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European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes PM 9/25 (2)

**National Regulatory Control Systems**

# PM 9/25 (2) *Bactericera cockerelli* and '*Candidatus* Liberibacter solanacearum'

## Specific scope

This Standard describes a national regulatory control system for the bacterial pathogen '*Candidatus* Liberibacter solanacearum' and its vector *Bactericera cockerelli* when regulated as quarantine pests. It also covers measures to reduce the risk of '*Ca*. L. solanacearum' spreading to potato production systems when listed as a regulated non-quarantine pest (RNQP) on seed potato

For the EPPO A1 listed pests recommended for regulation as quarantine pests *B. cockerelli* and '*Ca*. L. solanacearum' (Solanaceae haplotypes, i.e. non-European haplotypes, such as haplotypes A and B), the Standard describes measures to achieve:

- Exclusion from the EPPO region of *B. cockerelli*, which is an efficient vector of '*Ca*. L. solanacearum' within solanaceous crops (e.g. potato, tomato)
- Eradication of incursions of *B. cockerelli*
- Exclusion from the EPPO region of non-European haplotypes of '*Ca*. L. solanacearum'
- Eradication of incursions of non-European haplotypes of '*Ca*. L. solanacearum'.

Although reference will only be made to the non-European haplotypes A and B, the Standard would also apply to new non-European haplotypes of '*Ca*. L. solanacearum' which may have different host ranges or which may be vectored more efficiently by psyllids which are widespread in the region.

For the haplotypes which are not recommended for regulation as quarantine pests but are recommended for regulation as RNQPs on seed potato (i.e. European haplotypes, such as C, D and E), the Standard describes measures (specified in Appendix 4) to reduce the risk of spread to potato production systems to achieve:

- Exclusion of European haplotypes of '*Ca*. L. solanacearum' from the potato production system
- Suppression of European haplotypes of '*Ca*. L. solanacearum' in potato production systems where they are present.

Although reference will only be made to haplotypes C, D and E, Appendix 4 would also apply to new European haplotypes of '*Ca*. L. solanacearum'.

## Specific approval

First approved in 2017-09. Revised in 2020-09.

## 1. Introduction

**Recommendations for regulation:** In 2012, EPPO recommended that its member countries should regulate '*Candidatus* Liberibacter solanacearum', Solanaceae (i.e. non-European) haplotypes, and its vector *Bactericera cockerelli* (Hemiptera: Triozidae), commonly known as the tomato/potato psyllid, as quarantine pests. Neither the vector nor haplotypes A and B are present in the EPPO region (A1 pests). Details of their biology, distribution and economic importance are available in EPPO datasheets (EPPO, 2013, 2020) and the EPPO Global Database (https://gd.eppo.int/). In 2018, EPPO recommended European haplotypes (e.g. haplotypes C, D and E) to be regulated as regulated non-quarantine pests (RNQPs) on seed potatoes.[1]

***Bactericera cockerelli***

**Host plants:** *B. cockerelli* is primarily found on plants in the family Solanaceae, including crop plants such as *Solanum tuberosum* (potato), *S. lycopersicum* (tomato), *S. melongena* (eggplant), *Capsicum annuum* (pepper), *Nicotiana tabacum* (tobacco), *Lycium barbarum* and

[1]The recommendation for listing '*Ca*. L. solanacearum' as an RNQP on seed potatoes was developed within the EU Project on RNQPs (2016–2018). The Project recommended '*Ca*. L. solanacearum' for listing as an RNQP on seed potatoes. The Project recommended that '*if haplotypes A and B are regulated as quarantine pests in a country, the RNQP Status should then be restricted to European haplotypes C, D and E*'. More information on the Project and recommendations are available at https://rnqp.eppo.int/.



 

*L. chinense* (goji berry), and non-crop species such as nightshade (*Solanum* spp., including *S. elaeagnifolium*), *Physalis* spp. (groundcherry) and *Lycium* spp. (matrimony vine) where it can cause direct damage, including the condition known as 'psyllid yellows' in potato and some other solanaceous plants (e.g. tomato, eggplant and pepper) at high populations. It can also reproduce and develop on some species in the family Convolvulaceae, including *Ipomoea batatas* (sweet potato) and *Convolvulus arvensis* (field bindweed). Adults have been collected from plants from more than 20 families.

**Distribution:** *B. cockerelli* is present in North America, Central America, South America and Oceania (EPPO Global Database).

**Elements of biology and pathways for introduction**: *B. cockerelli* is a strong flier. In North America, *B. cockerelli* migrates annually, primarily with wind and hot temperatures in late spring, from its overwintering and breeding areas in the South-Western United States and Northern Mexico to northerly regions of the United States and Southern Canada. It has recently been shown to overwinter also in the North-Western United States. In countries and regions where there is no winter, the temperatures are relatively cool and suitable host plants are available (e.g. Mexico, Central America), *B. cockerelli* may reproduce and develop all year round.

Immature stages are essentially sedentary and do not actively disperse but long-distance transport, particularly in plants moving in trade, is possible. *B. cockerelli* was introduced into New Zealand, probably as eggs with plant material from the Western United States (Thomas *et al*., 2011). Entry on fruit of host species (e.g. tomato, pepper) is possible, especially when they are associated with green parts (e.g. truss tomato and *Capsicum* fruit). *B. cockerelli* has been intercepted in Florida on peppers and eggplants from Mexico (nymphs were found under the calyx; Halbert & Munyaneza, 2012) and in the United Kingdom on eggplants from Mexico (adults and several live nymphs were found underneath the calyx) (DEFRA, 2020). No life stages of *B. cockerelli* are associated with potato tubers or soil.

### *'Candidatus* Liberibacter solanacearum'

**Haplotypes:** Distinct haplotypes of '*Ca*. L. solanacearum' have been defined (Nelson *et al*., 2011, 2013; Teresani, 2014; Teresani *et al*., 2014; Swisher Grimm & Garczynski, 2019; Mauck *et al*., 2019; Contreras-Rendón *et al*., 2019) which occur in different geographical regions: haplotypes A, B, F, G and H (North American) in North or Central America; haplotype A in New Zealand; haplotype C, H (European) and U in Northern Europe (EPPO Global Database; EFSA, 2019); and haplotypes D and E in the Mediterranean region. Haplotype D has also been reported from Belgium (De Jonghe *et al*., 2019). Additional haplotypes have also been discovered (POnTE project, pers. comm., 2019). Within haplotypes, the different strain types may reflect adaptation to certain vectors/hosts.

