in Fig 1.

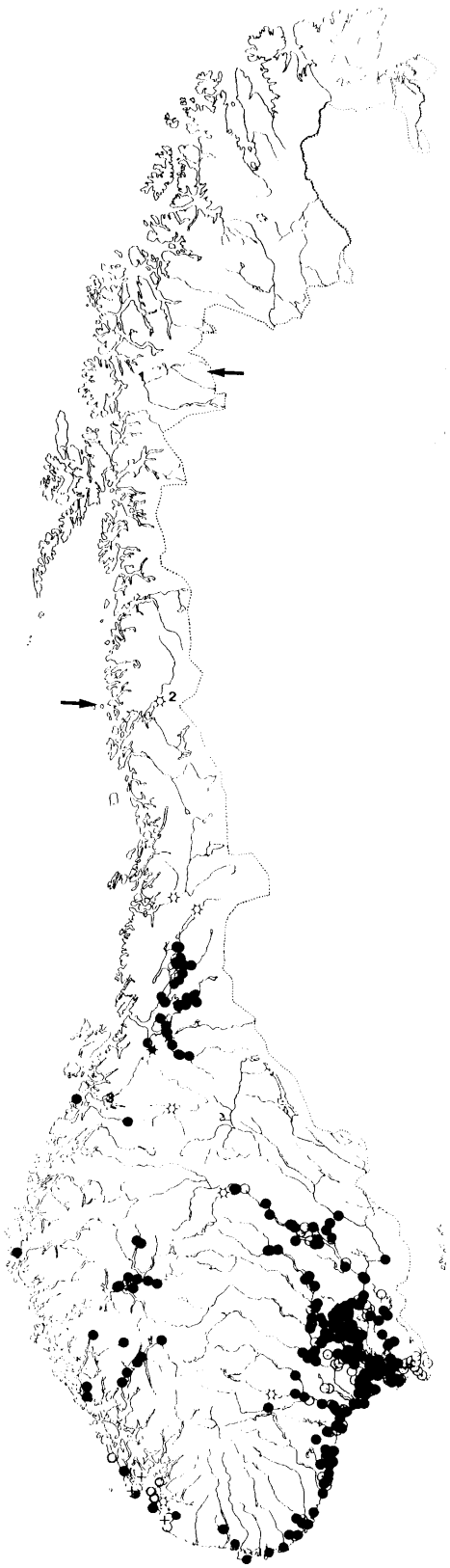

Figure 1. Recordings of *Solanum dulcamara* in Norway (from Fægri *et al.* 1960-).

This bacterium has a relatively high potential of natural spread through interaction with host plants growing along watercourses. Methodology to estimate distribution of agricultural land reached by natural spread (Fig. 2) from a given point of release into the environment of this bacterium was developed at NCRI during this project (Rafoss, 1999a). This method was based on biology of the bacterium, distribution of host plants, Geographical Information Systems (GIS) and necessary spatial datasets. The current model stops here, with the final output as an expression of agricultural land reached by natural spread of one introduction of *R. solanacearum*. If the decision-makers require more details, further consequences and determination of impact of these could then be derived on the basis of this risk model.

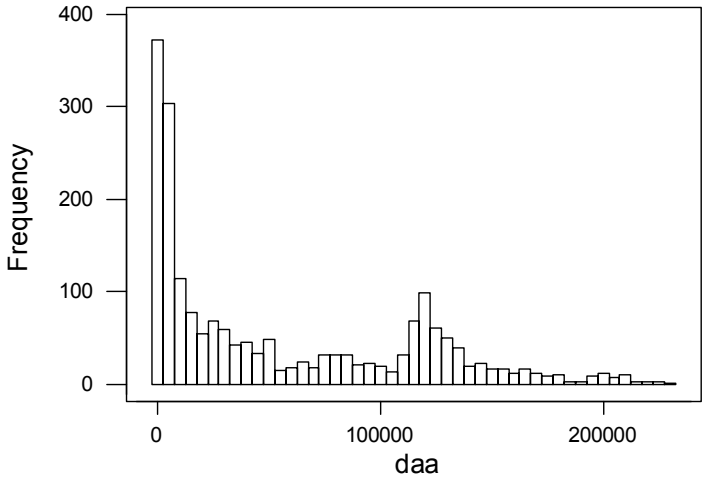

Figure 2. Estimate of distribution of natural spread area for *Ralstonia solanacearum* based on 2000 points of release into environment. (from Rafoss, 1999a)

4.3 The pine wood nematode story

The pine wood nematode (*Bursaphelenchus xylophilus*) is of North American origin and since the devastating effects of its introduction into Japan became known, there has been concern that the pine forests of Europe may be seriously damaged if the pine wood nematode was introduced into Europe. Heat treatment of Canadian chips and roundwood with bark has been required, but this treatment is expensive and the exporting companies want to avoid this.

The European Union established a PRA committee that included Dr. Christer Magnusson of NCRI. The Committee submitted 30.06.95 a PRA document that was challenged by Canada 08.11.95. Recent findings of the pine wood nematode in Portugal, will probably be exploited by Canada in the ongoing case with EU.

5.0 MANAGEMENT OF PLANT HEALTH

The International Plant Protection Convention (IPPC) defines a **quarantine pest** as a pest *of potential economic importance to the area endangered thereby and not yet present there, or present and under official control.* The precise level of potential economic importance to consider warranting the classification of a pest as a quarantine pest is open to a complete range of interpretations depending on the circumstances. There is no guidance as to any differential that may be necessary to allocate categories to a pest that causes 50 % crop loss in a season against one that have less than 1 % impact.

If quantitative analysis was possible, then a system to allocate ratings could be devised. The IPPC does not give any indication of a threshold of risk below which action is not justified.

The SPS Agreement identifies the term "acceptable level of phytosanitary protection" and although not set to any particular level, would indicate that some level of risk is accepted by governments in conducting trade.

5.1 Quarantine regulations

Most countries have quarantine regulations directed at protecting agricultural produce. The goal is to prevent the introduction of pests and diseases not known to be present in a region of a country, a country or a geographical area including several countries.

The efficacy of quarantines is difficult to determine. One method of evaluating quarantines is to compare the number of successful introductions of exotic pests before and after imposition of quarantine regulations. Darling (1977) states that during the years prior to the establishment of the US Quarantine law in 1912, there were two successful introductions per year, whereas in the years after 1912 there were on the average one successful introduction of exotic pests annually. Considering the increase in international trade during the period, the figures probably underestimate the efficacy of quarantine measures.

