New Zealand - Ministry of Agriculture and Forestry

Comments by the Government of New Zealand

on

Biosecurity Australia's Revised Draft Import Risk Analysis Report for Apples from New Zealand December 2005

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Executive summary

This document is the Government of New Zealand's formal response to Biosecurity Australia's (BA) latest Revised Draft Import Risk Analysis Report (the Report) for apples from New Zealand. The New Zealand Government welcomes the publication of this Report, but notes that it is the third draft report in response to New Zealand's fourth formal request for access, made in January/February 1999. An expeditious resolution to this request for commercially meaningful apple access is sought.

We have some concerns with the Report. Following an explicit request from BA this document does not detail criticism of the semi-quantitative method of analysis used in the Report. Instead, this document focuses on the science and analysis presented in the Report and addresses perceived errors in fact and reasoning. In a number of areas we suggest new analyses of risk and, where appropriate, ask that BA adjust the values used in the model. In particular, we express concerns about the Report's treatment of the mode and volume of the potential apple exports to Australia, and provide comment on the proposed draft measures where these are either unnecessary or are not the least trade restrictive possible.

We note that the Report does not comment on the findings of the World Trade Organisation Dispute Settlement Panel and Appellate Body in the 'Japan – Measures Affecting the Import of Apples' dispute. This was disappointing, because New Zealand believes that the findings, in relation to the disease fire blight, are relevant for all apples in commercial trade, regardless of origin and destination.

The following summarises the key points of our submission:

I. Mode of trade

i. The Report focuses on New Zealand apple exports in bulk bins. However, only retail-ready, class 1 export quality apple fruit in a range of packaging, including cartons, bags and crates, are likely to be exported to Australia. Furthermore, routine post-harvest practices would ensure that fruit would always be exposed to a minimum of 10-14 days cold storage from harvest to retail sale.

ii. The New Zealand Government requests that, in preparing the final IRA for the import of apples from New Zealand, BA analyses the importation of mature apple fruit free of trash, packed in retail-ready packages such as cartons, bags and crates, separately from sorted and graded bulk fruit and proposes separate quarantine measures for each type of export, should any measures be required.

II. Volume of trade

i. Volume of trade is a significant parameter in any risk analysis that uses quantitative methodology. The Report sets the volume of trade for New Zealand apples at 200 million fruit annually. In terms of the Australian preferred premium sizes of 100-110-120 count fruit, this volume of apple exports would comprise 47% of all New Zealand apple exports. The New Zealand pipfruit industry estimates that the actual volume of exports is likely to be significantly lower, starting at about 5 million fruit and growing slowly to no more than 50 million fruit per year.

ii. The New Zealand Government requests that, in preparing the final IRA for the import of apples from New Zealand, BA base their analysis on an estimate of potential volume of imports of 50 million fruit with a range of 25 million to 75 million fruit only.

III. Fire blight

i. New Zealand maintains that no risk management measures are scientifically justified for fire blight on commercially traded apples.

ii. The likelihood that mature export quality apple fruit, which has been processed through routine postharvest practices, including cold storage, is infested with *E. amylovora* is **‘negligible’**.

iii. The likelihood of transfer of epidemiologically significant numbers of *E. amylovora* bacteria from a mature apple fruit to a host, at a time when both that host is susceptible and the climate is suitable for multiplication, cannot be differentiated from zero. The pathway is broken at this point and analysis of risks associated with fire blight should cease.

iv. The consequences of fire blight, should the disease ever become establish in Australia, would be **‘very low’.**

v. The New Zealand Government estimates that the unrestricted annual risk for fire blight is **‘negligible’**, which is below Australia’s appropriate level of protection (ALOP). Therefore, risk management measures for fire blight should not be required for imports of New Zealand apples into Australia.

IV. European canker

i. We note that no restrictions on apple trade were applied during the 20-year outbreak of European canker in Tasmania, and that during this time, there was no evidence of spread of this disease. The risks of European canker entering Australia as a result of New Zealand apple trade would be no greater than the risk associated with trade in Tasmanian apples during the outbreak, that is, the risk is **‘very low’.**

ii. The New Zealand Government assesses that the unrestricted annual risk for European canker is below Australia’s ALOP, and consequently risk management measures would not be required.

iii. Suggestions are provided on potential risk management measures for this pest, which are based on verification of area and site freedom based on the biology of the European canker pathogen, *Nectria galligena*.

V. Apple leafcurling midge

i. New Zealand assesses that the overall likelihood that apple leafcurling midge (ALCM) will enter Australia as a result of imports of apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in that area and subsequently spread within Australia is **‘extremely low’**.

ii. The annual risk for ALCM is **‘very low’,** which is below Australia’s ALOP. Therefore, risk management measures should not be required for this pest.

iii. If risk management measures were required for ALCM, the normal phytosanitary inspection of a 600 fruit sample would be more than adequate to detect the presence of viable ALCM cocoons at levels that might be of quarantine concern to Australia.

VI. Leafrollers

i. New Zealand assesses that the overall likelihood that leafrollers will enter Australia as a result of imports of apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in an area and subsequently spread within Australia is, at most, **‘extremely low’**.

ii. The annual risk estimation for leafrollers should be either **‘extremely low’** or ‘**negligible**’, which is below Australia’s ALOP. Therefore, risk management should not be required for these pests.

VII. Apple scab

i. New Zealand challenges the claim that apple scab has been eradicated from Western Australia. The Western Australian climate is generally unsuitable for the development of apple scab and the expression of scab symptoms in apple orchards is probably masked by the use of intensive fungicide programmes for the control of apple powdery mildew.

ii. Consequently, no phytosanitary measures for this pest should be required by Western Australia for apples of any origin.

VIII. Codling moth

i. This document provides new data, which indicates that the likelihood of codling moth entering Western Australia with New Zealand apples is, at most, **‘low’.** New Zealand also assesses that the likelihood of distribution of codling moth in Western Australia, following importation, would be, at most, **‘low’**. Consequently, the annual risk estimation for codling moth is **‘very low’**, which is below Australia’s ALOP. Risk management measures for codling moth should not be required for imports of New Zealand apples into Western Australia.

ii. This document provides data from New Zealand’s experience in the use of a systems approach to the management of codling moth in orchards and apple exports to Taiwan. New Zealand asserts that should risk management measure be required this systems approach over codling moth is all that is needed.

IX. Mealybugs

i. This document provides new data, which indicates a normal phytosanitary inspection of a 600 fruit sample, followed by remedial treatment if pests are detected, would appropriately manage the annual risk associated with this pest.

X. Risk management

i. New Zealand asserts that the Report’s suggestion of AQIS involvement in New Zealand phytosanitary inspection systems runs counter to the Single Economic Market concept, which both governments have endorsed, and to the tenor of discussions between BA and Biosecurity New Zealand in recent years on recognition of standards and reduced inspection regimes.

ii. New Zealand would not object to an audit of MAFNZ systems by AQIS officials for agreed phytosanitary measures for the export of apples to Australia, and we suggest an audit regime, which is commensurate with the particular dimensions of this issue and the sensitivities involved.

iii. New Zealand re-states its position that no measures are justified for the management of risks associated with fire blight.

iv. While emphasising that no measures should be required for European canker, this document provides comments and suggestions, based on the biology of the European canker pathogen, *Nectria galligena*, for verifying area and production site freedom.

New Zealand's comments on the Revised Draft Import Risk Analysis Report for Apples from New Zealand

1. Introduction

1. This document is the Government of New Zealand's formal response to Biosecurity Australia's (BA) latest Revised Draft Import Risk Analysis Report (the Report) for apples from New Zealand, published in December 2005. The Report is the third draft report in response to New Zealand's fourth formal request for access, made in January/February 1999.

2. New Zealand's response to the Report (this document) was prepared by Biosecurity New Zealand (BNZ) with input from New Zealand scientists (bacteriologists, plant pathologists, entomologists and risk analysts) and Pipfruit New Zealand. For ease of reference, it follows the structure and format of the Report, however not every section of the report has been commented on.

3. New Zealand welcomes the publication of the Report. An expeditious resolution to New Zealand's request for apple access that establishes commercially meaningful access for New Zealand apples is now sought. Phytosanitary measures should be used only where they are scientifically justifiable and then in the form that is least trade restrictive.

4. New Zealand has expressed strong concerns regarding the semi-quantitative method of analysis used in the Report; however, following explicit requests from BA officials, this document does not detail criticism of this approach. (New Zealand has already shared its views on the risk analysis methodology with BA in previous communications). Instead, this document examines the science and analysis presented in the Report and addresses a number of errors in fact and reasoning. It provides comment on areas where the process and the interpretation of the science are not transparent and/or are erroneous, and provides more recent and relevant data where those presented in the Report are dated. In a number of areas this document suggests new analyses of risk and, where appropriate, asks that BA adjust the values used by the model (e.g. volume of imports).

5. This document also comments on the proposed draft measures where these measures are either unnecessary or are not the least trade restrictive measures possible. The absence of comment on any part of the Report should not be taken as an indication that New Zealand agrees with all the statements contained in such parts of the Report.

6. New Zealand is disappointed that the Report does not comment on the findings of the World Trade Organisation (WTO) Dispute Settlement Panel and Appellate Body in the 'Japan – Measures Affecting the Import of Apples' dispute (Japan-Apples) (WTO 2003 & 2005). The factual findings in this dispute represent conclusions based on a thorough examination by independent scientists of the most relevant and current scientific evidence. The findings are relevant for all apples in commercial trade, regardless of origin and destination. Accordingly, New Zealand

strongly asserts that the findings in this case are relevant and applicable to New Zealand apples and, therefore, that no fire blight-related measures are required on New Zealand apples. Where appropriate, the fire blight-related scientific evidence presented in the Japan-Apples case is cited and assessed.

7. This document will comment in detail on New Zealand's concerns regarding the mode and the volume of the potential apple exports to Australia. Analysis of the Report suggests it is the theoretical possibility of risks associated with imports of "sorted and graded bulk fruit" that trips the risks associated with fire blight over Australia's appropriate level of protection (ALOP).

8. The estimated volume of apple imports from New Zealand is a key parameter of the semi-quantitative model and has a significant impact upon the values of likelihood generated by the model. It is New Zealand's strong belief that the estimated import volume of 200 million individual fruit is highly speculative and excessive.

9. On a related issue it is pertinent to point out that almost all (>99%) apples marketed in Australia are waxed. The New Zealand apple industry is not set up for waxing of small runs of fruit but if this is what the market requires then it is probable that to meet market demand most New Zealand apples too would be waxed prior to packing. This too may have a significant impact on some risk analysis and has not been fully considered by the Report.

2. Mode of New Zealand Apple Exports

10. The Report defines the scope of the analysis as "the importation of mature apple fruit free of trash, either packed or sorted and graded bulk fruit from New Zealand". The Report goes on to state that regarding sorted and graded bulk fruit "Biosecurity Australia discussed this issue with New Zealand on several occasions but has not received any clear indication on the mode of exports".

11. However, the New Zealand pipfruit industry expects to export only retail-ready, class 1 export quality fruit in a range of packaging including cartons, bags and crates and advises that this fruit will be exposed to a minimum of 10-14 days cold storage from harvest to retail sale. In fact from the New Zealand pipfruit industry point of view this form of export is considered less trade restrictive than sorted and graded fruit in bulk bins.

12. New Zealand requests that when discussing the unrestricted import of New Zealand apple fruit BA should take into consideration the following:

i. The fruit will be class 1 export quality.

ii. The great majority of consignments will be packed in retail-ready packages (cartons, bags crates etc.) not bulk bins.

iii. The consignments will be 'retail-ready' and 'just-in-time', i.e. they will be packaged only a few days before shipment ready for immediate use by retail outlets. (This is the standard procedure for shipment of NZ apples to the discerning supermarkets of Europe and the volume of repackaging required is very low indeed even after 35+days at sea.)

iv. The fruit will always be subject to a minimum of 10-14 days cold storage from harvest time to time of retail sale.

> The New Zealand government **requests** that, in preparing the final Import Risk Analysis for the import of apples from New Zealand, Australian authorities analyse the importation of mature apple fruit free of trash, packed in retail-ready packages such as cartons, bags and crates, separately from sorted and graded bulk fruit and propose separate quarantine measures for each type of import, should any measures be required.

3. Volume of imports

13. In its comments on the 2004 Revised Draft Import Risk Analysis Report for Apples from New Zealand (MAFNZ 2004) New Zealand estimated the volume of apple fruit likely to be exported to Australia annually would be in the region of 50 million individual fruit. The Report, however, states that "This issue was discussed further with New Zealand and Australian industry representatives but conflicting information on the potential volume was provided." The Report then restates BA's earlier estimate of 200 million fruit per year or 20% penetration of the market (range 100 million – 400 million fruit or 10% - 40% of the market).

14. As noted above, it is New Zealand's strong belief that the estimated import volume of 200 million individual fruit is highly speculative and excessive. The Report's estimate is four times that of New Zealand. In terms of the range used, New Zealand strongly considers the top end of the Report's estimate to be extreme and even the bottom-end estimate is only likely to be achieved if the New Zealand estimate were out by a factor of two.

15. Pipfruit New Zealand advises that the Australian market is dominated by supermarket chains which control approximately 80% of all apple sales. Their supply specifications for apples are for export class one fruit. New Zealand apple fruit exported to Australia would only be suitable for the market if it complied with these high-quality specifications. For this reason all apples exported to Australia will be class one export quality. Further, these apples will be packaged retail-ready (i.e. packed in cartons, bags crates etc. as is standard procedure for supermarket chains).

16. There are considerable differences in the variety mix produced by the Australian and New Zealand apple industries, with many major New Zealand varieties uncommon in Australia (Table 1 below).

Table 1. Variety mix of apples grown in Australia and New Zealand

	Australia	New Zealand
Pink Lady	18.5%	3%
Sundowner	5%	0%
Red Delicious	20%	0%
Golden Delicious	6.5%	0%
Granny Smith	22%	3%
Fuji	6.5%	10%
Royal Gala	11%	30%
Braeburn	1%	28%
Pacific Series	0%	12%
Cox	0%	7%
Jazz	0%	5%
Other	9.5%	2%

(Sources: Pipfruit Industry Statistical Annual 2005 (Pipfruit NZ) and the Australian Bureau of Statistics 2004)

17. In order for New Zealand suppliers to compete against Australian suppliers with these varieties, they will need to overcome an extra $5 per carton cost, representing the cost of entry and transportation. (Current average container costs (1,176 cartons) of $4,500, plus bunker adjustment fee $1,000, plus an estimated allowance of 35 cents per box for export entry into Australia).

18. Currently all of Australia's domestic demand is supplied from domestic sources and the two major supermarket chains, with an 80% share of the market, have a series of existing supply arrangements with domestic producers and their agents. These supermarkets are on record several times as stating that they prefer to support local producers.

19. Under these circumstances the only opportunity for New Zealand exporters is to supply small volumes of high quality novel varieties that Australian consumers are not currently familiar with and that may not attract large market share. A marketing strategy will be required to grow the total consumption of apples so as to complement existing local supplies.

20. In recent years the New Zealand supply base has shrunk in response to international demand from 20 million export cases two years ago to 14 million this year. Most fruit is now committed to programmed supply with major supermarkets in Germany, UK and the USA. These are unlikely to be diverted to another market such as Australia irrespective of the price. To suggest that in the short term the Australian domestic market will absorb an extra two million cases is not supported by the facts outlined above.

21. In the medium term New Zealand expects that its unique varieties will establish a foothold in Australian stores and volumes will increase slowly. However, even New Zealand's most widely planted new variety, Jazz™, has already begun a planned 300,000 cases of production in Australia to serve the domestic market. In the longer

term, the joint venture investment between the New Zealand and Australian industries in Prevar Ltd will deliver exactly the same varieties to both countries

22. The two million cases suggested by the Report would comprise 13% of New Zealand's total current export crop. In terms of the Australian preferred premium sizes of 100-110-120 count fruit, it would comprise 47% of all New Zealand available exports. (ENZA average submissions 1999-2003). For the Report to suggest in the short, medium or even longer term that New Zealand will supply such a significant volume or that Australia will be capable of absorbing such a volume cannot be justified. The volume of imports initially will be experimental and is likely to be less than 50,000 cases. New Zealand's pipfruit industry's expectations are that this volume is likely to grow slowly to no more than 500,000 cases per year.

23. New Zealand's estimate of the volume of apples likely to be exported to Australia remains 50 million fruit and further suggests a range of 25 million to 75 million fruit.

The New Zealand government **requests** that, in preparing the final Import Risk Analysis for the import of apples from New Zealand, Australian authorities base their analysis on an estimate of potential volume of imports of 50 million individual fruit with a range of 25 million to 75 million fruit.

4. Fire blight

General comments

24. The Report proposes phytosanitary measures that are inconsistent with the significance and biology of the fire blight pathogen, *Erwinia amylovora*, on mature export quality apple fruit. New Zealand asserts that the proposed measures (growing season inspection and chlorine dip) to mitigate the risk of introduction, establishment and spread of fire blight via New Zealand apples are not scientifically justified and are not the least trade restrictive available.

25. New Zealand asserts that fire blight is not spread by the pathway (i.e. commercial export of New Zealand apple fruit) and that the requirements for pest free place of production and treatment should be removed.

26. International scientific literature, the international scientific community and the World Trade Organization disputes panel[1] (WTO 2005) have all concluded, based on all the available science, that there is a negligible risk that fire blight would be spread via the importation of commercial apple fruit. This determination is validated by the demonstrable fact that in the long history of trade in apple fruit between countries that have fire blight and countries that are free of the disease no case of natural introduction, establishment and spread of the fire blight pathogen, *E. amylovora*, has ever been reported associated with apple fruit.

27. Fire blight was first recorded in New Zealand in 1919 and imports of apple fruit continued to Australia for a further two years before suspension of imports from New Zealand. During this time, Australia remained free of fire blight.

28. Over the last 10-20 years New Zealand has exported millions of apple fruit without any phytosanitary measures against fire blight to four countries with commercial apple and pear industries (China, India, Pakistan and Russia) yet these countries remain free of fire blight. It is particularly worth noting that 790 million apple fruit, sourced from throughout the country, have been exported to Taiwan in the last 15 years (nearly 90% of this since 1998). The United States has exported 53 billion apples world-wide over the last 37 years including 22.1 billion apples, to its top ten fire blight free export markets with no spread of fire blight through these exports (WTO 2003).

29. In Europe a study conducted by Jock et al. 2002 showed that the distribution of strains of *E. amylovora* throughout Europe and the Mediterranean region were of an ordered occurrence of DNA fingerprint types. There was no observed mixing of DNA fingerprint types despite uncontrolled trade of fruit throughout Europe. If trade in fruit had distributed the disease the east European type would have been found in central and Western Europe, but this was not observed.

30. Furthermore, despite extensive efforts researchers have been unable to demonstrate, even experimentally, the dissemination of *E. amylovora* from discarded apple fruit to susceptible hosts resulting in subsequent establishment of new infections

[1] Supported by four independent international experts.

of fire blight. Hale et al. (1996) reported that there was no spread of *E. amylovora* from either calyxes or surfaces of fruit, which had been heavily inoculated with *E. amylovora*, to susceptible apple flowers that were in close proximity.

31. Taylor et al. (2003) showed that populations of *E. amylovora* on calyxes of 1,800 apple fruit, discarded in an apple orchard, decreased rapidly and were not spread to potential vectors or susceptible hosts despite favourable conditions.

32. Roberts (2002) in a joint US-Japan experiment harvested thousands of fruit at varying distances (0-300 m) from point sources of fire blight inoculum and was unable to detect epiphytic or endophytic populations of *E. amylovora* in these fruit. Finally, in the report of the WTO Disputes Panel on Japan-Apples: Article 21.5 (WTO 2005) in referring to evidence presented by Japan (a draft research paper by Tsukamoto *et al.*) on the possibility of transfer by flies the Panel commented in para 8.65:

> "we conclude that the experts have confirmed the assertion of the United States that the Tsukamoto *et al.* (2005b) study *does not establish that flies would serve as a vector which would complete the pathway*. In particular, the conditions of the experiment are too removed from natural conditions. Comparatively, we note that the study by Taylor *et al.* (2003), carried out in natural conditions, *did not* recover bacterium from insects." [Emphasis added]

33. The weight of scientific evidence supports the hypothesis that mature apple fruit **do not** transmit fire blight and that that mature, symptomless apple fruit **do not** harbour populations of epiphytic *E. amylovora* bacteria capable of transmitting fire blight. Also, that under natural conditions mature apple fruit **do not** harbour endophytic populations of fire blight bacteria.

34. Scientific evidence and documentation confirms that, in the rare event that the calyx of a mature fruit is infested with *E. amylovora*, the inside of the apple fruit **does not** become infested. There is no scientific evidence that a calyx-infested apple fruit will transmit fire blight.

35. There is a discontinuity in the pathway. No evidence has ever been presented, by the Report or elsewhere, to demonstrate that any pathway for the introduction of fire blight via apple fruit will ever be completed. The likelihood of entry and dissemination of *E. amylovora* from an infested fruit to a susceptible host is only a theoretical possibility. International guidelines and norms for risk analysis preclude the use of theoretical possibilities.

36. The Report's case rests on the assumption that if a lack of vectoring cannot be demonstrated then vectoring must occur. There is no scientific evidence to suggest that this might be the case.

Specific comments regarding the Report

Probability of importation

37. **Importation step 1**: The Report suggests that *E. amylovora* is present in every apple orchard in New Zealand. No justification given for this assertion.

38. The Report makes the assumption that: if New Zealand MAF cannot provide data to show any area in New Zealand is free of *E. amylovora* and that, for example, in the 1994/5 export season between 24.5% and 63.1% of orchards were withdrawn from the Japan export programme because of the detection of fire blight in the orchard and/or in a 500 m buffer zone, then they have to assume all orchards have *E. amylovora*. New Zealand strongly refutes this assumption.

39. The Report states "*Erwinia amylovora* was detected in New Zealand both from orchards with fire blight symptoms (Hale et al., 1987; Clark *et al*., 1993) and those without symptoms (Clark *et al*., 1993)." However, Clarke et al. (1993) clearly demonstrated that there was a close correlation between the results of intensive apple orchard inspections for fire blight symptoms and tests for *E. amylovora* in calyxes of apple fruit. Using DNA hybridisation detection methodology c. 60,000 apple fruit were tested from 10 orchards free of fire blight symptoms and no *E. amylovora* was detected.

40. The likelihood that apple fruit sourced from orchards with no fire blight symptoms will be infested with *E. amylovora* is very low and that the presence or absence of the bacterium in an orchard should not be used as an indicator of risk in Imp1. A more valid indicator would be the incidence of active fire blight. In this regard it is reasonable to assume that depending on weather and other factors anything from 36.9% and 75.5% of orchards are free of fire blight (i.e. the converse of the data presented above on the export of New Zealand apples to Japan). In many years only 7% of orchards are treated for the control of fire blight. Furthermore the orchards of central Otago are completely free of fire blight symptoms. If something cannot be demonstrated it cannot be assumed that the opposite must be true.