**Non-European haplotypes and respective host plants**: Haplotypes A, B and F are primarily associated with diseases of solanaceous crops, particularly potato, on which they cause zebra chip disease (Halbert & Munyaneza, 2012; Swisher Grimm & Garczynski, 2019) and significant economic loss (Greenway, 2014). The known vector of these haplotypes in Solanaceae is *B. cockerelli* (tomato/potato psyllid). A further haplotype, G, has been detected in the United States in a 49-year-old herbarium specimen of *Solanum umbelliferum,* a native host of *B. cockerelli* (Mauck *et al*., 2019) and a haplotype named H (North American) detected in Mexico in Convolvulaceae (Contreras-Rendón *et al*., 2019). Haplotype H (North American) in Mexico is different to haplotype H (European) reported in Northern Europe.

**European haplotypes and respective host plants:** Haplotypes C, D and E appear to be present wherever Apiaceae crops are grown in the EPPO region and vectors are present. These haplotypes are primarily associated with diseases of apiaceous crops, such as carrots (*Daucus carota*) (C, D, E) (Tahzima *et al*., 2014; Teresani *et al*., 2014; Alfaro-Fernandez *et al*., 2017; Hajri *et al*., 2017), celery (*Apium graveolens*) (D,E) (Alfaro-Fernandez *et al*., 2017; Hajri *et al*., 2017), chervil (*Anthriscus cerefolium*) and fennel (*Foeniculum vulgare*) (E) (Hajri *et al*., 2017), parsley (*Petroselinum crispum*) and parsnip (*Pastinaca sativa*) (D, E) (Alfaro-Fernandez *et al*., 2017). During research on alternative hosts, haplotype C has also been reported as infecting cow parsley (*Anthriscus sylvestris*, family Apiaceae) in Finland (Haapalainen *et al*., 2018b). Further haplotypes have been identified in Finland: haplotype H (European) in carrots and parsley (family Apiaceae), in wild buckwheat (*Fallopia convolvulus*) and in pale persicaria (*Persicaria lapathifolia*) (both of the family Polygonaceae) (Haapalainen *et al*., 2019), as well as haplotype U in stinging nettle (*Urtica dioica*), family Urticaceae (Haapalainen *et al*., 2018b).

**Vectors of European haplotypes**: In Europe, '*Ca*. L. solanacearum' is vectored by a range of psyllid species. Although most of these species have been reported throughout the EPPO region (https://www.hemiptera-databases.org/psyllist/), different species are associated with '*Ca*. L. solanacearum' transmission in different geographical areas: haplotype C (in the Apiaceae) is primarily vectored by *Trioza apicalis* (carrot psyllid) but also by *T. anthrisci* in Northern Europe (Sumner-Kalkun *et al*., 2020; Sjölund *et al*., 2017), and haplotype D and E primarily by *B. trigonica* in the Mediterranean region and the Canary Isles. It is suggested that haplotypes C and U are also vectored by *T. urticae* in Finland (Haapalainen *et al*., 2018b). Although *B. tremblayi* (onion/leek psyllid) and *B. nigricornis* may acquire '*Ca*. L. solanacearum' from feeding on plants of Apiaceae in Spain (Teresani *et al*., 2015), *B. tremblayi* failed to transmit the bacterium to carrot and is unlikely to be a vector in this crop (Antolinez *et al*., 2017b). Transmission by *B. nigricornis* is still being

studied. Different genotypes of '*Ca*. L. solanacearum' (identified by MLST) were observed to remain separate even within the same region if they are transmitted by different psyllid species that feed on different host plants (Haapalainen *et al*., 2018b).

**Seed transmission:** Seed transmission in solanaceous hosts has not been demonstrated, although tests were conducted in the United States and New Zealand on true potato seeds (J. Munyaneza, pers. comm., 2019) and on tomato seeds (L. Liefting, pers. comm., 2019). '*Ca*. L. solanacearum' has been found in the seed coat of carrot, and transmission to seedlings has been reported at relatively high levels (12% and 42% of the seedlings from infected seed lots tested positive) with the authors speculating that '*Ca*. L. solanacearum' outbreaks in carrot start with seed to seedling transmission and spread horizontally by psyllid species (Bertolini *et al*., 2015). Recent studies, however, have raised doubts on seed transmission in carrot, suggesting that even if it occurs, it is a rare event (Oishi *et al*., 2017; Loiseau *et al*., 2017a, 2017b; Mawassi *et al*., 2018; Carminati *et al*., 2019; Denton *et al*., 2019). This is supported by the absence of detection of haplotype D in Finland in the presence of large numbers of vectors, following detection in carrot seeds (Haapalainen *et al*., 2017, 2018b). Of more importance is the introduction of the bacterium in *T. apicalis* migrating from overwintering spruce hosts (A. Nissinen, LUKE, Finland, and R. Meadow, Norwegian University of Life Sciences, pers. comms.). Similarly, in other countries the main source of inoculum may be infective psyllids that either overwinter on weed plants or move from crop plants to new host plants as the cropping season progresses from one climatic zone to another.

**Biological differences:** The different haplotypes are not yet known to elicit biological differences, for example in the susceptibility of plants to infection or in the efficiency of transmission by psyllid vectors, although haplotype B was said to be more pathogenic than haplotype A (Wen *et al*., 2013). The discovery of '*Ca*. L. solanacearum' infected potato plants/tubers in Finland (haplotype C) and Spain (haplotype E) would suggest that all haplotypes can infect potato, but transmission is limited between the different plant families because of the lack of a vector that is able to feed efficiently on plants in both families and then transmit the bacterium within potato. Similarly, *B. cockerelli* inefficiently transmitted haplotype B to infect carrot with unlikely bacterial transmission within carrot (Munyaneza *et al*., 2016). In Finland, volunteer potato plants and cultivated potato grown at the edge of a carrot field were infected with haplotype C sequence type 1 (the most common sequence type infecting *T. apicalis* and carrot); plants and tubers were asymptomatic (Haapalainen *et al*., 2018a, 2018b). In Spain, haplotype E infections, most likely vectored by *B. trigonica* (Antolinez *et al*., 2017a), were detected in symptomatic potato tubers in the Castilla y Leon region (Cambra *et al*., 2014) and Cantabria (EPPO, 2017). However, *B. trigonica* was not able to transmit '*Ca*. L. solanacearum' from potato to potato (Antolinez *et al*., 2017a).

**Current impact of European haplotypes in the EPPO region**: Although high numbers of vectors have the potential to lead to epidemics of '*Ca*. L. solanacearum' in crops of Apiaceae, this is unlikely in potato since '*Ca*. L. solanacearum' has been present in the EPPO region for at least 40 years (Monger & Jeffries, 2018) without causing epidemics in potato. However, the risk posed by *B. nigricornis*, sometimes the most abundant psyllid species on potato crops in Spain, albeit at low populations (Antolinez *et al*., 2019), and which is able to reproduce on plants in the Apiaceae and Solanaceae, requires further study, particularly as regards potato spread of '*Ca*. L. solanacearum'. It can also reach high populations in potato crops, as observed in Iran (Fathi, 2011).

