DPI&F's response to Biosecurity Australia's Revised Draft Import Risk Analysis Report for Apples from New Zealand December 2005

1. Executive Summary

Biosecurity Australia released a Revised Draft Import Risk Analysis report (RDIRA) for apples from New Zealand on 1 December 2005. It was accompanied by Biosecurity Australia Policy Memorandum 2005/20, which requested stakeholders to comment on the RDIRA by 30 March 2006.

The scope of the RDIRA is the importation of mature apple fruit free of trash, either packed or sorted and graded bulk fruit in New Zealand (Part B, page 9).

The Queensland Department of Primary Industries and Fisheries (DPI&F) notes that Biosecurity Australia (BA) has identified ten pest species for further consideration for the whole of Australia:

Fire blight
European canker
Apple leafcurling midge
Garden featherfoot
Grey-brown cutworm
Leafrollers (five species)

Of these, fire blight, European canker, apple leafcurling midge and leafrollers all required risk mitigation measures. A further six species have been identified as particular risks to Western Australia only and are not commented on in this response.

DPI&F examined the estimation of risk in relation to the individual above-mentioned quarantine pests. Our primary concerns are about the consequences of incursions of fire blight, European canker and apple leafcurling midge on the apple-producing community in the Stanthorpe region, and these are discussed in detail below. We also have general concerns about these and other pests, arising from the conduciveness of the Queensland apple production environment to many pests. The risks are exacerbated by the supply chain issue that processing sheds are in production areas and imported bulk fruit would be repacked in these, with waste fruit coming in immediate proximity with orchards.

2. List of recommendations

Recommendation 1
DPI&F recommends that new information on infection of mature fruit by *Erwinia amylovora* be incorporated into the IRA process.

Recommendation 2
DPI&F recommends that trash be considered both as a source of infection and a potential means of injury to harvested apple fruit, for both fire blight and European canker.

Recommendation 3
DPI&F recommends that if the Australian Pesticide and Veterinary Medicines Authority (APVMA) cannot assure BA that registration of antibiotics for use as a control of *E. amylovora* will be approved then consideration of streptomycin should be removed from the RDIRA.

Recommendation 4
DPI&F recommends that given the field of research on viable but non-culturable cells (VBNC) is still relatively new, the potential for *E. amylovora* to enter a VBNC state not be discounted.

Recommendation 5
DPI&F recommends the efficacy estimated for chlorine be reduced in the light of new information on the asymptomatic infection of mature fruit.

Recommendation 6
DPI&F recommends that the previous standard of a history of area or block freedom from fire blight established by multiple inspections over two seasons should be restored, and these inspections should be unannounced. We also recommend the use of forecasting models to assist in the timing of inspections during likely infection periods.

Recommendation 7
DPI&F recommends that New Zealand needs to provide surveillance data documenting absence of endophytic infection of mature apple fruit from their orchards.

Recommendation 8
DPI&F recommends either that processing or repackaging of imported apples should not be permitted in production areas or within a certain distance of an orchard, and waste from wholesale or retail 'utility points' is disposed of as municipal waste i.e. capped landfill. Alternatively, the importation of apples should only be allowed if the fruit has been graded and packed in cartons and fruit in bulk bins should not be permitted.

Recommendation 9
DPI&F recommends the definition and use of 'utility point' in the RDIRA be given further consideration and the estimates reviewed.

Recommendation 10
DPI&F recommends that the RDIRA defines what constitutes suitable conditions for infection for European canker.

Recommendation 11
DPI&F recommends that prohibiting repackaging in production areas would also assist in mitigating risk from apple leafcurling midge.

Recommendation 12
DPI&F recommends that the environment of the Queensland Granite Belt be taken into account in completing estimates of the probability of entry, establishment and spread, and potential impact, as it is more conducive to many insect pests than other production areas.

3. Fire blight

Fire blight is caused by the bacteria *Erwinia amylovora*. The climate of Stanthorpe is particularly conducive to fire blight and, of the apple varieties growing in the region, only red delicious (25 percent) is resistant to fire blight. The majority of Queensland rootstocks are susceptible (M106) and there is a significant move towards high density planting. The susceptibility of the crop impacts on the probability of entry, establishment and spread, reduces the potential for eradication and increases expected economic impact.

