Additional report with Fact sheets of specific pathogens with a zero-tolerance for Indonesia

Including schematic overview of the risk analysis

Report for Indonesia

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**Introduction**

**Goal**
This document is an additional part on the report “Dutch Onions, from seed tot consumer”, which give a general overview of onion cultivation in The Netherlands and a description of the quality inspection processes during the whole onion production chain. For an effective control of pest organisms, an integrated management system is needed from initial seed production until finally exported product. Each step in the production chain should be checked and traceable forward and backward.

All described organisms occur in The Netherlands. Some are common, others are very rare, but there is a theoretical change that they occur. Thus, secondly there is also a risk that the pest organisms occur in onions. Also here, onions are not always host plants for the specific pests and therefore the risks can be reduced to an acceptable limit.

Indonesia describes three different methods for effective control of pest organisms, but none of these is applicable for onions, in The Netherlands.

This report describes a risk analysis method for each specific pathogen or pest organism. Zero-tolerance is statistically not possible for The Netherlands, because then each individual onion should be checked, and checked onions cannot be exported anymore.

An effective method to eliminate the change of infection is:

1) Make a risk analysis for the specific pathogen
2) Describe the change of each individual risk in the production chain for the specific pathogen
3) Make effective measurements for each risk in the different production steps
4) Implement measurements by a traceable inspection system
5) Secure the system by a final governmental inspection

**Risk analysis**

Important steps in the risk analysis are:

- Occurring of the pathogen in The Netherlands (common, incidental, rare)
- Occurring of the pathogen in onions (common, incidental, rare)
- Distribution and spreading of the pathogen (general, locally or plot, movement, flying insects, soil born, endo- or ectoparasites, etc.)
- Propagative material (clean seed and onion sets which are certificated, disinfection, seed coating, etc.)
- Clean soil (analysis, crop rotation, removal of plant debris, etc.)
- Good agricultural practice (GAP, hygiene, no irrigation, knowledge of biology of pathogens, etc.)
- Control methods (monitoring, biological or chemical treatments, etc.)
- Harvest (time, topping methods, transport, hygiene, etc.)
- Drying and storage (equipment, biology of the pathogen, inspection)
- Processing and packing (inspection at different production steps, hygiene, traceability, etc.)
- Final inspection (governmental inspections, additional procedures, etc.)
Report
This report gives a brief description of pests and pathogens which have a zero-tolerance for Indonesia (see country description of vegetables for Indonesia from Dutch Government).

Each fact sheet contains the following items:
1. The name of the organism (scientific name, common name and synonyms)
2. The geographical distribution
3. Biological characteristics (life cycle, development stages environmental conditions)
4. Parts of the onions which are infected/attacked and damaged
5. Damage period
6. Economic impact
7. Investigation and monitoring system
8. Control methods
9. Measures and risk management
10. Conclusion

Finally, a schematic overview of the pests which are described is given. Risk, measurements and inspections are summarized.

This report will give an answer on the question how specific pests and pathogens can be eliminated during the production chain, to make it acceptable to export products to countries which have a zero-tolerance for the described pest organisms. Statistically, the change is never zero, but can be reduced to an acceptable limit by effective measurements which are checked by good inspection protocols.
Fact sheets of specific pathogens with zero-tolerance for Indonesia

Fact sheets
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

*Erwinia chrysanthemi*

1. **Common name and scientific name**
   - Scientific name: *Erwinia chrysanthemi* (Burkholder),
   - Synonyms: *Erwinia carotovora* f. sp. *parthenii*
   - *Erwinia carotovora* f. sp. *dianthicola*
   - *Pectobacterium parthenii*
   - *Erwinia carotovora* var. *chrysanthemi*
   - Common names: Centre rot, Black heart rots disease, Bacterial soft rot (BSR)

2. **Geographical distribution**
   - *E. chrysanthemi* has a worldwide distribution. Any kind of strain may occur in temperate countries, where outdoor and glasshouse plants are produced. In onions *E. carotovora* spp. *carotovorum* is also common and cause the same visible symptoms. Therefore it’s difficult to say by which *Erwinia* species the onion is infected. But, both species are removed during production, processing and export handling steps.

3. **Biological characteristics**
   - *E. chrysanthemi* is a motile, Gram-negative, non-sporing, straight rod with rounded ends, and occurs singly or in pairs. It varies from 0.8-3.2 x 0.5-0.8 μm (average 1.8 x 0.6 μm). There are 3-14, but more usually 8-11, peritrichous flagellae. On Potato Dextrose Agar (PDA), young colonies are either circular, convex, smooth and entire, or sculptured with irregular margins, depending on the moisture content of the growth medium. After 4-5 days, both colony types resemble a fried egg, with a pinkish, round, raised centre and lobed periphery, which later becomes feathery or almost coralloid.
   - *E. chrysanthemi* is a soft rot pathogen degrading succulent fleshy plant organs such as roots, bulbs, and leaves by enzymatic (pectolyses) breakdown of cell walls. It is also a vascular wilt pathogen, colonizing the xylem and becoming systemic within the plant. The pathogen can remain latent in some plants. For onions, mainly the stem and bulbs are infected via rain drops by splashing from infected soil on the onion plants.

4. **Parts to be damaged**
   - For onions, the infection often take place via the neck to the centre of the onion bulb. Especially rain showers with hail can cause infections of *Erwinia* sp.. A common name of the disease is “centre rot”, because the infection spread from the inner site of the onion to the outer fleshy scales, instead of *Pseudomonas* sp. where rotting begins normally at the outer fleshy scales. During infection with *Erwinia* sp., the fleshy scales rot, dry out and the onion completely shrivel. The outer dry scales of the onion turn into a dark brown color and are the only parts which remain.

   Plants are infected in the field during the growing period and died. When the pathogen enters the plant late in the season, infected bulbs are harvested. During storage the onions are completely rotten inside and only the dry outer brown scales remain. That make it easy to infected bulbs during the processing and packing quality control inspections, which remains after harvest and storage.

   After initial infection a clear viscous fluid is formed, due to degrading of the cell walls. The bacteria infect the verticil (bulb base) via the centre of the onion. Symptoms on the bulb base somewhat look like a *Fusarium* infection. But *Fusarium* sp. cause a dry rotting and *Erwinia* sp. cause a wet and sour infection. Whereas, *Fusarium* has a different very characteristic smell.