**Potential impact in the EPPO region in case B. cockerelli is introduced**: Given the impact of *B. cockerelli* in regions where it occurs, its introduction in the EPPO region would have serious economic consequences for solanaceous crops, especially if the psyllids were carrying '*Ca*. L. solanacearum'. Additionally, although the risk of European haplotypes entering the seed production chain is low, measures need to be taken to reduce the risk of within-crop spread should an efficient vector such as *B. cockerelli* be introduced or agricultural or climatic conditions change to increase populations of potential vectors.

## 2. Outline of the system

It is recommended that EPPO countries establish a national regulatory control system for *B. cockerelli* and '*Ca*. L. solanacearum' (haplotypes A and B) and, based on this Standard, include measures to prevent their introduction into the country, carry out surveillance on potato and other solanaceous hosts and, if present, contain and attempt to eradicate *B. cockerelli* and '*Ca*. L. solanacearum'.

Measures are also recommended against European haplotypes of '*Ca*. L. solanacearum' (such as C, D and E) to prevent the introduction of '*Ca*. L. solanacearum' into the potato production system and to suppress '*Ca*. L. solanacearum' in potato production systems where it is present (Appendix 4).

The national regulatory control system should provide sufficient guarantees to allow export of potatoes within the EPPO region in conformity with EPPO Standard PM 8⁄1.

It is also recommended that EPPO member countries at risk prepare a pest-specific contingency plan (based on EPPO Standard PM 9/10 *Generic elements for contingency plans*) to ensure that the necessary management and operational arrangements are in place to deal with an outbreak.

Pest-specific plans should be developed in consultation with industry sectors to make sure they are feasible and rehearsed to help ensure prompt and effective official action can be taken in the event of an outbreak occurring.

## 3. Control system

The objectives of the control system for *B. cockerelli* and '*Ca*. L. solanacearum' haplotypes A and B are:

- To raise awareness
- To prevent the introduction of the pests into the country
- To prevent the introduction of the pests into the potato production system and other solanaceous hosts
- To determine if the pests are present in the country through surveillance of potential hosts (e.g. solanaceous hosts) and, if present, to determine their distribution
- To prevent their spread
- To eradicate the pests where it is feasible
- To provide guidance on phytosanitary measures if eradication is unsuccessful.

### 3.1. Raising awareness

Early detection and reporting are critical to the success of the control system, particularly for *B. cockerelli* should it be introduced. All those handling potential hosts throughout the supply chain, including growers, importers, packers, processors and retailers, should be aware of what psyllids look like and the potential symptoms of '*Ca*. L. solanacearum' in the growing crop (potato, tomato, pepper) and the harvested produce (see EPPO data sheets for details; EPPO, 2013, 2020). Promotional activities can involve, for example, pest identification cards, the internet, posters and workshops involving growers, potato traders and processors. Psyllid species are small insects and are not well suited to public reporting, but may be recognized by amateur entomologists, for example.

### 3.2. Pathways of introduction

*3.2.1.* Bactericera cockerelli

The following potential pathways have been identified from countries where *B. cockerelli* occurs:

- Seed potato tubers (including minitubers) and ware potato tubers if the tubers have sprouts or a green stem or leaf parts present
- Plants for planting of Solanaceae other than potato (covered above)
- Fruit of Solanaceae (especially when they are associated with green parts such as truss tomato)
- Living parts of Solanaceae (except fruits, seeds and plants for planting), for example cut flowers and cut branches and foliage such as ornamental *Physalis* spp.
- Plants in the families Convolvulaceae (e.g. *Ipomoea batatas*) and Lamiaceae (e.g. *Micromeria chamissonis*; syn. *M. douglasii*), *Mentha* spp. (mint).

*3.2.2. '*Candidatus *L. solanacearum' haplotypes A and B*

The following potential pathways have been identified from countries where '*Ca*. L. solanacearum' haplotypes A and B (EPPO, 2012a) occur:

- Entry of *B. cockerelli* infected with '*Ca*. L. solanacearum' (see 3.2.1)
- Seed potatoes (including microplants and minitubers) and ware potatoes
- Plants for planting of Solanaceae (other than potato) excluding seeds from countries where '*Ca*. L. solanacearum' occurs
- Fruit of Solanaceae (in particular tomato, *Capsicum* spp., eggplant, tamarillo, Cape gooseberry).

### 3.3. Measures to prevent introduction

*3.3.1.* Bactericera cockerelli

The holding and handling of *B. cockerelli* should be prohibited and, since containment measures for live populations will be very difficult and expensive to achieve, import of this pest for research purposes even under special permit or licence is not recommended. Collaboration with countries in which the pest occurs is recommended as a lower-risk alternative.

To prevent the introduction of *B. cockerelli*, potato breeding material should be inspected according to post-entry quarantine requirements (EPPO Standard PM 3/21, EPPO, 2019). All seed potatoes intended for planting in the EPPO region and all ware potatoes should come from a pest-free area for *B. cockerelli*. EPPO Standard PM 3/61 *Pest-free areas and pest-free production systems for quarantine pests of potato* should be followed.

Plants for planting of Solanaceae, Convolvulaceae and Lamiaceae should come from a pest-free area for *B. cockerelli*. Fruits of Solanaceae should come from pest-free areas for *B. cockerelli*. Equivalent measures may be considered as identified in the pest risk analysis (EPPO, 2012a,b). Living parts of Solanaceae (except fruits), for example cut flowers and cut branches foliage, should come from pest-free areas for *B. cockerelli*. All material at risk of being infested with *B. cockerelli* indicated in section 3.2.1 should be inspected for *B. cockerelli*, particularly for eggs.

*3.3.2. '*Ca*. L. solanacearum' haplotypes A and B*

The holding and handling of '*Ca*. L. solanacearum' haplotypes A and B should be prohibited, except under special permit or licence, as recommended in EPPO Standard PM 3/64 *Intentional import of organisms that are plant pests or potential plant pests* (EPPO, 2005).

To prevent the introduction of '*Ca*. L. solanacearum' haplotypes A and B, potato breeding material should be tested according to post-entry quarantine requirements described in EPPO Standard PM 3/21 (EPPO, 2019).

Based on the perceived risk nuclear stock or initial material should be tested for freedom from '*Ca*. L. solanacearum' haplotypes A and B. All seed potatoes intended for marketing in the EPPO region should come from a pest-free area for '*Ca*. L. solanacearum' haplotypes A and B. The

EPPO Standard PM 3/61 *Pest-free areas and pest-free production systems for quarantine pests of potato* (EPPO, 2005) should be followed.

Plants for planting of Solanaceae (except seeds) should come from a pest-free area and pest-free production and distribution system for '*Ca*. L. solanacearum' haplotypes A and B. Seed of other hosts, particularly solanaceous hosts (e.g. tomato), may also need to be considered for regulation if it is shown that transmission of '*Ca*. L. solanacearum' can occur.

### 3.4. Surveillance

*3.4.1. General surveillance*

Surveillance should be done in accordance with ISPM 6 *Guidelines for Surveillance*.