BA considers that a combination of fruit sourced from symptom less orchards and chlorine treatment of harvested fruit are sufficient to manage risks associated with fire blight (Part B, page 104). DPI&F would like to make the following comments:

3.1. New information

DPI&F brings the following papers, which are not cited in the RDIRA, to the attention of BA:

Azegami K *et al.* 2004. Invasion and colonization of mature apple fruit by *Erwinia amylovora* tagged with bioluminescence genes. J. Gen. Plant Pathol. 70: 336-341.

Tsukamoto T *et al.* 2005. Infection frequency of mature apple fruit with *Erwinia amylovora* deposited on pedicels and its survival in the fruit stored at low temperature. J. Gen. Plant Pathol. 71: 296-301.

Azegami K. *et al.* 2006. *Erwinia amylovora* can pass through the abscission layer of fruit-bearing twigs and invade apple fruit during fruit maturation. J. Gen. Plant Pathol. 72: 43-45.

These papers report a series of experiments using bioluminescent *E. amylovora* tagged with *lux* genes. These reports are very important, as they demonstrate asymptomatic infection of mature fruit could occur readily at harvest or later in the supply chain. Infection, even with low inoculum concentrations, occurred through the pedicel and through wounds and spread through fruit in vascular bundles to become extensive in the fruit, but not in the core. A high proportion of fruit became infected and bacteria remained viable for several months in stored fruit. Fruit also became infected by systemic passage through the pedicel (13 cm from the point of inoculation on the twig) during fruit maturation. Consequently, fruit was demonstrated as a means for long-range dissemination of fire blight; this does not seem to have been studied extensively before.

This information requires review of the components of importation:

- *Imp2* (likelihood that picked fruit is infested) – a significant proportion of mature fruit may be asymptomatically infected;
- *Imp3* (likelihood that clean fruit is contaminated during picking and transport to the packing house) – fruit may become infected and may also provide significant inoculum;
- *Imp4* (likelihood that *E. amylovora* survives routine processing procedures) – internal infection will not be removed by disinfestation treatments;
- *Imp5* (likelihood that clean fruit is contaminated during processing) – because mature fruit can become infected; and

- *Imp7* (likelihood that clean fruit is contaminated during processing) – because there may be significant inoculum reservoirs in asymptomatic infected fruit.

The information also requires revision of the probability of establishment and spread, because the scenario is changed. The main scenario in the report is of bacteria being washed out of the calyx and then transferred to hosts. With infection of fruit, very conceivable scenarios are:

- partly eaten fruit is discarded near a host, then bacteria dispersed by splash or browsing insects; and
- reject fruit is discarded in an orchard and bacteria dispersed by insects, splash or aerosol.

Thus, the discussion of exposure (Part B, pages 77-81) and the conclusion would need to be revised extensively. Also, the proposed risk mitigation measure of chlorine treatment would require revision.

See Recommendation 1

3.2. *Trash*

The RDIRA states that "Although the scope of the analysis is apples free of trash the risks associated with trash were considered" (Part B, page 48), acknowledging that free of trash is not practically possible, especially if fruit is transported in bulk bins. However, in the Risk Scenario BA concludes that leaves and small twigs taken "from apple trees at the time of harvest are no more likely to be carrying *E. amylovora* than fruit and therefore do not present a special risk over and above that presented by fruit" (Part B, page 48).

DPI&F would like to raise two issues in relation to this. Firstly, the new information in section 3.1 indicates that internal infection can be present in the harvested mature fruit. It is therefore reasonable to suggest that twigs are equally potentially infected and also capable of disease transmission. Additionally, DPI&F is concerned about the potential for trash to damage fruit, especially when in transit. There is then potential for inoculum on the surface of apples or calyces to initiate infection on damaged fruit. This point is supported in the study by van der Zwet *et al*. (1990) which found that approximately four percent of non-infested mature fruit sourced from a symptomless orchard developed fire blight symptoms when wounded on the surface. We acknowledge that fruit in the above mentioned study were not dipped in chlorine after inoculation, but as chlorine dipping does not completely control *E. amylovora*, there is still the potential for infection to occur in this way. This possibility does not seem to have been considered in the RDIRA. Injury by trash may also spread infection from asymptomatically infected mature fruit (see section 3.1).