5. **Damage period**
   - The bacterium is able to survive in the soil on organic matter (and plant debris), so that infestation remains between two crops. High humidity and free water favour the infection of the bacteria. Disease development is dependent on high temperatures, generally 25-30°C. Host specialization has not definitely been proved in *E. chrysanthemi*, except in pv. *Paradisiacal*. As describes above, leave damage due to intense rain or hail showers stimulate *Erwinia* infections. Onion flies can spread the disease.
6. Economic impact

Erwinia sp. can cause moderate to serious harvest losses. Moreover, rotten bulbs can stain healthy bulbs during processing. Therefore the bacterium causes also post harvest losses due to staining blank colored bulbs. Infections are not spread during storage.

7. Investigation and monitoring system

Erwinia chrysanthemi and related Erwinia species are common in soil and surface water. Onions are seldom irrigated in The Netherlands, therefore risk of infection via surface water is minimal. Infections occur mainly via splashing water drops of heavy rain and hail during periods with favor temperature.

During the growing season, initial infections can be monitored by looking to the neck of the onions where the infection begins. By cutting onions from top to base, centre rot can easily detected, due to the characteristic viscous fluid in the centre of the onion, from neck tot base.

8. Control methods

There are no chemical or biological treatments to control or prevent bacterial infection by Erwinia spp. Only good agricultural practice (GAP) can minimize soft rot disease. During storage infected onions shrivel completely and can easily selected during quality control. The infection is not spread during storage, and by good drying techniques staining of healthy bulbs can be minimized.

Crop rotation and removal of plant debris can reduce the initial bacterial population. In the Netherlands, onions are cultivated on heavy clay soils, with a low organic matter content. Moreover irrigation (with surface water) is seldom used. Risk of infection is mainly due to heavy rain showers in hot summer periods, when temperatures reach 30°C and relative humidity is high.

9. Measures of risk management

As described above, infection by Erwinia chrysanthemi (and Erwinia carotovora sp. carotovora) is not a very serious problem in The Netherlands which high risk for exported onions. Infection is mainly caused by heavy rainfall and can be quickly detected by monitoring in the field. Moreover most infected bulbs are completely shrieveled during drying and storage and can be selected easily by quality control during storage, processing, packing and final governmental inspection before loading for export. Moreover, the change that onions are infected by the specific Erwinia chrysanthemi species is less, than infection by the more common Erwinia carotovora spp. Carotovora subspecies, in onions.

10. Conclusion

E. chrysanthemi is common in The Netherlands, even as Erwina carotovora spp. Carotovora, which is likely more common. There are no effective chemicals or biological agents to control the plant pathogen. Clean and coated seed, good agricultural practices, no irrigation, secure harvest and very quick drying during storage can minimize the infection change. Infected bulbs can be easily selected during the different quality control steps in the whole process from storage to loading for export. Therefore, the change on specific Erwinia chrysanthemi infection in exported onions is low.
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

**Pseudomonas syringae pv. syringae**

1. **Common name and scientific name**
   - Scientific name: *Pseudomonas syringae* pv. *syringae* (Burkholder),
   - Synonyms: no synonyms found for *P. syringae* pv. *syringae*
   - Common names: rot (no specific names for *P. syringae* pv. *syringae* in onion)

2. **Geographical distribution**
   *P. syringae* has a worldwide distribution and many different pathovars. Pathovars may have also different strains which are pathogenetic on specific host plants. Different strains of *P. syringae* pv. *syringae* occurs also in The Netherlands, but are not common on onions.
   
   Common *Pseudomonas* ssp. on onions are *P. viridiflora*, with cause bacterial leaf streak and bulb rot, *P. cepacia* which cause characteristic sour skin, *P. alliicola* (=*Burkholderia gladioli* pv. *alliicola*) which cause slippery skin, *P. marginalis* pv. *marginalis* which cause soft rot and *P. aeruginosa* which cause bacterial internal brown rot of bulbs. *P. syringae* pv. *syringae* is not a common *Pseudomonas* species in onion. In general, *Pseudomonas* bacteria can be distinguished from *Erwina* bacteria, by infection symptoms. *Pseudomonas* species often infect via the outer scales and *Erwina* infect onions almost via the centre and always from the neck to the base of the onion. *Pseudomonas* strains can be distinguished by selective growth media, DNA tests, infection symptoms and characteristic smell.

3. **Biological characteristics**
   Several bacteria (*Pseudomonas* and *Erwina* ssp.) cause a range of symptoms known as slippery skin, sour skin and soft rot. These diseases may start in the field on the leaves and sometimes may not be detected until the bulbs have been in storage for some time, depending when infection occurred. In general, these bacterial diseases occur during wet periods and are favored by warm temperatures and damaged tissues, due to rain or hail showers or attack by other pest organisms. Initial foliar symptoms are characterized by severe breakdown of one or more leaves.

4. **Parts to be damaged**
   For onions, the infection often take place via the neck, from the outer fleshy scales, to the centre of the onion bulb. Especially rain showers with hail can cause infections of different bacteria species. Other *Pseudomonas* sp. which are more common in onions then *Pseudomonas syringae* pv. *syringae* could also damage leaves and onion bulbs. During storage onion bulbs could be destroyed completely. The change of specific *Pseudomonas syringae* pv *syringae* on onions is very small, because it’s a rare pathogen on onions in The Netherlands and moreover, all other plant pathogenic *Pseudomonas* sp. are removed also, by different quality control steps.
5. **Damage period**
These bacteria are able to survive in the soil on organic matter (plant debris). High humidity and free water favor spread and penetration of the bacteria. Disease development is dependent on relative high temperatures, generally 25-30°C. As describes above, leave damage due to intense rain or hail showers stimulate bacterial infections. But also other pest organisms which attack the crop or mechanical damage by farmer equipment. Also onion flies can spread bacterial diseases.

6. **Economic impact**
Overall, *Pseudomonas* sp. can cause serious losses in onions. But, *P. syringae* pv. *syringae* doesn’t occur in onions in The Netherlands and therefore there’s no economic impact of this specific pathovar of *Pseudomonas*.