The New Zealand government asserts that Imp1 should be expressed as follows: The likelihood that fire blight is being actively expressed in the source orchard in New Zealand is Moderate: uniform (0.3 - 0.7). Whatever distribution is finally settled on a value of "1"cannot be justified.

41. **Importation step 2:** The Report's representation of Imp 2 is misleading. The statement "Likelihood that picked fruit is infested/infected with *E. amylovora*" implies that even one bacterium cell is of epidemiological significance. New Zealand has never disputed that infestations of *E. amylovora* can occasionally be detected on the calyx of mature fruit harvested from orchards with severe symptoms of fire blight on apple trees or other host plants. However, New Zealand disputes absolutely that any of these infestations have any epidemiological significance.

42. There is no scientific evidence that demonstrates that mature apple fruit can either:

i. Harbour endophytic populations of *E. amylovora,* or

ii. Be naturally infected with fire blight from other contaminating sources.

Endophytic populations of *E. amylovora*

43. The Report presents two research papers as evidence that endophytic populations of *E. amylovora* could occur in mature apple fruit <u>in exceptional</u>

circumstances. New Zealand disputes the conclusions drawn by the Report. The research of van der Zwet et al. (1990) did not detect endophytic populations of *E. amylovora* in mature apple fruit. Van der Zwet et al. (1990) only recovered endophytic populations from immature fruit sampled from trees immediately adjacent to host plants with fire blight symptoms. These fruit were sampled in August and apple maturity would not have been reached for another 6 weeks. Other extensive efforts to determine if endophytic populations exist in mature apple fruit also failed to do so (Roberts *et al*. (1992; 2002)). This assessment is consistent with the 2003 findings of the WTO Disputes Panel on Japan Apples para 8.127 – 8.128 (WTO 2003).

44. The Report suggests that *E. amylovora* was infested in "14.7% of immature fruit (Clark *et al*., 1993) from orchards with no fire blight symptoms". However, in reference to this statement it is unclear how the Report has derived this figure. Clark *et al*. (1993) stated that *E. amylovora* was not detected in orchards free of fire blight.

45. The Report concludes from work by Mundt and Hinkle (1976) that *E. amylovora* may reside in fruit. However, the research conducted by Mundt and Hinkle (1976) was not specifically designed to determine if *E. amylovora* was associated with seed. Instead these researchers were examining the presence of bacteria within ovules and seed. They did not link *E. amylovora* with the host nor did they confirm the identification of *E. amylovora* by pathogenicity testing. The suggestion that *E. amylovora* may be found on apple seed is contradicted by work conducted in the US and New Zealand that specifically looked for *E. amylovora* in seed (Hale and Clark 1990; van der Zwet *et al*. 1990). New Zealand refutes the Report's supposition that the work of Mundt and Hinkle (1976) suggests that *E. amylovora* may reside in fruit.

46. The Report makes a further assumption that because *E. amylovora* is present in the vascular tissue of an apple tree, it could find its way into fruit. This has never been demonstrated or observed and would be unlikely considering that the abscission layer acts as a natural barrier to desiccation and invasion of fruit by micro organisms. Furthermore, in the report of the WTO Disputes Panel on Japan-Apples Article 21.5 (WTO 2005) in referring to evidence presented by Japan (a draft research paper by Azegami, *et al.*) on the possibility of mature symptomless apples being infected by *E. amylovora* through movement of bacteria across the abscission layer the Panel commented in para 8.52:

> "In light of the opinion of the experts, we conclude that the Azegami, *et al*. (2005) study does not support the conclusion that apples would become mature and symptomless and yet be latently infected in the natural conditions of an orchard."

47. The final Import Risk Analysis for apples from New Zealand should state unambiguously that from Imp 2 on it will not consider the possibility of endophytic infections of *E. amylovora* in commercial imports of apple fruit.

Infection of apples from other contaminating sources

48. New Zealand agrees that on rare occasions low levels of epiphytic populations of *E. amylovora* may exist on the calyx of mature apples harvested from orchards containing heavily infected host plants of any kind. However, it is important to stress

that *E. amylovora* populations on the apple calyx are in a state of continuous decline. Detection of *E. amylovora* on calyxes of maturing fruit declined from 50% of fruit sampled for fruitlets, to 3% for mature fruits (Hale et al. 1987). Populations of *E. amylovora* on calyxes of inoculated and naturally infested apples declined in cold storage and did not increase to detectable levels when incubated at room temperature (Hale and Taylor 1999).

49. Populations of *E. amylovora* inoculated into calyxes of apple fruit and stored at 2^{o} C decreased from 10^6 to 10^2 cfu over a 20-day cold storage period (Taylor and Hale 2003). Infestations of 10^6 cfu on calyxes of discarded apple fruit decreased to 10^2 cfu per calyx in 20 days (Taylor et al. 2003). These studies further support the conclusion of Roberts et al. (1998) that the apple calyx is not an environment that supports the growth or survival of *E. amylovora*.

50. Populations of *E. amylovora* that are associated with calyxes of mature fruit at harvest are at levels unlikely to be of epidemiological significance. Several studies indicate that the numbers of bacteria found on calyxes from mature export quality apples at harvest would be les than 10^4 cfu per calyx.

51. Taylor et al. (2003) and Thomson (1986) detected populations of 10^5- 10^7 cfu on flowers that developed into healthy fruit. Thomson and Gouk (2003) demonstrated that flowers more than 4 – 5 days old did not support growth of *E. amylovora*. From this point on populations of *E. amylovora* are in a state of decline. The declining populations on calyxes of these fruit after approximately 100 days would proportionally decrease to less than 10^4 cfu per calyx. Van der Zwet et al. (1990) detected only 1- 50 cfu per calyx of immature fruitlets sampled approximately 6 weeks prior to harvest.

52. In conclusion, there is no evidence that any infestation of calyxes of mature apple fruit have epidemiological significance.

53. **Importation step 3**: Contamination of clean fruit at harvest would be unlikely as the likelihood of populations of *E. amylovora* on leaf and fruit surfaces occurring at harvest is negligible. It is well documented that *E. amylovora* on leaf and fruit surfaces have very short survival times when exposed to UV light and other elements. For example, Dueck and Morand (1975) did not detect populations of *E. amylovora* from apple leaf samples collected at harvest. "*E. amylovora* is not generally considered to be a very good epiphyte and populations usually decline rapidly on most flowers or leaves with a few hours or days" (Thomson 2000). Consequently by harvest time bacterial populations on leaf and fruit surfaces are either non-existent or insignificant. Any contention that an individual cell of *E. amylovora* that might be present on the skin of an apple has any epidemiological significance is strongly refuted.

54. **Importation step 4**: The effects of fluctuating temperatures during routine postharvest procedures in New Zealand pack houses, and cold storage before during and after transportation, are detrimental to the survival and growth of *E. amylovora* on calyxes of apple fruit. The Report does not take into full account the effect these postharvest procedures would have on the rate of decline in *E. amylovora* populations and therefore overestimates the infestation rate of *E. amylovora* on mature apple fruit.

55. New Zealand has routine commercial quality systems in place that ensure that wounded or bruised fruit would not be exported. All pack houses in New Zealand conduct routine grading out of damaged fruit. This would result in a significant reduction in fruit that could harbour bacteria.

56. There have been reports that suggest that *E. amylovora* can survive on mature apples after cold storage and in some cases apples have developed blight symptoms in storage (Anderson 1952; Goodman 1954; Dueck 1974; Nachtigall et al. 1985; van der Zwet 1990). However, in all of these cases the fruit were wounded and a high inoculum levels (*ca* 10^9 CFU ml/1) injected into the apple cortex. The above reports do not reflect the conditions encountered naturally or the levels at which *E. amylovora* would be likely to infest mature apples. Van der Zwet *et al*. (1990) reported that fruit collected from blighted and blight-free orchards adjacent to infected orchards developed internal fruit blight symptoms in storage. However, they noted that symptoms were difficult to distinguish from those of other fruit rots and they did not isolate *E. amylovora* from the blight-like symptoms seen in storage to confirm the causal agent.

57. Sholberg et al. (1988) did not conduct experiments on calyx-infested apples. The experiments in this paper were conducted on surface-borne populations of naturally infested and artificially inoculated apples. The naturally infested apples at harvest were found to be contaminated with *c.*10^3 cfu per ml. These apples were stored at 2°C and were only sampled and assayed for the presence of *E. amylovora* after 5 months. *E. amylovora* was not detected on the naturally infested apples after this cold storage period. It is highly likely that these surface-borne populations had died out months earlier. Populations of *E. amylovora* on artificially inoculated apples, swabbed with of 10^7 cfu per ml, declined in cold storage to undetectable levels after several months. The high inoculum level on these fruit is not reflective of the level likely to be naturally encountered at harvest on infested fruit. The authors concluded that "possibly cold storage alone could be used as a method to assure countries free of fire blight that the apples they are importing are free of epiphytic *E. amylovora*".

58. The period of cold storage would have a significant impact on epiphytic populations of *E. amylovora* on the apple calyx (the only place *E. amylovora* has been demonstrated to reside on mature apple fruit). Populations of *E. amylovora* on calyxes of inoculated and naturally infested apples significantly decrease in the first few days of cold storage at 2.0°C (Hale and Taylor 1999; and Taylor and Hale 2003). In a study conducted on fruit harvested from an orchard with fire blight symptoms *E. amylovora* was detected in 2 % of apples before cold storage but not in any fruit after 25 days of cold storage under commercial conditions at 2°C (Hale and Taylor 1999). Populations of *E. amylovora* on apple fruit infested with 10^4 cfu decreased to non-culturable levels after 14 days cold storage and apple fruit infested with 10^2 cfu decreased to non culturable levels after 8 days (Taylor et al. 2003). As mentioned above it is unlikely that calyxes of mature export quality apples at harvest would be infested with populations greater than 10^4 cfu and therefore populations, even if they were to occur at this level, would not survive a cold storage period of 14 days.

59. The estimated probability that 3.9 % of the total number of apples imported from New Zealand would be infested with *E. amylovora* is an overestimate. The calculation of this probability did not factor in or fully consider:

- That not all orchards are infested with *E. amylovora*.
- The numerous variables associated with different varieties that would affect infestation levels of *E. amylovora*, e.g. different harvest dates, open and closed calyxes, and susceptible and resistant varieties.
- The low populations, if any, of *E. amylovora* present on the apple calyx.
- The detrimental effect of routine post harvest practices on population levels of *E. amylovora* on apple fruit.

60. There is no scientific evidence to suggest that, on the rare occasions that a small number of infested calyxes of mature fruit might be found at harvest, the low levels of *E. amylovora* present would survive routine post harvest process. Any contention that an individual cell of *E. amylovora* that might be present on the calyx of an apple has any epidemiological significance is strongly refuted.

61. **Importation step 5**: As mentioned above epiphytic survival outside the apple calyx at harvest is unlikely and thus no bacteria would be available for the contamination of clean fruit. The likelihood value used by the Report for Imp 5 must therefore be reduced by several orders of magnitude.

62. **Importation step 6**: As mentioned above cold storage would have a negative impact on any small populations of *E. amylovora* remaining on apple fruit, including on the calyx, and specifically would reduce populations of *E. amylovora* of less than 10^4 cfu to unculturable levels.

63. **Importation step 7**: If contamination is improbable at Imp 5 then it is significantly more improbable at Imp 7 where all surfaces are essentially free of *E. amylovora* and the fruit is not moving relative to each other. The likelihood that clean fruit is contaminated at Imp 7 cannot be differentiated from zero.

64. **Importation step 8**: Imps 4 -8 are all part of the cool chain and consequently populations of *E. amylovora* are in decline at every step of the process. The Report's suggestion that the likelihood of Imp8 should be represented as a value of '1' cannot be sustained; a much lower value must be used.

Probability of entry, establishment and spread

65. As discussed above the majority of New Zealand apple fruit exported to Australia will be shipped as retail-ready, class 1 export fruit in a variety of retail packaging (e.g. cartons, bags and crates). Consignments will be packaged, out of cold storage, only a few days before shipment ready for immediate use by retail outlets. This is the standard procedure for shipment of New Zealand apples to the discerning supermarkets of Europe and the volume of repackaging required is very low, even after 35 days or more at sea. All apple fruit will always be exposed to temperature fluctuations and a minimum of 10 days cold storage from the time of harvest to time of retail sale. These criteria should be considered as part of the definition of unrestricted access.

66. The Produce Marketing Association (PMA) of Australia has advised that any "reconditioning" of retail-ready packs is done at facilities adjacent to wholesale markets in metropolitan areas well away from commercial orchards. In Sydney alone

there are at least eight such facilities. Also if fruit for some reason does go "out of specification" it is either sold quickly at the store or returned to a wholesale market for sale in other retail outlets.

67. Based on the above, the Report's analysis of issues around exposure of host plants near utility points, particularly commercial fruit crops near orchard wholesalers requires reassessment. The estimate of '1' for the latter exposure combination must be adjusted downwards significantly.

Exposure

68. In the vast range of studies on the biology of *E. amylovora* the only, demonstrated, sources of primary inoculum are over wintering cankers. Several mechanisms have also been demonstrated to vector the pathogen from these cankers to open flowers. No other pathway has been proven to be the origin of primary inoculum for new infections.

New Zealand asserts that the likelihood that mature export quality apple fruit that has been processed through routine post harvest practices and undergone a further cold storage period in transit is infested with *E. amylovora* is negligible.

69. *Location of bacteria*: New Zealand agrees that on rare occasion's mature export fruit at harvest may contain very low populations of *E. amylovora*. (Generally, populations of *E. amylovora* have only been found on apple calyxes when fruit has been sourced from severely infected orchards.) However, the likelihood that there would be any surface populations of *E. amylovora* present on mature export quality fruit is negligible. Hale et al. (1987) did not detect surface populations of *E. amylovora* on mature fruit sourced from severely infected orchards. Furthermore subsequent post harvest practices (apple washer, cold storage, etc.) would further reduce surface populations on fruit and on the calyx in the unlikely event that they occurred.

70. *Survival*: The Report's statement "When cores are discarded into the environment, nutrients released from damaged cells in apple cores could encourage viable bacteria in the calyx to multiply" is unsubstantiated. This has never been demonstrated to occur. These researchers discarded 1,800 apple fruit with calyxes infested with high levels of *E. amylovora* into an orchard environment with conditions conducive for fire blight to occur. Bacterial populations decreased significantly and at no time did multiplication occur despite extensive decay of the infested apples (Taylor et al. 2003).

71. *Transfer mechanism*: As above, the rotting of an apple leading to multiplication of fire blight bacteria resulting in the production of bacterial ooze has never been demonstrated. Van der Zwet and Kiel, (1979) state that pollinating insects are rarely seen in contact with ooze produced by over wintering cankers, the same would apply to ooze from apples if this were to occur. Pollinating insects have been recorded as distributing *E. amylovora* from flower to flower (Hildebrand et al. 2000; van der Zwet and Kiel 1979) but it is unlikely that these insects would visit both the infested calyx of a discarded apple and a susceptible host within the short space of time required to

vector epidemiological significant quantities of *E. amylovora*. Indeed dissemination of *E. amylovora* by an insect vector from thousands of heavily infested apple calyxes to a susceptible host did not occur despite favourable conditions Taylor et al. (2003).

72. As described above Japanese work on this issue failed to convince the WTO Disputes Panel (WTO 2005) that insects were a reasonable transfer mechanism even in the laboratory. Insect and mechanical transmission from an infested apple to a susceptible host has never been demonstrated or documented to occur. Continued discussion of this issue is merely theoretical speculation about possibilities.

73. *Inoculum dose*: Schroth *et al*. 1974 concluded that "fire blight is a disease where inoculation often is accomplished in nature by massive rather than low dosages of inoculum". This conclusion was further supported by research conducted by Beer *et al*. (1975); and Taylor *et al*. (2003) which showed approximately 10^6 cfu of *E. amylovora* is required to initiate successful infection on a susceptible flower in an orchard environment.

74. Thomson (1986) observed on several fire blight hosts, including apple, populations of *E. amylovora* ranging from 10^3 to 10^7 cfu per flower without causing symptoms. The population levels of *E. amylovora* required to cause disease in this study far exceeded those found in previous studies on infested apples at harvest (Hale *et al*. 1987; van der Zwet *et al*. 1990; Clark *et al*. 1993), after cold storage (Taylor & Hale 2003) and apples discarded in an orchard (Taylor *et al*. 2003). The probability that low levels of *E. amylovora*, associated with apple fruit, are capable of spreading to a susceptible host and causing infection is so small it cannot be distinguished from zero.

75. *The reproductive strategy of the pest*: *E. amylovora* may divide approximately every 20 minutes in a Petri dish with appropriate nutrient under optimum conditions in the laboratory and at this rate it is possible one bacterium may produce 10^6 cfu in 24 hours. However, this simply does not occur in an orchard environment as many studies conducted on the population dynamics of *E. amylovora* on apple flowers have demonstrated (Beer *et al*. 1975; Taylor *et al*. 2003; Thomson 1986). Thomson 1986 showed that 10^3 cfu of *E. amylovora* required 4 days to reach levels greater than 10^6 cfu on apple flowers. Taylor *et al*. 2003 in a study to elucidate the inoculum threshold required to cause fire blight found that populations of *E. amylovora* on flowers inoculated with either 10^2 or 10^1 cfu increased very slowly over 10 days to reach 10^6 cfu. In another orchard where climatic conditions were more conducive for fire blight development 10^1 cfu increased to 10^7 cfu per flower over 4 days (Taylor *et al*. 2003).

76. *Minimum population needed for establishment*: As above it has been clearly demonstrated that bacterial population dynamics that occur in the laboratory are completely different to those in an orchard. Therefore, New Zealand asserts that the Report should only focus on studies that have occurred in orchards. For example, it has never been demonstrated that one bacterium is capable of initiating fire blight in an orchard. In fact low populations of *E. amylovora* are considered to be of little epidemiological significance (Schroth *et al*. 1974; Thomson 2000; Taylor *et al*. 2003).

77. The lack of fire blight observed with lower inoculum doses (Norelli & Beer 1984; Hale et al. 1996; Taylor et al. 2003; Thomson 1986) confirms that the efficiency/probability of a small population to incite disease is much less than that of

a large population.

78. *The method of pest survival*: It has been considered that survival in soil is of little epidemiological significance (Thomson 2000).

79. *Probability of spread*: As the Report states the presence of bacterial ooze (signifying high populations of *E. amylovora*), accompanied by warm temperatures and rain would provide ideal conditions for spread and infection. However, as previously stated in this document, it is very difficult to envisage a scenario where imported apples would provide a source of bacterial ooze. This hypothetical situation has never occurred; there is no scientific evidence for this and no documented occurrences.

80. *Potential vectors*: The Report suggests that "Of the 27 insect vectors listed in van der Zwet and Keil (1979), Australia has either the same species or a closely related species (AQIS, 1998a)". However, an examination of these putative insect vectors indicates that most are unlikely to transmit fire blight, because they do not commonly visit both discarded fruit and the blossoms or wounds of susceptible hosts. The only potential exception is the bee, but as discussed in paras. 71 & 72 and below even this is only a highly improbable, theoretical possibility that has never been demonstrated. International guidelines and norms for risk analysis preclude the use of theoretical possibilities.

81. The Report discusses the possibility of *E. amylovora* being vectored from discarded apple fruit to a susceptible host by insects. This argument has been rebutted a number of times previously. We reiterate the key points here:

– Export quality apples exhibiting no symptoms of fire blight have no endophytic populations of *E. amylovora* present.
– On rare occasions there may be epiphytic populations of *E. amylovora* present on the calyx but the numbers present are of no epidemiological significance.
– Populations of bacteria on the calyx are not multiplying; they are in fact declining.
– Bacterial ooze (the only source of significant *E. amylovora* inoculum) has never been observed in field collected mature apple fruit.
– The cut surface of a discarded apple (as shown in Report Figure 4.) may in fact expose the calyx (and *E. amylovora* if it were present) to insects but it also exposes the fruit surface to a range of invasive bacteria and fungi which aggressively compete for food resources. Under these circumstances any *E. amylovora* populations that may be present will be further suppressed.
– No vectors have ever been demonstrated to transfer *E. amylovora* from a discarded fruit to a susceptible host. The fact that this cannot be demonstrated not to occur does not supply grounds for the inference that it does.
– Few insects have feeding habits or other biological traits that would lead to an assumption that they move between a discarded fruit and a susceptible host even occasionally.
– Insect inoculation from discarded apples to susceptible hosts is unlikely to result in fire blight. In the improbable event bacterial cells are transferred

from a discarded apple to an insect the subsequent transfer of bacterial cells, deposited during an insect visit to a susceptible host, would be too low to initiate infection.

– The report of the WTO Disputes Panel (WTO 2005) para 8.65 found that the evidence presented by Japan failed to demonstrate transfer of the pathogen by flies from artificially inoculated fruit to a susceptible host even under ideal conditions in a laboratory.

82. Not only must this highly improbable event occur (i.e. an insect become contaminated with sufficient numbers of bacteria to initiate an infection) but it must also occur at the same time that susceptible hosts are available (for wounds this is 1-2 days before it heals over, for apple blossom this is approximately 3 days) and when the climate is conducive to multiplication.

83. It cannot be stated firmly enough that the likelihood of the transfer of sufficient quantities of *E. amylovora* bacteria from a discarded apple fruit to a host when it is susceptible, at a time when the climate is conducive for multiplication is so low that it cannot be differentiated from zero. At this point analysis of the probability of spread should cease as the pathway is broken. This is the same conclusion as reached by the WTO Japan - Apples disputes panel and their four independent technical experts using essentially the same science (WTO 2003).

84. The Report also indicates that vectoring is possible through a pathway of New Zealand apple fruit imported in bulk bins being repackaging in packhouses near orchards. The Report suggests that the hands of packhouse workers could become contaminated with sufficient *E. amylovora* bacteria to initiate an infection, and that these workers could then transfer these bacteria to the cut surfaces of a susceptible host (e.g. pruning scars) at a time when the climate is conducive for bacterial multiplication.

85. The only site on an apple that has been demonstrated to hold any quantity of *E. amylovora* bacteria is the calyx. The Report agrees with this after hypothesizing about the possibility of other sites of epiphytic contamination and concluding that the likelihood of this occurring is negligible.

86. The calyx is dead internal tissue and any *E. amylovora* present are in continuous natural decline as they have no food source and are being exposed to fluctuating and cool temperatures. The numbers of *E. amylovora* present are always below what scientists agree would be sufficient for the spread and establishment of fire blight (i.e. always less than 10^4 cfu).

87. The Report suggests that the few bacteria that may be in the calyx could be washed out by the water in the floatation tank. (although the Report indicates this is unlikely to happen even in New Zealand packhouses where high volume water washers are used.) It is highly improbable that the small numbers of bacteria that might be present on the calyx would, after being diluted in the water tank, contaminate the hands of a worker in sufficient quantities to initiate infection should those bacteria then be transferred from the worker's hands to susceptible hosts. Individual cells of *E. amylovora* are not epidemiologically significant under orchard conditions.