See Recommendation 2

3.3. Use of Streptomycin

The RDIRA states that the antibiotic streptomycin is the most effective chemical to control fire blight, but it is not registered for use in agriculture in Australia (Part B, page 84). Reference is also made to the development of bacterial resistance to streptomycin (Part B, page 82), potential for residues in other products such as honey (Part B, page 93) and the impact of use on organic growers (Part B, page 91). There are substantial concerns in Australian and international markets and communities about the use of antibiotics for agricultural pest control.

DPI&F considers that in the event of an incursion of fire blight, it is probable that registration will not be given for streptomycin. If the Australian Pesticide and Veterinary Medicines Authority (APVMA) cannot assure BA otherwise, then consideration of streptomycin as a control agent should be removed from the RDIRA. This would have substantial impact on Australia's ability to eradicate fire blight. Also, no other treatments of similar efficacy are available or in use elsewhere in the world, even though this has been studied extensively, so the consequences of losses and control costs need to be estimated accordingly.

See Recommendation 3

3.4. Viable but non-culturable state

The RDIRA refers to stakeholder concerns for the potential for underestimation of pathogen numbers if viable but non-culturable (VBNC) cells of *E. amylovora* are not considered when only culture methods are used (Part B, page 53). However, the validity of this concern appears to be discounted by the following statements:

"The few studies on *E. amylovora* show that only a small proportion of the cells appear to enter a VBNC state. One study (Sly *et al.*, 2005) was unable to demonstrate recovery of cells to a culturable state suggesting that the VBNC state may be an irreversible stage towards cell death. Furthermore, the ability of *E. amylovora* to enter a VBNC state in or on any apple tissue is yet to be demonstrated." (Part B, page 53).

Given that the field of VBNC research is still relatively new, DPI&F considers that the potential for *E. amylovora* to convert to a VBNC state, and the role it may then play in the lifecycle and possible transmission of disease of *E. amylovora*, should not be discounted. The inability to revert cells into a culturable state does not mean that these cells are not capable of producing infection, and subsequently disease. It simply means with current scientific knowledge they were unable to be grown in culture.

See Recommendation 4

3.5. Chlorine treatment

The RDIRA concluded the fire blight risk assessment stating that a chlorine treatment of fruit harvested from symptomless orchards would manage the risks associated with fire blight. However, the RDIRA does not detail when in the pathway the chlorine treatment should occur, nor the measures that should be taken to ensure that fruit are not contaminated after the chlorine treatment. BA also acknowledges that "chlorine may not fully penetrate the calyx of the fruit and therefore would only slightly reduce the number of apples carrying fire blight bacteria in the calyx" (Part B, page 98). Similarly, there is no mention of requirements for the concentration of chlorine to be maintained, even though they discuss in several places (Part B, pages 64, 65 & 97) the need for the available chlorine concentration to be maintained at a certain level. The efficacy estimated for chlorine needs to be reduced in the light of new information on the asymptomatic infection of mature fruit (see section 3.1).

BA is also not explicit about the assumptions made in arriving at the reductions compared to the unrestricted risk values if chlorine were to be applied at the rate of 100 ppm (Part B, page 98). DPI&F believes that that process for use of chlorine as a mitigation measure for fire blight needs to be very clearly defined and concentrations of chlorine in the flotation tanks tightly monitored to ensure efficacy of the treatments.

See Recommendation 5

3.6. Areas free from disease symptoms

The RDIRA uses the presence or absence of symptoms in an orchard as an indicator of inoculum load (Part B, page 96). However, if sourcing fruit for export from areas free from disease symptoms is to be a mitigation factor, then there needs to be a connection made between the expression of symptoms and environmental conditions. For disease symptoms to appear, the correct environmental conditions must occur. *E. amylovora* requires wet conditions for the infection to develop. Hence, it may be misleading to survey orchards in a dry year or too early in the season.