7. **Investigation and monitoring system**
Bacteria are common in soil and surface water. Onions are seldom irrigated in The Netherlands, therefore risk of infection of bacteria via surface water is minimal. Infections occur mainly via splashing water drops of heavy rain and hail during periods with favor temperature. In The Netherlands, onions are cultivated on heavy clay soils, therefore the risk of large initial bacterial populations is lower than cultivation on soils with a high organic matter content.

During the growing season, initial infections can be monitored by looking to the neck of the onions where the infection begins. By cutting onions *Pseudomonas* spp. can be easily detected, due to the characteristic infection patterns.

8. **Control methods**
There are no chemical treatments or biological agents to control or prevent bacterial infection. Only good agricultural practice can minimize bacterial diseases. During storage symptoms of initial infected onions develop further, but spreading occurs not during storage. Heavily infected onions can cause staining of healthy onions when they are processed and packed.

Crop rotation and removal of plant debris can reduce the initial bacterial population. In the Netherlands, onions are cultivated on heavy clay soils, with a low organic matter content. Moreover irrigation (by surface water) is seldom used. Risk of infection is mainly due to heavy rain showers in hot summer periods, when temperatures reach 30°C and relative humidity is high. The change of infection by *P. syringae* pv. *syringae* is nihil, because the pathogen doesn’t occur in onions in The Netherlands. Other *Pseudomonas* species are more common on onions, but they are removed during different quality inspections.

9. **Measures of risk management**
As described above, infection by *Pseudomonas syringae* pv. *syringae* is not a problem in The Netherlands which risk for exported onions. Moreover infected bulbs by related pathogens can be selected easily by quality control during storage, processing, packing and final governmental inspection before loading for export. Bacterial symptoms are clear and can be detected quick and easily by cutting the onions, which is an standard procedure during the different quality inspections steps, from harvest to final export.

10. **Conclusion**
*P. syringae* pv. *syringae* is not a pathogen which risk for onion cultivation in The Netherlands, because the pathogen doesn’t occur on onions. Some related *Pseudomonas* sp. are more common and can be detected by different quality control steps in the production chain from harvest to final export and thus theoretically, when an infection with *P. syringae* pv. *syringae* occurs, the infected onion is removed by control steps of related *Pseudomonas* spp.
Fact sheet: Specific pests of Onions with a zero-tolerance for Indonesia

Pyrenochaeta terrestris

1. **Common name and scientific name**
   Scientific name: *Pyrenochaeta terrestris* (Hansen),
   Synonyms: *Phoma terrestris*
   Common names: *Pink root*

2. **Geographical distribution**
   The plant pathogenic fungus *P. terrestris* has a worldwide distribution and occurs also in The Netherlands. The soil born pathogen is adapted to sub-tropical, temperate and tropical climates due to its ability to survive well in many soil types and a wide range of temperature and pH. Although, the pathogen needs a relative high soil temperature for growing and effective development of hyphae.

3. **Biological characteristics**
   It is presumed that the pathogen overwinters as microsclerotia in the soil for many years in the absence of a host. These structures also serve as the primary inoculum, importance of the pycnidial stage has not been investigated thoroughly and no sexual stage has been found. Hyphal infection occurs most vigorously at 24-28°C. Therefore, the soil born pathogen is not very common in The Netherlands, with a moderate climate, where soil temperatures are relative low.

4. **Parts to be damaged**
   The most obvious symptom is the light pink to yellowish-brown discoloration on roots that becomes dark pink then red and eventually purple in advanced stages of the disease. Diseased roots eventually shrivel, become brittle and die. Although plants will attempt to compensate for the loss of roots by producing new roots, unfortunately these new roots will also become infected and die. The pathogen does not infect the basal plate of onion bulbs. However, basal plate rot caused by *Fusarium oxysporum* spp. often occurs on plants with pink root when both pathogens are present in the soil.

Severely infected plants appear stunted, exhibit tip die back and produce undersized bulbs. The weakened leaves often become infected with other weak opportunistic pathogens such as *Alternaria porri*, the causal agent of purple blotch. Significant yield losses occur when hot dry weather occurs simultaneously with the infection of roots, particularly when the infection occurs early in the growing season and the compromised root system cannot keep up with the plants’ demand for water.

5. **Damage period**
   The soil born pathogenic fungus infect onion at a soil temperature of 24-28°C. In The Netherlands these soil temperatures occur only sometimes in July and August, during hot weather conditions, when onion plants are well developed and reach their mature period. Therefore *P. terrestris* is not a big problem in onion cultivation in The Netherlands.

6. **Economic impact**
   *P. terrestris* is not a big problem in The Netherlands. Sometimes, the fungus is confused with *Fusarium oxysporum* spp. or *Sclerotium cepivorum*, but these fungi never forms pink colored roots. Moreover, *S. cepivorum* produce dark brown to black sclerotia (2-5mm) and *F. oxysporum* spp. led to basal plate rot and white hyphae. *P. terrestris* infect only the root system and not the basal plate. After infections of *P. terrestris*, the change on secondary infections by different (soil born) pathogens is higher.

7. **Investigation and monitoring system**
   *P. terrestris* can be monitored in the field. Special attention is necessary under favorite weather conditions, when soil temperature reach 26°C. Roots of affected plants usually turn pink. The diseased roots soon shrivel, then
darken in color to red, purple and finally brown or black, and die. New roots may be produced one or more times, and commonly they also become diseased and die. When the fungus infected the onion plant and weather conditions are favor, this process continues until harvest.

If infection is severe, the leaves of diseased plants turn white, yellow or brown and die back from the tip as if damaged by drought. Various leaf-blighting fungi may attack the withered leaves. Affected plants are usually not killed, but often remain stunted and produce soft, undersized bulbs, because of the restricted root system. The dead outer scale tissue of the leaves and the bulb may also be attacked by the pink-root fungus. Living scales or bulb bases are not affected.

8. **Control methods**
There are no effective chemical treatments to control or prevent *P. terrestris* infection. In The Netherlands, pink root is not a common pathogen. Crop rotation (at least 1:5), monitoring and removal of infected plants are control methods. There are also resistant onion cultivars on the market.

9. **Measures of risk management**
Because pink root is not common in The Netherlands and cause only damage by warm weather conditions, risk of infection is relative low and symptoms are clear.