The New Zealand government asserts that the likelihood of transfer of sufficient numbers of *E. amylovora* bacteria from a mature apple fruit to a host when it is susceptible and while the climate is suitable for multiplication cannot be differentiated from zero. Therefore the pathway is broken at this point and analysis should cease.

Assessment of the consequences

Plant life or health

88. The Report suggests that the consequences affecting plant life or health would be significant at national level and highly significant at a regional level. A rating of '**F**' was assigned to this criterion. This rating is based on the studies that overstate the probable real impact of fire blight in Australia because they rely on unrealistic assumptions about production losses and scale of spread.

89. The Report cites literature that assumes production losses of 50 per cent for pears and 20 per cent[2,3] for apples. Oliver et al. (1997) state that this is the 'widely held view'. All studies that use these figures as production loss estimates cite their source as Roberts (1991a) which itself uses a model developed more than 20 years ago by Billing (1980) and is no longer used. Roberts (1991a) states "[t]he results suggest that fire blight could be severe in most areas in most seasons. In the *worst case,* with *every area* affected, this could result in up to 20% losses in apple production and up to 50% losses in pear production" (p.623) [emphasis added]. That is, if all apple and pear production areas in Australia had a severe outbreak of fire blight 20 per cent of the national apple crop and 50 per cent of the national pear crop could be lost.

90. Roberts' (1991a) estimates of production losses are based on estimating the severity of a fire blight outbreak in different Australian growing areas[4] and then using this information to estimate production losses based on an unsubstantiated assumption. No reference or basis for the assumptions underlying these estimates is provided. Roberts (1991a) concludes that a severe season may result nationally in a 20 per cent drop in apple production and 50 per cent drop in pear production.

91. In summarising his results, Roberts (1991a) states "this sort of study obviously has to take a conservative approach…but, if it is too conservative, then trade and economic activity maybe inhibited. However, an under-estimate of disease risk may result in the entry of the disease" (p. 629). This suggests that even the author is not confident about these production loss estimates.

92. Roberts (1991a) then goes on to say,

> "there are also real problems in deciding if these models are even appropriate, given that they were formulated for different climatic areas and growing systems than those experienced in Australia. For example, fire blight in New Zealand is not as severe as might be predicted by Billing's model (Thomson and Hale, 1987).

[2] For example, Wittwer (2004), Street Ryan (1996), Bhati and Rees (1996) and. Oliver *et. al*.(1997).
[3] Kilminster (1989) assumes that both the pear and apple production will suffer 50 per cent losses.
[4] Using Billing's (1980) model.

This has been attributed to the presence of *Erwinia herbicola* and other bacteria that compete with the pathogen…In this work the conservative assumption that this would not occur was used" (p. 630).

93. *Erwinia herbicola* is a cosmopolitan bacterium and has been recorded in Australia. It is probable that it will have a similar impact on fire blight in Australia as it does in New Zealand.

94. Given the concerns raised above about the use of the production loss estimates arising from Roberts' (1991a) model we turn to the experience of countries with fire blight to try to develop a more accurate estimate of the effects of fire blight on production. Following recent interviews with New Zealand apple industry consultants, NZMAF analysts concluded that production losses (i.e. lost yields) in apples due to fire blight have been "inconsequential" in recent years.

95. This view is shared by Hinchy and Low (1990) who state "it [the impacts of fire blight in New Zealand] has declined to a level where it is seldom regarded as a problem and control measures are rarely applied" (p.10), and Roberts (1991a) who states "now only sporadic outbreaks occur and it is not generally to be of major economic importance" (p. 623).

96. When a severe outbreak occurs (which on average is approximately once every ten years) the impact on apple production is 'inconsequential' but such outbreaks do affect pear production and pear tree mortality. For example, in the 1998 outbreak in New Zealand, pear production losses in the Hawke's Bay district, which was by far the worst affected area, were between 20 to 40 percent in individual orchards. However, over the whole district it was estimated that at most 5% of pear trees were lost due to fire blight (MAFNZ 2004).

97. The Roberts (1991a) assumption of 20 per cent production losses in apples and 50 per cent in pears is an average across all orchards, suggesting that the impacts in the worst affected areas will be will be above 20 per cent and 50 per cent in respective crops. These estimates are clearly at odds with the New Zealand experience.

98. The Report (page 89) seeks to estimate losses elsewhere due to fire blight. It mentions figures of "US$200-500 million despite regular control of the disease (Kennedy 1980)". In fact Table 3 in Kennedy (1980) estimates losses in the USA of US$2-5 million only. Kennedy (1980) makes no mention of US$200-500 million losses due to *E. amylovora*. The New Zealand government requests that the final IRA accurately reflects Kennedy's (1980) actual estimate. If adjusted for inflation,[5] these national losses are still only US$6-15 million in 2005 dollar terms. These losses are hardly significant if one considers the size of the USA pipfruit industry even in 1978.[6] Additionally, these losses were sustained more than 20 years ago when control methods were poor at best.

99. The Report also provides more recent Untied States data of US$42 million in a

[5] Adjusted for inflation using the USA's historical Consumer Price Index series from the U.S. Bureau of Labour Statistics website.

[6] According to http://usda.mannlib.cornell.edu/data-sets/specialty/93006/ the USA exported 153,930 tonnes of apples and 41,306 tonnes in the season 1977/78.

severe outbreak in West Michigan in 2000 where the industry is valued at approximately US$210 million. These numbers sound large but they must be viewed against the background of a national industry worth more than US$3 **billion** per year. Thus while losses on a local scale may be significant in outbreak years, they are not on a national scale.

100. The Report quotes losses for the Hawke's Bay region during the 1998 outbreak of NZ$10 million (from Vanneste, 2000). However, in 1998, New Zealand exported NZ$341.9 million worth of apples and NZ$11.37 million in pears (World Trade Atlas, 2006). Given that Hawke's Bay represents approximately half of New Zealand's pipfruit industry, these losses represent at most 5.67 per cent of pipfruit exports from Hawke's Bay meaning the impact at a regional level even in a severe year is still only minor.

101. By assuming the 20 per cent production loss in apples and 50 per cent production losses in pears in each season a region is infected by fire blight the authors of the impact studies quoted by the Report (for example, Wittwer, 2004) are assuming that the impact of fire blight will be 'severe' in all seasons. This contrasts with the New Zealand experience which, as discussed above has a severe season approximately once every ten years.

102. The 1998 fire blight outbreak in New Zealand occurred prior to the introduction of the pip fruit industry's fire blight warning system for growers (which informs growers of potential fire blight infection periods and the best time to manage these). This system was introduced by the industry as part of its programme of fire blight management. An early warning of the potential for a fire blight outbreak will enable growers to take preventative action to reduce the occurrence and impact of the disease.

103. The fact that horticultural consultants in the Hawkes Bay estimate that only 30 per cent of pear and apple growers apply Blossom Bless (a biological control for fire blight) provides further anecdotal evidence from New Zealand that fire blight does not impact heavily on apple and pear growers as the majority of growers feel they do not need to control for it.

104. The impact assessments of fire blight assume the large production losses described above, but also commonly factor in costs of the management of fire blight (for example, Oliver et al., 1997 assume A$925 per hectare for pears, A$1,245 per hectare for apples; and Wittwer, 2004, assumes A$2,000 per hectare). However, more realistically as discussed above, New Zealand asserts that based on the New Zealand and other countries' experience in non-outbreak years the actual production losses will be significantly lower.

105. Production losses are the critical input in the assessments of the impacts of an incursion of fire blight into Australia as they form the basis for estimating the economic value of the lost production and the impact of that lost production on downstream industries. Therefore revising the estimates of production losses downwards to the level that the evidence from New Zealand suggests, is likely to result in a large reduction in the impacts.

106. An analysis of Wittwer (2004) shows his estimate of lost national aggregate

household consumption is 234% lower if production losses are revised from 50% in pears and 20% in apples (Wittwer 'scenario 2') to 25% in pears and 10% in apples (Wittwer 'scenario 1'). However, it should be pointed out that the 234% decrease is not solely due to the change in production losses. Wittwer (2004) assumes ten times more area is infected in 'scenario 2' (although the spraying cost is the same between scenarios, as spraying is assumed as being pervasive of the whole region) and eradication occurs after five years in 'scenario 1', while it doesn't happen in 'scenario 2'.

107. While this result needs to be treated with caution it does give an indication of the sensitivity of the impact assessments to changing production losses.

108. Bhati and Rees (1996) and Hinchy and Low (1990) argue that the most likely scenario is that fire blight will occur in one region, and that as soon as the disease is detected, federal and state authorities will act to isolate the region. Interestingly, Bhati and Rees (1996) attribute this conclusion to a second paper written by Roberts in 1991b[7]. New Zealand asserts that the wide scale spread of fire blight is unlikely to occur because:

- A fire blight incursion is likely to be detected very quickly given the widespread publicity/industry awareness literature given to the disease.
- On the first appearance of fire blight, state and national authorities would act rapidly to prevent further spread.
- Apple production is widely dispersed over significant distances; therefore transmission of fire blight between production sites, on planting material, will be difficult if not highly unlikely to occur.

109. Thus it is unlikely that fire blight would occur simultaneously across a state, let alone across the entire country.

110. The Report cites Oliver et al's (1997) state by state predictions of production losses. These range from $49 million (Queensland) to $424 million (Victoria). However, even taking into account that these are overestimates of the probable impacts, due to unrealistic production loss estimates and the assumption of a simultaneous outbreak across the state, the impacts, when compared with state Gross Domestic Product (GDP), are not significant.

111. Impacts as a per cent of GDP range from 0.04% to 0.8% (Table 2.) suggesting that the impacts at a regional level are unlikely to be discernible. It should be noted that these impacts are estimated over a five year period compared to GDP which is an estimate of output for one year. Therefore, if the impact per year is compared to GDP the percentages given below will be even lower. Additionally, if fire blight was able to be restricted to an even smaller area (e.g. within a district, as discussed above) the impact as a percentage of the state GDP will be even lower still. Table 2 shows the impacts at a state level will not be discernable.

[7] Roberts (1991b) *unseen*.

Table 2. Losses as a per cent of Gross State Products GSP[8] from Oliver *et. al.* (1997)

State	% losses of GSP
NSW	0.05%
Victoria	0.19%
Queensland	0.03%
Western Australia	0.065%
South Australia	0.08%
Tasmania	0.6%
Whole of Australia	0.09%

112. Wittwer (2004), despite his disputed assumption with regard to production losses, indicates that real GDP of the Goulburn Valley will decline by at most 0.75 and 1.5% relative to what it would have been in the absence of fire blight; with real consumption declining between 0.4% and a little over 0.7% relative the situation without fire blight.

113. Thus the impact of an outbreak in “the heart of Australia’s apple and pear industry” (Oliver et al., p. 14), which “produces most of Australia’s pears and a significant proportion of Australia’s apples” (Wittwer, 2004, p.3) is likely to be “minor”. **Note:** these losses were calculated for the district likely to be most severely affected by a fire blight incursion should one ever occur there, i.e. the Goulburn Valley. Given the fact that much Australia’s pipfruit is concentrated in this one area (18% of Australian apple production and 86% of Australian pear production)[9] the impact on other areas (i.e. not the Goulburn valley) is unlikely to be discernable.

114. Pears are more susceptible to fire blight than apples, and in consideration of the impact across the Australian national crop the fact that pear production is concentrated in the Goulburn Valley the probability of an incursion occurring <u>nationally</u> in pears will be lower than one occurring in the more widely dispersed apple crop. Thus the likelihood of these major production losses occurring is low.

115. New Zealand asserts that the direct impact on plant life or health is unlikely to be discernible at both a national and regional level, minor at a district level, and significant only occasionally at a local level. In line with the ratings provided in Report Table 10 the overall impact score should be revised to ‘**C**’. We have based these conclusions on the following:

- A major outbreak, as suggest by Oliver et al. (1997), will be detected quickly and restricted to the outbreak area (i.e. likely to be a localised area); thus the effects of that outbreak will not be discernible at both a national and regional level.
- The production losses at a district and local level are likely to be minor in most years, and significant only occasionally at a local level because:
    - Major fire blight outbreaks only occur periodically (e.g. in New Zealand approximately once every ten years).

[8] Gross State Product 2004-05 estimates are from http://www.treasury.act.gov.au/snapshot/index.shtml
[9] http://www.apal.org.au/research/vic.htm

  - The New Zealand experience of production losses when fire blight is between major outbreaks are that they are very small (i.e. less than two per cent).
- The impacts in the event of an outbreak in the Goulburn valley will have an important effect on pear production. However, experience suggests that the effects will not be to the extent described by Roberts (1991a). Additionally given the concentration of Pears in this one locality in Australia, the impacts will only be significant in that one locality and will not be discernible in all other localities.

Control or eradication

116. The Report suggests the consequences affecting domestic trade or industry would be minor at the national level, significant at a regional level, significant at the district level, and highly significant at a local level. A rating of '**E**' was assigned to this criterion. New Zealand asserts that this rating is 'too high'.

117. Fire blight impacts on the New Zealand pipfruit industry by adding a range of extra costs.

- The New Zealand Ministry of Agriculture and Forestry recently surveyed a range of horticultural consultants, scientists and growers on the costs incurred as the result of fire blight. This research indicated that fire blight adds less than 1.3% to typical orchard expenditure for an apple grower in a normal season;[10] increasing to 1.66% in a severe season (excluding extra pruning if required). Assuming that pear growers face a similar cost structures to apple growers, orchard expenditure due to the presence of fire blight increases by between 2 and 2.8% for the typical orchard and up to 5.28% in a severe outbreak (including pruning). Additionally less than 30% of respondees indicated they are using sprays to control fire blight suggesting that most are not incurring additional expenditure on chemicals. This is a long way from the 30% increase in chemical costs referred to in the Report.
- The cost to the New Zealand pipfruit industry to operate the fire blight early warning and advisory system is NZ$18,000 per year (NZMAF 2000). There is no evidence to suggest that costs would be dissimilar for a similar system in Australia, if needed.
- Until recently most fire blight related research funded by the New Zealand pipfruit industry has been to address concerns associated with this request for apple access. In New Zealand research funding allocated to improving fire blight control mechanisms is and has always been relatively small. Research costs in Australia should fire blight become established are unlikely to be as large, as spread will be contained and the industry will be able to take advantage of the research already available from other countries.

118. Also, as the Report mentions trees will be removed during an eradication campaign and costs will be incurred in replanting these areas. However, these costs will not be large relative to the size of the industry and state GDP, particularly if the incursion, should one ever occur, is detected early as seems probable.

[10] Typical orchard expenditure as reported in MAF (2005).

119. The Report also suggests that organic growers may be compelled to use streptomycin; however, organic growers can use the organically certified copper sprays or "Blossom Bless".

120. New Zealand asserts that in light of the above, the indirect impact on control or eradication will be minor at the district level and significant only at the local level. Consequently in line with the ratings provided in Report Table 10 the overall impact score should be revised to '**C**'.

Domestic trade

121. The Report suggests that the consequences affecting domestic trade or industry would be minor at the national level, significant at a regional level and significant at the district level, and highly significant at a local level. A rating of '**E**' was assigned to this criterion. New Zealand asserts that this rating is 'too high'.

122. The Report suggests that the impact will be felt by several sectors associated with pipfruit production, such as packing houses, the juicing sector, repairers of agricultural equipment, agricultural suppliers, the banking and finance sector, the transport sector, honey sectors and retail industries in general.

123. Given the production losses are unlikely to be large (as discussed above) then the impacts on associated industries are unlikely to be large also. The Report cites Kilminster (1989) as estimating a 30-40% decline in the juicing sector if apple supply fell by 50%, which given the evidence about probable real production losses is an extreme estimate. In an average year where there is no major fire blight outbreak (9 years in 10) if production losses resemble New Zealand's (i.e. less than 2%) it is unlikely that associated industries will be affected very much at all.

124. In focussing on the costs involved with the 'unemployment' of resources due to fire blight the Report ignores the fact that these resources have alternative uses. Thus the costs to domestic trade is not represented by the lost production in the sectors outlined above, rather the cost is the difference between the lost production due to fire blight and the value derived form the use of the resources freed up due to fire blight, in their next best alternative use (this difference is likely to be larger in the short-run as there will be inertia in resource change over).

125. Evidence from New Zealand indicates that the flow-on effect of production losses due to fire blight is very low. For example, New Zealand exported NZ$36.3 million worth of apple juice in 1997 indicating associated industries are still very viable even in the presence of fire blight.[11] In a non fire blight affected years juice exports have been variable depending on the world market (Table 3). Volumes exported in fire blight years are well within natural fluctuations caused by the market and hence fire blight *per sé* has no real impact on the volumes produced:

[11] http://www.hortnet.co.nz/publications/science/m/miriams/stat97.htm

Table 3. Value of New Zealand apple juice exports 1999-2004.

Year	**NZ$**
2004	$19.2 million
2003	$20.3 million
2002	$ (figure not available)
2001	$45.9 million
2000	$21.1 million
1999	$17.7 million

Source: New Zealand Horticulture Facts & Figures 1999 – 2005, HortResearch, New Zealand.

126. In light of the above discussion, New Zealand asserts that the indirect impact on domestic trade or industry is unlikely to be discernable at the district level and only minor at the local level. Consequently the rating should be reduced to ‘**B**’.

Communities

127. The Report suggests that the indirect impacts on communities are unlikely to be discernible at the national level, minor at a regional level and significant at the district level, and highly significant at a local level. A rating of ‘**D**’ was assigned to this criterion. New Zealand asserts that this rating is ‘too high’.

128. The Report bases it assessment of the impacts on the community on Oliver *et al*. (1997), Street (1996) and Kilminster (1989). Again these studies all adopt the Roberts (1991a) assumption with regard to production losses when calculating their estimates of community impact. As they assume unrealistic production losses their estimates of the impact on communities are likely to be significant overestimates.

129. For example, Oliver *et al*. (1997) use output, income, value added and employment multipliers to estimate the impacts on the wider Goulburn Valley area. Oliver *et al*.’s (1997) output value multiplier assumes that a $1 change in horticultural output results in $1.534 change in regional wide output across all industries.

130. Because Oliver *et al*. (1997), Street (1996) and Kilminster (1996) all multiply the overestimates of production losses (discussed above) to estimate the wider impacts this will result in an overestimate of the impacts on communities. This overestimate will actually be significant as the estimate of change in output (derived directly from the production loss estimates) is multiplied by up to four multipliers (output, income, value added and employment).

131. If estimates of production losses are scaled back to more realistic levels, which according to New Zealand industry analysts are ‘inconsequential’ 9 years in 10 and, at most 5 per cent in apples in an outbreak and 40 per cent in pears in a severe outbreak then the estimates of Oliver *et al*. (1997), Street (1996) and Kilminster (1996) on the impacts on communities must also be scaled back dramatically.

132. In light on the above discussion, New Zealand asserts that the indirect impact

on domestic trade or industry is unlikely to be discernable at the district level and only minor at the local level. Consequently the rating should be reduced to '**B**'.

International trade

133. The Report suggests that the consequences affecting international trade or industry would be unlikely to be discernible at the national level, minor at a regional level, significant at the district level and highly significant at a local level. A rating of '**D**' was assigned to this criterion. New Zealand asserts that this rating is high.

134. The Report suggests that access to markets free from fire blight would be affected following a fire blight incursion. However, the Report states "[a]pples and pears are exported to premium markets in the UK and European countries, and to the bulk markets of south-east Asia. At present, none of these countries impose restrictions on apple imports from countries where *E. amylovora* occurs" (p.92). The Report then goes on to state "[a]ccess to markets in countries free from *E. amylovora* would be affected" (p.92).

135. On the basis of the above two statements, one can conclude that Australia's international trade in pipfruit will **not** be affected as they mostly export to countries that do not impose restrictions on apple imports from countries with fire blight (UK, Europe and south-east Asia). The only realistic impact could be if Australia wanted to export to South Korea and Japan, as these countries have to date restricted access on the basis of fire blight.

136. Australia has recently negotiated access for apples to Japan but the volume of exports has been insignificant. However, given the result of the WTO Japan – Apples case (WTO 2005) it is probable that apples from fire blight infected countries will be allowed into Japan in the near future without significant measures. Australia does not have access for apples to Korea but it is probable that Korea will eventually follow the Japanese stance on the issue and not impose measures.

137. The reliance of the Australian pipfruit industry on exports is not significant. For example, data from the USDA 2005 Foreign Agriculture Service Report on the Australian pipfruit industry (USDA 2005) suggests that only 4.2% of Australian apples and 6.2% of Australian pears produced in 2006 will be exported.

138. In view of the Australian pipfruit industry's small volume of pipfruit exports and the fact there are unlikely to be any significant restrictions into present or future markets New Zealand asserts that the impact score should be revised to '**A**'.

139. Based on the decision rule described in the Report i.e. that where the consequences of a pest with respect to one or more criteria are 'C', the overall consequences are considered to be '**very low**'.

The New Zealand government asserts that when drafting the final import risk analysis for apples from New Zealand Biosecurity Australia uses a consequence assessment of '**very low**'.

Unrestricted risk

140. A revised unrestricted annual risk estimation for fire blight is shown in Table 4.

Table 4. Unrestricted risk estimation for fire blight

Overall probability of entry, establishment and spread	Negligible
Consequences	Very Low
Unrestricted risk	Negligible

141. As indicated in Table 4, the unrestricted annual risk for fire blight is '**negligible'**, which is below Australia's ALOP. Risk management measures for fire blight would not be required for imports of New Zealand apples into Australia.

Risk management for fire blight

142. New Zealand asserts that based on the above assessment, risk management measures for fire blight are not warranted for imports of New Zealand apples into Australia. Additionally, the risk management measure proposed by Australia to require that all apples are sourced from individual orchards free from fire blight symptoms is not justified. The WTO has ruled against Japan on this specific point (WTO 2003 and 2005). There is insufficient scientific evidence to support a measure requiring fire blight freedom in orchards. There is no evidence that the export of mature apple fruit would serve as a pathway for the introduction of fire blight into Australia. However, for completeness we shall comment on the risk management measures suggested in the draft Import Risk Analysis Report.

143. The Report states "the use of areas free from visible fire blight symptoms for sourcing export apples would not be a sufficient risk management measure by itself". As above we dispute that this measure is justified let alone for it to be coupled with other measures. There is no scientific evidence that establishes that mature calyx-infested fruit, even from a severely infected orchard, contain *E. amylovora* populations of epidemiological significance in the spread and establishment of fire blight.

144. The proposed disinfection treatment using chlorine as a further risk management measure appears to be targeted at surface populations of *E. amylovora* on apple fruit. However, as the Report points out, chlorine is unlikely to penetrate the calyx of fruit. Chlorine treatment as a risk management measure is not linked to the negligible epidemiological role that surface populations of *E. amylovora* have on mature apples. As previously stated (and agreed by the Report) it is considered highly unlikely that there would be any surface populations of *E. amylovora* present on mature export quality fruit at harvest let alone after fruit had been processed through routine pack house procedures.

145. Cold storage of 10-14 days could be an effective risk management measure that is already incorporated into current pack house processes, and the pre-export, transport and post-import steps. Cold storage has been shown to reduce epiphytic populations of *E. amylovora* localised on the apple calyx (Taylor and Hale 2003) hence would eliminate any perceived risk that these populations may pose.