*B. cockerelli* and '*Ca*. L. solanacearum' haplotypes A and B should be considered as notifiable pests. All persons suspecting or confirming the presence of *B. cockerelli* or '*Ca*. L. solanacearum' (haplotypes A and B) should notify the NPPO.

Potentially infested hosts may be officially inspected at import. ISPM No 31 *Methodologies for sampling of consignments* may be used as a basis for establishing sampling rates.

In certification schemes for seed potato, both the growing crop and tubers are inspected. In general, there is less official monitoring of ware potato crops and tubers, although tubers are inspected at grading and many EPPO countries undertake monitoring of ware potatoes for other pests that could potentially lead to the detection of *B. cockerelli* or '*Ca*. L. solanacearum' (haplotypes A and B). A good example is the official annual survey of potato crops for ring rot (*Clavibacter michiganensis* subsp. *sepedonicus*) and brown rot (*Ralstonia solanacearum*) that is undertaken by European Union countries.

Inspectors should be made aware of the potential signs of infestation by *B. cockerelli* and the characteristic symptoms of '*Ca*. L. solanacearum' infection. Symptoms are described in EPPO datasheets.

In carrot, '*Ca*. L. solanacearum' haplotype B induces disease symptoms, including leaf reddening (Munyaneza *et al*., 2016), which appears similar to that described for haplotype C (Nissinen *et al*., 2014).

*3.4.2. Specific surveys*

Specific surveys are necessary following an outbreak, or when the pest-free status of a country or an area for *B. cockerelli* or '*Ca*. L. solanacearum' (haplotypes A and B) needs to be established. Specific surveys are recommended for potato and other solanaceous crops (e.g. tomato, pepper). Weeds (e.g. *Solanum dulcamara*, *Solanum nigrum*) should also be included in surveys. Adult *B. cockerelli* may be sampled using preferably yellow sticky traps or yellow water traps. Sweep nets, vacuum trapping and sampling leaves may also be used, but these methods are less efficient. The height at which the sticky trap is set in the field appears significant, with lower traps giving better results; a standard trap, set in the crop just below the canopy of the plants is used by both US and New Zealand researchers. Egg and nymphal sampling requires visual examination of foliage. Psyllid populations are initially highest at field edges. For crops grown under protection, traps may also be located near potential points of pest entry.

Where a country considers that *B. cockerelli* poses a significant threat to its potato industry and wants to protect itself by increasing the probability of detecting an outbreak at an early stage, the NPPO should target surveys in high-risk locations, e.g. where host fruits from countries where the pest is known to occur are imported or packed.

*3.4.3. Identification*

Host material suspected of being infected with *B. cockerelli* or '*Ca*. L. solanacearum' should be subject to confirmatory examination and testing according to agreed diagnostic protocols for *B. cockerelli* (EPPO not yet developed) and '*Ca*. L. solanacearum' (ISPM 2017; EPPO PM 7/143). It is important to quickly identify the psyllid vectors and '*Ca*. L. solanacearum' haplotype since the severity of measures to be applied depends on the vector species and the '*Ca*. L. solanacearum' haplotype. Determining the population level of *B. cockerelli* present and the incidence of '*Ca*. L. solanacearum' may give an indication of the likely source. Psyllids should be tested for '*Ca*. L. solanacearum'.

### 3.5. Immediate action to prevent further spread

To prioritize action during an outbreak the NPPO should follow EPPO Standard PM 9/18 *Decision-support scheme for prioritizing action during outbreaks* from the point at which an outbreak is suspected as a result of a finding in a crop, store or consignment moving in trade.

'*Ca*. L. solanacearum' cannot be transmitted mechanically but may be spread to new areas by the planting of infected material (e.g. potato tubers, tomato plants). For further efficient spread a vector is required. Adult *B. cockerelli* are unlikely to be carried on, for example, equipment, farm machinery and people because they fly away when disturbed. However, eggs and nymphs of *B. cockerelli* can readily be carried on equipment, machinery and by farm workers and, if infected with '*Ca*. L. solanacearum', can effectively spread '*Ca*. L. solanacearum' to new areas.

The following scenarios may occur:

- *B. cockerelli* is found with or without '*Ca*. L. solanacearum' haplotypes A or B.
- '*Ca*. L. solanacearum' haplotype A or B is found without *B. cockerelli*.

These scenarios may be further divided according to the plant species on which the pest(s) is found and whether it is found in a crop, in store or on a consignment.

The finding of *B. cockerelli* requires prompt action to contain and eradicate it. Eradication may only be possible if it is a single incursion which has been detected very early so it has not spread from the infested site. It is envisaged that the pests may be found on:

- crops under field cultivation (e.g. potato, tobacco, tomato)
- crops under glasshouse cultivation (e.g. pepper, tomato and potato minitubers)
- harvested host plants or plant products in a store at the production site, in a packing house, or in a processing facility
- consignments of potential host plants or plant products (including potato tubers) moving in trade (see section 3.2.1) originating in areas where the pest is present.

The following sections describe the measures to be taken on suspicion and confirmation of the presence of the pest(s) under various scenarios. Measures are summarized in Fig 1.

*3.5.1. Measures to be taken at suspicion of an outbreak of B. cockerelli and/or 'Ca. L. solanacearum' haplotypes A or B*

An outbreak of *B. cockerelli* may be suspected because of plant symptoms or the finding of eggs, larvae or adult psyllids on plant foliage. The presence of '*Ca.* L. solanacearum' may be suspected because of symptoms in the plant foliage and, in the case of potato, symptoms of zebra chip in the harvested tubers.

Depending on the strength of the suspicion of pest presence and the risk of spread (e.g. level of containment, nearby host crops), a provisional regulated area should be established comprising:

- The potentially infested consignment, the lot, the crop
- The potentially infested production site (e.g. field, glasshouse) or premises where the suspected infestation was found
- A potentially infested area. The size and what is covered by this area will have to be decided on a case by case basis.

Within this area, handling and movement of the host plants or plant products should be prohibited until a diagnosis is made. Restrictions should also be placed on the movement of staff, tools and machinery. Staff should be trained to implement good hygiene standards to prevent the potential spread of the vector, and tools and machinery should be disinfested if removed from site under suspicion (e.g. application of insecticide followed by steam cleaning or cleaning with detergent).

If initially only '*Ca*. L. solanacearum' is suspected, surveys should be conducted to check for the presence of *B. cockerelli* or other vectors. Because '*Ca*. L. solanacearum' is not mechanically transmitted, if it can be established that vectors are not present in the regulated area measures can be limited to ensuring that there is no further spread of the pathogen. If the initial suspicions of pest presence are not confirmed, then any prohibitions should be lifted.