More recently McGregor (1978) calculated that successful establishment of exotic plant pathogens in USA has occurred at the rate of about three per year. The increase since the early part of this century probably relates to the increased volume of trade and travel.

In addition to effects on pest introduction and suppression, quarantines have important economic consequences. Growers in areas affected by quarantines can suffer severe economic losses due to restrictions on crops to cultivate in infected fields and banning of produce sale.

Norway requires quarantines for import of seed potato, fruit tree stocks and scions, strawberry plants and some other species.

6.0 NEW PESTS AND DISEASES WHICH REPRESENT MAJOR THREATS TO NORWEGIAN PLANT HEALTH.

International publications and contacts with colleagues in European countries have given indications on some potential new pest and diseases that threaten Norwegian plant health status.

Past experiences has taught us that surprises will almost certainly occur. The development of Karnal bunt of wheat during the last 30 years is an example of a new disease posing a serious threat worldwide. Earlier the disease was unknown in most major wheat growing countries. Until the outbreak in Skåne, Sweden, potato brown rot was regarded as a disease of tropical and subtropical climate with a northern limit in the Mediterranean countries.

Insect pests of tropical origin are a constant threat to Norwegian greenhouse crops. Propagating materials of ornamentals are frequently contaminated with exotic pests. Inspection at the production site or at the border will only cover samples from the imported consignment. The import of the tomato spotted wilt virus and its thrips vectors are recent examples of problems encountered by Norwegian greenhouse growers.

There have been several outbreaks of exotic pests and diseases in Norway during recent years. Some examples of potentially serious threats to the plant health situation in Norway are presented below.

6.1 Karnal bunt of wheat

Karnal bunt is one of five bunt and smut diseases that infect wheat. All reduce yield, and some cause quality loss by making spores that discolour the grain and produce a bad smell in the grain lot. Three

of these are common in all wheat growing areas, while two of the bunts are restricted in distribution. Karnal bunt has been rapidly spreading during the last twenty years, and recent finds in the United States, the major wheat exporting country in the world, poses a threat to the wheat production in Norway and other European countries.

The Karnal bunt is caused by the fungus *Tilletia indica*, and the fungus was first detected in 1931 at Karnal, a town in the state of Haryana, India. It has since spread to most wheat growing states in India, and it is also present in Pakistan, Afghanistan, Iraq, Iran and Nepal. In 1970 it was detected in northwest Mexico and remained confined to those areas until 1996, when it was found in Arizona, USA (Nagarajan et al. 1997). Lately, it has also been detected in California, New Mexico and Texas. Norway and most European countries have placed Karnal bunt on the A1 list of pests with 0 % tolerance.

The disease is both seed and soil borne. Resting spores are released when an infected crop is harvested and reaches the soil together with infected seed shed during harvest. The spores can also be spread over long distances by wind at harvest, and resting spores may survive up to 5 years in the soil. They will survive freezing down to –18 °C (Chahal and Mathur 1992). The fungal resting spores germinate on the soil when there is moisture available, and the temperature is in the range of 5 - 25 ^{o}C (Bonde et al.1997). When the resting spores germinate, they produce secondary spores which are wind disseminated to wheat leaves. Upon germination on the leaves a new crop of spores is spread to higher leaves which infect the head. Typically, only part of the seed is destroyed and turned into dark brown spore masses. The infected grain emits a fishy odour and the wheat grain is unpalatable. If the embryo is intact, the seed will germinate and produce weak plants. In a wheat stand, all ears do not get infected and only some of the grains in a spike are converted into black spore powder. However, a small percentage of infection is sufficient to reduce the quality from bread wheat to animal feed. Feed made from heavly infected wheat will be rejected by domestic animals.

Development of Karnal bunt depends on favourable weather conditions for infection and disease development during the period from heading to flowering of the wheat crop. Moderate temperature, high relative humidity and rainfall during flowering favours disease development. Sansford (1996) performed a provisional pest risk analysis and concluded that there are no critical factors which would prevent the establishment of Karnal bunt in the climate of northwest Europe. The temperature and precipitation during flowering of the European winter wheat crop is within the range of similar data from the wheat flowering period in the Indian states where Karnal bunt is endemic. Thus, it is highly probable that there would be serious consequences of Karnal bunt attack in the Norwegian wheat crop. Importation of infected seed from affected areas presents the highest risk of introduction, but also air-disseminated spores from infected wheat for milling may be a pathway for introduction. European wheat varieties probably have no resistance to Karnal bunt.

6.2 Potato leafroll virus

Potato leafroll virus (PLRV) is a serious virus disease on species in the Solanaceae. In Western Europe, the virus is essentially confined to potato. The yield depression varies with virus strain and potato variety, but losses of 50 - 80 % in tuber yield is common (Kojima & Lapierre 1988). World wide the average yield loss due to PLRV has been estimated at 10 %, which amounts to about 20 million tonnes of potatoes annually (Kojima & Lapierre 1988).

The PLRV was previously a disease in Norwegian potato crops, but it was eradicated around 1950 following a nearly total renewal of the seed potato material. A recent survey did not detect any PLRV in Norwegian grown potatoes (Munthe 1996). The Norwegian Agricultural Inspection Service will in the growing season of 1999 repeat the survey in major potato districts.

The virus is spread by infected seed tubers, which give rise to infected plants. Aphids, feeding on infected plants, become vectors of the virus and infect by feeding on healthy plants during the growing season. The virus is transported in the potato plant down to the new tubers in the soil. Several aphid species transmit the virus in the field. *Myzus persicae*, the peach aphid, is considered the most efficient vector. This species is common in greenhouses in Norway, but in the warmest part of the country, the peach aphid can also be found on crop plants in the fields. Also, some other aphid

species commonly found in Norwegian potato fields, are less efficient vectors of the virus (de Box 1987). Thus, if introduced, it is likely that the virus will be disseminated and represent a threat to Norwegian potato production.

Infected potato tubers for consumption or industrial processing are the most likely pathways for reintroduction of PLRV. Potato wart and probably several other potato diseases have been introduced into Norway, when people have planted potatoes imported for consumption or industrial purposes in their gardens or fields.

Possible import of seed potato will most likely originate from potato lots, which have been inspected by national certification scheme. In most countries PLRV is considered a serious pathogen, with a tolerance limit for certification. In the EU area, plants showing PLRV symptoms should not exceed 4 % for basic seed and 10 % for certified seed production. Some countries have lower limits. The Danish seed potato scheme sets a maximum level of plants showing symptoms at 0.2% for basic seed, and 0.5 % for plants grown for certified seed, respectively.