146. The population levels of *E. amylovora* required to survive cold storage, be discarded in an orchard, be vectored to a susceptible host and initiate an infection far exceeds those expected to be found on infested apples at harvest (Hale et al. 1987; van der Zwet et al. 1990; Clark et al. 1993).

New Zealand asserts based on the facts presented above that the unrestricted annual risk for fire blight is '**negligible'**, which is below Australia's ALOP. Risk management measures for fire blight should not be required for imports of New Zealand apples into Australia.

5. European canker

General comment on the analysis

147. There have been significant changes in the risk assessment methodology since the 2004 Draft IRA report (BA 2004). Australia has taken the quantitative analysis approach further by adding probability values for partial probabilities, rather than the qualitative probability descriptors previously used. This change makes it impossible to determine whether Australia has modified its assessment of partial probabilities for importation as requested in the New Zealand Government comments on the 2004 Draft. For example, the probability of importation for European canker has been changed from a qualitative 'extremely low' to a mean value of 0.0069% of the proposed number of apples imported from New Zealand.

Specific comments on the analysis

Probability of importation

148. The Report errs in its attempt to determine a likelihood of entry of European canker into Australia on imported fruit. The Report does not cite any scientific data to demonstrate that a pathway associated with fruit exists by which *N. galligena* could be vectored, as contamination on fruit, or as latent infection inside fruit, to Australian apple and pear orchards, to nurseries, or to wild and amenity plants. In this regard the Report's analysis for European canker is based on theoretical possibilities and hypothesis that have never been conclusively demonstrated.

149. Notwithstanding the above the Report makes several incorrect assumptions in determining likelihood values.

Importation steps 6 and 8:

150. The Report states, for Imp 6, that the "Likelihood that *N. galligena* survives palletisation, quality inspection, containerisation and transportation to Australia is '1'" and for Imp 8 that the "Likelihood that *N. galligena* remains with the fruit after on-arrival minimum border procedures is '1'".

151. New Zealand asserts that these assessments of the way in which fruit with latent infection might lead to fruit with disease symptoms at some later time is incorrect for two reasons:

1) The probability value of '1' could never occur because the expression of symptoms arising from latent infection is a stochastic process, whereby a proportion of fruit with latent infection would never show symptoms. If a quantitative analysis approach is to be pursued then a distribution with minimum and maximum probabilities would be required, as is done for Imp6 for apple scab.

2) The actual proportion of fruit with latent infection that might eventually develop symptoms is likely to be much less than 100%. Evidence for this is shown for other pathogens, e.g. Biggs (1995). It cannot be shown specifically for *N. galligena*, because no relevant data for *N. galligena* has

> been published[12] and the numbers presented in the Report are speculative at best. Biggs (1995) inoculated fruit in the field with *Botryosphaeria dothidea* and *Colletotrichum acutatum.* Recovery of these pathogens from latent infections was low, with only 30% of fruit inoculated with *B. dothidea* and 38% inoculated with *C. acutatum* yielding the respective pathogens. This compares with 71% and 90% for the respective pathogens recovered from fruit inoculated, then treated with paraquat. (Paraquat treatment is a method used for determining levels of latent infection.) Consequently it is probable that most latent infections in fruit are never likely to express disease symptoms.

152. Because only a proportion of fruit with latent fungal infections eventually produce lesions, the risk assessment for Imp 6 and Imp 8 overestimates the likelihood of survival of *N. galligena* inside fruit. If a quantitative analysis approach is to be pursued, then it needs to be re-evaluated using a probability function with a uniform distribution with a minimum and a maximum value.

Probability of entry, establishment and spread

153. In relation to exposure, New Zealand disputes the assignment of a probability of '1' for the proportion of orchard wholesalers that are near commercial fruit crops and disputes the claim that "All orchard wholesalers would be in close proximity to commercial fruit crops". Certainty cannot be assigned to this step when the text describing the rationale for this probability conveys uncertainty in statements such as "orchard wholesaler waste may be dumped…" and "before waste is finally dumped it could remain exposed…". [Emphasis added] The assignment of probabilities for the purpose of quantitative analysis is arbitrary and not justifiable for events that have not been, nor are ever likely to be, observed.

154. Additionally, as clarified earlier the large majority of fruit entering Australia from New Zealand will be retail-ready, class 1 export fruit in a variety of retail packaging including cartons, bags and crates. Little or no fruit will arrive in bulk bins for packaging in Australian packhouses. The Report's estimate of the exposure value of an individual apple for orchard wholesaler waste must be reduced significantly. A reasonable estimate for this would in fact be less than any value that might be determined for an individual apple for urban wholesaler waste.

The Tasmanian experience

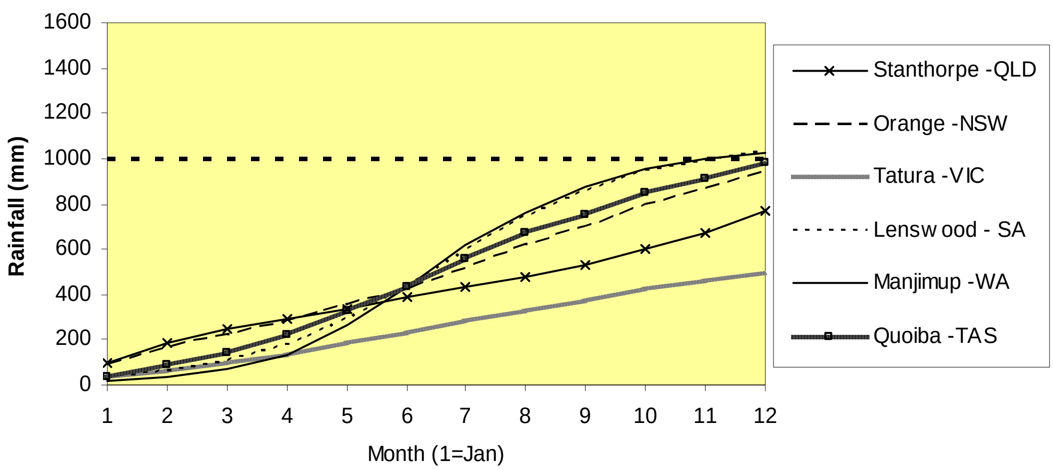
155. New Zealand disputes that there is a real risk of establishment and spread of European canker in Australia, and believes that the occurrence of European canker in Tasmania for about 40 years during the 20th century without spread adequately shows that Australia has misinterpreted the likelihood of spread and hence has overstated the consequences of importation of New Zealand apples in relation to European canker.

156. European canker was present in northern Tasmania from around 1930 until the last detection in 1974. The canker symptoms that had been present in orchards near Spreydon for about 20 years were identified as *Nectria* canker in 1952 (Ransom 1997). The presence of the disease for the 20 years before eradication began was not

[12] Suggesting that world scientific opinion rates the likelihood of latent infections being important in the transfer of this disease as very low.

associated with any recorded spread to nurseries or to wild and amenity plants and there was no spread recorded between apple orchards even within Tasmania. The long term localised occurrence of the disease in one of the higher rainfall apple growing areas in Australia (Figure 1) clearly demonstrates that the climate in northern Tasmania was not conducive to spread.

Figure 1. Cumulative mean monthly rainfall in Australian apple growing areas in relation to an arbitrary 1000 mm annual rainfall threshold (Aust. Bureau Met.)



157. The Report itself supports New Zealand's view, including the statements, "the extent of dispersal was quite limited despite being present for many years" and Spreydon has "unfavourable climatic conditions" for this disease. This is validated by Ransom (1997) who stated that "there were no reports of the disease spreading to wild and amenity plants, including forest plants or household garden plants during the 40 year eradication programme".

158. During the eradication programme in Tasmania only movement of propagation material was prohibited from the scheduled area around the infected orchards (Ransom 1997). There was no restriction on the movement of apple fruit from Tasmania to other states as a result of the presence of European canker in Tasmania (Ransom *pers. comm.*).

159. The lack of restriction on fruit movement shows that there was no concern at that time about the importation of fruit from an area within Australia with European canker to other areas within Australia without European canker. Even if the numbers of fruit exported from Tasmania to mainland Australia were small 20 years ago, the principal that fruit could potentially transfer the disease was not considered to be an issue by authorities at that time. Since the time of the European canker eradication programme there have been no new scientific data, nor does the Report present any new data, to suggest that fruit could vector this disease to orchards.

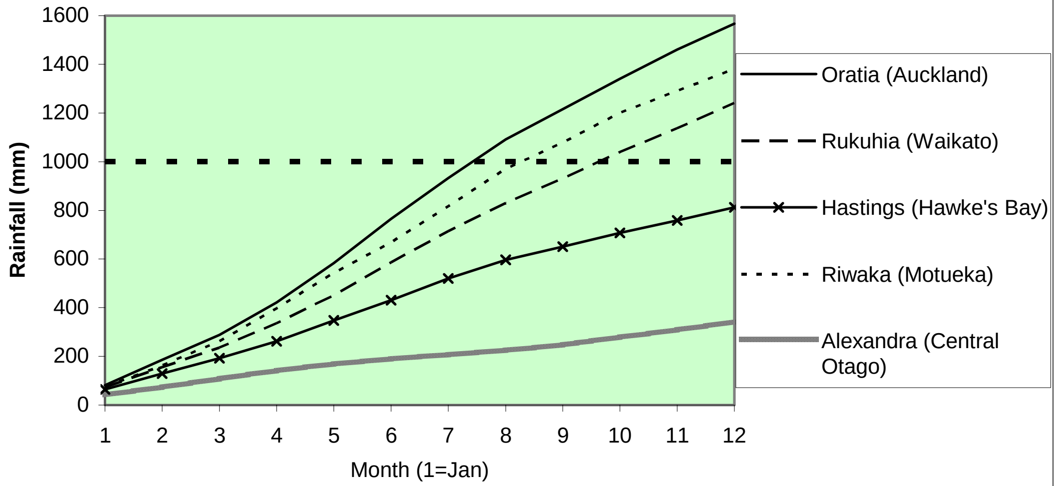
160. The risk of importing fruit from New Zealand, especially from areas of low canker risk, to Australia is no greater than importing fruit into the Australian mainland from Tasmania was during the European canker outbreak. Proposed restrictions on the import of New Zealand fruit on the basis of European canker presence in the source country therefore show a significant inconsistency in approach to risk assessment.

Climate incompatibility

161. The Report misinterprets the climatic risk in Australia for European canker establishment and spread, as well as for consequences. Climatic comparisons between Australia and parts of the world where European canker is a problem indicate that establishment and spread of European canker in Australia is not climatically feasible. Australian apple growing areas have characteristically low rainfall compared to parts of the world where European canker is problematic. A particular feature of the climate in Australian temperate areas is the low summer rainfall. Summer rainfall is generally considered to be a prerequisite for European canker development.

- The Report quotes Grove (1990) as stating that "Areas where average annual rainfall is greater than 1,000 mm favour establishment of the disease". The Report then claims that the several apple growing areas in Australia have an average rainfall of around, or just over, 1,000 mm. This is the entire basis for the assertion that the climate in Australia would be suitable for European canker development.
- However, Grove (1990) did not intend to suggest that below 1,000 mm mean annual rainfall canker does not occur and above 1,000 mm it does. Grove actually stated that "Nectria canker of apple is particularly troublesome in areas of coastal California where fog, moderate temperatures and mean annual precipitation of 100 cm or more occur". The only Australian apple growing area that is coastal is northern Tasmania, with mean annual rainfall of about 1000 mm (Quoiba in Figure 1), and, as noted above, there is adequate evidence that when canker was present there, untreated, for 20 years it did not spread (Ransom 1997).
- Grove (1990) also stated that "It is also an important disease of apple and pear in cool moist portions of Western Oregon, Washington and British Columbia." Rainfall in these areas exceeds 1,500-2,000 mm per year (Oregon State University College of Oceanic and Atmospheric Sciences. www.ocs.oregonstate.edu) and they are therefore far wetter than in any Australian apple growing area. Australia does not have rainfall patterns that match any of those cited by Grove as being associated with European canker occurrence.
- Further evidence of the rainfall requirements for European canker is shown in New Zealand, where European canker is problematic in high rainfall areas, where mean annual rainfall of 1,200-1,600 mm per year occurs (Auckland, Waikato and Motueka in Figure 2). Again, these areas are far wetter than any apple growing areas in Australia. European canker has never been reported a disease problem in the low rainfall areas of Hawke's Bay and Central Otago.

Figure 2. Cumulative monthly rainfall in New Zealand apple growing areas in relation to an arbitrary 1000 mm rainfall threshold (NIWA).



Consequences for European canker

Direct and indirect impact

162. The direct impact of European canker **on plant life or health** (rated E) is based on the argument, discussed above, that the Australian climate is conducive for European canker development based on climatic comparisons with other parts of the world where European canker is problematic. It is overstated in the Report and should be changed to '**B'**, minor at the local level.

163. The assessment of direct impact of European canker on the **environment** and specifically household and garden plants and amenity trees, attempts to create issues where none exist. The arguments for impact on amenity plants stem from lists of recorded hosts for *N. galligena*. The Report suggests that *N. galligena* could be an important pathogen on all these plants, when in fact, in areas with climates much more conducive than any in Australia, this disease is unknown or is of minor importance. The specific reference to the "highly significant" impact that European canker could have on Melbourne's elm tree population is an attempt to draw an emotive comparison between European canker and Dutch elm disease. These diseases are caused by two separate pathogens with very different biology.

164. In high rainfall areas of New Zealand, where the risk of *N. galligena* causing an important disease on amenity and wild plants is more likely than in Australia, European canker has not been recorded as a problem on these plants. *N. galligena* is unknown as a pathogen of Australian native plants, despite its presence in Tasmania for more than 40 years (Ransom 1997).

165. On the basis of the above New Zealand asserts that the Report rating for potential impact on the environment should be changed from 'D' to at most '**B**'.

Unrestricted risk

166. It is New Zealand's assessment that the overall probability of entry, establishment and spread is at most '**very low**' and that the potential consequences are also '**very low**'.

New Zealand asserts that the unrestricted annual risk estimation for European canker is below Australia's ALOP and consequently risk management ought not to be required.

Risk management

Pest free areas/ pest free places of production

167. The Report suggests that export apples sourced from either areas free from disease symptoms or pest free places of production would be an effective risk management measure for *N. galligena*. Because the likelihood assumptions in the risk analysis are not based on scientific fact, New Zealand disputes that pest free areas or pest free places of production in New Zealand would have any bearing on the actual risk of importation of *N. galligena* into Australia. If, however, it could be shown that *N. galligena* could be vectored on fruit, then several details about the analysis for restricted risk would be incorrect.

168. In relation to pest free areas, the basis for the risk assessment shown in Report Table 38 is inconsistent and also violates the implicit assumption in the semi-quantitative methodology that probabilities in each step in the importation pathway are independent. Imp2 (likelihood that picked fruit is infested/infected with *N. galligena*) has a restricted likelihood of zero, whereas Imp5 (the likelihood that clean fruit is contaminated by *N. galligena* during processing in the packing house) has a restricted likelihood range from zero to 10^{-6}.

169. Imp5 should also be zero because there could be no opportunity for fruit to become contaminated during processing in pest free areas. The packing house registration and audit requirements would ensure that no apples from orchards with European canker, and thus with *N. galligena* contamination, could possibly enter the packing house during processing of fruit for export to Australia. The use of two different likelihood scenarios for Imp2 and Imp5, given that both are clearly driven by the same area freedom considerations is not justified.

170. The argument above also applies to pest free places of production (Report Table 39). In this case the restricted likelihoods for Imp2 and Imp5 are the same, but the argument as to why Imp2 here is greater than Imp2 for pest free areas is not given. New Zealand challenges that there is any basis for assigning a greater likelihood for a pest free place of production as compared to a pest free area, given the packing house registration and audit requirements. The restricted likelihoods for importation steps Imp2 and Imp5 for pest free areas and pest free places of production, and additionally Imp3 for pest free areas, should all be zero.

Orchard inspections for European canker

171. In some apple growing areas of New Zealand European canker does not spread because rainfall patterns are never conducive to spore production and dispersal of *N. galligena*. These areas include Hawke's Bay, Wairarapa, Marlborough, Canterbury and Central Otago. These areas are all characterised by annual rainfall of less than 1,000 mm, summer rainfall (December through February) of less than 200 mm and rain days per year of less than 100 days.

172. New Zealand suggests that in these areas of low rainfall it would not be necessary to repeatedly inspect apple and pear orchards to establish freedom from European canker, providing trees were disease free at the time of planting. If they were free at this time they would remain free unless new infected planting were introduced and rainfall exceeded these levels for a number of years.

New Zealand suggests that if the Final IRA considers measures are necessary (which as stated above New Zealand contests), they should be based on the biology of the organism and:

- in the areas of low rainfall (e.g. Hawkes Bay, Wairarapa, Marlbourgh, Canterbury, Central Otago) orchard freedom from European canker shall be determined by a single inspection in the winter two years after planting (or if trees are older than this in the winter prior to the start of the first export season) for visible canker symptoms on a sample that would, at 95% confidence level, detect visual symptoms if shown by 0.5% of the trees (unless the rainfall criteria were repeatedly exceeded or European canker was detected in fruit from this region).
- in areas where climatic conditions are suitable for spread of European canker, e.g. Auckland and Waikato, annual orchard inspection of a sample that would, at 95% confidence level, detect visual symptoms if shown by 0.5% of the trees is sufficient to detect European canker at epidemiologically significant levels.

6. Apple leafcurling midge (ALCM)

Probability of Importation

173. **Importation step 1:** The Report has increased the Imp1 value for apple leafcurling midge (ALCM) from 'high' in the 2004 draft import risk analysis for New Zealand apples (BA 2004) to 'certain'. New Zealand asserts that this change is not justified:

- Data supplied previously (refer to Table 6 and 7, in Comments by the Government of New Zealand 2004 (MAFNZ 2004)) shows that more than 72% of growers' lines of fruit submitted for packing were considered free of infestation at the packhouse grading table.
- This is supported by data on carton endpoint inspections referred to in Report Table 40, where a high percentage (88.1%) of inspected packed cartons were identified as free of ALCM cocoon infestation.
- The presence of larval midge populations on apple foliage does not mean that it is certain that ALCM cocoons will be present on fruit at harvest. A relatively small proportion of the ALCM population cocoons on fruit, most (~90%) drop to the soil surface for cocooning and pupation (Tomkins 1998).

174. As a pest that has such a restricted climate range (e.g. lack of occurrence in California, whereas it is either present or not recognised as pest in all other US apple growing states) it is not tenable to suggest that every orchard in New Zealand will have an infestation of ALCM. New Zealand asserts that this assessment should be revised back down from 'certain' to '**high**'.

175. **Importation step 2**: The use of 1994 data (Tomkins et al. 1994) is inappropriate because there has been significant reduction in midge activity in New Zealand orchards since the introduction of the industry-wide Integrated Fruit Production (IFP) programme between 1996 and 2001. Consequently the use of a 1-2% to 11.5% fruit contamination rate for pupae or larvae is inappropriate and the decision to use a triangular distribution with a minimum of 1.5×10^{-2}, a maximum of 0.115 and a most likely value of 5×10^{-2} is not justified

176. It is not clear whether the Report has taken into consideration data supplied by New Zealand for the period 2001-2004 (Table 6 and 7 in Comments by the Government of New Zealand 2004 (MAFNZ 2004)). The data in these Tables show infestations detected by fruit graders immediately following packhouse apple washing (apple washing might be expected to reduce fruit infestation by 32-54% (refer to Table 5. below)).

177. Furthermore the Report also does not appear to have taken into consideration the data provided in Tomkins et al. (1994) that most (63%) of the ALCM cocoons on fruit at harvest were found to be empty. In addition, more recent data (see Table 5.) found that 36-42% of the cocoons were empty (Rogers et al[13] (*in prep*)) and provides further support for reducing the apparent infestation rate used in the risk analysis.

[13] Dr. D. R. Rodgers, IFP Entomologist, HortResearch, New Zealand .

Table 5. Mean percentage of empty ALCM cocoons on different varieties of Nelson fruit. (Rogers et al (*in prep*))

Variety	% empty cocoons (± SEM)	
Braeburn	42.2 ±	1.9
Fuji	41.1 ±	10.8
Royal Gala	36.5 ±	4.4

178. The high proportion of empty cocoons on harvested fruit is to be expected. By mid-summer (mid-January) the shoot growth required to support ALCM population development has largely terminated. Pre-pupal larvae drop from old leaf-rolls whenever dew or rainfall occurs during mid summer and ALCM emergence from these cocoons (either in the soil or those few on fruit) is substantially completed by the time even early fruit is harvested from mid-late February onwards.

179. Only a small percentage of the cocoons infesting fruit at harvest are actually occupied by healthy or viable ALCM pre-pupae. Most of those cocoons remaining on the fruit are empty, dead or parasitized by *Platygaster demades*. Todd (1959) found 95% parasitism of pupae in cocoon samples taken in late summer.

180. Recently collected data, Rogers et al (*in prep*), demonstrates in 24 samples each of 25 infested Braeburn fruit (600 infested fruit total) that the pupae were shrivelled or dead within 58.9% of the occupied cocoons (58.9 ± 2.2 SEM % mortality). That is only 41% of the occupied cocoons on these fruit contained viable/living ALCM pupae.

181. New Zealand asserts that a lower incidence of viable cocoons should be used to reflect the field incidence of ALCM under current management regimes. The average probability of fruit infested with live ALCM larvae within cocoons, after empty cocoons and mortality factors are considered, is 4.00×10^{-5}. Accordingly the probability of ALCM on fruit should be reduced from ‘very low’ to **‘extremely low’** to reflect the very high proportion of the cocoons that are empty or contain dead or parasitised pupae.

182. **Importation step 3**: The likelihood that clean fruit is contaminated by ALCM during picking and transport to the packing house is negligible, if not zero. The decision to apply a uniform distribution with a minimum value of 10^{-3} and a maximum value of 5×10^{-2}. $U(10^{-3}, 5 \times 10^{-2})$ cannot be justified.

183. Shoot growth on producing apple trees terminates by mid summer, some 4-6 weeks before the harvesting of the even earliest maturing varieties in New Zealand. Any ALCM damage to leaves is old; old leaf rolls are empty and no longer contain either larvae or the pre-pupal stages.

184. It is highly improbable therefore that the usual low incidence of leaf trash at harvest will contribute to any new (additional) infestation of fruit during picking and transport to packing facilities. New Zealand asserts that the value for this likelihood should be reduced to ‘**negligible’**.

185. **Importation step 4**: The decision to represent Imp4 with a triangular distribution with a minimum value of 0.5, a maximum value of 0.8, and a most likely

value of 0.67. T(0.5, 0.67, 0.8) is inappropriate.

186. High pressure apple washers for the removal of contaminant insects on harvested fruit were first tested in New Zealand packhouses in 1999 but the technology was not widely implemented until harvest 2001. Preliminary unpublished studies examined the removal of ALCM cocoons and found that the prototype washer removed ~20% of cocoons (Walker, *unpublished data*).