In the 2004 RDIRA, BA stipulated that a registered export block would undergo three inspections per season on all trees in the season of export and the previous season. This approach has a great deal of merit in terms of providing a history of inoculum levels in an orchard over a longer period, and in a way less likely to be affected by the environmental conditions, such as weather. DPI&F recommends that the previous standard of a history of area or block freedom established by multiple inspections over two seasons should be restored, and these inspections should be unannounced.

DPI&F suggests that the proposal to inspect orchards between 4 and 7 weeks after flowering is not sufficient. Fire blight can occur later than this and as reported recently (see section 3.1), fruit can become internally infected. A strategy that is readily available is to use infection prediction models such as MaryBlyt, which is widely used in New Zealand. Inspection timing could be guided by the prediction of an infection period, which could be at any time in fruit development. Alternatively, orchards that experience an infection period during the present or previous season could be ruled out of the export market.

The new information outlined in section 3.1 indicates that it may be justified to require isolation of *E. amylovora* as part of the inspection process.

See Recommendation 6

3.7. Endophytic infections

Endophytic infection of *E. amylovora* was demonstrated first by Goodman (1954) and although it is most commonly associated with fruit found either on or very close to severely affected trees, it should not be ignored in the risk assessment. The RDIRA lists several instances where endophytic infections have been found in apples in the US and Canada (Part B, pages 55 & 56), but further on the RDIRA states:

"Endophytic infection of fruit .... has not been recorded in orchards free from symptoms of fire blight in New Zealand" and "the IRA team concluded that endophytic infection was not a risk factor for fruit sourced from orchards free of symptoms" (Part B, page 96).

A lack of record of endophytic infection in New Zealand is not an indication of absence of infection, if there are no documented studies showing that they have looked and been unable to find endophytic infection. DPI&F considers that even if the possibility is low, endophytic infection must still be considered as a possible source of infection, especially for fruit damaged during transport.

See Recommendation 7

3.8. Disposal of damaged / unsaleable fruit in Australia

There is no reference in the RDIRA to the guidelines to be followed for the disposal of injured (and potentially fire blight diseased) or unsaleable fruit from New Zealand. As there has been no indication as to the mode of importation of fruit (i.e. either in bulk bins for packaging in Australian pack houses or pre-packaged ready for wholesale distribution), DPI&F is concerned, in particular, about the prospect of waste fruit, from bulk bins regraded and packaged in Australia, being discarded in or near commercial orchards. As discussed in the RDIRA "The most likely mechanism of transfer of bacteria from discarded apples to a receptive site in a susceptible host is by browsing insects (AQIS 1998a). Discarded apples are attractive to a wide range of insects and this attraction may be increased by rotting" (Part B, page 78). The occurrence of the following scenario needs to be considered:

A bulk bin arrives in Stanthorpe from New Zealand. A percentage of fruit is asymptomatically infected (see section 3.1) or are injured during transport and infected with *E. amylovora* from epiphytic or calyx inoculum. The fruit is regraded after storage in Stanthorpe in Spring during flowering. An injured, yet still symptomless, apple is discarded in a dump pile at the back of the packing shed or in the inter-rows of an orchard block nearby. Fruit decays over a number of days or weeks and symptoms of fire blight appear over the course of a couple of rainy days. Symptomatic tissues start to ooze bacteria on to the surface of the fruit, and inoculum is then transferred from the rotting fruit to flowers by browsing insects, with potential for establishment of *E. amylovora* in Australian orchards.

DPI&F recommends either:

- that processing or repackaging of imported apples should not be permitted in production areas or within a certain distance of an orchard, and waste from wholesale or retail 'utility points' is disposed of as municipal waste i.e. capped landfill; or alternatively,

- the importation of apples should only be allowed if the fruit has been graded and packed in cartons and fruit in bulk bins should not be permitted.