*3.5.2. Measures to be taken after confirmation of an outbreak of B. cockerelli (with or without 'Ca. L. solanacearum' haplotypes A or B) in an infested crop (field or glasshouse)*

*3.5.2.1. Solanaceous crops or other potential host plants growing in a glasshouse or a field.* If infestation by *B. cockerelli* (with or without '*Ca*. L. solanacearum' haplotypes A and B) is confirmed, the NPPO should:

Designate as 'infested':

- The host plants (including tubers) from which the sample was taken
- The site of production (e.g. field, glasshouse) where the infested host plants were found.

Designate as 'probably infested' an area of not less than 1 km around the site of production (e.g. the infested field), taking account of other pathways of spread, particularly within the place of production. If *B. cockerelli* is only detected in a glasshouse it should be sealed as far as is practically possible to prevent the psyllid spreading to the wider environment. If this can be achieved, based on a risk assessment, the radius of the probably infested area may be reduced below 1 km.

Demarcate a regulated area which is composed of:

- The infested site of production
- The 'probably infested' area
- A buffer zone of at least 1 km around the probably infested area.

In determining the size and shape of the regulated area meteorological data, especially wind speed and direction, may be useful. The movement of any potential host plants of *B. cockerelli* and of '*Ca*. L. solanacearum' from the regulated area should be prohibited.

A delimiting survey should be conducted within the regulated area to determine the extent of infestation by inspecting all potential host plants for eggs, nymphs and adults that may be present on the foliage. The use of yellow sticky traps, water traps, suction traps or sweep nets is recommended in determining the infested area.

The boundaries of the regulated area should be adjusted depending on survey results. The results may indicate whether eradication is still possible.

The origin of the infestation should be investigated by traceback, investigating potential links in the case of seedling/transplant/produce links for solanaceous or other host crops.

Potential sources of *B. cockerelli* within the regulated area should also be investigated. However, since adults are strong flyers, particularly when assisted by the wind, it may not be possible to identify the source of any infestation in the regulated area, in which case specific surveys will be required outside of the regulated area.

Trace forward should be done for potentially infested material moved from the infested area prior to the regulated area being established and NPPO of other countries should be notified if this is relevant.

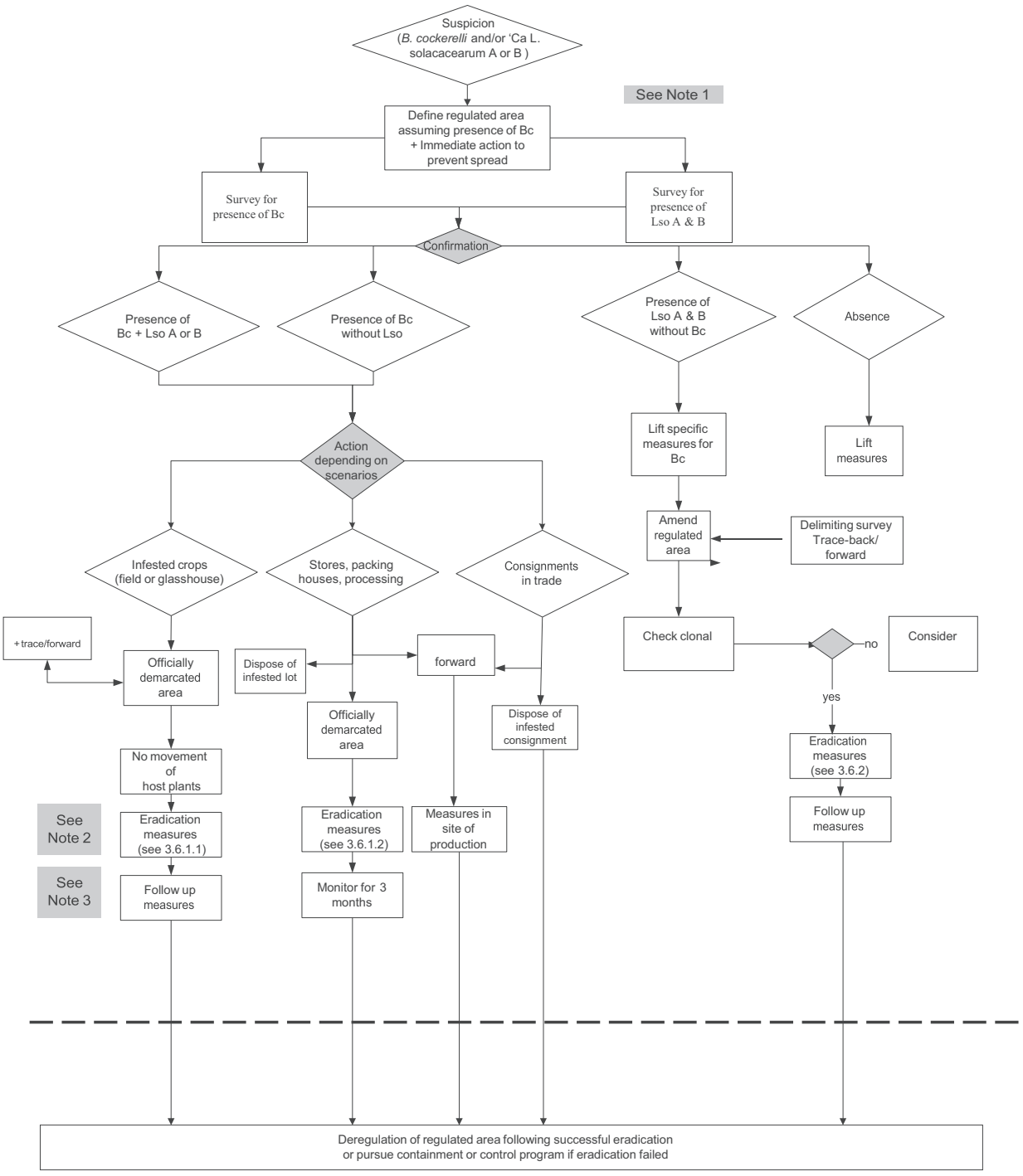


**Fig 1** Measures to be taken at suspicion and after confirmation of an outbreak of *B. cockerelli* with or without '*Ca.* L. solanacearum' haplotypes A or B.

Note 1: No movement of plant products, restrictions on movement of staff, tools and machinery, good hygiene.

Note 2: Treat infested crop and all crops in infested and probably infested area, harvest host plants and destroy or process them, disinfest machinery.

Note 3: No host crops in infested and probably infested area for 2 years (except trap crops), monitoring for 2 further years, host crops in buffer zones treated against psyllids.

*3.5.2.2. Stores, packing houses, and processing facilities.* If infestation by *B. cockerelli* (with or without '*Ca.* L. solanacearum' haplotypes A or B) is confirmed, the NPPO should:

Designate as 'infested':

- The lot of host plants (or tubers) from which the sample was taken
- Other plants (or tubers) within the facility/site unless the NPPO can exclude the possibility of the pest being present on them
- The facility/site where the infested host plants were found.