At harvest and during processing, roots and leaves are cut from the onions, before final quality selection and packing. Pink root infected plants have clear disease symptoms, therefore the disease can easily detected. In The Netherlands, roots and leaves are not completely removed from the onion bulb, instead of some other onion exporting countries. Because, completely removing enhance the risk of infection. Short (2-4cm) leave and root remains are very effective natural barriers against plant pathogens.

10. **Conclusion**
*P. terrestris* is a soil born pathogen with characteristic symptoms. In The Netherlands, pink root is not common in onions. There are no effective fungicides or biological agents, but good agricultural practice, effective monitoring and removal of roots during harvest and processing, with combination of different internal quality control programs and final governmental control makes that the risk of *P. terrestris* in exported onions can be eliminated.
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

**Urocystis cepulae**

1. **Common name and scientific name**
   - Scientific name: *Urocystis cepulae* (Hansen),
   - Synonyms: *Tuburcina cepulae* (Frost), *Urocystis colchici var. cepulae* (Schltld.), *Urocystis magica*.
   - Common names: Onion smut, leek smut

2. **Geographical distribution**
   - This pathogen is widespread in Europe, western Asia, Canada and the USA, and is also known from Australia, Chile, Egypt, India, Japan, Korea Republic, Mexico, Morocco, Peru, Philippines and Thailand. Onion smut occurs also in The Netherlands.

3. **Biological characteristics**
   - Onion smut is caused by the soil-borne fungus *Urocystis cepulae* and infects the flag leaf (cotyledon) as it grows through the soil. This is the most common, maybe only infection stage. Often the seedling survives this initial infection and the characteristic black streaks and blisters appear in the leaves and small bulbs later in the growing season as the fungus moves from the infected flag leaf to younger leaves. Some seedlings will be killed by the disease.

   A cool (13-22°C) and wet spring increases the incidence of smut infection, because the onion seedlings grow slowly and the flag leaf is in the soil for a longer period. Similarly, planting onion seeds too deep will also make them more likely to be infected. Smut spores (teliospores) survive in the soil for about 15-20 years, and even long crop rotations may not reduce disease incidence very effectively. Seed treatments with fungicides can reduce losses to the disease and growing onions from onion sets avoids the disease. The disease is spread when contaminated soil or set onions are transferred to smut-free areas.

4. **Parts to be damaged**
   - First symptoms are observed at the cotyledonary stage as dark, thickened areas which break open during further leaf development, showing characteristic dark spore masses. Plants may be killed in 3-5 weeks. Surviving plants show short, distorted leaves bearing lesions throughout their length. Bulb development is poor. The spores are spread by wind, rainfall, soil particles and plant residues. There is no seed transmission, but spore balls could occur as contaminants of onion seeds samples. The optimum infection temperature is 13-22°C.

5. **Damage period**
   - The soil born pathogenic fungus infect very young onion plants in the flag leaf stadium, during wet and cold weather conditions. Infecting hyphae penetrate the leaf epidermis and enter the mesophyll where they keep pace with the growth of the cotyledon leaf. The sori are produced in these tissues. If the fungus penetrates the meristematic tissue at the base of the cotyledon leaf, then the leaves may also become infected. Damage period occurs mainly in the months April and May, but can continued during the growing season. The spores are mainly found on the outer scales of the onions.

6. **Economic impact**
   - This soil born fungus occurs in The Netherlands, but is not very common. *Fusarium oxysporum* or *Sclerotium cepivorum* are more common and have a larger economic impact.

7. **Investigation and monitoring system**
   - *U cepulae* can be monitored in the field. Specific symptoms are black elongated blisters on cotyledons and young leaves. These blisters contain the characteristic black fruiting bodies (chlamydospores) of the fungus.
8. **Control methods**
   There are no effective chemical treatments to control or prevent *U. cepulae* infection during the growing season. In The Netherlands, onion smut is not a common pathogen. Clean seed, crop rotation, monitoring and removal of infected plants are the control methods which are available.

9. **Measures of risk management**
   Because onion smut is not common in The Netherlands and infection can be monitored easily on young seedlings, risk of infection is low. There are no effective pesticides or biological agents available to control *U. cepulae*.

   During processing and packing, disease symptoms can be detected easily. Different internal quality controls and final governmental control ensures that exported onions are free of onion smut. Moreover, most infected plants die already during the growing season and are completely destroyed before harvest. Sometimes, infections continued during the growing season, when weather conditions are optimal for the soil born fungus.

10. **Conclusion**
    *U. cepulae* is a soil born pathogen with characteristic symptoms. In The Netherlands, onion smut is not very common in onions. There are no effective fungicides for protection during the growing season, but clean seed, good agricultural practice, effective monitoring and the combination of different internal quality control programs and final governmental control makes that the risk of *U. cepulae* in exported onions can be eliminated.
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

**Delia antiqua**

1. **Common name and scientific name**
   - Scientific name: *Delia antiqua* (Meigen),
   - Synonyms: *Hylemya antiqua*
   - Common names: Onion maggot, Onion fly,

2. **Geographical distribution**
   *D. antiqua* is a pest in Northern America, Western Europe, China, Japan, Korea. In the former USSR it is found everywhere, north to forest-tundra inclusive. In Central Asia it rises up to 3600 m above sea level, absent in deserts. *D. antiqua* occurs also in The Netherlands.

3. **Biological characteristics**
   The body of the onion fly reaches 5-7 mm and has an ash-gray color with a mesonotum with greenish shimmer. The legs are black and the antennal arista is pubescent. Male abdomen has a more or less clearly expressed dark longitudinal stripe. On the female abdomen, this stripe is absent. Wings of *D. antiqua* are transparent.

   Each female lays eggs in series or in groups (5 to 20) on onion shoots, leaves, bulbs, and on ground near plants for 12-30 days, up to 200 eggs total. Most favorite place is the neck of the onion plants. Eggs are white, elongated and the larvae hatch in 3-8 days. Larvae reach 10 mm long, with a white color and a cylindrical shape.

   Hatching larvae enter the onion bulb from the root side or through the base of leaves. Larvae hatching from one egg-batch usually keep together and eat away rather big cavities in bulbs. Sometimes more than 50 larvae feed on one bulb, originating from eggs laid by different females. Larvae feed for 15-25 days and molt three times. Larval development proceeds in one bulb in large onions and in several bulbs in seeding-onions. Pupation occurs in the ground at depths of 10-20 cm. The pupal phase of spring generation is during between 2-3 weeks.