Seed potatoes imported from Denmark represent a potential pathway of reintroduction of PLRV. The risk of PLRV introduction will be significantly higher with seed potato import from The Netherlands and other European countries exporting seed potatoes.

6.3 Colorado Beetle

The Colorado beetle is a serious insect pest in most potato producing countries. In Europe it is widely distributed in most continental countries, since it first appeared in 1922. Of special interest are interceptions and eradication of the beetle in the United Kingdom, Denmark, Finland and Sweden. The situation in the United Kingdom is discussed by Barlett (1980) while reports on the situation in Finland have been given by Markkula and Tittanen (1975) and in Sweden by Wiktelius (1985). The beetle has been reported from potato fields in these countries, but the pest is not established today (EPPO/CABI 1992).

In Norway, the Colorado beetle has been intercepted several times in potato imports and shipments of other agricultural commodities. The first report was in 1947, when living beetles were found in a shipment of onions from Spain. All reports of Colorado beetle in Norway have been from ships or shops. The pest has not been reported from potato fields in this country. The last reported case was in 1984 (Fjelddalen 1991) and a few beetles in imported lettuce in 1999.

The host plants of Colorado beetle are all within the Solanaceae family, and wild species can act as reservoir for infestation of potato fields. Three *Solanum* spp. and *Datura stramonium* are the only wild growing Solanaceae in Norway. Tomato plants are grown extensively in gardens in the best climatic zones of Norway, while all commercial production takes place in greenhouses. Paprika, sweet pepper and aubergines are Solanaceae species rarely grown in Norway

Potato is the most important host for the Colorado beetle. The cultivation of potato as a stable food has long traditions in Norway and most farms have a potato field. Also, potato is grown in most home gardens in climatic zones where a crop can be harvested.

In Europe, the Colorado beetle has one generation per year. It overwinters as pupae, 25 - 40 cm deep, in the soil. A temperature above 10-12 °C has been indicated as a threshold for development of the pest. For development of one generation the minimum day degrees of 400 °C is required (Sutherst et al. 1991). A Russian study based on distribution in Russia indicates that the development of one full generation requires a period in the summer of at least 60 days of temperatures over 15 °C and winter temperature not falling below
- 8 °C.

While the Colorado beetle is a poor flyer, long distance dissemination in strong wind can carry beetles 75-100 km from an infested potato field. Beetles arriving in South Sweden and United Kingdom have been airborne, or drifted the last part of the distance at sea and washed up on the shores (Johnson 1969, Wiktelius 1985). Thus, it is a possibility that the Colorado beetle may arrive by air or sea in

southeastern Norway. With development of permanent populations in Sweden or Denmark, the probabilities for passive transport will increase. However, based on the rather few records during the last 40 years, the most likely pathway is by shipments of imported potato and other commodities.

In the counties Østfold, Vestfold and Aust-Agder, there have been summers with more than 400 day-degrees above 12 °C during the last 10 years. Thus, the Colorado beetle has a potential for establishment in the best climatic zones of Norway (Hofsvang 1996). Crop losses if no control measures are applied, can be 50 % or more (Hill 1987). In the case of Colorado beetle establishment, the farmers would have to spray with pesticides to reduce losses. The extra annual pesticide costs for the farmers in Østfold and Vestfold counties have been estimated at 200 000 NOK (Hofsvang 1996). Also, application of pesticides on a large scale would mean additional pollution of the environment in potato districts, which already have problems with pesticides in soil water and ground water.

6.4 Potato brown rot

The plant pathogenic bacterium *Ralstonia solanacearum* causes the disease potato brown rot. The host range of the bacterium includes over 200 plant species, mostly in the Solanaceae family. But more than fifty other plant families contain susceptible species. Tomato, banana, tobacco and numerous weeds are hosts to the bacterium (Buddenhagen et al. 1992). Among its host are also *Solanum dulcamara* and *S. nigrum*, which commonly occur along waterways and in wet areas in southeast and western parts of Norway.

The bacterium causing potato brown rot is worldwide in distribution, and specialised races exist, which infect different host plants. There have been outbreaks in Skåne, Sweden and recently in the Netherlands. When infected seed and ware potato were exported from the Netherlands, several European countries reported cases of potato brown rot (EPPO 1997).

The natural spread of *R. solanacearum* is usually limited and slow. Root-to-root spread of the bacterium has been recorded, but there is little evidence of long distance spread. The bacterium has been shown to spread over long distance with surface water when *S. dulcamara* grows with its roots floating in water. The bacterium may subsequently spread to other hosts, like potato, when contaminated surface water is used for irrigation. A likely source of *S. dulcamara* infection is sewage effluent from potato processing industry and households using infected ware potato. There is strong evidence that sewage from industrial plants in Sweden contaminated a local river in Skåne. When surface water from the river was used for irrigation of potato, the crop became infected with potato brown rot (Olsson 1976). Import of infected seed potato, ware potato and potato for industrial processing are obvious means for dissemination.

R. solanacearum may survive in soil, but probably only in relatively short periods on its own (Sequeria 1964). Long term survival in perennial hosts, like *S. dulcamara* is the most likely survival strategy for the bacterium, should it be introduced by any pathway into Norway.

Potato brown rot has been reported from Oxfordshire in England, from Skåne in Sweden and from Leveroj close to the Belgian border in the Netherlands (EPPO 1997). The summer temperature and precipitation in those regions are not very different from the climatic conditions of the potato districts of southeast Norway. Thus, it is very likely that *R. solanacearum* will establish itself in wild host plants if introduced into Norway.

There are no chemical control measures available against potato brown rot. Breeding for resistance to the disease has had some success, but European potato varieties have probably no resistance to this pathogen. In countries where the disease is widespread, up to 5 - 7 year long rotations have been recommended. The most important control strategies includes use of healthy seed potato, early detection and eradication of disease outbreaks, long term crop rotation, control of weed hosts and volunteer plants, and to avoid the use of surface water for irrigation (EPPO 1997).

If *R. solanacearum* was introduced into Norway, the climatic conditions will not prevent its establishment and survival in groundkeepers and common weeds. All infected potato lots would have to be destroyed, and strict measures for hygiene and crop rotation would have to be imposed. The

costs for affected growers would be considerable. The reduced supply of domestic potato would make the country more dependent on import of ware and industrial potato from other countries.

6.4 The red stele disease of strawberry

The red stele disease is caused by the soil borne fungus *Phytophthora fragariae* var. *fragariae.* The disease is found in most strawberry growing countries, but it is most damaging in a cool, wet climate. The typical symptoms of the disease are rotting of the roots, reduced plant growth and yield. Wilting and discoloration of the foliage at patches in the field are the first symptoms found. When roots of infected plants are observed, a reddish brown colour can be seen in the central core (stele) of roots not yet rotted. Resting spores (oospores) develop along the stele in attacked roots, and infected roots become brown in colour and disintegrate in the soil. When severely diseased plants are lifted, very little of the root system follows the top.