If risk was mitigated by use of geographical constraints, it would be necessary to use fruit stickers that showed the country of origin (in addition to package markings). This would facilitate compliance checking (DPI&F understands that fruit marking would be required in any case, given the special risk requirements for Western Australia).

See Recommendation 8

3.9. *Definition and use of 'utility point'*

The development of likelihood estimates around utility points is complex and it is difficult to understand some of the estimates. For example, the estimates for 'Household and garden plants near utility points' (Part B, p. 75) seem to be too low, given that host plant species are quite numerous and common, and that many commercial premises have either garden beds and residential gardens onsite or next door. Are the estimates based on host surveillance data, or are they presumptive? It would improve transparency if the basis for each estimate was explained in more detail.

See Recommendation 9

4. European canker

European canker is caused by the fungus *Neonectria galligena*. The RDIRA states that the risk of *N. galligena* could be mitigated by sourcing apples from orchards free of disease symptoms (Part B, page 139).

4.1. *Trash*

No consideration seems to have been given to the ability of trash (or fruit stalks), especially in bulk bins, to cause injury to fruit in transit, and for this injury to result in the initiation of symptoms from an internal or latent infection. It is possible for a fruit with latent infection to be injured in a bulk bin during transport to Australia and subsequently to develop rotting symptoms which would make it unsaleable. This fruit may then be disposed of in a situation which would lead to further symptom development (i.e. in or near an apple orchard) and eventually to the production of inoculum.

See Recommendation 2

4.2. *Influence of the environment on symptom development*

Climatic conditions are critical for both inoculum production and infection by *N. galligena*. DPI&F considers that the RDIRA must define what constitutes suitable conditions for infection. Strategies must then be implemented as part of the orchard assessment and fruit handling protocols, to ensure that fruit intended for export is exposed to minimal periods of conditions favourable to disease development. This process is especially important considering that latent infections are known to occur, and fruit infected late in the season, and showing no obvious sign of rot symptoms, could be picked from these orchards (Part B, page 110).

See Recommendation 10

4.3. Disposal of damaged / unsaleable fruit in Australia

The RDIRA states that internal and latent infections are possible (Part B, page 105), and that European canker infections "could go unnoticed at harvest or during the early part of storage, and therefore could be transmitted in fruit as latent infections" (Part B, page 110). However, there is no discussion as to how injured or unsaleable fruit would be treated after arrival in Australia.

DPI&F recommends either:

- that processing or repackaging of imported apples should not be permitted in production areas or within a certain distance of an orchard, and waste from wholesale or retail 'utility points' is disposed of as municipal waste i.e. capped landfill; or alternatively,
- the importation of apples should only be allowed if the fruit has been graded and packed in cartons and fruit in bulk bins should not be permitted.

If risk was mitigated by use of geographical constraints, it would be necessary to use fruit stickers that showed the country of origin (in addition to package markings). This would facilitate compliance checking (DPI&F understands that fruit marking would be required in any case, given the special risk requirements for Western Australia).

See Recommendation 8

5. Apple leaf curling midge

DPI&F notes that the inspection rate for apple leaf curling midge (ALCM) has been set at 3000 fruit from each lot. This is a departure from the conventional inspection rate of 600 units from a lot. The justification for this is based on analysis including the expected prevalence of the pest (Part B, p. 168). DPI&F supports the application of case analysis in determining inspection requirements.

The proposed inspection protocol would reduce the risk to within Australia's ALOP and no further risk mitigation measure can be required. However, we note that prohibiting repackaging in production areas (see sections 3.8 and 4.3) would also assist in mitigating risk from ALCM.

See Recommendation 11

6. Other insects

DPI&F makes the general comment that the environment of the Queensland Granite Belt is more conducive than other production areas to many insect pests, and that this needs to be taken into account in completing estimates of the probability of entry, establishment and spread, and the potential impact. DPI&F has research data on canopy leaf wetness, which can be provided to Biosecurity Australia. It demonstrates that the internal canopy of an apple tree can have high relative humidity for long periods in day and night, that exceed the requirements of pathogens for penetration and infection.

See Recommendation 12