   The flight of imagoes of spring generation occurs in April - May during cherry and dandelion flowering. Flies of the second generation appear at the end of June and the beginning of July. Females need additional feeding on nectar of flowers for egg laying. Optimum conditions for egg development are temperatures of 17-22°C and humidity levels at 75-80%. The lowered temperatures stimulate pupae to enter winter diapauses, instead of development to the fly stage.

4. **Parts to be damaged**
   The most serious damage is caused by the first generation of onion flies which extends over a very long period owing to the female longevity. It occurs especially on seedlings of onion, where the damage can be very serious. The young plants wilts and dies. A larva can attack several seedlings in succession. If the onion plants are more developed, they wilts, especially in warm weather and can die also. Later on in the season the second generation of flies promotes the onset of rotting, visible only at time of uprooting, which attracts saprophytic *Diptera* whose maggots are then found in the onion bulbs. Leaves start to turn yellow in damaged plants, and bulbs rot quickly, especially in humid weather conditions.

5. **Damage period**
   The first period of attack is in the spring, when the sexually mature females lay their eggs in young seedlings. At the end of May till begin June the first generation larvae begin to feed. Moderate to hot temperatures an high relative humidity are optimum conditions for rapid development. About one month later, the second generation lay their eggs in the more developed onion plants and feed on the developing onion bulbs.

6. **Economic impact**
   The pest larvae damage onions bulbs. Young seedlings can be died and therefore the onion fly can cause serious harvest losses. Moreover, onion flies can spread (bacterial) diseases. First generation of the fly is the most harmful because the development of larvae coincides with the beginning of onion growth. Damage of the onion fly is lower in humid and cold springs, as the imagoes occur later and the period of larvae hatching is extended.
Fact sheets of specific pathogens with zero-tolerance for Indonesia

7. **Investigation and monitoring system**
   
   Plants must be monitored to prevent severe attacks from *D. antiqua*. Plants can display visual signs of stress from onion flies such as wilting, yellowing, and unexpected death. Roots may be severed or blackened. The soil around the roots may contain maggots themselves and their feeding tunnels. Removing of infected plants help to decrease the population development.

   *D. antiqua* can be monitored and controlled through the use of colorful sticky traps or buckets of soapy water that attract maggots and trap them. Pheromone traps have also been successful in controlling maggots. These are also effective in catching adult flies, limiting future generations of maggots.

8. **Control methods**
   
   Control measures include periodic survey and removal of infested plants and deep ploughing of ground for destruction of the pest pupae. As explained above, different traps play an important role in detecting the pest pathogens early in the season. Onion seeds are treated with a specific insecticide coating to prevent attack of young seedlings by onion flies.

   Two very effective insecticides which can be used during the growing season are: Mundial with the effective compound fipronile and Perfection with dimethoate as effective compound. The Insecticide Perfection is forbidden for onion treatment after June 14th 2010 in The Netherlands. Fipronil is used for seed coating and is very effective. Moreover, seed coating can prevent use of (large amounts) pesticides later in the growing season.

   Fipronile is a broad spectrum insecticide that disrupts the insect central nervous system by blocking the passage of chloride ions through the GABA receptor and glutamate-gated chloride channels (GluCl), components of the central nervous system. This causes hyperexcitation of contaminated insects' nerves and muscles.

   Dimethoate is an organophosphorus compound. Like other organophosphates, dimethoate is an anticholinesterase which disables cholinesterase, an enzyme essential for central nervous system function.

9. **Measures of risk management**
   
   Prevention and monitoring are effective instruments to eliminate the change of pest development by onion flies. There are a variety of natural enemies in onion fields that collectively helps to reduce population of the onion fly and its larvae. Some predatory beetles, flies and birds consume larvae and adult flies. Dutch onion seed is coated with mundial to prevent pest development. Moreover, seed coatings lower the use of pesticides later in the growing season. As explained above, deep ploughing of the production field is useful to destruct overwintering larvae of the onion fly to eliminate the initial population. During the growing season insect traps and frequent observation of the onion plants are effective methods to notice the pest in an early stage.

   When *D. antiqua* is observed, chemical treatment is effective to protect the onion crop. There are different insecticides available against onion fly. Second (or third) generation larvae can be a problem during storage when bulbs are rotting due to infection by bacteria and fungi. Each processing centre (sorting and packing stations) for onions have certified hygiene and quality control programs, such as British Retail Consortium-rules (BRC), HACCP and Intern Quality Regulations (RIK). Each batch of onions is sampled for quality and pathogen detection, before the onions are processed and packed. Larvae of the onion fly can be detected easily during quality control. Moreover, when during the growing season insecticides are used, the change of pest development during storage period is very low.

   The Quality Inspection Service (KCB) inspect each batch and take samples from each container which is loaded to secure that the product is free of *D. antiqua*.

10. **Conclusion**
    
    *D. antiqua* is a pest which is present in The Netherlands. However, there are very effective chemicals available to protect the onion. Clean seed, good agricultural practice, effective prevention and monitoring methods can eliminate the change of infection. Certificated internal and governmental security controls in combination with a tracking and tracing program are very strong instruments during the sorting and packing process and export.
Fact sheet: Specific pests of Onions with a zero-tolerance for Indonesia

Liriomyza trifolii

1. Common name and scientific name
Scientific name: Liriomyza trifolii (Burgess),

Synonyms: Oscinis trifolii
Agromyza phaseolunulata
Liriomyza alliicola
Common names: American serpentine leafminer, serpentine leafminer, Florida leafminer, chrysanthemum leaf miner

2. Geographical distribution
L. trifolii is common in many parts of the World. Including North, Central and South America, Japan, Philippines and other Asian countries, Africa and Oceania. The insect has a broad host range of more than 120 plant species. In The Netherlands L. trifolii is not common in onions.

3. Biological characteristics
Adults of the serpentine leafminer are small, 1.3 to 2.3 mm long. Head of the fly is yellow, thorax and abdomen are blackish-grey and the feet and scutellum are bright yellow. Male much smaller than the female. Eggs are 0.2 x 0.1 mm, cream colored and semi-transparent at first. Lightly inserted under the leaf epidermis. The larva on emergence, colorless and measuring 0.5 mm long. When full development they reaches 3 mm long, with a bright yellow color.