Most European countries have reported widespread distribution of the red stele disease in strawberry growing regions. Finland is one of the few countries where the disease is absent (CABI/EPPO 1992). In Norway a survey of 200 samples from strawberry fields in 1995 revealed two cases of the disease at separate locations in Hedmark County and Aust-Agder County. Later the red stele disease has been detected at five locations in Norway (Stensvand et al. 1998).

The import of strawberry plants from countries where the red stele disease is present represent the most probable pathway for future import of the disease. There are no airborne spores in the life cycle of the fungus causing red stele. To avoid more damage from the disease, import of strawberry plants should be allowed only with appropriate quarantine measures also in the future.

6.5 Tomato spotted wilt virus

The tomato spotted wilt virus (TSWV) has a very extensive range of host plants, both economically important crop plants, weed and wild plants (Heinze et. al. 1995). The first case of the virus was reported in Australia in 1919, and it rapidly developed to be the most serious tomato disease in the country. Tomato, pepper, lettuce, impatiens, chrysanthemum, dahlia are some of the most important hosts.

Some of the TSWV susceptible plants grown in Norwegian greenhouses are (annual production in Norway in parenthesis): *Agyranthemum fructescens* (1.4 mill),
Begonia spp. (5.1 mill), *Campanula isophylla* (0.6 mill), *Cyclamen* sp. (1.2 mill), *Dendranthema* sp. (2.9 mill), *Diffenbachia* sp. (0.5 mill), *Gerbera* sp. (0.5 mill), *Hydrangea* sp. (0.6 mill), *Impatiens* spp. 1.3 mill), *Kalanchoe* sp (2.8 mill), *Lobelia* sp. (4.9 mill), *Pelargonium* spp. (3.7 mill), *Petunia* sp (3.9 mill), *Primula* sp. (1.2 mill), *Saintpaulia* sp. (3.0 mill), *Verbena* sp. (0.5 mill).

The TSWV is transmitted and spread in nature and in greenhouses by insects of the thrips (Thripidae) family (EPPO 1992). The following thrips species are known vectors for the virus *Frankliniella fusca*, *F. occidentalis, F. schultzei, Thrips palmi, T. Setosus, T. tabaci* and *Scirtothrips dorsalis*. Of those *F. fusca* and *T. tabaci* are widespread in Norway, while *T. palmi* and *F. schultzei* have been intercepted and eradicated (Blystad and Johansen 1996).

TSWV is distributed in most countries in the world. In continental Europe it is common, while it has not become established in Finland, Sweden, Denmark and Norway (Blystad and Johansen 1996). The virus is only spread by living plants and thrips vectors. Trade with plant material for propagation is the most important means of dissemination. The thrips vectors may be transported by winds over long distances, and they are easily carried into greenhouses and between greenhouses by wind. Since 1980 *F. occidentalis* has spread and become established in greenhouses worldwide, including most European countries.

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Regulations relating to the import of plants and parts of plants, etc. to Norway

Laid down by the Ministry of Agriculture 10.09. 1998

REGULATIONS RELATING TO THE IMPORT OF PLANTS AND PARTS OF PLANTS, ETC. TO NORWAY

Laid down by the Ministry of Agriculture on xx xx 19xx pursuant to the Act of 14 March 1964 relating to measures to prevent plant diseases and pests (the Plant Diseases Act), cf. Royal Decree of 30 October 1964.

§ 1

Definitions

Place of cultivation: the place where the plants or parts of plants were cultivated (farm, market garden, nursery).

Country of cultivation: the country where the plants were grown, or in the case of transplantation, where they were grown during the last growing season. For plants grown from cuttings, the country of cultivation is also the country where they took root.

Consignment: the quantity of a product group (nursery products, fruit, vegetables, etc.) dispatched or transferred from an exporter to a recipient.

Harmful organisms (cf sections 1b and c of the Plant Diseases Act): viruses, bacteria, fungi, nematodes, insects, mites and other organisms or pathogens which may damage or cause diseases in plants.

§ 2

Control

The Norwegian Agricultural Inspection Service and the Customs and Excise Administration or others authorized by the Ministry of Agriculture will be responsible for ensuring compliance with the provisions laid down in these regulations.

The Norwegian Agricultural Inspection Service may require a consignment to be detained by the Customs and Excise Administration so that the goods can be inspected. Furthermore, the Norwegian Agricultural Inspection Service may for the same purpose require that a consignment that has been released shall be detained in the importer's warehouse.

The Norwegian Agricultural Inspection Service may on issue of a receipt take samples for further examination without providing compensation.

The importer or forwarder shall convey the goods to and from the place that the Norwegian Agricultural Inspection Service considers most suitable for carrying out adequate inspection, and shall provide any necessary assistance during inspection. In the event that the presence of a dangerous organism is suspected, the Norwegian Agricultural Inspection Service may without providing compensation detain the consignment until a final identification has been made.

§ 3

Prohibition against import

It is prohibited to import into the country:

a) All developmental stages of live nematodes, insects and mites, cultures of viruses, bacteria and fungi, and other harmful organisms.
b) Plants and parts of plants that are infected or infested with those harmful organisms listed in Appendix 1A, or which are more than slightly infected or infested with those harmful organisms listed in Appendix 1B.

c) Plants and parts of plants listed in Appendix 2.
d) Plants and parts of plants for cultivation or propagation of the plant genera that are host plants for San José scale (*Quadraspidiotus perniciosus*), fire blight (*Erwinia amylovora*) or Sharka ("Plum pox virus"). See the host plant lists in Appendix 3. The prohibition applies to the countries where these organisms occur. However, cf section 4, subsection 5.
e) Rooted plants of Chrysanthemum and Gerbera, cut Chrysanthemum and leaves of Gerbera, and rooted small plants of cucumber, tomato and lettuce.
f) Consignments of plants and parts of plants that have been refused entry to Denmark, Finland or Sweden pursuant to phytosanitary import regulations.
g) Soil, peat, bark, compost or animal manure that do not satisfy the requirements of section 4 D (with the exception of soil attached to the plants, cf section 7, last sentence).
h) The import of consignments of plants that are infested or infected with harmful organisms other than those mentioned in Appendix 1 may be prohibited if the Ministry of Agriculture in consultation with another competent authority regards such organisms as dangerous.