187. This pest removal technology was refined and improved during commercial installations of apple washing equipment. In 2005 studies conducted by Rogers et al (*in prep*) examined the midge cocoon removal performance of current installations in Hawke's Bay and Nelson packhouses. Data summarising the removal performance of apple washing equipment operating with recommended pressure and throughput configurations is given in Table 6.

Table 6. Mean percentage decrease in apples infested with ALCM cocoons after washing in different Hawke's Bay and Nelson packhouses.

Packhouse	% decrease in infestation (± SEM)	
Hawke's Bay 1	32.5 ±	5.5
Hawke's Bay 2	53.6 ±	3.5
Hawke's Bay 3	54.0 ±	10.0
Nelson 1	30.8 ±	9.3
Nelson 2	49.4 ±	9.8
Nelson 3	54.3 ±	7.8

188. This data demonstrates that the current configuration of high pressure apple washing equipment in New Zealand packhouses is capable of reducing the incidence of cocoon infested fruit by 31-54%.

189. Subsequent fruit grading also removes a proportion of the fruit infested with ALCM cocoons. It is acknowledged, however, that not all fruit with ALCM cocoons will be detected during high volume fruit grading.

190. Endpoint inspections are carried out by independent quality control personnel who have received specific training on all aspects of quality control including pests and diseases and the recommended phytosanitary responses. These detailed examinations of 600 packed fruit from within each packed line (an individual variety submission by a grower for packing) provide the most comprehensive record of cocoon incidence on fruit. However, this data does not take into consideration that many of these cocoons are empty, or the pupae contained within them are either parasitized or dead.

191. These processes ensure that there is a relatively low incidence of viable ALCM cocoons in export consignments of New Zealand apples. Phytosanitary inspection records by accredited independent verification agency personnel supplied by New Zealand (Report Table 40) show that, in quarantine endpoint inspections between 2001 and 2004, a high proportion, between 80.7% and 90.0%, of inspected cartons were pest free i.e. contained no infestation of ALCM cocoons.

192. Furthermore, the presence of empty cocoons (incidence 36-42%), the high mortality (59%) of remaining cocoons and high levels of parasitism (up to 95%), suggest the probability of viable cocoons on fruit is extremely low and certainly much lower than the incidence of 'assumed viable' cocoons in endpoint QC inspections.

193. Packhouse quality management procedures (including high pressure fruit washers, quality grading and independent verification agency carton audits) therefore serve to substantially reduce the incidence of viable ALCM on fruit. This data is completely consistent with any earlier higher ALCM infestation levels in New Zealand apples that were based on either field infestation (Tomkins et al 1994) or infestation after packhouse apple washers but prior to quality grading and end point inspection.

194. New Zealand asserts that the value ascribed to Imp4 should be reduced to at least '**very low**'.

195. **Importation Step 5**: The Report suggests a likelihood that clean fruit is contaminated by ALCM during processing in the packing house: uniform distribution with a minimum value of 0 and a maximum value of 10^{-6}. U(0, 10^{-6}).

196. A very small percentage of viable pre-pupae and pupae remain in cocoons after harvest. These either remain bound to fruit or are dislodged from fruit when subjected to high pressure apple washing.

197. If they are dislodged from fruit then they are either entrapped in high capacity filtration systems or must survive being subjected to high pressures and mechanical forces within pumping systems and/or the very high impact forces when exiting via a washer nozzle.

198. The probability that any viable midge pre-pupae or pupae dislodged from fruit could survive this treatment and transfer to other fruit and remain viable can only be **zero**.

199. Other pathways for the fruit to become infested in the packhouse, either from larvae or adults are also **zero**.

200. As in other places in the Report where contamination is considered, the quantitative model itself adds contamination to the fruit where even the Report acknowledges contamination of clean fruit is improbable. This is a serious flaw in the model which should be corrected before the final IRA is drafted.

201. **Importation step 6**: Likelihood that apple leafcurling midge survives palletisation, quality inspection, containerisation and transportation to Australia: uniform distribution with a minimum value of 0.7 and a maximum value of 1. U(0.7, 1).

202. New Zealand questions the values assumed in the Report. For example, no information is provided on whether, following the USDA-APHIS interceptions of ALCM, the cocoons were dissected to determine what was present in the cocoons and if they were viable ALCM. Without this level of detail these interception records are of little relevance.

203. The Report mentions the interceptions of ALCM being made in several US ports. New Zealand would be interested to know what ports these are as the vast bulk of New Zealand apple exports enter the USA only through the port of Long Beach, California. Other ports in the USA would have no interest in detecting ALCM as it is only California that imposes controls on the pest.

204. It is of note that Californian authorities claim that ALCM is not established in California. This is despite more than 30 years of New Zealand apple exports to Californian markets prior to the introduction of the Californian midge regulation in 2001. During that period it is estimated that New Zealand's annual apple exports to California averaged ~1.5m 18kg cartons (Pipfruit New Zealand Inc. and New Zealand MAF estimates). It is estimated that ~6,400m fruit, presumably with ALCM cocoons incidences similar (or higher) than those described in Report Table 40 and many millions more from the eastern states of the USA that have ALCM, were shipped to Californian markets without establishment of ALCM. This would appear to challenge the entire likelihood of apple fruit acting as a pathway for ACLM introduction, establishment and spread.

205. New Zealand asserts that the likelihood associated with importation step 6 should be reduced from 'high' to '**moderate'** at most.

206. **Importation step 7**: Likelihood that clean fruit is contaminated by apple leafcurling midge during palletisation, quality inspection, containerisation and transportation: uniform distribution with a minimum value of 0 and a maximum value of 10^{-6}. U(0,10^{-6}). New Zealand asserts that this value should be **zero**.

207. Once the midge pupa, inside a cocoon, is adhered to fruit there is no further movement of the cocoons nor does the pupa exit the cocoon to spin a new cocoon. Therefore, no further increase in numbers of cocoons is possible. The likelihood value for importation step 7 must therefore be **zero**.

208. The wording of Imp7 is: "Likelihood that clean fruit is contaminated by apple leafcurling midge during palletisation, quality inspection, containerisation and transportation". This statement makes no comment about whether or not there would be a net change (increase or decrease) in numbers of ALCM yet the report discusses this rather than sticking to the actual event at issue, i.e. contamination of clean fruit.

209. The arguments given in Imp5 above apply equally to Imp7. The likelihood that clean fruit is contaminated by ALCM during palletisation, quality inspection, containerisation and transportation can only be **zero**. The use of a range of possibilities is inappropriate.

210. In all the potential contamination events, i.e. where clean fruit is contaminated with new organisms, discussed in the Report where common sense indicates no contamination would occur the model itself in fact adds contamination to the consignment. Even the use of the model's lowest values (0, 10^{-6}) adds contamination to even a perfectly clean consignment. This is a flaw either in the model or in its implementation and should be corrected in preparing the final IRA.

211. **Importation step 8**: Likelihood that apple leafcurling midge survives and remains with the fruit after on-arrival minimum border procedures: triangular

distribution with a minimum value of 0.7, a maximum value of 1, and a most likely value of 0.9. T(0.7, 0.9, 1)

212. It is probable that minimum border procedures in Australia would be less effective than on-shore quality and endpoint phytosanitary inspections in New Zealand. The information provided in Report Table 40, gathered from large volumes of fruits by highly trained and independent IVA-QC personnel, is the best quality data on the presence of ALCM cocoons in packed cartons of New Zealand apple fruit. This data should be used as a base in any calculation of probabilities.

213. However, even the data in Report Table 40 makes the assumption that all fruit infested with cocoons represent viable ALCM. In fact, data provided in New Zealand's comments on Imp4 and Imp5 above show that the many ALCM cocoons on harvested fruit are empty, while most of the pupae contained within the remainder are either not viable or parasitised. This information should also be used in any re-calculation of the probabilities.

214. The Report's methods require use of a triangular distribution only "when information (e.g. literature and expert opinion) on the most likely value was available". No such information was presented for Imp8 and consequently only a uniform distribution for a 'high' likelihood should have been used.

Probability of entry, establishment and spread

215. **Commercial fruit crops near utility points:** The statement of risk applies only to apple wholesalers who are in proximity to apple orchards. Discussion of any other fruit orchards is not relevant. Also, as described earlier this risk applies only to graded and sorted fruit imported in bulk bins. It should not enter into any calculation associated with fruit in retail-ready packaging such as cartons, bags or crates.

216. Proximity needs to be clearly defined. For a single ALCM female proximity must be less than 40m to susceptible apple leaf tissue (refer to Appendix for female dispersal distance data). Not only must the female ALCM emerge and mate near the commercial apple orchard but that orchard must also have young, unfurling apple leaves suitable for oviposition and larval growth.

217. No data is presented showing what proportion of orchard wholesalers would re-pack New Zealand apples within 100m of actively growing apple shoots. As noted previously, the Produce Marketing Association (PMA) of Australia has advised that if re-packaging of retail-ready packs is required, it is commonly done at facilities adjacent to wholesale markets in metropolitan areas well away from commercial orchards. Therefore, a rating of 'certain' is unjustified and this estimate should be reassessed downwards to lower than the rating for urban retailers near commercial fruit crops.

218. **The proportion of urban wholesalers, retailers, food services, and of consumers near commercial fruit crops:** As the Report points out the majority of the Australian population is located in metropolitan areas with only 5% estimated to be located near commercial fruit crops. However, the Report goes on to state "but the distance to these crops may be too far for the apple leafcurling midge to fly". No data is given on the ALCM flight distances yet there are implicit assumptions in the above statements and supposed 'risk' determinations that suggest ALCM adults are capable

of long distance flight. This is not correct. Individual males are thought to fly approximately 50m and females approximately 30m. (refer to Appendix 2 for female dispersal distance data).

219. Based on the evidence given above, and the fact that oviposition only occurs on young actively growing apple leaves, New Zealand assesses that the values of probability listed in the Report overstate the likelihood of female flight, mating and oviposition occurring from apples discarded in the above list of utility points. The probability value finally determined should be significantly lower.

Transfer to hosts

220. The Reports states 'If pre-pupae or pupae survive cold storage or controlled atmosphere storage, adults would need to emerge from the pupal stage after the apples have been taken out of storage. They could emerge wherever the cold chain is broken, such as at unpacking and repacking facilities or retailers and during the transportation of purchased apples from retailers to households'.

221. This statement makes many assumptions about diapause termination and the emergence of ALCM adults after exposure to periods of cold storage. If viable ALCM are present within cocoons on fruit supplied from New Zealand then they will be in the pupal stage. Diapause termination and pupal development must occur before adults can emerge from cocoons.

222. Conditions for the termination of diapause in New Zealand have not been studied but a critical day length and subsequent temperatures are known to be key factors.

223. First adult emergence in New Zealand typically occurs between September 15 and 25th and is completed by mid-November (A. Tomkins and J. Walker *unpublished data*). Pupal development time (to adult emergence) is 30 days at 23^{o}C (M. Sandanayaka[14] *unpublished data*) so the critical day length must occur at least 30 days prior to mid-September i.e. early August.

224. Adult emergence will therefore not occur "whenever the cold chain is broken such as at unpacking and re-packing facilities or retailers and during the transportation of purchased apples from retailers to households."

225. Adult emergence will only occur when the conditions required for diapause termination have been met. This means that any break in the cold chain before early August (even in Australia) will not result in spontaneous ALCM emergence.

226. From early August pupal development will occur but the relatively long period required at ambient temperatures (e.g. 23^{o}C) for adult development (30 days) means that there would be no risk of adult ALCM emerging in Australia before early September so only breaks in the cold chain from September early onwards should be considered. It would make little biological sense for the adult ALCM to emerge spontaneously prior to this time because apple shoots are not likely to be available for this monophagous insect before late August/early September (in Australia).

[14] Manoharie Sandanayaka, Integrated Fruit Production Entomologist, HortResearch, New Zealand

227. Breaks in the cool chain occurring from early August onwards carry some risk of diapause termination and ALCM emergence after 30 days at average temperatures of 23°C. Fruit is usually held in commercial cool storage or domestic refrigeration for at least some, if not the largest amount of time prior to consumption. It will be unlikely that there would be significant physiological development of ALCM pupae present in cocoons to complete adult emergence in the normal supply chain where fruit is kept either refrigerated (or at least cool) prior to consumption.

228. Therefore there is little (if any) risk of adult emergence occurring during the normal course of fruit supply in the domestic consumption of apples. Any fruit held longer ~30 days at approximately 23°C is senescent and unlikely to be consumed. This fruit will be dumped and covered in a composting pit. The covering, layering and weight of dumped, senescent fruit substantially reduces the probability of emergence of these frail adult midges over the relatively long period required for pupal development. Consequently, New Zealand considers the likelihood of emergence of adults from this situation to be negligible.

229. The risk of pupal development and adult ALCM emergence from discarded apple cores (after eating) is also extremely low because any cocooned and viable pupae are highly likely to be damaged while the fruit is held during the eating. Any risk of adult ALCM emergence associated with consumers discarding small quantities of either fruit or apple cores must be negligible given the likely volume of fruit purchased by individual domestic consumers.

230. The only potential risks of adult emergence from fruit (followed by successful mate location and mating) occur when large quantities of fruit are removed from cold storage in spring and then dumped leaving any pupae present exposed to ambient temperatures for a long period, ~30 days. New Zealand asserts that in the unlikely event such a situation occurs, the fruit would be in a poor condition at the time of dumping. The chance of pupal survival and adult development, emergence and mating being successfully completed would be low in any such dumps of decomposing fruit. Dumping of fruit will be negligible with only class 1 export grade in retail-ready packs being exported this would be reduce this risk even further to very low.

Spread (Potential for movement with commodities or conveyances)

231. The Report twice states that: "research on the response of apple leafcurling midge to apple midge sex pheromone has shown that 'significant numbers of (male) midges were caught at all distances up to 50m and greater distances were not investigated'; however, 'numbers caught at 50m were still significant (several per day)' and 'no experiments on the distances females can fly' have been attempted (Cross, 2005)". And then on one occasion the Report goes on to propose anecdotal comment as fact: "Nevertheless, some researchers consider apple leafcurling midge strong fliers able to disperse well with the wind."

232. This statement on dispersal characteristics is presumably fundamental to many of the calculations made in the ALCM risk analysis including many of the calculations made above on the 'Probability of entry, establishment and spread' and 'Proximity'.

233. Flight distance data used in this analysis is presumably based on the statements

made by Cross (2005) that many male ALCM are caught at distances up to 50m and possibly beyond (not studied). However, in the risk analysis (i.e. the basis of distance for 'proximity' or 'near' calculations) it would be more useful to have data on the distances that female ALCM are able to disperse by flight and/or other mechanisms. Information on female dispersal distance data, supplied in Appendix 2, should form the basis of a re-calculated risk analysis.

234. The distance responses of Cross (2005) are based on whole population movements (i.e. from high densities of ALCM) rather than individual (albeit male) movements. Individual male movement (e.g. trivial flight) could be expected to be less than pheromone trap induced flight. Corresponding female flight could be expected to be significantly less than male flight and wing-loading information for each sex provided in Appendix 2 also confirms this.

235. In the situation where New Zealand apples are imported into Australia the initial incidence of cocoons on fruit, if present at all, is low (Report Table 40). Actual presence of viable ALCM inside any cocoons is extremely low when one takes into consideration the numbers of empty cocoons, non viable and parasitized pupae.

236. The risk analysis should therefore not be based on long distance movements of males recorded in pheromone traps from very large populations within infested orchards (Cross, 2005) but rather much shorter distances of 30-40m (refer to Appendix 2) moved by two (maybe a few) isolated individual ALCM associated with any disposal of waste fruit.

237. There are no known other studies of ALCM female and male flight distances but in many studies of flight in other insect species, female flight distances are usually significantly less than male flight distances (e.g. Suckling et al. 1994). Also, the distance moved by individuals in this instance could be expected to decline with exponential decay as a function of the number of individuals at the source population.

238. Pheromone-mediated flight of male ALCM normally occurs 5-10cm above the soil surface and shows strong directional flight towards the pheromone source, with straight directed flight or zigzagging behaviours (Harris et al. 1996). This response is not comparable to female flight. Females have quite different behavioural cues and there is no evidence that they exhibit flight behaviours or distances that are comparable to male flight (M. Sandanayaka *unpublished data*).

239. Female and male ALCM are of similar size but gravid females have considerably greater (1.8 times) wing-loadings than males. Observations of female behaviour suggest that they mate shortly after emergence and then relatively quickly move short distances (estimated at a maximum of 30m) to oviposit on the margin or upper side of young unfolding apple leaves. (Walker *unpublished data*)

240. This observation is supported by 2005/06 studies (Suckling et al. *in prep*) which found that high male catch may be recorded in pheromone traps without any measurable level of female oviposition (i.e. infested leafrolls) nearby. (refer to Appendix 2. for female dispersal distance data).

241. There are no references to support the claim that "Nevertheless, some researchers consider apple leafcurling midge strong fliers able to disperse well with

the wind." New Zealand researchers studying many aspects of ALCM movement, behaviour and flight responses to pheromone traps strongly disagree with this assertion.

242. Field observations and results by New Zealand scientists indicate a lack of flight by ALCM in the presence of wind of any significance. The upper threshold for flight activity is estimated at about 0.5m/s.

Conclusions - probability of entry, establishment and spread

243. New Zealand asserts that the predicted numbers of fruit infested with viable ALCM arriving at utility points (Report Table 43) are overestimates of the likely occurrence and therefore the risk associated with ALCM. Estimates based on August 2005 data do not take into consideration the high proportion of empty cocoons on harvested fruit (~40%), dead and shrivelled pupae (~59%) and high parasitism levels in cocoons containing live pupae; reported to be up to 95% parasitism. These empty cocoons and high mortality factors reduce the probability of live midge within cocoons on New Zealand apples to 4.00×10^{-5} and this should be used in a re-calculation of the risks of ALCM at the various utility points given in Report Table 43.

244. New Zealand asserts that the Median value of 0.51 in Report Table 47 is excessive in light of the above newly supplied data on empty cocoons and pupal mortality, unspecified (unrealistic) assumptions on female flight distances and the assumptions made on the rapidity of pupal development and adult emergence once the cool chain is broken.

245. New Zealand asserts that a Median value of negligible or extremely low be applied to the probability of entry, establishment and spread. This position is strongly supported by the lack of entry, establishment and spread into California from ~6,400milion apples shipped into that market over the 30 years prior to USDA including ALCM in their inspection process in 2001 at the request of California Department of Food and Agriculture.

246. If New Zealand apples are exported to Australia then the probability of entry, establishment and spread of apple leafcurling midge is extremely low based on the lack of establishment in California and estimated volume of New Zealand apples shipped to that market. The number of apples exported to California, showing zero entry, establishment and spread over the 30 year period of exports up to 2001 is equivalent to 127 years or 32 years of the proposed apple exports to Australia based on New Zealand's estimate of 50m or Australia's estimate of 200m fruit per year respectively for apples imported from New Zealand.

In light of the new data provided, New Zealand asserts that. the overall likelihood that apple leafcurling midge will enter Australia as a result of imports of apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in that area and subsequently spread within Australia must now be at most '**Extremely Low**'.

Assessment of consequences

Direct impact

Plant life or health – D

247. The ‘highly significant’, ‘D’ rating is excessive. This score relies substantially on an out-of-date survey of Nelson growers (district significance only) when control practices were based on old insecticides and technology and no integrated pest management (IFP) practices. With the introduction of new selective pesticides, modern integrated pest management practices and integrated fruit production systems the significance of ALCM control problems has declined markedly. Accordingly there are no specific recommendations for ALCM control given for export apple crops in documentation supporting New Zealand’s IFP programme.

248. ALCM has had little if any impact on apple production in New Zealand. Its impact is restricted to apple export programmes to a few countries where this insect is either not present (e.g. China), or present (USA) but with an area of freedom (California). In each of these cases ALCM does not prevent substantial volumes of New Zealand apples meeting the respective phytosanitary requirements and being exported to these markets each year.

249. Based on the above New Zealand asserts that a rating of at most ‘**C**’ is appropriate for the direct impact of ALCM on plant life or health.

Indirect impact

Control or eradication – D

250. If required insecticidal control of apple leafcurling midge can still be achieved in New Zealand with diazinon, an organophosphate insecticide. The primary use of this insecticide in the New Zealand apple industry is for the control of woolly apple aphid, *Eriosoma lanigerum*, which is a significant and widespread pest of apple crops in both countries.

251. Average diazinon use in the New Zealand apple industry (based on industry-wide submission of spray diaries) during the 2004-2005 season was less than 0.2 applications. Nearly all of this use being targeted to woolly apple aphid control, the national average use of diazinon for midge control is estimated to be less than 0.02 applications per season.

252. Establishment of ALCM would be unlikely to increase organophosphate insecticide use which is disruptive to many natural enemies that contribute to biological control. New Zealand growers make no effort to control midge on producing trees and neither are there recommendations in IFP documentation to suggest that insecticidal control measures are required.

253. Although the parasitoid *Platygaster demades* is absent from Australian orchards, New Zealand experience suggest that many other predaceous species contribute to effective biological control of ALCM. These includes predaceous phytoseiid mites (F. Phytoseiidae) and predaceous bugs (F. Miridae and F. Anthocoridae) all of which occur, and probably contribute to existing biological control programmes and integrated pest management in Australian orchards.

254. New Zealand maintains that a ‘**C**’ rating is an appropriate assessment.

Domestic trade or industry – D

255. Fruit can become damaged from ALCM larval feeding activity in developing blossom. While this can occur, the frequency is rare; so uncommon in fact that commercial packhouses do not record this defect for pack-out analysis reports supplied back to growers.

256. It does not necessarily follow that ALCM establishment in Australia will lead to a significant pest status because this pest is limited by geographical and climatic barriers. For example, the presence of ALCM in other states of the USA has not lead to establishment within California despite many years of unrestricted and large volume apple shipments from New Zealand to California. Neither has ALCM been transferred to California with the large volume of domestic apples moved from areas of known ALCM presence within the USA, e.g. Washington and Michigan States.

257. New Zealand maintains that a '**C**' rating is appropriate to cover any risks to either local or regional trade in apples.

International trade– D

258. The rating of D is excessive. ALCM has no major impact on New Zealand apple exports. New Zealand regularly exports to ALCM sensitive markets, e.g. China, India and California. When ALCM is detected the consignment is fumigated; New Zealand consignments with ALCM have never been rejected. Fumigation is a quite common practise in all importing countries, including Australia; it cannot be regarded as having a highly significant effect even at the local level. The Report is unnecessarily alarmist in suggesting that consignments will be rejected.

259. An impact rating of at most '**B**' would be more appropriate.

Conclusion – consequences

260. In drafting the final IRA for New Zealand apples New Zealand suggests, as per our earlier submission on the 2004 draft IRA report (MAFNZ 2004), that this estimate should be downgraded to '**very Low**.

Unrestricted annual risk

New Zealand asserts that the risks associated with ALCM on New Zealand apple fruit are below Australia's ALOP and risk management measures should not be required.