Designate as 'probably infested' an area surrounding the facility/site if there is a potential risk of the psyllid infestations having spread into the field.

Demarcate a regulated area which is composed of:

- The infested facility/site
- The 'probably infested' area
- A buffer zone if there is a potential risk of the psyllid infestations having spread into the field.

The size of this 'probably infested' area and buffer zone should be decided on a case-by-case basis.

A delimiting survey should be conducted. The boundaries of the regulated area should be adjusted depending on survey results. Traceback should be done to identify the source of the infestation. Where the site or place of production can be identified, measures should be applied accordingly.

*3.5.2.3. Consignment(s) moving in trade.* If *B. cockerelli* (with or without '*Ca.* L. solanacearum' haplotypes A and B) is confirmed on a consignment moving in trade the consignment should be designated as infested. Depending on where the consignment is located (port, rural area) the NPPO should amend the provisional regulated area established on suspicion so that it now comprises:

- The infested area
- A probably infested area
- A buffer zone.

The size of this 'probably infested' area and buffer zone should be decided on a case-by-case basis. A delimiting survey should be conducted. The boundaries of the regulated area may be adjusted depending on survey results. Other consignments from the same or related sources should be traced backwards and forwards and surveys carried out at the suppliers' and recipients' premises and intermediate points of handling, such as ports of entry and packing stations, to confirm whether the pests are present. If the consignment is from another country the NPPO of that country of origin and the consignor(s) should be notified.

*3.5.3. Confirmation of 'Ca. L. solanacearum' haplotypes A or B only*

If infestation by '*Ca.* L. solanacearum' haplotypes A or B is found (without *B. cockerelli*) the NPPO should:

Designate as 'infested':

- The host plants (including tubers and the lot or crop) from which the sample was taken
- The production site (e.g. field, glasshouse) where the infestation was found.

Designate as 'probably infested' any potentially infested crop, lot or consignment if other vectors are identified.

Demarcate a regulated area which is composed of:

- the infested site of production
- the 'probably infested' area if other vectors are identified.

Traceback should be done. The boundaries of the regulated area may be adjusted depending on survey results. Since '*Ca.* L. solanacearum' is not mechanically transmitted, if it can be established that vectors are not present in the regulated area measures can be limited to ensuring that there is no further spread of the pathogen.

### 3.6. Eradication and follow-up measures

*3.6.1. B. cockerelli with or without 'Ca. L. solanacearum' haplotypes A and B*

*3.6.1.1. Solanaceous crops or other potential host plants growing in the regulated area.*

- The whole of the infested growing crop should be treated promptly with an approved insecticide (see Appendix 1). All other crops (not just host crops) in the regulated area (excluding the buffer zone) and other plants including weeds should be treated at appropriate intervals with an approved insecticide.
- All host plants (including haulms, tubers and *Solanum* weeds) should then be harvested from the regulated area (excluding the buffer zone), sealed and transported to an approved facility for disposal or processing in such a way that there is no risk of spread or destroyed *in situ* (e.g. by a foliar desiccant or by burning with appropriate machinery) (see Appendix 2 Treatment or disposal of infested material). Desiccated foliage with no remaining green material may be left *in situ* and does not require further treatment. Infested glasshouses and premises, and all machinery in contact with the infested and probably infested crops, should be disinfested.

Measures to be applied in the following years:

- After a finding in solanaceous crops or other potential host plants, no host crops of *B. cockerelli* should be grown in the infested site of production and the probably infested area for two consecutive years, during which time the crops, volunteers and weeds should be officially monitored. After this time solanaceous crops may be planted but these should be subject to monitoring for 2 years.
- After a finding in potatoes, the infested field should be maintained for 3 years in bare fallow or in permanent pasture with frequent close cutting or intensive grazing. Alternatively, cereals or other arable crops may be grown for 3 years provided control of potato volunteers can be achieved using selective herbicides. After 3 years either seed or ware potatoes may be produced, but these crops should be subject to monitoring during the growing season.

As an exception to this prohibition, small plots of solanaceous host crops may be grown as trap crops. These should be inspected at appropriate times, treated with an insecticide and destroyed *in situ*. This will enable monitoring of the level of the pest and may aid in avoiding its dispersal.

- Host crops grown within the buffer zone should be monitored for the presence of psyllids and treated with an approved insecticide.
- Surveillance should be carried out in the regulated area for 4 years following the outbreak using visual inspections and appropriate traps. Where '*Ca*. L. solanacearum' (A or B) has been found in addition to *B. cockerelli*, monitoring may include testing of host crops/psyllids for the presence of the pathogen.

*3.6.1.2. Stores at the production site, packing houses and processing facilities.*

- The infested plant material should be disposed of according to the measures described in Appendix 2 at an approved facility.
- If the infested plant material is to be transported, it should be sprayed or fumigated prior to transportation with an approved insecticide to kill the psyllid. Containers should be sealed to prevent the escape of any surviving *B. cockerelli* during transportation.
- The regulated area, including containers, machinery and buildings, should be disinfested.
- Surveillance should be carried out in the regulated area using appropriate traps for 3 months or longer if appropriate.

*3.6.1.3. Consignments moving in trade.* Measures are the same as for stores (see section 3.6.1.2).

*3.6.2. 'Candidatus L. solanacearum' haplotypes A or B in the absence of B. cockerelli*

The following measures should be applied after an outbreak in a potato crop (e.g. when infection is linked to clonal material):

- If the infected crop is still growing, the potato haulm should be treated immediately with an effective insecticide and destroyed since there is still some uncertainty about the potential presence of unknown effective vectors.
- Infested fields may be maintained for 3 years, either in bare fallow or in permanent pasture (with frequent close cutting, intensive grazing). Alternatively, cereals or other arable crops may be grown for 3 years provided control of potato volunteers can be achieved using selective herbicides.
- Potatoes or other host crops of '*Ca*. L. solanacearum' should not be grown in the 'infested' fields until no volunteer potato plants have been found for two consecutive years.
- Control of *Solanum* weeds should be carried out.
- After this period either seed or ware potatoes or other host crops may be produced. The first production (growing crop and tubers) should be inspected for symptoms.

### 3.7. Possible control programme if eradication of *B. cockerelli* is not successful

A management plan and programme of phytosanitary measures should be drawn up to provide ongoing control of the pest in the event of failure of eradication of *B. cockerelli*. EPPO recommendations may be developed in future. Information from New Zealand and Australia is included in Appendix 3.

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## Appendix 1 – Control options

### 1. Chemical control

Effective control is dependent on the timely application of insecticides with good activity against *B. cockerelli* and other potential insect vectors. The NPPO should assess the portfolio of insecticides available to control *B. cockerelli* in advance of any outbreak because it is likely to influence the overall control strategy adopted. Furthermore, if there is a shortage of effective insecticides it may be possible to apply for emergency clearance so that more effective chemicals are available in a future outbreak situation. It is also important to have chemicals available with different modes of action in order to mitigate against any existing resistance and to help limit the development of resistance to ensure that control remains effective in the longer term.