The larva lives by mining leaves and passes through 3 larval instars. Once fully developed, the larva usually cuts a half-moon-shaped opening in the upper epidermis of the leaf, escapes and pupates, usually in the soil; in the case of a particularly severe infestation, the puparium may remain on the leaf near to the entrance to the gallery. Adults feed on flower nectar and liquids oozing from lesions on the leaves caused by females using their oviscapt.

The pre-imaginal cycle length varies depending on the temperature and the host plant. The larval phase of the cycle is very brief at optimum temperatures: 4 days at 30°C and 7 to 8 days at 20°C. 1 to 2 weeks elapse between pupating and adult emergence (at 30 and 20°C, respectively). Adults may live for 15 to 30 days, females living longer than males. Development ceases at temperatures lower than 7.5 or 12.9°C, depending on the stage and the host plant. The optimum temperature is around 25°C. Above 30°C, larval mortality increases.

4. Parts to be damaged
In onions L. trifolii is not common in onions. The main damage is caused by larvae who mining the leaves of the onion plant and should not be confused by other mining insects as Ceuthorhynchus suturalis or Phytobia cepae. Young seedling are most susceptible for insects pests and feeding by larvae. Older plants more readily tolerate attacks by this pest. However, if the infestation is severe and many larvae are feeding on the same leaf, photosynthetic capacity is reduced, thus causing a slowing in development of the plant and in later stadium also bulb formation.

The first larval stage of the vegetable leafminer burrows into the mesophyl tissue. The second stage also feeds in the mesophyl tissue, which reduce photosynthetic capacity. The third stage larva concentrates its feeding towards the upper leaf surface. When it is mature, it cuts a longitudinal slit in the leaf and leaves to pupate on the leaf surface or on the ground.

5. Damage period
Potentially damage period is as long as climate conditions are favorable to develop. Insects feed on seedlings and mature plants with green leafs. Damage of seedlings is more serious than damage on mature plants. Resistance to insecticides is worldwide a serious problem, because the insect has a relative short life cycle and multiply many
times within a season. Some broad spectrum insecticides have no effect on *L. trifolii* but can reduce the population natural enemies of the insect, and act as stimulant to the population development of *L. trifolii*.

6. **Economic impact**

*L. trifolii* is not common in onions in The Netherlands. Moreover, there are effective control methods and therefore the economic impacts is not high. Only when young seedlings are attacked, plants can be die and led to harvest losses. Because these young plants died in the early growing season, risk on contamination on matured bulbs is low.

7. **Investigation and monitoring system**

Onion fields can be very effective monitored to prevent severe attacks from *L. trifolii* by special insect traps or buckets of soapy water that attract insects and trap them. As described above, the insects is rarely find in onion fields.

Because *L. trifolii* enters the plant via the leaves and feed via tunnels on the mesophytic cells monitoring is easy, but should not be confused by others leaf miners in onions. On the other hand, spraying with systemic insecticides is most effective because of the feeding in the leaves instead on the leaves. Therefore, contact insecticides are less effective.

8. **Control methods**

There are different insecticides to control *L. trifolii*. Most of them are also used against onion fly (*Delia antiqua*) which is more common in onions. Special treatments against *L. trifolii* are not executed in The Netherlands, because of the low frequency in onions.

9. **Measures of risk management**

As described *L. trifolii* is not common in Dutch onions. Symptoms are clear and pesticides against onion fly are also effective against *L. trifolii*. Frequent monitoring in the field, use of traps and spraying against other insects is effective to eliminate the change of pest development in onions. Infection takes only place during the field period and insects attacks mainly the leaves of the plants. During harvest, storage and processing onion bulbs are free of this specific insect. Also during internal quality control and inspection by governmental certification bodies, *L. trifolii* is a very rarely insect in onions.

10. **Conclusion**

*L. trifolii* is a rare insect in onions in The Netherlands. There are good methods to prevent and control possible pest development. Quality control during the production and packing processes and also governmental inspections guarantee a pest free product.
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

**Mythimna unipuncta**

1. **Common name and scientific name**
   Scientific name: *Mythimna unipuncta* (Haworth),
   Synonyms: *Pseudaletia unipuncta*
   Common names: Armyworm, White speck, eenstipgrasuil

2. **Geographical distribution**
   *M. unipuncta* occurs in many countries. North and South America, England and South Europe. In The Netherlands, the white speck moth is very rare and cannot overwinter. Larvae are never found in The Netherlands.

3. **Biological characteristics**
   The eggs are whitish, bead-like and are laid in masses. Caterpillars are smooth-bodied and have alternating light and dark stripes running lengthwise along the top and sides of the body. Young larvae have stripes on greenishgrey background while older larvae have stripes on a greenishbrown or black background. There is some variation in the coloration of stripes as larvae mature. Mature larvae have the following pattern of stripes: There is a narrow broken stripe down the centre of the back. This is bordered by a wider, darker, mottled one (half of this stripe reaches the side). Seen from the side there are three stripes of about equal width. Below the darker mottled stripe is 1) a pale-orange, white-bordered stripe, 2) a dark-brown, light-mottled stripe just reaching the spiracles, and 3) a pale-orange, unmottled one edged with white. The prolegs (false legs) at the posterior end of the caterpillar have a dark band on the outer side and a dark tip on the inner side. The pupa is red-brown and is approximately 2 cm long. Adults have a wingspan of 4 centimeters. Forewings are pale brown with a white dot near the centre. This dot is useful for identification. The hind wings are pale grey-brown and have a slightly darker area on the posterior edge. Larvae of the armyworm are often mistaken for that of the fall armyworm. On the armyworm, as mentioned above, at the top side of the caterpillar there is a wide dark (mottled) stripe above a lighter stripe. The fall armyworm has the opposite, a lighter stripe above a darker one, in this area. The fall armyworm also usually has an inverted white “Y” pattern on the front of the head.

4. **Parts to be damaged**
   *M. unipuncta* attacks mainly grasses. Onions are never attacked in The Netherlands, therefore description of symptoms is difficult for onions. Feeding of larvae and adults of the white speck can cause damage on the leaves.