Risk management

261. As the risks associated with ALCM are below Australia's ALOP no risk management measures should be required. New Zealand will, however comment on the measures suggested in the Report

Inspection

262. The Report suggests that a 600 fruit sample was adequate to detect ALCM cocoon presence at a 4.1% infestation rate but inadequate for reliable detection in the range of 0.1%–0.8% infestation rates for which they require 3000 fruit sample to meet Australia's ALOP.

263. If assessment is based on the total presence of cocoons (empty, non-viable, viable but parasitised and viable - see Imp4 comments) the actual infestation rate as determined by sampling will be significantly overstated. Accordingly data presented in Report Table 54 and 55 should be re-calculated with consideration that any presence of viable pupae in cocoons will be significantly lower than values reported for merely detection of cocoons. The inclusion of many empty or non viable cocoons in the analysis of risk means that the actual risk (viable pupae) is significantly lower.

In light of the new data presented above New Zealand asserts that the overall likelihood of entry and establishment of ALCM is '**Extremely low**' and that the normal 600 sample would be more than adequate to detect the presence of viable cocoons at levels that might be of quarantine concern.

7. Leafrollers

264. This assessment relates to five species of leafrollers:

Brownheaded leafroller, *Ctenopseustis herana* (Felder and Rogenhofer)

Brownheaded leafroller, *Ctenopseustis obliquana* (Walker)

Greenheaded leafroller, *Planotortrix excessana* (Walker)

Greenheaded leafroller, *Planotortrix octo* (Dugdale)

Native leafroller, *Pyrgotis plagiatana* (Walker).

265. These five species of tortricid moths were assessed together because they are classified in the same family and are predicted in the Report to have a similar biology.

Probability of entry, establishment and spread

266. New Zealand maintains that based on comprehensive USDA pre-clearance inspection of 55million individual fruit between 2000 and 2004 (Table 7.) the probability of importation should be reduced to either '**low**' or '**very low**'.

267. This data (Table 7.) shows the incidence of greenheaded leafroller in export apple consignments was zero while brownheaded leafrollers were detected in only 2 out of 5 years with a maximum individual incidence of 2.5×10^{-7} (in 2002) and an average incidence of 9.1×10^{-8} over this period. *Pyrogotis plagiatana*, an incidental non-pest species (Wearing et al., 1991) was also only detected in 2 out of 5 years with a maximum individual incidence of 3.1×10^{-7} (in 2004) and an average incidence of 1.3×10^{-7}. Neither of the greenheaded leafrollers (*P. octo or P. excessana*) were detected in the estimated 54.9 million fruit examined over this period.

Table 7. The occurrences of native leafroller larvae in USDA Pre-clearance inspections of New Zealand apples between 2004 and 2004.

NATIVE LEAFROLLER FOUND IN USDA PRE-CLEARANCE INSPECTION

Common name	Species	2000	2001	2002	2003	2004
Greenheaded	*P. octo* and	0	0	0	0	0
leafrollers	*P. excessana*	0	0	0	0	0
Brownheaded	*C. obliquana*	0	0	4	0	1
leafroller	*C. herana*	0	0	0	0	0
Native leafroller	*P. plagiatana*	0	0	3	0	4
Lightbrown apple moth	*Epiphyas postvittana*	7	59	27	9	32
No. of lots inspected		308	410	639	576	792
Total sample size (estimated)		77,000	82,000	160,000	100,000	130,000
No. inspected fruit (~100 fruit/ctn.)		7.7m	8.2m	16m	10m	13m

268. The incidence of internal leafroller larvae within the New Zealand apple crop is

negligible. This USDA fruit inspection record data (Table 7.) is the result of the pipfruit industry adopting several leafroller risk reduction steps including highly effective integrated fruit production (IFP) pest management programmes, high pressure apple washing, fruit grading and end-point quality control (QC) carton inspections.

269. USDA inspection is based on large volumes of individually inspected fruit (7.7-16 million fruit per season). Cartons of fruit are inspected and this is completed several days to several weeks after packing and final packhouse carton QC inspections.

270. During the period of several days prior to fruit reaching long term storage temperatures any larval activity within the calyx cavity becomes more apparent, with the presence of feeding damage, frass or webbing. Frass is collected and easily detected in packaging materials and is readily identified by independent verification agency personnel carrying out inspections.

271. This data is of high quality and the detection of relatively large numbers of the Australian leafroller or lightbrown apple moth, *Epiphyas postvittana,* (134 larvae with an average incidence of 2.4×10^{-6}) compared to just five *C. obliquana* larvae over the 5 year period confirms that this inspection process is highly effective in detecting internal leafroller larvae even after all packing and QC inspection procedures and subsequent cool storage at $0.5^{o}C$. These fruit were free of external leafroller larvae and damage after high pressure washing, grading and endpoint QC inspections. New Zealand therefore believes that this clearly demonstrates that the USDA pre-clearance data supplied is an accurate and independent record of the risk of internal native leafrollers associated with export apples from New Zealand.

272. These records from a national apple export programme are unparalleled and New Zealand maintains that this data provides an unarguable basis for reducing the risk of importation from moderate to '**very low**'.

273. The presence of native leafrollers in New Zealand apple crops has also declined since the introduction of IFP pest management practices. Selective pest management based on IGR (insect growth regulation) insecticides (e.g. tebufenozide) has enhanced the role of biological control. Consequently publications prior to 1998 are out of date and reflect the former status of leafroller management and control in the presence of old organophosphate based approaches to pest control and not the current pest status.

274. In support of this statement recent estimates of parasitism levels of all three leafrollers has increased, with 54.9% (range 52.0 - 69.9) of leafroller larvae parasitised in recent surveys of vegetation immediately surrounding Hawke's Bay orchards exporting apples (Lo and Walker, *unpublished data*). This parasitism further reduces the probability of larval leafroller importation on New Zealand apples which has consequences for all subsequent steps in the risk analysis assessment.

Importation and distribution

275. New Zealand believes that the 'Moderate' rating given to both importation and distribution overstates the actual risk of native New Zealand leafrollers arriving in Australia on imports of New Zealand apples.

276. Lightbrown apple moth, E. *postvittana*, (of Australian origin) is the most common leafroller species in New Zealand apple crops and accounts for over 90% of all leafroller found associated with packed cartons of apple in USDA pre-clearance inspections over a 5 year period (2000-04), see Table 7.

277. The occurrence of greenheaded and brownheaded leafrollers in export apple crops is rare (Table 7.). Information on their pest status used in the Report also does not reflect the current pest status of these species following the enhanced levels of biological control achieved from introduced biological control species as a consequence of IFP-based selective pest management.

278. The incidence of native leafroller within export apple crops is so low that there are no specific monitoring or control programmes recommended for these species within the New Zealand IFP programme documentation. Control of these species is either biological or incidental and a consequence of controlling the much more abundant lightbrown apple moth.

279. New Zealand's IFP programme provides a very high level of leafroller control and even lightbrown apple moth larval detections are uncommon. Sightings of the reportedly 'economically important' native leafroller species in the national export apple crop is rare with the highest annual detection in any one year being the incidental species *P. plagiatana* at 3.1×10^{-7} (Table 7).

280. Larvae are the only stage that has been found within fruit; they can occur singly within in an apple calyx but such occurrences are rare (Walker *unpublished data*). Eggs, pupae and adults have never been reported to occur within fruit.

281. Larvae can not develop inside stored consignments of fruit to a 'pre-pupation' state because the minimum threshold temperatures for larval development of brownheaded leafroller and greenheaded leafroller (4.8°C and 6.1°C respectively) are considerably higher than the typical storage temperature of 0.5^{o}C.

282. Physiological development within New Zealand leafroller species is slow. Larval development at 20^{o}C takes 32.1 and 36.1 days for males and females respectively. Pupal development at 20^{o}C takes 16.4 and 13.8 days for males and females respectively (Clare and Singh 1988).

283. Fruit would need to be subjected to relatively long periods even at moderate temperatures for adult development to be completed. Even small increases in temperatures equivalent to the threshold of larval development (4.8°C and 6.1°C) would quickly result in fruit becoming senescent and unmarketable.

284. Even at higher temperatures the developmental rate of these species is relatively long; at 20^{o}C development of *C. obliquana*, from the neonate larvae to adult, taking 51.3 and 52.3 days for males and females respectively (Clare and Singh 1988). The pre-pupal and pupal periods for *C. obliquana* are also long. At 20^{o}C this is completed in 3.1+16.4 days for males and 3.5+13.8 days for females (Clare and Singh 1988).

285. Waste fruit disposed of in dumps at these temperatures would be likely to decompose and rot within the combined period required to complete both larval and pupal development. It is also highly probably that any waste fruit would be covered

by other waste dumped during this time.

286. Mature larvae move only short distances (typically much less than 1m) before pupation occurs, usually in a folded actively growing leaf. They are not likely to encounter living plant material within the fruit dump.

287. Both sexes of the same species must emerge at similar times for there to be any chance of mating which must occur within the 7-10 day period of adult life for the production of viable eggs and subsequent larvae. In the worst case scenario the probability of this occurring within a standard shipping container of ~500 cartons is $\sim 3.0 \times 10^{-5}$ for *C. obliquana* (2002) and $\sim 5.9 \times 10^{-5}$ for *P. plagiatana* (2004) respectively.

Probability of entry (importation x distribution)

288. New Zealand believes that the importation x distribution probability for native leafrollers should be reduced to '**extremely low**' or '**negligible**' given the levels of control as documented above and in USDA inspection records (provided in Table 7.).

289. These comprehensive inspections of some 55m individual fruit by trained IVA personnel between 2000 and 2005 found no larvae of greenheaded leafroller species while just 5 brownheaded leafroller larvae were detected over this 5 year period (an average frequency of 9.1×10^{-8}over this period).

Probability of establishment

290. New Zealand disagrees with time stated for greenheaded leafroller development (4-6 weeks from egg to adult) in information obtained from Landcare Research (1999). Published scientific data (Clare and Singh 1988) suggests that the time taken is significantly longer.

291. At a constant temperature of 20°C *C. obliquana* takes 9 days to complete egg development and a further 51.3 and 52.3 days for neonate to develop to adults. The total development time for this species is then 60.3 days and 61.3 days or 8.6 - 8.8 weeks respectively.

292. It is expected that *P. octo* developmental time would be very similar because both species have similar phenologies and numbers of generations each season.

293. On this basis we also dispute statements made in the Report about the number of generations occurring in New Zealand. In Hawke's Bay and Nelson three generations occur while in Otago there are usually only two generations completed. Four generations may occur in upper North Island regions but more than this is extremely unlikely given the long developmental times and an assessment of New Zealand's relatively low mean monthly temperatures.

294. These observations are entirely consistent with the New Zealand's regional mean temperatures and the development times for *C. obliquana* reported by Clare and Singh (1988).

295. Rather than developing quicker in the warmer Australian environment, New Zealand native leafroller may not lay any eggs. Brownheaded leafrollers are a cool-climate adapted species that are unable to lay eggs at 22°C and 25°C (Clare and

Singh, 1990).

296. The minimum population needed for establishment is a single mated female. However, adults are not found on export apples, so this mated female will have had to emerge from a larva that has arrived on an apple, subsequently pupated and emerged to find a male and mate.

297. However, with the very long larval and pupal development times for native New Zealand leafrollers there is a high probability that larvae would not have enough time to develop into pupae before the fruit rots.

Probability of establishment *(minimum population for establishment)*

298. Larval presence on apples is a rare event (Table 7) and establishment would require sexual reproduction. The probability of two very rare events (each individual event for *C. obliquana* in 2002; 2.5×10^{-7} and for *P. plagiatana* 2004; 3.1×10^{-7}), occurring at the same time and place after the fruit have left the cool chain and been divided into small groups (supermarkets or domestic residences) will be very low indeed.

299. Even without consideration of mortality due to parasitism and any mortality occurring during cool storage, following the approached used in the Report, the probability of two larvae of the same species occurring is 6.3×10^{-14} and 9.5×10^{-14} for *C. obliquana* and *P. plagiatana* respectively.

300. New Zealand therefore asserts that the probability of establishment is N**egligible** due to the highly improbable circumstances that would require these very large volumes of fruit to be simultaneously dumped at one location.

Probability of spread

301. New Zealand maintains that the probability of spread is actually '**Low**' rather than 'high' as suggested in the Report. The importation incidence of internal larvae is 'very low' (Table 7) and the likelihood of simultaneous emergence of two adults, one male and one female is '**negligible**'.

302. Leafrollers also move relatively short distances. Suckling et al. (1994) found that 80% of adult lightbrown moths and *Planotortrix octo* male moths were recaptured within 100m in a release-recapture study while 99% of lightbrown apple moth females were recaptured within 100m. This short distance for adult moth dispersal further reduces the probability of spread.

303. The probability of larval survival (in part due to high levels of larval parasitism; 54.9% (range 52.0 - 69.9) (Lo and Walker, *unpublished data*) and the fruit volume and temporal considerations for simultaneous adult emergence add further weight to the case for reducing the probability of spread to '**Extremely low'**.

Conclusion – probability of entry, establishment and spread

304. New Zealand has exported apples to the USA for more than 36 years with an estimated average fruit volume of 2.53 million cartons per year. The total number of apples exported to the USA in this period (based on an average of 100 fruit per 18kg carton) is estimated to be 9,400 million fruit. Some of this was fruit was exported

prior to the introduction and disciplines of the current USDA Pre-clearance programme in 1970. Despite widespread distribution of New Zealand apples throughout the USA there has been no establishment of any of New Zealand's native leafrollers anywhere within the USA during this long period of apple exports from New Zealand.

305. If New Zealand apples are exported to Australia under IFP programme protocols then the probability of entry, establishment and spread of native leafrollers is extremely low. This fruit volume exported to the USA, showing zero entry, establishment and spread over at least 36 years of apple exports, is equivalent to 187 years or 47 years of the proposed apple exports to Australia based on New Zealand's estimate of 50m or the Report's estimate of 200m fruit per year respectively for apples imported from New Zealand.

In light of the data discussed above, New Zealand asserts that the overall likelihood that leafrollers will enter Australia as a result of imports of apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in that area and subsequently spread within Australia is at most '**Extremely Low**'.

Assessment of consequences

Plant life or health – D

306. The data presented above clearly demonstrate that the direct impact of these pests on plant life or health is not 'D', as suggested in the Report. New Zealand asserts that a rating of '**C**' would be appropriate.

Control or eradication – E

307. Statements in the Report on insecticide resistance in leafroller species present in New Zealand significantly overstate the actual situation.

308. Greenheaded leafroller and brownheaded leafroller were well controlled by organophosphate (OP) insecticides and, unlike lightbrown apple moth (Suckling *et al.* 1984), small shifts in sensitivity to these OP insecticides never resulted in any significant level of field control failure.

309. OP insecticides were last used for leafroller control in the New Zealand apple industry in the 1999-2000 season. Prior to the introduction of IFP a resistance management strategy was developed and the potential for resistance development in leafroller populations was examined.

310. Wearing (1998) showed the potential for tebufenozide resistance when a population of *Planotortrix octo* was selected four times over 7 generations in the laboratory. Lo *et al*. (2000) showed that there was a small shift in sensitivity to tebufenozide in field populations of *Ctenopsuestis obliquana* in Hawke's Bay. Neither of these studies found naturally occurring field populations of native leafroller that were resistant to tebufenozide.

311. Neither of these studies found field resistance to the IGRs but highlighted the need for a resistance management strategy prior to the widespread implementation of

IFP pest management.

312. Tebufenozide has been used by the New Zealand apple industry since 1994 and has formed the basis of the IFP programme since 1996. There have not been any field control failures of leafrollers in either Central Otago or Hawke's Bay under the IFP programme, while it has delivered an extremely high level of leafroller control as is demonstrated by the very low incidence of all leafroller species found in large volumes of fruit inspected as part of the USDA Pre-clearance programme (Table 7).

313. Organophosphate-resistant populations of both *Planotortrix octo* and *Ctenopsuestis obliquana* were tested with lufenuron (Lo et al. 2000). Lufenuron was highly effective against both species, neither species showed any potential for cross-resistance to this insecticide.

314. New Zealand asserts the impact assessment for control or eradication is overstated by the Report. The lightbrown apple moth which is of Australian origin is the most significant of these pests. It is probable that mechanisms for the control of this pest in Australian apple orchards will similarly control the New Zealand native leafrollers. New Zealand asserts that a rating of '**C**' would be appropriate

Domestic trade or industry – D

315. New Zealand disagrees with this rating. The most serious leafroller species in New Zealand is lightbrown apple moth and this is of Australian origin. USDA Pre-clearance inspection data (Table 7) confirms that the occurrence of native species in New Zealand export apple crops is rare and that lightbrown apple moth is dominant. There can be little doubt that the situation would be similar in Australia were these moths ever to become established. New Zealand asserts that an impact score of at most '**B**' would be appropriate..

International trade – E

316. New Zealand has been a significant global exporter of apples for more than 40 years and now ships apples to more than 60 countries including many temperate countries where these pests might be expected to establish. Native New Zealand leafrollers have never threatened export programmes during that period nor have they ever caused restrictions leading to market loss. No cases of establishment of these pests outside New Zealand have ever been reported. New Zealand asserts that an impact score of at most '**B**' would be appropriate.

Conclusion – consequences

317. New Zealand has provided data and information which it believes justifies reducing the overall consequences of leafrollers to either '**Extremely low**' or '**negligible**'.

Unrestricted risk

New Zealand asserts that in light of this data, the annual risk estimation for leafrollers should be either **'extremely low'** or **'negligible'**, and thus below Australia's ALOP. Therefore, risk management should not be required for these pests.

Risk management

318. New Zealand agrees that these pests are bona fide quarantine pests for Australia and considers that the standard 600 fruit sample from each lot and remedial action if leafrollers are detected to be appropriate in this case.

319. However, New Zealand advises that the suggestion to cut 600 fruit to determine the possible infestation level of internal leafroller larvae will add nothing to the level of security Australia is seeking with respect to the importation of leafrollers on New Zealand apples.

320. New Zealand has provided independently collected data of extremely high quality (five years of USDA Pre-clearance programme inspection results) that confirms the negligible risk. While leafroller larvae are readily sighted by trained personnel, the two species of 'economic importance', brownheaded and greenheaded leafrollers are either extremely rare or have not been found in approximately 55million individual inspections of New Zealand apples in the 5 year period 2000-2004.

321. New Zealand maintains that the risk is '**negligible'**.

8. Apple scab

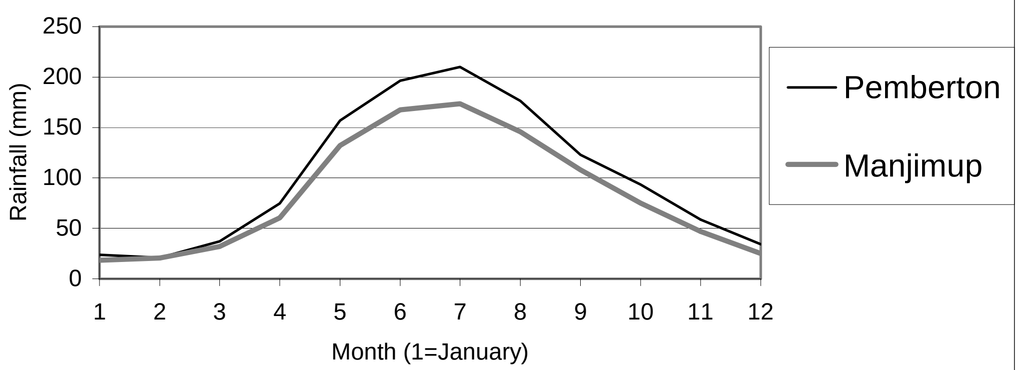
Apple scab is endemic in Western Australia

322. The Report suggests that Western Australia is free of apple scab and the state implements eradication measures to eliminate it whenever it is found. However, New Zealand asserts that apple scab is endemic in Western Australia.

323. A combination of low summer rainfall and the routine use of scab-active fungicides in intensive spray programmes to control powdery mildew and fungal fruit rots in apple crops, means that weather conditions suitable for orchard build-up of scab occur infrequently and that its presence is usually masked by disease control spray programmes. It is therefore argued that the import of New Zealand apples into Western Australia would not add in any way to the likelihood of apple scab outbreaks occurring in the apple growing areas of Western Australia.

324. Spring and summer rainfall causes scab development in scab-prone apple growing regions (Beresford *et al*. 1989). Rainfall during October triggers the release of ascospores allowing primary infection. Primary infection does not develop into a significant amount of apple scab unless there is adequate rainfall for secondary infection during the main fruit development period from October to February. A characteristic of the Western Australian climate is the generally very dry summers with a winter predominance of rainfall (Australian Bureau of Meteorology) (Figure 3.).

Figure 3. Mean monthly rainfall - southern Western Australia



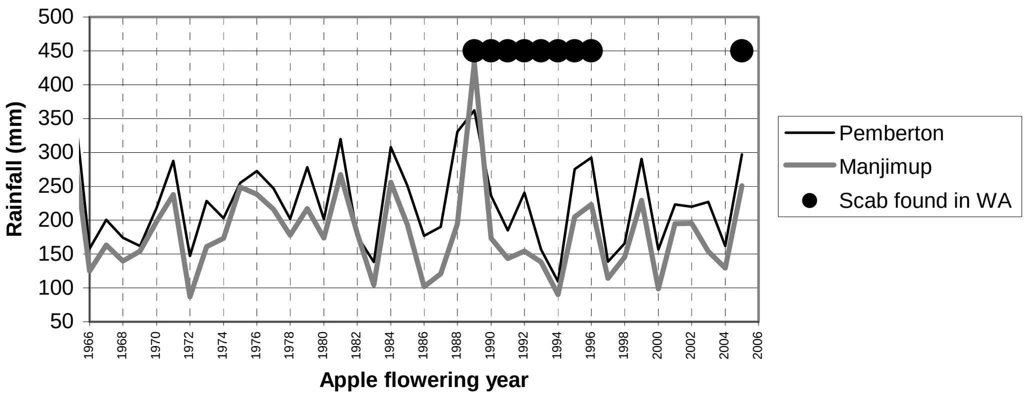
325. Apple scab has been under constant surveillance and eradication programmes in Western Australia since 1930, having been found in 17 seasons during two major outbreak periods (1930-1948 and 1989-1996). A third outbreak period appears to have begun in 2005 and scab is again under attempted eradication.

326. Apple scab has been recorded in most parts of southern Western Australia at various times since 1930, particularly in the apple growing area around Manjimup and Pemberton. It has been recorded in an apple nursery and in a home garden and as far as north as Stoneville, 30 km northeast of Perth (MacHardy 1996). A further outbreak has been reported in spring 2005 by the Western Australia Department of Agriculture at Pickering Brook, northeast of Perth.

327. During the 1930-1948 outbreaks the inoculum source was able to be traced to infected planting material brought in from the eastern states of Australia and since then strict quarantine laws have controlled the introduction of apple planting material. The source of inoculum for the outbreaks since 1948 is not known (MacHardy 1996) and the repeated occurrence of scab strongly suggests that there is an endemic inoculum source.