§ 4

Import on particular conditions

A. Plants and parts of plants for cultivation or propagation

1. Official phytosanitary control during the growth period

The plants shall have been under official phytosanitary control during the growth period in the growing season prior to import, and shall have been found free from the harmful organisms listed in Appendix 1 A. As regards other important harmful organisms listed in Appendix 1 B, the plants may only be slightly contaminated. Plants that are grown under official phytosanitary control in Norway shall also satisfy the requirements laid down for officially-controlled Norwegian plant material. Official phytosanitary control during the growing season shall consist of at least two inspections that shall have taken place during the previous growing season.

2. Colorado beetle (*Leptinotarsa decemlineata*) and Japanese beetle (*Popillia japonica*)

These pests must not occur at the place of cultivation, which must either be in an area where neither of the pests occurs, or where there is a permanent official control and treatment regime. This provision applies only to plants and parts of plants cultivated in the open air.

3. Potato cyst nematodes (*Globodera rostochiensis* and *G. pallida*)

The place of cultivation must have been inspected according to a method recommended by EPPO and must have been found free from cysts of the above-mentioned nematodes. The inspection must have taken place within the last four years. If potatoes or tomatoes have been grown in the place of cultivation during the past four years, the nematode inspection must have taken place after the end of the growing season for the tomatoes or potatoes.

4. Potato wart disease (Synchytrium endobioticum)

The plants must have been cultivated in a place where potato wart disease has never occurred, or where a public authority in the country of cultivation has demonstrated in accordance with a method recognized by EPPO that the disease no longer occurs.

Subsections 3 and 4 apply to plants with roots and to underground parts of plants (including tubers, bulbs, etc.). Cuttings, pot plants and container plants from nurseries are exempt from these requirements if they have been cultivated in material that is free from infection.

5. a) Fire blight (*Erwinia amylovora*)
b) San José scale (*Quadraspidiotus perniciosus*)

c) **Sharka (Plum pox virus)**

a) Host plants for fire blight (see Appendix 3) may not be imported from countries where this organism occurs.

b) It is prohibited to import host plants for San José scale (see Appendix 3) in the period 15 April to 30 September. In the period 1 October to 14 April, both dates inclusive, such plants may be imported on condition that the place of cultivation is in an area that is subject to an official control regime and where inspections during the past two years have not demonstrated the presence of this pest.

c) Host plants for Sharka (Plum pox virus) (see Appendix 3) may only be imported from places of cultivation in areas that during the past three years have been subject to an official control regime and where inspections have not demonstrated the presence of this virus.

6. ***Liriomyza trifolii*, *L. huidobrensis*, *L. sativae* and *Amauromyza maculosa***

a) It is prohibited to import certain types of plants, cf. section 3, litra e.

b) Unrooted cuttings of Chrysanthemum and unrooted cuttings of Gerbera taken directly from the propagation bed may be imported subject to conditions that will be further specified in each case.

7. **Puccinia pelargonii-zonalis**

Pelargonium (plants and cuttings) may only be imported on condition that they are cultivated in quarantine according to the guidelines and under the conditions laid down by the Norwegian Agricultural Inspection Service (cf. section 11.3).

8. The plants or parts of plants shall not more than 15 days before dispatch be examined by the exporting country's official plant inspection service, which by issuing a certificate confirms that the consignment satisfies the conditions laid down in these regulations, including the condition that the plants or parts of plants have been found to be free from the harmful organisms listed in Appendix 1 A. Furthermore, the harmful organisms listed in Appendix a B must not occur in the consignment or must only be present in insignificant amounts.

9. The phytosanitary requirements that apply to the plants or parts of plants also apply to the soil or other growth medium attached to the plants or parts of plants.

10. Consignments to which section 4 A applies must not be released before the Norwegian Agricultural Inspection Service has controlled and accepted the certificates.

11. In the case of imports of seed potatoes, the importer must have prior permission from the Ministry of Agriculture, which in addition to the requirements of this section, may lay down other requirements for import.

B. **Plants and parts of plants that are not intended for cultivation or propagation**

1. **Potatoes for food, fodder and technical uses:**
The requirements laid down in section 4A, subsections 1-10, apply, but the Ministry of Agriculture may also lay down other conditions for import.

2. **Fresh (not preserved) fruit and berries:**
Apricots, raspberries, apples, peaches (including nectarines), strawberries, cherries (including morellos), plums, pears, redcurrants, blackcurrants, gooseberries, grapes and citrus fruits.

3. **Fresh (not preserved) vegetables:**

Unwashed vegetables with their roots, and onions (excluding garlic), aubergines, melons, tomatoes, cauliflower, broccoli, celery, fennel, chicory and lettuce.

4. Other products:
Cut Gerbera without leaves, carnations, roses and Gypsophila, both leaves and flowers. (It must be clearly stated on the certificate if the product is cut flowers.)

The following conditions apply to products listed in section 4 B, subsections 2, 3 and 4:

The plants or parts of plants shall not more than 15 days before dispatch have been examined by the exporting country's official plant inspection service and been found to be free from the harmful organisms listed in Appendix 1 A. Furthermore, the organisms listed in Appendix 1 B must only be present in insignificant amounts in the consignment.

Each consignment shall be accompanied by a phytosanitary certificate issued by the exporting country's official plant inspection service.

No certificate is required in the period 1 October to 15 April for raspberries, strawberries, redcurrants, blackcurrants and gooseberries or for aubergines, celery, cauliflower, broccoli, fennel, chicory, lettuce, melons and tomatoes.

C. Timber, wood and chips

Timber, wood and chips of elm (*Ulmus* spp., *Zelkova* spp.) from all countries and timber, wood and chips of conifers (Coniferae), chestnuts (*Castanea* spp.), beech (*Fagus* spp.), poplar (*Populus* spp.), *Prunus* spp. and oak (*Quercus* spp.) from all countries outside Europe may only be imported to Norway on the following conditions:

1) Timber and wood shall be thoroughly stripped of their bark and chips shall be made of such timber and wood. Small remnants of bark are permitted provided that the bark is free from infection.

2) Each consignment shall be accompanied by a phytosanitary certificate issued by the exporting country's official plant inspection service, certifying that the consignment was inspected not more than 15 days prior to despatch and was found to be free from dangerous organisms.

3) Unloading of consignments to which section 4 C applies shall not be permitted before the Norwegian Agricultural Inspection Service has approved the certificates and import in each case.

D. Soil, etc.

For the import of soil, peat, bark, compost and animal manure, the importer must have prior permission from the Norwegian Agricultural Inspection Service, which, in addition to requiring it to be free from the harmful organisms mentioned in Appendices 1 A and 1 B, shall require each consignment to be accompanied by a phytosanitary certificate issued by the exporting country's official plant inspection service. The Norwegian Agricultural Inspection Service may with the consent of the Ministry of Agriculture lay down other conditions for import.