5. **Damage period**
   The larvae and adults feed almost during the night, therefore it’s difficult to scout them. During the day if larvae are present, they often hide in the leaf whorl, in crop debris or under soil clods. Larvae are usually active for 3-4 weeks from late May to early July, depending on the weather conditions.

6. **Economic impact**
   Because *M. unipuncta* is very rare in The Netherlands and never found on onions, economic impact is extremely low. The change that the adult is present in onion which are exported is very small.

7. **Investigation and monitoring system**
   Attacks can be monitored during field period, especially in the early morning or evening, when larvae and adults feed on plants.

8. **Control methods**
   If larvae or adults are found, there are effective insecticides to control the moths.

9. **Measures of risk management**
   *M. unipuncta* has a very low risk profile, because the insect is very rare in The Netherlands. Moreover, attack of onion crop is never found. Periodically monitoring of the crop during the damage period is sufficient.
10. Conclusion

*M. unipuncta* is a rare insect in The Netherlands. Larvae are never found. Moreover grasses are favorite host plants. The risk of these moths in onions is almost zero.
Fact sheet: Specific pests of Onions with a zero-tolerance for Indonesia

**Ditylenchus dipsaci**

1. **Common name and scientific name**
   - Scientific name: *Ditylenchus dipsaci* (Kuhn),
   - Synonyms: *Tylenchus dipsaci*, *Ditylenchus phloxidis*, *Ditylenchus fragariae*
   - Common names: Stem nematode, stem and bulb eelworm, onion bloat, Nématode des tiges, Stengelälchen

2. **Geographical distribution**
   - *D. dipsaci* occurs in most temperate areas of the world (Europe, Mediterranean region, North and South America, Northern and Southern Africa, Asia and Oceania), but it does not seem able to establish itself in tropical regions except at higher altitudes that have a temperate climate. *D. dipsaci* occurs also in The Netherlands.

3. **Biological characteristics**
   - *D. dipsaci* is a slender transparent worm. Adults is about 1,0 - 1,3mm long with a moderately developed head skeleton and a very short stilet of about 10-12μm long with distinct basal knobs. Lateral fields with four incisures and a tail which terminus is sharply pointed. The post-vulval sac extending about half-way to the anus.
   - *D. dipsaci* is a migratory endoparasite that feeds upon parenchymatous tissue in stems and bulbs, causing breakdown of the middle lamellae of cell walls. Therefore infected plants often causes swellings and distortion of aerial plant parts (stem, leaves and flowers) an necrosing or rotting of stem bases and bulbs. The stem of onions is the very small part between roots and bulb and is only a few millimeters long.
   - In onion plants at 15°C, the life-cycle takes about 20 days. Females lay between 200-500 eggs each. Fourth-stage juveniles tend to aggregate on or just below the surface of heavily infested tissue to form clumps of “eelworm wool” and can survive in a dry condition for several years. They may also become attached to the seeds of host plants. In clay soils, *D. dipsaci* may persist for many years. Cool moist conditions flavour invasion of young plant tissue by this nematode.

4. **Parts to be damaged**
   - In general, this nematode causes swellings and distortion of aerial plant parts and necrosis or rotting of stem bases and bulbs. Penetration of onion leaves by *D. dipsaci* causes leaf deformation and leaf swellings or blister-like areas on the surface. The leaves grow in a disorderly fashion, often hang as if wilted and become chlorotic.
   - Young plants can be killed by high infestations. The inner scales of the bulb are usually more severely attacked than the out scales. As the season advances the bulbs become soft and when cut open show browning of the scales in concentric circles. Infected bulbs spread a penetrating odor, which inform the presence of the nematode (during storage) immediately.

5. **Damage period**
   - The nematode infect young onion plants in the field, during the early spring. During the growing season nematode populations increase rapidly by temperatures between 15 - 20°C. *D. dipsaci* can also invade shoots by entering the host trough the stomata. Infestations are favored by wet and mild temperatures and adversely affected by dry conditions and temperatures below 10°C and above 22°C. In temperate regions, nematode density and damage increase in fall and diminish drastically in winter. High nematode density (> 1 nematode/cc soil) can cause complete disruption of young onion plants.

6. **Economic impact**
   - *D. dipsaci* is one of the most devastating plant parasitic nematodes, especially in temperate regions. Without control, it can cause complete failure of host crops. Infected soils cannot be used for onion cultivation for decades.

7. **Investigation and monitoring system**
   - Soil analysis is a strong method to know if the soil is infected by *D. dipsaci*. In The Netherlands a number of laboratories are certificated to detect *D. dipsaci* in soil samples. Onion seed is tested six times on *D. dipsaci*
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contamination by seeds companies, before the seeds are packed and used for sowing. Each seed pack have an unique lot number, by which the seeds can traced directly to the cultivation fields forward and backward.

During the growing season periodically monitoring of the onion crop is necessary, especially during favored developing conditions for the nematode in the spring. Patches with stunted and sparse plants in an onion field can be a signal that the soil is infected by nematodes. In the Netherlands, onion plants can be tested within 24 hours on infection by *D. dipsaci* by certificated laboratories.

8. **Control methods**

Regulations require that propagative materials (onions seeds and onion sets) are certified to be free of *D. dipsaci*. The use of certified propagative material in uninfected soils is the best preventive and economical measure to avoid infestations of *D. dipsaci*. In The Netherlands all onion seeds and onion sets are free of *D. dipsaci*.

Spreading and development of the nematode occurs mainly by infected soil of production fields. Therefore optimal hygiene of farmer equipment is a strong method to prevent further spreading of *D. dipsaci* between fields. The nematode itself spread very slowly. When a field infection is observed further spreading of the population can be restricted by removing all onion plants within the infected patch and a few meters around it. A good weed control is also necessary, because *D. dipsaci* have a broad range of host plants, including weeds. As described above, when a infection of *D. dipsaci* is monitored, no onions should be cultivated on that plot anymore.

Chemical treatments of the soil are not an economic proposition for large areas, because they are expensive and are pose environmental and human risk. In The Netherlands, there are no nematicides to control *D. dipsaci*.