328. Figure 4 shows that the onset of the 1989-1996 scab outbreak was associated with the exceptionally wet summer that occurred during the 1989-90 growing season (Australian Bureau of Meteorology). Considering the very widespread nature of the 1989-96 outbreak (from Albany in the South to Stoneville in the north) it is probable that this outbreak occurred from the coincidence of suitably wet summer conditions and an endemic pathogen population that had been building undetected for several years.

Figure 4. Apple scab outbreaks in relation to rainfall from October to February at Manjimup and Pemberton (WA)



329. Apple scab is known to over winter on wild apples and crab apples (Nichols 1972) and this is where the endemic population in Western Australia probably occurs. There is also a high likelihood that scab resides in apple orchards, but usually remains undetected because climatic conditions are unsuitable for spread and because the use of fungicides masks its presence.

330. Fungicides recommended at 7-14 day spray intervals in Western Australia for powdery mildew and fungal fruit rot control include kresoxym-methyl, myclobutanil, penconazole, pyrimethanil + fluquinconazole, trifloxystrobin, mancozeb and copper hydroxide (Sutton, Trainer, Siyver 2003). These fungicides include several of the most active compounds against apple scab and they are commonly used in apple scab control programmes at 7-14 day intervals to suppress scab symptoms in areas where scab routinely occurs.

331. The highly mobile ascospore stage of the fungus can travel several kilometres and Aylor (1998) indicates that ascospores from an unmanaged orchard can cause infections in a managed orchard 2-5 km distant. Much larger dispersal distances than this were documented in Western Australia during the 1989-96 outbreak, where distances of up to 24 km were recorded for specific rainy periods (MacHardy 1996).

The presence of ascospores and the widespread occurrence of scab mean that the pathogen, *Venturia inaequalis*, was certainly present at a significant level, but undetected, during the seasons before the outbreak was detected.

332. Although it was claimed in 2001 that apple scab had been successfully eradicated in Western Australia (McKirdy et al 2001), a further outbreak was reported by the Western Australia Department of Agriculture at Pickering Brook east of Perth in spring 2005 and further eradication attempts are in progress during the 2005-06 season.

333. In conclusion, it is highly probable that *V. inaequalis* is endemic in Western Australia. The claim that it could have been eradicated is unlikely considering how widespread occurrences of it have been in that state since 1930 and how mobile the ascospore stage of the pathogen is. The Western Australian climate is generally unsuitable for scab development and the expression of scab symptoms in apple orchards is probably masked by the use of intensive fungicide programmes for the control of apple powdery mildew.

Comments on the risk analysis

Importation steps 1 and 6

334. The Report states, for Imp 1, that the "Likelihood that *V. inaequalis* is present in the source orchards in New Zealand is '1'". Although the probability of *V. inaequalis* presence in New Zealand orchards is quite high, it cannot be '100%' because in some areas, notably Central Otago, scab is not found in some orchards in some seasons. Therefore, this likelihood is not 'certain' and needs to be described by a probability distribution with a range of values.

335. The Report states, for Imp 6, that the "Likelihood that *V. inaequalis* survives palletisation, quality inspection, containerisation and transportation to Australia: uniform distribution with a minimum value of 0.7 and a maximum value of 1." These likelihood values are too high, given that all fruit from New Zealand would be cool stored and the pathogen will be in continuous decline. Therefore a uniform distribution with a much lower minimum and a maximum value is a more realistic assessment for this step.

Assessment of consequences

336. All assessments of consequence of apples scab are unchanged from those presented in New Zealand's comments on the 2004 draft IRA for New Zealand apples report (MAFNZ 2004), except for domestic trade or industry, where the value has been increased.

Direct impact on plant life and health

337. The Report is unable to refer to any data on crop losses in the eastern states which implies that the disease is of little significance in those areas. Instead the Report refers to 70% losses reported elsewhere "when environmental conditions are favourable for the pathogen." Clearly the environmental conditions in Western Australia are only favourable on rare occasions. New Zealand asserts, as previously, that a rating of '**B**' is more realistic.

Indirect impact on control and eradication

338. New Zealand asserts that apple scab is endemic in Western Australia and is serendipitously managed below economically significant levels by routine sprays of fungicides for the control of apple powdery mildew. A rating of 'E' cannot be sustained. New Zealand asserts, as previously, that that a rating of '**B**' is more realistic.

Indirect impact

Domestic trade or industry, International trade, communities

339. New Zealand asserts that apple scab is endemic in Western Australia and current high quality apple production is maintained in the presence of the disease with no apparent impact on quality. No state of Australia or country is likely to impose restrictions on the movement of apples from Western Australia or press for lower prices because of the presence of the apple scab pathogen. The rating for all these issues should be changed to '**A**'.

Conclusion- consequences

340. Based on the above re-evaluation of the consequences, New Zealand suggests that the overall rating of consequences for apple scab in Western Australia should be reduced from 'moderate' to **'extremely low'**.

Unrestricted risk

341. New Zealand asserts that apple scab is endemic in Western Australia and the risk associated with importing apples from New Zealand has no effect on Australia's ALOP, consequently no phytosanitary measures should be required.

Risk Management

342. New Zealand asserts as it did in its comments on the 2004 draft import risk analysis for New Zealand apples report (MAFNZ 2004) that there is a high probability that apple scab is endemic in Western Australia. This means that the risk of infection of Western Australia orchards from endemic populations of *V. inaequalis* is many times greater than any risk associated with the import of export quality apples from any area where apple scab occurs.

New Zealand asserts that no phytosanitary measures should be required against apple scab on apples from any source.

9. Codling moth

Probability of entry, establishment and spread

Importation

343. The Report suggests a likelihood that codling moth will arrive in Western Australia with the importation of apple fruit from New Zealand as **Moderate**. New Zealand asserts that for most of the same reasons as provided by the Report this should be revised down to **Low**.

344. New Zealand disagrees with the qualitative likelihood of 'moderate' that implies at least a 30% chance of importation (Report Table 12) of codling moth through imports of New Zealand apple fruit.

345. Codling moth activity in New Zealand is low by comparison with many other countries and references to the level of codling moth control from other countries is completely irrelevant to a risk assessment of codling moth in New Zealand's 'source orchards'. For example, codling moth 'control' with broad spectrum insecticides in commercial Australian orchard keeping damage levels below 2% (Rothschild and Vickers 1991) would be a highly unacceptable outcome to New Zealand's export apple growers.

346. Equally irrelevant and alarmist are statements of the very high incidence of codling moth in abandoned apple trees in Nova Scotia (MacLellan, 1977) and in the Crimea (Tanskiy and Bulgak, 1981). The damage numbers quoted by the Report paint a bleak picture of potential codling damage. The implication is that these are the norm, whereas they really only apply to localised uncontrolled situations in unmanaged orchards or research orchards where infestations are deliberately allowed to grow uncontrolled.

347. New Zealand growers are professional producers of high quality apples from highly managed production systems with extremely low occurrences of codling moth damage to meet phytosanitary standards for codling moth control in some of world's most demanding markets.

348. Available published literature showing the incidence of codling moth activity and damage in New Zealand orchards (Walker et al., 1997, Walker et al., 1998), together with other infestation data provided in this document should form the basis of the import risk analysis. These papers report codling moth damage levels in the range of 0 - 0.06% of fruit at harvest in commercial orchards following integrated fruit production (IFP) recommendations.

349. The incidence of codling moth damage in New Zealand apples is given in Table 8. This shows the average seasonal incidence of codling moth across all growers' submissions of Royal Gala and Braeburn apples through major packhouses in Hawke's Bay and Nelson. It represents the average incidence of codling moth damage in the field in each region.

Table 8. The average seasonal incidence of codling moth damage across all growers' submissions of Royal Gala and Braeburn apples through major packhouses in Hawke's Bay and Nelson.

	Hawkes Bay		Nelson	
Year	Royal Gala	Braeburn	Royal Gala	Braeburn
1999	0.00000%	0.00588%	_	_
2000	0.00074%	0.00000%	_	_
2001	0.03110%	0.02499%	_	_
2002	0.08889%	0.18538%	0.00000%	0.00000%
2003	0.02693%	0.02540%	0.00017%	0.00010%
2004	0.01502%	0.03575%	0.00183%	0.00000%

350. New Zealand apple growers using selective insecticides and standard IFP practices achieve high levels of codling moth control as is shown by data presented in Table 9. on the incidence of codling moth larvae in New Zealand apples collected during USA Pre-clearance inspection procedures. This information shows the incidence found in inspection after all grading, packing and endpoint QC inspection procedures and shows that codling moth incidence ranged from 2.6×10^{-7} in 2000 to 2.0×10^{-6} in 2002 and 2004.

Table 9. The incidence of codling moth, *C. pomonella,* larvae in New Zealand apple crops submitted for USDA inspection.

Year	2000	2001	2002	2003	2004
Nos of larvae intercepted	2	14	31	7	26
Total lots inspected	308	410	639	576	792
Total sample size (est.)	77,000	82,000	160,000	100,000	130,000
No. inspected fruit (est. of 100 fruit/ctn.)	7.7m	8.2m	16m	10m	13m

351. These detection frequencies from uncontrolled IFP programmes after packing and QC inspection for apples being shipped to the USA, a non-codling moth sensitive market, range from one event in 500,000 apples (2004) to one in 3.5m apples (2000). These fruit volumes represent 1 - 10 larvae per year or 4 - 40 larvae per year in apple exports to Western Australia based on New Zealand's estimate of 5m fruit and Australia's estimate of 20m fruit respectively.

352. New Zealand also operates a regulatory systems approach to codling moth risk management for codling moth sensitive markets (refer to Appendix 1) such as Taiwan. Codling moth management within this programme is audited to ensure high levels of grower compliance. This has resulted in the export of 125,000,000 kg of fruit to Taiwan since 1998 without the detection of any codling moth larvae in New Zealand fruit subjected to quarantine inspection procedures in Taiwan. If a fruit count of 100 is assumed then this volume is equivalent to 700m apples. This 'pest free' fruit volume represents either 140 years or 35 years of potential apple exports to Western Australia based on New Zealand's estimate of 5m fruit and Australia's estimate of 20m fruit respectively

353. Normal New Zealand pre-export phytosanitary inspection procedures require a sampling regime that will detect nominated quarantine pests (which codling moth is) with a 95% level of confidence if more than 0.5% fruit are infested. This will be

similar to standards of inspection applied by biosecurity authorities in Western Australia. These levels of detection (particularly when combined) will be significantly below the 30% chance of importation suggested by the Report.

The New Zealand government asserts that when drafting the final import risk analysis for apples from New Zealand Biosecurity Australia uses a likelihood of importation of codling moth of at most **'low'**.

Distribution

354. The Report suggests that the likelihood that codling moth will be distributed to the endangered area as a result of the processing, sale or disposal of apple fruit from New Zealand is **Moderate**.

355. As described above the numbers of larvae of codling moth potentially arriving in Western Australia with apple fruit will be low, certainly well below the minimum 30% likelihood of importation suggested by the report. The next stage of the distribution process requires a larva to leave an infested apple, pupate and then for a male moth to emerge within 1km of a calling female that will also have had to arrive in the same consignment to ensure synchronisation of emergence.

356. While adult female codling moth are capable of flying 300m and male moths 1km it is unrealistic to assume that most females and males fly these distances. In fact most female and male moths will fly shorter distances and this should be considered in the risk analysis.

357. The concurrent use of maximum dispersal distance and 'long range communication' with sex pheromone is suggestive of codling moth mate finding over similar distances. The flight-distance response of a male to a calling female is in reality likely to be much less than 1km, in fact just a few 10's of metres under ideal conditions (A. El-Sayed[15], *pers. com.*). In fact flight and mate location is far more complex with pheromone induced flight behaviour occurring over distances of less than 1km with flight (including mating) limited to thresholds for both temperatures ($\geq 16^{o}C$) and wind-speed ($\leq$ 8km/hr) at dusk (Knight and Weiss, 1997, Williams 2000).

358. As stated in the Report 'A successful transfer of codling moth to a susceptible host would require multiple insects escaping from utility points where large numbers of imported apple are stored for unpacking or packing.' This implies a significant level of infestation of consignments which, as discussed above, is improbable. This is even more improbable from class 1 export fruit that have been imported retail-ready in cartons, bags or crates.

359. No large larvae are likely to be found infesting fruit as such infestation and damage is very conspicuous during grading and packing. Regular 600 fruit endpoint QC inspections ensure that gross damage and large larvae do not occur in packed

[15] Dr El-Sayed is an internationally renowned pheromone chemist and insect behaviour specialist currently employed by HortResearch, Lincoln New Zealand.

export cartons. Larvae, if present, will be inconspicuous and small and will have to complete their development at low temperatures (0.5^{o}C) while in storage between packing and arrival in Australia.

360. If spoilt fruit is dumped a reasonable period would still be required to complete larval development (complete codling moth larval development takes 264 degrees-days above a base of 10^{o}C Williams, 2000). Some days at ambient temperatures would still be required for larval development to be completed. After which the larva must find a suitable and 'safe site' for cocooning and pupation.

361. Even if the larva does not enter diapause, pupation to adult emergence still requires a further 222 degrees-days above a base of 10^{o}C (Williams, 2000). The likelihood that these processes will be successfully completed by a single larva within at least a 22 day period within a dump of decomposing fruit must be low. For two or more moths to complete this within a 1km radius of each other must be either '**very low**', or '**Extremely low**'.

362. The near simultaneous emergence of two moths, one female and one male would require very large quantities of fruit to be dumped within the distance range of male moth flight (1km). Based on the highest recorded larval incidence in New Zealand apples (2002 and 2004) this would require at least 1,000,000 fruit, or 10,000 cartons of fruit (100 count size), to be dumped at similar times and locations (i.e. within 1km) for the chance probability that two larvae might occur. This is a highly unlikely scenario within the fruit distribution chain and should fruit ever be dumped in this quantity it is highly probable that it would buried for environmental reasons.

363. Also as Western Australia is such an enormous state and while a significant proportion of the New Zealand fruit will be distributed in urban areas, much of it will be spread thinly over the state. The likelihood that a male and a female codling moth will emerge from imported New Zealand fruit, which have a normal low level of infestation, within 1km of each other is very low.

364. New Zealand apples will arrive in Western Australia in early autumn and winter when most host plants are in decline and are not suitable for egg laying. Thus even if a male was able to locate and fertilise a female the likelihood of that female finding suitable egg laying sites will be remote.

365. Codling moths over winter (even the mild Western Australian winter) as hibernating late instar larvae, not eggs, and pupate the following spring. These hibernating larvae are prey to a wide range of predators including birds, rats, frogs to insects, mites and diseases. Few will survive the winter.

The New Zealand government asserts that when drafting the final import risk analysis for apples from New Zealand Biosecurity Australia uses a likelihood of distribution of codling moth in Western Australia, following importation, of at most '**Low**'.

Probability of entry (importation x distribution)

366. After combining the descriptive likelihoods for importation and distribution using the matrix of rules the likelihood that codling moth will enter the PRA area as a

result of imports of apple fruit from New Zealand and be distributed in a viable state to the endangered area is estimated as '**very low'.**

Probability of establishment
367. The Report suggests that the likelihood that codling moth will establish based on a comparative assessment of factors in the source and destination areas considered pertinent to the ability of the pest to survive and propagate is **High**.

368. The incidence of codling moth in New Zealand apple is very low, ranging from 2.6×10^{-7} in 2000 to 2.0×10^{-6} in 2002 and 2004. The probability that two larvae might occur within a single consignment of 10,000 cartons that is ultimately spoilt and then dumped is at very most **low**. Then for any larvae that might occur within this spoilt fruit to complete development and pupation through to simultaneous adult emergence must also be **low**.

369. However, as the Report states: "Egg-laying usually takes place on warm evenings (12 to 30°C). Eggs are laid singly on developing fruits and foliage." While the warm evenings may be available it is questionable whether the developing fruits and foliage will be during the months that New Zealand apples arrive in Western Australia, i.e. March to August.

370. Thus, not only may very small numbers arrive and that these small numbers will have difficulty of finding each other to mate, but the mated female will also have difficulty in finding a suitable place to lay its eggs such that emerging larvae have a ready food source. On these factors alone the likelihood that codling moth will establish based on a comparative assessment of factors in the source and destination areas considered pertinent to the ability of the pest to survive and propagate must be reduced from High to at most '**Low'**.

Probability of spread
371. New Zealand does not dispute the fact that if the very small numbers of codling moths that could arrive overcome the difficulty of finding each other to mate and the mated female actually finds a suitable place to lay its eggs such that emerging larvae have a ready food source then the likelihood of spread within that local district is probably **High**. For wider spread, linkages between districts within a potential host region would necessitate either widespread movement of heavily infested fruit or 'corridors' of host plants which may not be available.

Conclusion – probability of entry, establishment and spread
372. After combining the descriptive likelihoods for importation, distribution and spread using the matrix of rules the overall likelihood that codling moth will enter Western Australia as a result of imports of apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in that area and subsequently spread within Western Australia is '**very low'**.

Consequences

Control or eradication'
373. With three outbreaks of codling moth in Western Australia since 1993 the Area of Freedom status with respect to codling moth is obviously seriously challenged by the existing movement of infested plant material from other states into Western Australia. However Western Australia has demonstrated that it regularly implements

eradication programmes to either eradicate or control these outbreaks when they occur.

374. New Zealand maintains that the likelihood of a codling moth outbreak occurring in Western Australia from the importation of New Zealand fruit is very low (based on comprehensive New Zealand fruit inspection data) and substantially lower than that associated with the existing internal movement of codling moth infested plant material. New Zealand has also demonstrated that its codling moth management programmes in export crops achieve control at much higher standards than those values given in the Report for elsewhere in Australia (Rothschild and Vickers 1991).

375. New Zealand asserts that the economic consequences, as a result of eradication, control and management restructuring would not be as significant to Western Australia as is being suggested and the 'E' assignation should be reduced to '**C**'.

International trade'

376. As mentioned by the Report codling moth is widespread worldwide wherever pipfruit are grown. There is little evidence that Western Australia currently or plans to export any significant volume of apples to any markets currently free of codling moth, e.g. Japan, Korea or, Taiwan. Should Western Australia wish to export fruit to codling moth free countries in the future the New Zealand experience shows this can be done profitably as New Zealand has successfully exported apples to Taiwan since 1991. The impact on international trade would be very low and therefore New Zealand asserts that the 'D' assignment should be reduced to a '**B**'.

377. These changes produce a revised Report Table 74 were the DIRECT criteria remain the same and the INDIRECT criteria become C, B, D, B, B respectively. These criteria, in accordance with the matrix of 'rules' reduce the overall consequences of codling moth to **'low'**.

Unrestricted risk

378. A revised unrestricted annual risk estimation for codling moth is shown in Table 10.

Table 10. Unrestricted risk estimation for codling moth

Overall probability of entry, establishment and spread	Very Low
Consequences	Low
Unrestricted risk	Very Low

379. As indicated in Table 10. the unrestricted annual risk for codling moth is '**very Low**', which is at Australia's ALOP.

Risk management measures for codling moth should not be required for imports of New Zealand apples into Western Australia.

Risk Management

380. New Zealand asserts that based on the above assessment risk management measures for codling moth would not be required for imports of New Zealand apples into Western Australia. However, we shall comment on one of the options suggested by the Report.

381. New Zealand exports significant quantities of apples to Taiwan, 790 million apple fruit, sourced from throughout the country, in the last 15 years (nearly 90% of this since 1998). No codling moth has been intercepted by Taiwan during this period despite their intercepting the moth several times in consignments from the USA. This admirable record is the result of an intensive pest management programme carried out by growers and audited by MAFNZ to standards agreed with Taiwan.

382. A description of the New Zealand codling moth management programme is attached (Appendix 1). This is similar to that suggested in Report option 2. If measures were considered necessary (which as stated above New Zealand contests), such a programme would be implemented for New Zealand apples being exported to Western Australia.

10. Mealybugs

Probability of entry, establishment and spread

Importation Source orchards

383. Three species of mealybugs are commonly found in New Zealand orchards including longtailed mealybug, *Pseudococcus longispinus*, obscure mealybug, *P. viburni*, and citrophilus mealybug *P. calceolariae*. Comprehensive records from USDA pre-clearance inspections completed up to 2001 confirm that interceptions of other species of mealybugs (including *Planococcus mali*) on New Zealand apples are extremely rare.

384. There have been two sightings of *P. mali* in USDA pre-clearance inspection records from New Zealand export apples between 1994 and 2005, both of these occurred during 1998 inspections. This comprehensive analysis was based on phytosanitary inspections of more than 100 million individual fruit carried out by independent verification agency (IVA) personnel over this period. Species were identified in official diagnostic laboratories using both conventional taxonomic and DNA based approaches and thousands of individual mealybugs were identified to species during this period.

385. New Zealand believes that this data alone is justification to eliminate *P. mali* from further consideration with respect to this risk analysis for Western Australia.

386. Official diagnostic records of mealybug species taken from 1999 USDA Pre-clearance inspection records show the distribution of mealybug species found on New Zealand apples is presented in Table 11. This data, based on both conventional taxonomy and DNA analysis to separate juvenile stages of different mealybug species, shows that *P. calceolariae* was the least abundant species comprising just 17-19% of the species found on New Zealand apples.

Table 11. Mealybug species found on New Zealand two apple varieties during USDA pre-clearance inspections in harvest 1999.

Apple variety & mealybug species	**No. of mealybug infested fruit**		**Species distribution**
	with live mealybug	with dead mealybug	based on % alive
Royal Gala			
P. calceolariae	59	26	17.6
P. longispinus	133	46	39.7
P. viburni	143	38	42.7
Braeburn			
P. calceolariae	39	4	19.1
P. longispinus	64	13	31.4
P. viburni	101	8	49.5

387. This data was collected just prior to implementation of apple washing and the impact of the Pipfruit New Zealand integrated fruit production (IFP) programme, both of which lowered the pest status and occurrence of mealybugs respectively on New Zealand apples in subsequent seasons. More recent data on the mealybug species and their numbers found in USDA pre-clearance programme inspections is shown in Table 12. This data shows that *P. calceolariae* is identified as the species present in 26-27% of the mealybug infested apples in USDA pre-clearance inspections and that the incidence is low.

Table 12. USDA pre-clearance programme mealybug interceptions for the 2000 season and up to May 11th, 2001 across all export varieties. The estimated volume of fruit inspected in USDA inspections during 2000 and 2001 were 7.7 million and 8.2 million fruit respectively.

Year & mealybug species	North Island	South Island	Total	Species %	Incidence
2000 7.7m inspected fruit					
P. calceolariae	16	5	21	25.9	3.0×10^{-6}
P. longispinus	31	4	35	43.2	5.0×10^{-6}
P. viburni	24	1	25	30.9	3.6×10^{-6}
2001 ~8.2m inspected fruit					
P. calceolariae	49	12	61	27.4	7.4×10^{-6}
P. longispinus	69	53	122	54.7	1.5×10^{-5}
P. viburni	39	1	40	17.9	4.9×10^{-6}

Processing of fruit in the packing house

388. Apple washing has been shown to reduce the incidence of mealybug on infested fruit by 84-100% (J. Walker and S. Bradley, *unpublished data*) and this equipment was installed in most apple packhouses between 1999 and 2001. This significantly reduced the incidence of mealybug in lines of fruit presented to fruit graders at the grading table and the impact of apple washing can be seen with reductions in mealybug incidence from 2000 onwards (Table 13.).