E. Grain

Grain of the genera wheat (*Triticum* spp.), rye (*Secale* spp.) and triticale (*x Triticosecale*) for seed corn, food and fodder from countries where the fungal disease *Tilletia indica* is known to occur may only be imported on condition that the consignment is accompanied by a phytosanitary certificate.

For grain for use as seed corn, the consignment shall originate in an area which is free from *Tilletia indica*.
The name of the area of origin shall be given on the phytosanitary certificate.

For grain for food or fodder one of the following is required:

a) that the consignment originates from an area which is free from *Tilletia indica*. The name of the area of origin shall be given on the phytosanitary certificate.

b) that the consignment is from a place of cultivation that has been controlled during the most recent growing season and found to be free from *Tilletia indica*, and that samples of the consignment have been tested on harvesting and before dispatch from the country of cultivation and found to be free from *Tilletia indica*.

An additional declaration on the phytosanitary certificate shall state ”tested and found to be free from *Tilletia indica*”.

§ 5
Phytosanitary certificate and re-export phytosanitary certificate

The certificate shall be in accordance with FAO’s international model and shall be drawn up and filled out in one of the following languages: Danish, Swedish, Norwegian, English, German, French, Italian or Spanish. The certificate shall be completed in full, either typewritten or in another easily legible form, and it shall be signed by the official plant inspection service of the country in question. There must be no corrections unless it is clear that they have been made by the plant inspection service in question. The scientific names of the plants shall be given on the certificate. The content of the consignment shall be specified on the certificate or in an attached, certified list. Goods to which section 4 A applies shall be declared by number, except in the case of seed potatoes and onion sets, for which the weight shall be given. Goods to which section 4 B applies shall be declared by weight, except in the case of cut flowers, for which the number of flowers or number of bunches shall be given.

If disinfection or other chemical treatment has been carried out in the exporting country in connection with export or preparations for export, this must be stated on the phytosanitary certificate. Treatment with a preparation that is not approved in Norway may be grounds for rejection of the consignment. The same is true if treatment has been carried out and is not declared on the certificate.

The original certificate shall accompany the consignment to Norway.
A copy should be sent to the district office of the Norwegian Agricultural Inspection Service at the point of entry, before the goods arrive in the country.

If the exporting country is not the country of cultivation for the plants or parts of plants, a re-export phytosanitary certificate issued by the official plant inspection service of the final exporting country (re-export country) shall accompany each consignment.

A re-export certificate may be issued on condition that the conditions laid down by the re-export country for import of the goods in question conform with the Norwegian rules for import of the goods. The re-export certificate shall also certify that nothing has happened to the consignment during storage in the re-export country to cause it to contravene the requirements of the Norwegian import rules in force at any given time. A copy of the original phytosanitary certificate from the country of cultivation, attested by the inspection service of the re-export country, shall accompany the re-export certificate. The requirements regarding language, completion of the certificate and other procedures are the same as for ordinary phytosanitary certificates.

Photocopies of certificates will only be accepted if they are signed and stamped as true copies by the public authorities.

§ 6
Points of entry

Plants and parts of plants to which these regulations apply should be imported at one of the following points of entry: Oslo, Tønsberg, Kristiansand S, Sandnes/Stavanger, Bergen, Trondheim, Bodø and Vadsø.
The Norwegian Agricultural Inspection Service may claim a refund according to the government scale for any travel and accommodation expenses incurred in connection with control measures at other points of entry.

§ 7
Packaging, etc.

It is prohibited to use grass, hay and straw as packaging when importing plants or parts of plants from abroad.

Plants and parts of plants that are imported shall as far as possible be free from soil.

Imports of previously used empty packaging for plants and parts of plants shall be accompanied by certification from the plant inspection service of the exporting country or another public authority that the packaging has been cleaned/disinfected and is free from soil and plant remains and contamination by harmful organisms.

Packaging shall be cleaned/disinfected after each use.

§ 8
Plant consignments that fail to meet the requirements

Consignments of plants or parts of plants that do not meet the requirements of these regulations shall be stopped at the point of entry.

If a consignment of goods for which a phytosanitary certificate is mandatory lacks such a certificate, or the certificate is incomplete, the consignment may not be delivered to the recipient or deposited in a bonded warehouse or private transit warehouse, and as a general rule internal transit may not take place before a special permit has been obtained from the Norwegian Agricultural Inspection Service. (As regards internal transit from frontier customs posts, see section 9, subsection 2.) The Norwegian Agricultural Inspection Service will decide in each case what action is to be taken with regard to plant consignments that do not meet the requirements, and may decide that such consignments shall be destroyed or returned.

Any expenses incurred in carrying out the measures taken in respect of consignments that do not meet the requirements are not the responsibility of the Norwegian Agricultural Inspection Service or the Ministry of Agriculture.

§ 9
Exemptions

1. These regulations do not apply to consignments that are re-exported without customs clearance or are exported for use on board ships, provided that such consignments are not to be stored in a bonded warehouse or private transit warehouse.

2. Internal transit of consignments for which a certificate is mandatory from a frontier customs station may take place without the presentation of certificates, since such transit takes place on the understanding that certificates will be submitted at the destination of the consignment. For goods to which section 4 A and 4 B apply, this applies only if the consignments have been or will be sealed.

3. The following plants and parts of plants are exempted from the requirement for a certificate if they are brought in by passengers as hand luggage for personal use:

    a) A total of up to 3 kg of flower bulbs and tubers.

b) A total of up to 25 flowers of cut roses, carnations, Gerbera and Gypsophila.

c) A total of up to 5 kg of the types of fruits and berries listed in section 4 B, subsection 2.

d) A total of up to 5 kg of the types of vegetables listed in section 4 B, subsection 3.

Seeds, aquarium plants and mycelium and spores of edible fungi are exempted from the provisions of these regulations.

§ 10
Frontier trade

For certain plant consignments from frontier zones of Sweden to frontier zones of Norway, the Ministry of Agriculture may lay down special regulations.

§ 11
Miscellaneous provisions

1. Consignments for which a certificate is mandatory and that are in transit through Norway shall be transported in sealed railway wagons, sealed TIR-approved vehicles or sealed containers. If sealing is not possible, transit may only take place when the Norwegian Agricultural Inspection Service has given its permission.

2. It is prohibited to use plants and parts of plants for cultivation or propagation if another purpose was stated on import, cf. sections 4 A and B.