For treatment of growing crops good insecticide coverage or an insecticide with translaminar activity is important because psyllids are commonly found on the underside of the leaves. Insecticides which are effective against adults do not necessarily work against nymphs or eggs, therefore several different insecticides may need to be applied, although an insecticide with activity against all stages of the life cycle of *B. cockerelli* is preferable.

Insecticides approved in the United Kingdom known to control one or more psyllid growth stages are listed in

**Table A1.** Insecticides approved in the UK (in 2016) known to control one or more psyllid growth stages. Registration in other EPPO countries may differ. Plant protection products should be used following the instructions on the label for the particular use in the country concerned

| Active ingredient | Product | Insecticide class | Potato | Tomato | Aubergine | Pepper | Authorization expiry date |
|---|---|---|---|---|---|---|---|
| Esfenvalerate | Barclay Alphasect | 3A | Label | Not authorized | Not authorized | Not authorized | 30/04/2017 |
| Lambda-cyhalothrin | Hallmark with Zeon Technology | 3A | Label | Ex no. 2012/1994 | Ex no. 2012/1994 | Ex no. 2012/1994 | 30/06/2018 |
| Acetamiprid | Gazelle | 4A | Not authorized | Label | Label | Label | 31/10/2019 |
| | InSyst | 4A | Label | Not authorized | Not authorized | Not authorized | 31/10/2019 |
| Thiacloprid | Calypso | 4A | Not authorized | Ex no. 2014/2151 | Ex no. 2014/2151 | Ex no. 2014/2151 | 17/08/2018 |
| | Biscaya | 4A | Label | Not authorized | Not authorized | Not authorized | 17/08/2018 |
| Thiamethoxam | Actara | 4A | Label | Not authorized | Not authorized | Not authorized | 31/10/2020 |
| Spinosad | Conserve | 5 | Not authorized | Label | Label | Label | 31/10/2020 |
| | Tracer | 5 | Ex no. 2890/014 | Not authorized | Not authorized | Not authorized | 31/10/2020 |
| Abamectin | Dynamec | 6 | Not authorized | Label | Ex no. 2007/0421 | Ex no. 2007/0422 | 31/12/2021 |
| Pymetrozine | Plenum WG | 9B | Label | Not authorized | Not authorized | Not authorized | 30/06/2018 |
| | Chess WG | 9B | Not authorized | Ex no. 2007/0501 | Ex no. 2007/0501 | Ex no. 2007/0501 | 30/06/2018 |
| Spiromesifen | Oberon | 23 | Not authorized | Label | Ex no. 2006/3645 | Ex no. 2006/2149 | 30/04/2016 |

3A, pyrethroids; 4A, neonicotinoid; 5, nicotinic acetylcholine receptor allosteric modulator' 6, chloride channel activator; 9B, selective feeding inhibitor; 9C, selective homopteran feeding inhibitor; 23, inhibitors of acetyl CoA carboxylase. Ex no., extension of authorization number.

Table A1. In the United States, abamectin and spirotetramat are widely used. Tolfenpyrad, cyazapyr and sulfoxaflor are effective alternatives.

### 2. Biological control

In New Zealand the release of the non-indigenous psyllid parasitoid *Tamarixia triozae* has been recently approved to assist with the biological control of *B. cockerelli* in field crops (EPA, 2016a,b), as well the indigenous predatory mite *Amblydromalus limonicus* for greenhouses.

## Appendix 2 – Treatment or disposal of infested material

### 1. Plants infested with *B. cockerelli*

Plant material can be collected and piled up in a heap on the infested field or in the infested glasshouse, covered to prevent escape of *B. cockerelli* and left at ambient temperatures for a period of at least 12 months or until well rotted.

Desiccated foliage with no remaining green material may be left in the field and does not require further treatment.

No plant material should be removed from the infested area unless it is securely enclosed during transportation to be disposed in a facility approved by the NPPO according to procedures recommended below, for example:

- deep burial
- incineration
- heat treatment of at least 70°C for 30 min throughout the material
- freezing small quantities at ≤–20°C throughout the material for 24 h.

Potato tubers or other solanaceous crops harvested from the infested field can also be submitted to industrial processing in such a way that there is no risk of dispersal or survival of the pest. This should be done under official supervision and only at a processing plant with appropriate waste facilities.

Machinery used in the disposal process should be thoroughly disinfested.

### 2. Plants infested with '*Ca.* L. solanacearum' only

In addition to the options mentioned above, infected material may be disposed of using, for example:

- industrial processing at a processing plant with appropriate waste facilities
- anaerobic digestion for production of biogas at an officially approved site
- fermentation and composting at an officially approved composting site following EPPO standard PM 3/66

*Guidelines for the management of plant health risks of biowaste of plant origin* (EPPO, 2005)
- fermentation of contaminated plants during silage production then feeding to animals
- steaming and feeding to animals.

## Appendix 3 – Control programme against B. cockerelli developed in New Zealand and Australia

### 1. Glasshouse crops

Tomatoes New Zealand and Vegetables New Zealand (2016) has published the New Zealand Code of Practice for the Management of the Tomato/Potato Psyllid in Greenhouse Tomato and Capsicum Crops. This has been used to describe some key elements for a control programme:
- The glasshouse should be designed to minimize the risk of entry of psyllids (appropriately sized insect screens, double-door entry system, with change of clothes at entry).
- All potential weed hosts and noncommercial ornamental plants should be removed from the place of production.
- Clean and disinfect the greenhouse ensuring all plant material including weeds and volunteer plants is removed and destroyed before a new crop is planted.
- Only source pest-free plants.
- Drench or spray plants on arrival with an approved insecticide.
- Establish a crop monitoring plan and, using trained staff, monitor the crop weekly, increasing to daily during periods of high pest pressure, marking infested plants and areas.
- Set up sticky traps in the glasshouse (at least 10 per hectare), at greenhouse entrance (at least every 10 $m^2$) and outside.
- Spot spraying may be effective in a glasshouse for controlling limited incursions.
- Crop removal and actions between cropping cycles: before the end of a crop, close the glasshouse to contain the psyllids, thus preventing them from being spread into the wider environment. Apply a high-volume pesticide spray together with a surfactant or mineral spraying oil. Keep the greenhouse closed for 24 h before plant removal. Remove the plants securely (e.g. in covered bins) to land fill or composting. Check that all flying insect pests have been eradicated by hanging yellow sticky traps (at least 10 per hectare) and inspect daily. Use fog or spray insecticide if pests are present. Close the greenhouse ventilators and doors and allow a period for warming to accelerate pest eradication.