9. **Measures of risk management**

As described above, the most effective prevention methods are clean soil and certified propagative materials which are free of *D. dipsaci*. Maybe soil analyses of production fields can be used to ensure that a production field can be marked as a “pest free area” on field scale. This could be an effective method, because the nematodes spread very slowly and cannot reach adjacent cultivation plots by itself. (Flying) insects for example, which have a habitat of square kilometers should have also a broader “pest free area” instead of *D. dipsaci* which spread only a few meters per year.

After harvest, the symptoms of *D. dipsaci* can be observed due to split bulbs which have a characteristic odor. When the lower part of the bulb is cut off and placed in a petri dish with tap water for a few minutes *D. dipsaci* is can be detected easily by a stereomicroscope. Nematodes swarm from the part of the bulb into the water. This is a very rapid first indication method, but some experience witch determination of *D. dipsaci* is on its body characteristics is necessary. Size, tailshape and stilet are first indications, moreover no plant parasitic nematodes are acceptable at all.

Each processing centre (sorting and packing stations) for onions have certified hygiene and quality control programs, such as British Retail Consortium-rules (BRC), HACCP and Intern Quality Regulations (RIK). Each batch of onions is sampled for quality and pathogen detection, before the onions are processed and packed.

For destinations with a zero-tolerance for *D. dipsaci* the Quality Inspection Service (KCB) inspect each batch by a new protocol (may-2010) and take samples from each container which is loaded. All the individual pallets of one container are marked by tie-wraps with a unique number for traceability. The results of the packed products are available within 24 hours. When the analysis is “negative” the container is free for export.

10. **Conclusion**

*D. dipsaci* is a pathogen which is present in The Netherlands. There are no chemicals available to protect the onion completely. But due to soil analysis, certified propagation material which is free of *D. dipsaci*, the knowledge about biological and developing characteristics of this nematode, the risk for contamination is very small. Moreover, effective intern and new governmental quality programs in combination with samples of each batch which is loaded and a traceability of each pellet ensures that risk of *D. dipsaci* in Dutch onions is eliminated tot an absolute minimum.
Fact sheet: *Specific pests of Onions with a zero-tolerance for Indonesia*

**Longidorus elongatus**

1. **Common name and scientific name**
   - Scientific name: *Longidorus elongatus* (de Man),
   - Synonyms: *Longidorus menthosolanus*  
   *Longidorus sylphus*
   - Common names: Common needle nematode

2. **Geographical distribution**
   - *L. elongates* is a common nematode in many parts of the world. This free living needle nematode occurs in The Netherlands, but is not a common pathogen in onions. In fact it’s very rarely found in onion fields.

3. **Biological characteristics**
   - *Longidorus* sp. are relative long and slender nematodes with a length of 4.5-6.4mm. Males are usually rare and reproduction is apparently parthenogenetic, although bisexual reproduction is possible in populations were males are common.  
   - *Longidorus elongates* have four juvenile stages and overwinter as juveniles and adults in the soil. Eggs are laid in the spring and early summer when soil temperatures are cool and new roots are being produced. Females produce relatively few eggs—20 per year. Needle nematode adults live for several years and may require more than a year to complete a generation. As temperatures rise and soil moisture levels decrease in the summer, needle nematodes move deep into the soil. They often rest 2 to 4 feet below the soil surface. During the fall, they move up to return to the root zones. It is best to sample for needle nematodes in the spring or fall (period November-March) when they are near the soil surface.

4. **Parts to be damaged**
   - *L. elongates* is a ectoparasite and only the nematodes’ stylet penetrate the roots of the host plant. Instead of *Ditylenchys dipsaci*, an endoparasite of onions who live in the plant. *L. elongates* feed just behind the young root tips, causing a characteristic swelling or galling and a general stuntiing of the root system. When the roots are heavily infected water and nutrient uptake are not possible for the plant. Feeding of this needle nematode can result in serious stuntiing or death of young plants, but as described *L. elongatus* is rarely found in onions, and these heavily symptoms are never monitored in onions in The Netherlands.

5. **Damage period**
   - Because, during warm and dry conditions the nematodes move deep in the soil (up to 60cm), infection change is highest in spring and fall. During the spring, onions can be infected, but in fall the onions are already harvested.

6. **Economic impact**
   - Economic impact is low, because this needle nematode is not a common parasite in onions in The Netherlands. Moreover, the ectoparasitic pathogen manifest only in the field on the roots of onions, and therefore is not a high risk for exported products. During harvest, storage and processing soil is removed from the onions. Moreover during harvest the environmental conditions are not favorable for the needle nematode, and therefore it moves deep into the soil. Far beyond the range of harvesting equipment.

7. **Investigation and monitoring system**
   - Infections can be monitored during the field period with special attention for this nematode in spring. Patches with stunted plant are checked for presence of pathogens. Symptoms can be detected by looking to the root system of onions plants. By microscopic monitoring, the characteristics of pathogen are clearly different from *D. dipsaci*.

8. **Control methods**
   - There are no effective chemicals or biological agents available in The Netherlands to control the nematode. Moreover, *L. elongatus* move deep into the soil, thus deep ploughing or chemical treatment are not very effective possibly.
Rotation to non-host crops is recommended to reduce population densities of common needle nematodes. Because these nematodes are often present in fairly low numbers and produce only few eggs, a year without a host plant may be sufficient to adequately reduce their numbers.

9. Measures of risk management
As described *L. elongatus* is rarely found in Dutch onions. Symptoms are clear and the nematode is only spread via infected soil and not via the plants itself. Soil which remains on the onions is removed during harvest, drying, processing and packing. Therefore, the change of infected soil in packed bags is very small. Moreover, the nematodes move deep into the soil during dry and warm weather conditions. These conditions are also needed to harvest the onions, thus the risk that *L. elongatus* is present on onion roots during harvest is extremely low.

10. Conclusion
*L. elongatus* is rarely in onions in The Netherlands. There are no effective chemical or biological treatments available, but the change that the nematode is present in packed onions is very small. Because, harvest time and weather conditions are not favorable for *L. elongatus*. Under these conditions, the free living nematode move deep into the soil. Moreover, packed onions contain no soil, due to effective harvest, drying, storage and process conditions. The change that such a large nematode as *L. elongatus* is present in packed onions, which are exported is very small.
schematic overview of the risk analysis
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scheme