3. The Norwegian Agricultural Inspection Service may decide that plants and parts of plants that are imported shall be disinfected, or that other safety precautions shall be taken, and that plants and parts of plants for cultivation and propagation shall be cultivated in quarantine.

4. The Ministry of Agriculture may issue further regulations concerning the implementation of these regulations and control measures to ensure compliance with the regulations.

5. For imports of second-hand agricultural machinery, documents from the plant inspection service of the exporting country or another agricultural authority shall be available attesting that the machinery has been cleaned/disinfected and is free from soil and plant remains and contamination by harmful organisms.

6. The Norwegian Agricultural Inspection Service may in special cases grant exemptions from the provisions of these regulations.

7. Decisions made pursuant to these regulations may be appealed, cf. the Public Administration Act of 10 February 1967.

§ 12
Control fee

To cover the expenses of control measures in connection with imports pursuant to these regulations, a fee shall be paid that until further notice is set at 0.8 per cent of the import value for the import of any type of goods to which these regulations apply, cf. Royal Decree of 19 August 1983. However, the fee shall be at least NOK 25.

The fee is to be paid to the Customs and Excise Administration and is collected according to the same rules as those for customs duty.

§ 13
Contravention

Contravention of these regulations is punishable pursuant to the Act of 14 March 1964 relating to measures to prevent plant diseases and pests (the Plant Diseases Act).

§ 14
Entry into force

These regulations enter into force on xx xx 19xx. From the same date, the Regulations for the import of plants and parts of plants, etc. to Norway, laid down by the Ministry of Agriculture on 12 September 1983, are repealed.

APPENDIX I

HARMFUL ORGANISMS
(Import into Norway prohibited. Tolerance limit 0 %)

	Organism	Important host plants
Bacteria		
	Corynebacterium michiganense	Tomato
	Corynebacterium sepedonicum	Potato
	Erwinia amylovora	Prunus spp, Malus spp., etc, Cotoneaster, hawthorn.
	Erwinia chrysanthemi pv. chrysanthemi	Chrysanthemum
	Erwinia chrysanthemi pv. dianthicola	Carnation
	Pseudomonas caryophylli	Carnation
	Pseudomonas solanacearum	Potato
Fungi		
*)	Angiosorus solani	Potato
*)	Atropellis spp.	Pine
*)	Ceratocystis fagacearum	Oak
	Ceratocystis ulmi	Elm, Zelkova spp.
*)	Cercospora pini-densiflorae	Pine
*)	Chrysomyxa arctostaphyli	Spruce
*)	Cronartium spp. (non-European)	Oak, pine
*)	Dibotryon morbosum	Prunus spp.
	Elytroderma deformans	Pine
*)	Endocronartium (=Peridermium) harknessii	Pine
	Endothia parasitica	Chestnut, oak
*)	Guignardia laricina	Larch
*)	Gymnosporangium spp (non-European)	Juniper (Pomoidae)
*)	Hamaspora longissima	Rubus
*)	Melampsora farlowii	Tsuga
*)	Melampsora medusae	Conifers, poplar
*)	Mycosphaerella laricileptolepis	Larch
*)	Mycosphaerella populorum	Poplar
	Ophiostoma spp.	Oak
*)	Peridermium kurilense	Pine
*)	Phellinus (=Poria) weirii	Conifers
	Phialophora cinerescens	Carnation
*)	Phoma andina	Potato
*)	Phyllosticta solitaria	Apple
	Phytophthora fragariae var. fragariae	Strawberry
	Phytophthora fragariae var. rubi	Raspberry
	Puccinia horiana	Chrysanthemum
	Puccinia pelargonii- zonalis	Zonal geranium
*)	Puccinia pittieriana	Potato
	Scirrhia acicola	Conifers
	Sclerotium cepivorum	Onion
*)	Septoria lycopersici, var. malagutii	Potato
	Synchytrium endobioticum	Potato
*)	Tilletia indica	Wheat

	Uromyces transversalis	Gladiolus

Viruses and mycoplasm-like organisms

	Apple proliferation (MLO)	Apple
	Barley stripe mosaic virus	Grain
*)	Cherry rasp leaf virus (American)	Cherry
	Chrysanthemum stunt viroid	Chrysanthemum
*)	Elm phloem necrosis (MLO)	Elm
*)	Peach mosaic virus (American)	Peach
	Pear decline (MLO)	Pear
*)	Plum line pattern virus (American)	Plum
	Plum pox virus (Sharka)	Prunus spp.
	Potato leaf roll virus	Potato
	Potato spindletuber viroid	Potato
*)	Potato viruses and mycoplasm-like organisms (outside Europe), incl. non-European strains	Potato
*)	Raspberry leaf curl virus (American)	Rubus
	Rubus stunt (MLO)	Rubus
	Stolbur (MLO)	Solanaceae
*)	Strawberry latent C virus	Strawberry
	Strawberry vein-banding virus	Strawberry
*)	Strawberry witches' broom (MLO)	Strawberry
	Strawberry yellow edge virus	Strawberry
	Tomato spotted wilt virus	Polyphagous

Insects and mites

*)	Acleris variana	Conifers
*)	Amauromyza maculosa	Chrysanthemum, polyphagous
*)	Anomala orientalis	Polyphagous
	Cacoecimorpha pronubana	Carnation, polyphagous
*)	Conotrachelus nenuphar	Prunus spp.
*)	Cydia (=Grapholitha) prunivora	Apple, cherry, plum
	Diarthronomyia chrysanthemi	Chrysanthemum
	Epichoristodes acerbella	Carnation, chrysanthemum
	Eriosoma lanigerum	Fruit trees, deciduous trees, shrubs
	Helicoverpa armigera	Ornamental plants
*)	Hylurgopinus rufipes	Elm
	Hyphantria cunea	Deciduous trees
	Ips amitinus	Conifers
	Leptinotarsa decemlineata	Potato
	Liriomyza trifolii	Chrysanthemum, polyphagous
*)	Liriomyza huidobrensis	"
*)	Liriomyza sativae	"
	Opogona sacchari	Ornamental plants
	Phthorimaea operculella	Potato
*)	Pissodes spp. (non-European species)	Conifers
*)	Popillia japonica	Polyphagous
*)	Premnotrypes spp.	Potato (tubers)
	Quadraspidiotus perniciosus	Fruit trees, deciduous trees, shrubs
	Rhagoletis cerasi	Cherry
*)	Scolytidae (non-European species)	Conifers
	Scolytus laevis	Elm, Zelkova
	Scolytus multistriatus	"
	Scolytus scolytus	"
*)	Spodoptera litura	Ornamental plants, polyphagous
	Spodoptera littoralis	Ornamental plants, polyphagous
	Steneotarsonemus pallidus	Cyclamen

	Thomasiniana ribis	Ribes
	Thrips palmi	Polyphagous
*)	Trypetidae (non-European species)	Fruit

Nematodes

	Bursaphelenchus xylophilus	Conifers
x)	Ditylenchus destructor	Potato, etc.
x)	Ditylenchus dipsaci	Onion, etc.
	Globodera pallida	Potato (soil)
	Globodera rostochiensis	Potato (soil)
x)	Meloidogyne spp	Greenhouse plants, polyphagous
*)	Nacobbus aberrans	Potato (soil)
x)	Radopholus similis	Ornamental plants, polyphagous
	Xiphinema americanum	Polyphagous (roots, soil)

x) Applies only to plants for cultivation and propagation

*) Organisms that only occur outside Europe (= EPPO's A 1 list common to all member countries).