### 2. Field crops

Plant Health Australia (2011) has developed a management plan for *B. cockerelli* in anticipation of the pest, with or without '*Ca*. L. solanacearum', becoming established in the country. This includes application of a number of pesticides, with effect on different metabolic processes, to provide protection of potato crops at different developmental stages:
- Imidacloprid: applied in the planting furrow provides control for up to 42 days from planting, but with decreasing efficacy after 28 days.
- Spirotetramat: applied as three spray applications at 7–14 day intervals depending on conditions, provides control of psyllids from 28 to around 55 days after planting.
  (a) First spray application is at the beginning of stem formation (about 28 days after planting).
  (b) Second spray application around 7–14 days later.
  (c) Third spray application around 7–14 days after the second application.
- Spinosad applied as a spray application in two applications beginning at around 55 days after sowing provides psyllid control up to 70 days.
- Remaining sprays include either organophosphates, carbamate or synthetic pyrethroids applied weekly, providing control for 30 days from weeks 70 to 100.

Potato New Zealand (2014) underlines the need to consider insecticide resistance management when choosing active substances. Oils may be used to reduce the number of insecticide sprays They note that monitoring should be conducted with traps, as well as using degree days to determine the start of the spray programme. Depending on the conditions, thiamethoxam may be used early in the season. A best practice programme then includes spirotetramat (two applications), abamectin (four applications), spinetoram (four applications) and cyantraniliprole (three applications).

## Appendix 4 – Control system against 'Candidatus L. solanacearum' haplotypes present in the EPPO region

The objectives of the control system are:
- To raise awareness about '*Ca*. L. solanacearum' (haplotypes C, D and E) and psyllid vectors known to be present in the EPPO region.
- To prevent introductions of '*Ca*. L. solanacearum' (haplotypes C, D and E) into the potato production system and help in suppressing '*Ca*. L. solanacearum' in potato production systems where it is present. Limiting the spread of European haplotypes would reduce the risk of potential damage to potato crops in case a more efficient vector for transmission to potatoes (e.g. if *B. cockerelli*) were to be introduced or environmental changes leads to more efficient transmission by vectors currently present.
- To investigate the source of infection in case of an outbreak (seed potatoes, farmed saved seed potatoes or vectored from Apiaceae) and the possible vectors involved in transmission.
- if a vector transmission is suspected, to identify rapidly the vector. Intensive investigation is needed where unusually high levels of infected plants or tubers are found and confirmed by testing.

## 1. Raising awareness

New occurrences of '*Ca*. L. solanacearum' (haplotypes C, D and E) in potato should continue to be reported to the NPPO as well as to EPPO so that the effects can be monitored.

To raise awareness about the '*Ca*. L. solanacearum' haplotypes and psyllid vectors known to be present in the EPPO region, promotional activities can involve, for example, the internet, posters and workshops involving growers, potato traders and processors, seed producers and preparing pest identification cards for distribution to relevant people.

Psyllid species are small insects and hard to find and identify but may be recognized and reported by, for example, amateur entomologists.

## 2. Pathways of introduction to potato

Within the EPPO region, the main pathway for introduction of '*Ca*. L. solanacearum' haplotypes C, D and E to potato appears to be infected carrot or other *Apiaceae* crops from which psyllids acquire the bacterium. The epidemiology of haplotype C may be different to D and E, probably because they are associated with different vectors. In Finland, the main source of inoculum ('*Ca*. L. solanacearum' haplotype C) appears to be infective carrot psyllids (*T. apicalis*), suspected to overwinter on Norway spruce. In countries where haplotypes D and E are present, the main source of inoculum appears to be another infective psyllid (*B. trigonica*).

## 3. Measures to prevent introduction in seed potatoes

The Regulated Non-Quarantine Pest (RNQP) status is recommended for '*Ca*. L. solanacearum' haplotypes C, D, and E on seed potatoes, with a zero tolerance.

### *3.1. Nuclear stock or initial material*

Nuclear stock or initial material for entry to the certification scheme should be tested to ensure freedom from '*Ca*. L. solanacearum'.

### *3.2. Other types of seed potatoes*

The following measures are recommended for other types of seed potatoes:

(a) Plants produced in areas known to be free from '*Ca*. L. solanacearum'; or

(b) No symptoms of '*Ca*. L. solanacearum' have been seen during official crop or tuber inspections of seed potatoes at the place of production during the growing period of the crop; or

(c) Inspection of each lot (cut a representative sample of tubers) and testing of symptomatic tubers to confirm the absence of '*Ca*. L. solanacearum'.

## 4. Surveillance

The NPPO should carry out surveillance in Apiaceae crops (i.e. carrot, celery and parsnip or other potential hosts) to support the PFA status for haplotypes C, D and E. This surveillance should follow EPPO Standard PM 3/61 *Pest-free areas and pest-free production systems for quarantine pests of potato* and should be based on symptoms and confirmation by testing.

## 5. Immediate action in case of suspicion and in case of confirmed outbreak in seed or ware potatoes

### *5.1. Suspicion of an outbreak of 'Ca. L. solanacearum'*

Suspicion of an outbreak may be because of symptoms in the potato foliage and/or symptoms of zebra chip in the harvested tubers. The probably infested crop should be designated as probably infested and any movement of potatoes prohibited.

If the initial suspicions are not confirmed, then any prohibitions should be lifted.

### *5.2. Confirmation of an outbreak*

- '*Ca*. L. solanacearum' in seed potatoes

If infestation by '*Ca*. L. solanacearum' haplotypes C, D or E is confirmed in the plants tested, the NPPO should designate the crop from which the sample was taken as infested.

The crop should not be used as seed but may be grown on and used as ware.

- '*Ca*. L. solanacearum' in ware potatoes

No measures are required for '*Ca*. L. solanacearum' haplotypes C, D or E. They should not be planted as farm saved seed potatoes. However, to support the pest-free area status or the pest-free place of production of seed potatoes, additional measures may be taken on ware potatoes.

### *5.3. Investigations in case of outbreak in potato to identify the possible source of infection*

Specific investigations (symptomatic plants confirmed by testing) should be conducted in the vicinity of the outbreak to determine whether '*Ca*. L. solanacearum' is present in Apiaceae (i.e. carrot, celery and parsnip or other potential hosts).

A specific investigation should also be conducted for the presence of potential vectors in the growing crop. The presence of possible high levels of '*Ca*. L. solanacearum' haplotypes C, D or E in potato would indicate the potential presence of an efficient vector. Psyllid species require morphological identification by an expert or molecular testing. '*Ca*. L. solanacearum' infested host material should be subject to confirmatory examination and testing according to EPPO Diagnostic Protocol PM 7/143. It is important to quickly identify the psyllid vectors and '*Ca*. L. solanacearum' haplotype since the range of measures to be applied depends on the vector species and the '*Ca*. L. solanacearum' haplotype.

The vector species that are known to feed not only on Apiaceae hosts but also on solanaceous hosts should be identified and tested for '*Ca*. L. solanacearum'.