B. OTHER IMPORTANT HARMFUL ORGANISMS
(May be present in insignificant amounts only)

Organism	Important host plants
Bacteria	
Agrobacterium rhizogenes	Apple, roses, Rubus
Agrobacterium tumefaciens	Trees and shrubs (roses, etc.)
Corynebacterium fascians	Strawberry, chrysanthemum, etc.
Pseudomonas gladioli	Gladiolus, Freesia
Pseudomonas syringae pv. mors-prunorum	Prunus spp.
Xanthomonas campestris pv. begoniae	Begonia
Xanthomonas campestris pv. hyacinthi	Hyacinth
Xanthomonas campestris pv. pelargonii	Pelargonium
Fungi	
Botrytis spp.	Flower bulbs, etc.
Cronartium ribicola	Pine, blackcurrant
Didymella chrysanthemi	Chrysanthemum
Fusarium spp.	Flower bulbs, potato, etc.
Phoma exigua var. foveata	Potato
Plasmodiophora brassicae	Brassicas
Puccinia graminis	Berberis, grain
Rhizoctonia tuliparum	Tulip
Sclerotinia spp.	Flower bulbs, Gladiolus
Sclerotium perniciosum	Tulip
Septoria azaleae	Azalea
Viruses and mycoplasm-like organisms	
Viruses and mycoplasm-like organisms other than those specified in list A	
Insects and mites	
Anarsia lineatella	Prunus spp., (peach)
Bemisia tabaci	Greenhouse plants
Cecidophyopsis ribis	Ribes
Ceratitis capitata	Citrus, peach, apricot (fruit)
Eriophyes avellanae	Hazel
Frankliniella occidentalis	Ornamental plants
Gracilaria (Caloptilia) azaleella	Azalea
Hemitarsonemus latus	Greenhouse plants
Laspeyresia spp.	Prunus spp., (peach)
Merodon equestris	Narcissus, etc.
Metatetranychus (Panonychus) ulmi	Fruit trees, deciduous trees, shrubs
Paratetranychus ununguis	Conifers
Steneotarsonemus fragariae	Strawberry
Tetranychus urticae	Polyphagous
Trialeurodes vaporariorum	Polyphagous
Nematodes	
Aphelenchoides fragariae	Strawberry, ornamental plants

Aphelenchoides ritzemabosi	Strawberry, ornamental plants
Pratylenchus convallariae	Convallaria
Pratylenchus penetrans	Polyphagous
Pratylenchus vulnus	Polyphagous

APPENDIX II

PLANTS AND PARTS OF PLANTS WHOSE IMPORT INTO NORWAY IS PROHIBITED

Plant species

Scientific name	English name	Plants and parts of plants	Geographical area
Ulmus spp. Zelkova spp.	Elm	Plants, including cuttings, grafts, cut branches, timber with bark, wood and wood products with bark and chips from timber with bark, but not seeds.	All countries
Coniferae	Conifers	Plants, including cuttings, grafts, cut branches, timber, wood and chips, but not seeds.	Canada, China, Korea, Japan, USA
		Plants, including cuttings, grafts, cut branches, timber with bark, wood and wood products with bark and chips from timber with bark, but not seeds.	All countries outside Europe
Castanea spp., Fagus spp., Populus spp., Prunus spp., Quercus spp.	Chestnut Beech Poplar Prunus Oak	Plants, including cuttings, grafts, cut branches, timber with bark, wood and wood products with bark and chips from timber with bark, but not seeds.	All countries outside Europe
Fragaria spp.	Strawberry	Plants and parts of plants, but not fruit and seeds	All countries
Chrysanthemum	Chrysanthemum	Plants and parts of plants. Unrooted cuttings are exempt on certain conditions.	All countries
Gerbera spp.	Gerbera	Plants and parts of plants. Cuttings are exempt on certain conditions. Flowers without leaves are also exempt.	All countries
Berberis spp.	Berberis	All forms of B. vulgaris.	All countries
		All grafted Berberis.	
		All Berberis propagated by seed or vegetatively, except those resistant to black rust (see list).	
Mahoberberis neubertii		All types	All countries

Berberis species whose import is permitted (resistant to black rust, *Puccinia graminis*)

B. aggregata Schneid.	B. parvifolia Sprague	B. wilsonae Hemsl. et Wils
B. dictophylla Franch	B. rubrostilla Chitt.	All evergreen species
B. koreana Palib.	B. thunbergii DC.	

APPENDIX III

HOST PLANT LISTS

Fire blight (*Erwinia amylovora*)

Plant genera considered to be host plants for fire blight (*Erwinia amylovora*)

- Chaenomeles
- Cotoneaster
- Crataegomespilus
- Crataegus
- Cydonia
- Malus
- Pyracantha
- Pyrus
- Sorbus
- Stranvaesia

San José scale

Plant genera considered to be host plants for San José scale (*Quadraspidiotus perniciosus*)

- Acacia
- Acer
- Amelanchier
- Chaenomeles
- Cotoneaster
- Crataegus
- Cydonia
- Euonymus
- Fagus
- Juglans
- Syringa
- Maclura
- Malus
- Populus
- Prunus
- Ptelea
- Pyrus
- Ribes
- Rosa
- Salix
- Sorbus
- Symphoricarpus
- Ligustrum
- Tilia
- Ulmus
- Vitis

Sharka

Plant species considered to be host plants for sharka (plum pox virus)

- Prunus amygdalus
- " armeniaca
- " brigantina
- " cerasifera
- " domestica
- " insititia
- Prunus nigra
- " persica
- " salicina
- " spinosa
- " tomentosa
- " triloba

Other *Prunus* species that are susceptible to sharka.