Table 13. The incidence of mealybug per 10,000 fruit presented to graders at the grading table at a major Hawke's Bay packhouse between 1999 and 2005.

Harvest season	1999	2000	2001	2002	2003	2004	2005
Incidence per 10,000 fruit	60.3	12.7	4.2	11.4	8.5	2.2	2.2

389. Data shown in Table 14. is endpoint Quality Control (QC) carton inspection information from a second major Hawke's Bay packhouse. This data shows the frequency of *P. calceolariae* and *P. longispinus* in cartons based on many QC phytosanitary inspections of packed export cartons by appropriately trained and authorised personnel.

390. This more recent endpoint QC inspection data shows that predominant mealybug species in 2004 and 2005 seasons was *P. longispinus* with *P. calceolariae* constituting just 2.1% and 0.4% of mealybug species respectively. In over 1,700 QC inspections annually of Royal Gala no *P. calceolariae* were found infesting fruit in

either 2004 or 2005 seasons while 8 and 3 individuals were found in Braeburn QC checks.

Table 14. Endpoint QC carton phytosanitary inspection information coming from a major Hawke's Bay packhouse showing the relative frequency of *P. calceolariae* and *P. longispinus* in packed cartons in 2004 and 2005 seasons.

Year	Variety	Number of QC samples	Number of inspected fruit	***Pseudococcus calceolaraie*** No. found	Average per sample	Average per fruit
2004	Royal Gala	1747	1243165	0	0.000000	0
	Braeburn	2163	1535925	8	0.003699	5.2×10^{-6}
2005	Royal Gala	1777	1251640	0	0.000000	0
	Braeburn	1727	1174250	3	0.001737	2.6×10^{-6}

Year	Variety	Number of QC samples	Number of inspected fruit	***Pseudococcus longispinus*** No. found	Average per sample	Average per fruit
2004	Royal Gala	1747	1243165	241	0.137951	1.9×10^{-4}
	Braeburn	2163	1535925	141	0.065187	9.2×10^{-5}
2005	Royal Gala	1777	1251640	545	0.306697	4.4×10^{-4}
	Braeburn	1727	1174250	128	0.074117	1.1×10^{-4}

391. The stated 'High' risk of importing mealybugs into Western Australia on New Zealand apples is not correct; the data presented here clearly demonstrates that there is a very low incidence of *P. calceolariae* associated with packed cartons of New Zealand apples. New Zealand believes that the actual risk of *P. calceolariae* infestation of apple calyces is '**Low**' as is the risk of its importation on New Zealand apples

Pre-export and transport to Australia

392. Short-term cold storage has been shown to be a highly effective treatment for the control of mealybugs in harvested fruit. Data showing the time to achieve 100% mortality is shown (Figure 5.) for two of the mealybug species found in New Zealand apples, *P. viburni* and P. *longispinus* (Hoy and Whiting 1996, D. Whiting[16] and L. Jamieson[17], *unpublished data*).

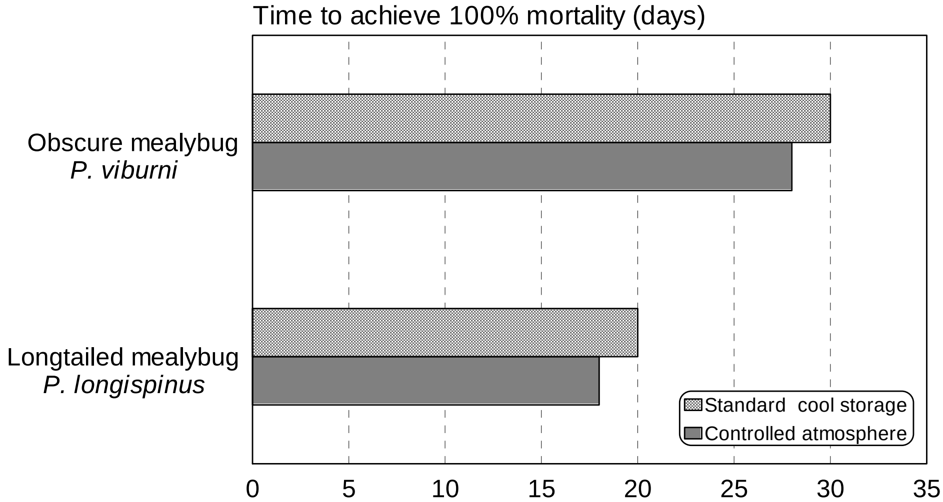
393. Unfortunately no equivalent data exists for *P. calceolariae* but, in the absence of such data, it is not unreasonable to assume that *P. calceolariae* would respond

[16] Diana Whiting, IFP Entomologist, HortResearch, New Zealand
[17] Lisa Jamieson, IFP Entomologist, HortResearch, New Zealand

similarly with expected 100% mortality times similar to, or shorter than, *P. viburni*, i.e. 30 days in standard air storage and 28 days in CA storage.

394. It is proposed that the risk of live *P. calceolariae* mealybugs in fruit shipped to Western Australia could be eliminated by ensuring that fruit was subjected to this minimum period of cool storage that could be achieved by both on-shore storage in New Zealand and the transit time to Western Australia.

Figure 5. The time taken in air and CA storage to achieve 100% mortality of the mealybug species *P. viburni* and *P. longispinus* infesting apples (Hoy and Whiting 1996, D. Whiting and L. Jamieson, *unpublished data*).



On-arrival procedures

Distribution

395. The risk from all mealybug species in New Zealand fruit is either moderate or low because any fruit with external mealybug is likely to be eliminated in the packhouse by post-harvest washing and normal grading procedures. Carton end-point inspection data confirms that the risk of external (visible) mealybug is therefore low (Table 14).

396. If the incidence of *P. mali* on New Zealand fruit is negligible then risk of *P. calceolariae*, the only remaining New Zealand species on apples of concern to Western Australia, must therefore be '**low**' or '**very low'**.

397. Any internal mealybug infestation is associated with the stem end or calyx cavity and mealybugs that may be found in these situations are normally juvenile. These juvenile stages are susceptible to both desiccation and low temperatures during extended periods of cool storage.

398. We believe that the data supplied above on the impact of cool storage on the mortality of two mealybug species would be an appropriate risk management response to deal with any low incidence of *P. calceolariae* associated with the importation of New Zealand apples to Western Australia. A conservative approach to risk management would be the requirement of either unbroken air storage or CA storage prior to or during shipment for either 30 or 28 days respectively.

Probability of entry (importation x distribution)

399. Several mealybug species can be found on New Zealand apples but with the supplied data showing the incidence of *P. mali* on New Zealand apples to be negligible then *P. calceolariae* should be the only New Zealand species of concern to Western Australia.

400. Data supplied shows that the incidence of *P. calceolariae* on New Zealand apples is low, between 0 and 7.4 x 10^{-6} and it constitutes just 0.4 - 2.1% of the mealybug species found infesting fruit in 2004 and 2005 (Table 14). The probability therefore of entry with New Zealand apples should be reduced to either '**low**' or '**very low**'.

Probability of establishment

401. Several mealybug species can be found on New Zealand apples but with the supplied data showing the incidence of *P. mali* on New Zealand apples to be negligible then *P. calceolariae* should be the only New Zealand species of concern to Western Australia

402. Data supplied shows that the incidence of *P. calceolariae* on New Zealand apples is low, between 0 and 7.4 x 10^{-6} and it constitutes just 0.4 - 2.1% of the mealybug species found infesting fruit in 2004 and 2005 (Table 14).

403. Mealybugs found in the calyx cavity are juvenile and if fruit were dumped would have already likely been exposed to a long period of cool storage; if greater than 30 days of cool storage they will be dead.

404. The probability therefore of *P. calceolariae* establishment associated with the importation of New Zealand apples should be reduced, to either '**low**' or '**very low**'.

Probability of spread

405. Several mealybug species can be found on New Zealand apples but with the supplied data showing the incidence of *P. mali* on New Zealand apples to be negligible then *P. calceolariae* should be the only New Zealand species of concern to Western Australia.

406. Data supplied shows that the incidence of *P. calceolariae* on New Zealand apples is low, between 0 and 7.44E-06 and it constitutes just 0.4 - 2.1% of the mealybug species found infesting fruit in 2004 and 2005 (Table 14). The probability therefore (Table 14) of its spread associated with the importation of New Zealand apples should also be reduced, to either '**low**' or '**very low**'.

Potential for movement with commodities or conveyances

407. New Zealand seeks assurances that the risk management assessment and process required for New Zealand apples are consistent with those applied to the movement into Western Australia of other Australian host species of *P. calceolariae*. This species of mealybug is highly polyphagous and can be found on 40 families of host plants. Does Western Australia control the import of all these plant species from the eastern states in a similar manner as is being suggested for New Zealand apples?

Conclusion – probability of entry, establishment and spread

408. New Zealand believes that the probability of entry, establishment and spread of

the only mealybug species that might be of concern to Western Australia, *P. calceolariae*, is actually '**low**'. The risk of *P. mali* is '**negligible'**. The conclusion of 'moderate' is an overstatement of the probability of entry, establishment and spread based on higher infestation levels of 'mealybugs' than actually occur for *P. calceolariae* in packed cartons of New Zealand fruit (Table 14).

Assessment of consequences

Direct impact

Plant life or health – D

409. New Zealand believes that a rating of '**C**' is appropriate given that there are at least two existing mealybug species in Western Australia. Biological control programmes for *P. calceolariae* are reported to be highly effective elsewhere in Australia and, given the climatic similarities stated in '*Suitability of natural and/or managed environment*' there is no reason to believe that this biological control would not be equally effective in Western Australia.

410. All three mealybugs *P. viburni*, *P. longispinus* and *P. calceolariae* are reported to be vectors of closterovirus associated with grapevine leafroll disease (Petersen & Charles, 1997; Golino et al. 2002). The risks associated with *P. calceolariae* and the growers' response to management and control would be unlikely to be different to those already in place for the management of *P. viburni* and *P. longispinus* that are present in Western Australia.

New Zealand asserts that based on the new data provided above the risk assessment for mealybugs will be below Australia's ALOP and a normal 600 fruit sample followed by remedial treatment if pests are detected will be appropriate in this case.

Risk management for mealybugs

Visual inspection and remedial action

411. If mealybugs are detected in 600 fruit sampling programmes then the list of approved treatments should include an option to use either unbroken air or CA cool storage for either 30 or 28 days respectively.

11. Risk management and operational framework

Use of AQIS staff

412. The Report suggests the involvement of AQIS staff for all orchard inspections for fire blight and European canker and for fruit inspections for apple leafcurling midge. Quite apart from the technical justification for even requiring any of these inspections, New Zealand asserts that there is no justification for requiring AQIS staff to be involved in anything other than routine audits of MAFNZ's systems.

413. The Report has extended the term "pre-clearance" from the original meaning of a routine AQIS border inspection done pre-export rather than post-arrival, to AQIS involvement in the phytosanitary measures themselves, i.e. orchard and fruit inspections.

414. The Report recognises MAFNZ as the "competent authority" in New Zealand and MAFNZ is the National Plant Protection Organization under the terms of the International Plant Protection Convention. However, the Report has not provided evidence for, and MAFNZ has not been separately informed by BA of, any concerns BA has around the veracity and effectiveness of New Zealand's phytosanitary inspection systems.

415. This is the first time Australia has required anything other than an audit process for New Zealand systems. The concept of AQIS "involvement" in these inspection systems runs counter to the spirit of the Australia/New Zealand Closer Economic Relations agreement and to the tenor of discussions between BA and Biosecurity New Zealand in recent years on recognition of standards and reduced inspection regimes.

416. The inspections required are labour intensive and time consuming but they are not technically difficult for inspectors familiar with the pests. If the measures set out in the Report are implemented, New Zealand growers and exporters would be required to pay for two inspectors at more than double the cost of one, where even if the inspection was justified only one would be needed. That is, the measure is overly trade restrictive, it is not justified, and no evidence is provided that enhanced phytosanitary security will be achieved.

417. New Zealand would not object to a genuine audit of MAFNZ systems by AQIS officials for agreed phytosanitary measures for the export of apples to Australia. Indeed, because of the sensitive nature of this issue, New Zealand would understand if the audits were of an enhanced nature for the first 2-3 years so as to the build confidence of the Australian apple industry. But if this latter issue were conceded New Zealand would require a firm commitment to normalising the audit regime after 2-3 years unless BA was able to point to a major non-compliance in the New Zealand systems. It is also expected, as with all audit regimes, that the frequency of audits would reduce as the auditor became confident of the systems being audited. That is, New Zealand expects that the audit would be annual for the first 2-3 years but reduce after that time to bi or triennial unless a major non-compliance occurred when the audit would return to annual.

Measures for fire blight

418. Based on the re-analysis of the risks associated with fire blight given in this submission New Zealand asserts that orchard inspections to determine presence or absence of active fire blight plus dipping of fruit in chlorine are not warranted. Concentrations of *E. amylovora* of around 10^6, the quantity needed to initiate an infection, have never been demonstrated to occur on mature apple fruit even on the calyx. Concentrations of 10^4 have been recorded on calyces but only from apples harvested from severely infected orchards. These concentrations are not epidemiologically significant and are in all cases are in continuous decline from the moment they fail to initiate an infection in the blossom and, in particular, through the cool chain process after harvest.

419. Speculation about theoretically possible transfer mechanisms for epidemiologically significant concentrations of bacteria from discarded fruit to a susceptible host at a time when climate is conducive to multiplication should form no part of an import risk analysis. The elimination of an entire orchard from export trade because of the presence of one active fire blight canker is not justified and is overly trade restrictive.

420. The suggestion made in the Report that dipping in a 100ppm solution of chlorine will effectively eliminate *Erwinia amylovora* from the surface of apple fruit is not supported by any evidence. The Report agrees that endophytic populations of *E. amylovora* do not occur in mature fruit. It states on several occasions that the likelihood of there being bacteria on the skin of apple fruit even at harvest is negligible and it agrees that chlorine dips will have little impact on bacteria residing on a closed calyx. The requirement for chlorine dipping is not justified and is overly trade restrictive.

Measures for European canker

421. The Report suggests that only orchards surveyed and found free of European canker should be allowed to export apples to Australia. Based on an assessment of the evidence presented here New Zealand asserts that no measures should be required. Even if measures were to be introduced, the ones being suggested in the Report are not the least trade restrictive possible.

422. For European canker New Zealand apple orchards can be divided into two broad categories according to their climate:

1) Those characterised by annual rainfall of less than 1,000 mm, summer rainfall (December through February) of less than 200 mm and rain days per year of less than 100 days; these include Hawke's Bay, the Wairarapa, Marlborough, Canterbury and Central Otago districts.
2) Those where climatic conditions are suitable for spread of European canker, e.g. Auckland and Waikato districts.

423. In category 1) areas the biology of European canker precludes its spread because rainfall patterns are never conducive to spore production and dispersal of *N. galligena*. In such areas it would not be necessary to repeatedly inspect apple and pear orchards to establish freedom from European canker, providing trees are disease free at the time of planting.

424. If measures were considered necessary, they could be based on the biology of *N. galligena*. Orchard freedom from European canker in the Hawke's Bay, the Wairarapa, Marlborough, Canterbury and Central Otago districts could be determined by a single inspection by an independent verification agency (IVA) for visible canker symptoms on a sample that would, at 95% confidence level, detect visual symptoms if shown by 0.5% of the trees in winter two years after planting (or if trees are more than two years old then in the winter prior to the first apple export season). No further inspections should be necessary unless the climate changes or infected fruit are detected in export consignments.

425. In areas where climatic conditions are suitable for spread of European canker, i.e. Auckland and the Waikato, annual wintertime orchard inspection by an IVA of a sample that would, at 95% confidence level, detect visual symptoms if shown by 0.5% of the trees would be sufficient to determine whether European canker were present or not at unacceptable levels. A 100% tree inspection (including the use of ladders in high canker areas) would not be justified and would be overly trade restrictive.

Measures for apple leafcurling midge

426. The Report suggests that a 600 fruit sample would be adequate to detect ALCM cocoon presence at a 4.1% infestation rate but inadequate for reliable detection in the range of 0.1%–0.8% infestation rates. The Report proposes that a 3000 fruit sample is required to meet Australia's ALOP.

427. In light of the new data presented in this document New Zealand asserts that the:

– Overall likelihood of entry and establishment of ALCM is '**Extremely low**'.
– Actual infestation rate of viable ALCM is significantly overstated by sampling for cocoons.
– A standard 600 fruit sample would be more than adequate to detect the presence of viable cocoons at levels that might be of quarantine concern to Australia.

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APPENDIX 1

A systems approach to codling moth (*Cydia pomonella*) management for *C. pomonella* sensitive markets

A summary

By

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Executive Summary

A systems approach to codling moth management for export of apples to codling moth (*Cydia pomonella*) sensitive countries is described. It is based on the successful Apples to Taiwan programme administered by Biosecurity NZ. The programme is audited by Biosecurity NZ authorised, third party, Independent Verification Agencies (IVAs).

Taiwan is a *C. pomonella* sensitive market with effectively a nil tolerance for *C. pomonella*.

New Zealand exported approximately 790 million apples (142 million kgs) of apples to Taiwan between 1991 and 2005. During that period no *C. pomonella* have been intercepted by Taiwan's BAPHIQ yet they are detecting *C. pomonella* from other exporting nations.

The programme is based on monitoring and application of appropriate control agents at specific trap thresholds.

The system fits within the NZ pipfruit 'PipSure' integrated fruit production system. It is audited from production site to packing/cool-store facility. Production sites, packers, cool stores and exporters all have to be registered to participate.

The success of the Apples to Taiwan programme to date is a far better indication of its suitability to provide *C. pomonella* free fruit into other *C. pomonella* sensitive markets than any theoretical risk assessment model is capable of as this is an operating export programme that is verified with each export consignment of apples.

Contents

1.0 Introduction

New Zealand exports fresh apples to the Codling Moth (*Cydia pomonella*) sensitive market of Taiwan. Exports have increased annually since the joint protocol was approved in 1990.

In that period approximately 142million kgs of apples (125 million kgs since 1998) have been exported to this market which does not tolerate codling moth infestation and has an effective regulatory maximum pest level of zero.

The production and packaging process involves an integrated fruit production systems approach for this market to ensure codling moth does not enter the importing market.

This document describes the systems approach to Codling Moth management for *Cydia pomonella* sensitive markets using the NZ Apples to Taiwan programme as a model.

2.0 Registration requirements

Export pipfruit production sites in New Zealand are registered annually pre season. Part of this registration process is a secondary registration for *C. pomonella* sensitive markets. This registration is on behalf of Biosecurity NZ. Only fruit from production sites registered for the *C. pomonella* programme can export to *C. pomonella* sensitive markets.

All packing and cool storage facilities wishing to be involved in the *C. pomonella* programme must be registered annually with Biosecurity NZ. Only packing and cool storage facilities so registered can be involved in the *C. pomonella* programme.

All exporters wishing to send fruit to *C. pomonella* sensitive markets are registered with Biosecurity NZ annually. These are the only exporters able to export apples to *C. pomonella* sensitive markets.

All *C. pomonella* registered production sites, packhouses, coolstore facilities and exporters are identified on the Biosecurity website.

3.0 Production protocol

The activities within the production protocol are third party audited by independent verification agencies (IVAs) authorised by Biosecurity NZ.

The production protocol is pheromone trap based. Placement and monitoring of traps is audited by the IVAs. Monitoring trap inspection personnel are identified as competent for the task by the IVAs.

3.1 Pheromone trapping

The protocol is based on monitoring pheromone traps and responding to trap thresholds throughout the season.

3.1.1 Trap density

Pheromone 'delta' traps are placed within the production site at the following densities. These densities have been determined to maximise trap catch efficiency and minimise interference between traps.

Traps must be placed within designated production site(s) at a density of at least one trap per 2 ha. For orchards smaller than 10 ha, traps are to be placed at the following densities:

Orchard Size (Ha)	No. of Traps Required
2.99 or less	2
3.0-3.99	3
4.0-9.99	4
10 +	1 per 2 ha

Traps must be placed internally within designated production sites rather than on boundaries. Additional traps may be placed on boundaries especially if an off-orchard source of infestation has been identified that the grower cannot influence.

Trap placement within designated production sites must be biased towards high risk areas of the production site(s), where these exist.

3.1.2 Trap Monitoring

Accurate monitoring and recording of trapping activity is essential. Records must be retained for audit purposes

Traps must be checked weekly, the number of *C. pomonella* recorded and then removed over the life of the sticky base.

At each inspection: the date of inspection and trap catch must be recorded within a field notebook. Initials of the registered trap surveyor must be recorded in paper based systems however this is not required in electronic recording systems providing identification of the surveyor is traceable through the system. All records must be complete and accurate for audit by the IVA.

Trap monitoring for *C. pomonella* must continue until the main flight periods have ended and these dates are notified to growers annually in the protocol.

The monitoring end date is usually mid March in Hawke's Bay and other North Island apple production areas, and early March in Nelson, Canterbury, Central Otago and other South Island apple production areas.

3.1.3 Trap Maintenance (Replacement of Bases and Pheromone Lures)

All trap maintenance must be recorded and records retained for audit purposes.

Trap bases must be replaced every 3 weeks or more often if dust or other contaminants affect trapping efficiency.

Pheromone lures (caps) must be replaced every 6 weeks. The old pheromone lure must be removed from the trap when the new one is placed. The old lure must not be discarded within the orchard.

3.2 Codling Moth Control Measures

Chemical control measures are closely linked to the phenology of the life cycle of *C. pomonella*. Monitoring of day degree (DD) accumulation and moth flights is critical to this process.

3.2.1 Timing of sprays

3.2.1.1 Day Degree (DD) accumulation

The BIOFIX and required DD were established from examination of 30 years weather and trapping data.

The BIOFIX is the date of first flight of new season emerged *C. pomonella*.

In New Zealand it takes 120 degree-days (base 10^{o}C) for *C. pomonella* eggs to develop and hatch. This means there needs to be an accumulation of 120 DD from the time of oviposition before any larval entry of fruit can occur. Therefore the key initial period for management of the first new season population is this BIOFIX + 120DD.

The DD accumulation is based on the average daily temperature and only includes temperatures above 10°C because *C. pomonella* eggs do not develop below that temperature.

There is a compulsory initial spray application based on the *C. pomonella* BIOFIX date + 120 degree days (DD) (base 10°C). All compulsory applications MUST be made between BIOFIX and BIOFIX + 120DD, and can be optimised based on the type of agrichemical product being used.

> BIOFIX + 80DD to 110DD (ovicides) - these products are active on developing eggs and therefore need to be applied well before egg hatch but late enough to offer protection from all egg masses laid by the spring adults.
>
> BIOFIX + 90DD to120DD (larvicides) – these products that are active on larval stages only and need to be applied just before or at the time of egg hatch to maximise effect on the emerging population.

The industry hosts a DD calculator on its website for grower convenience and audit trail. The DD calculator can be tailored for each region enabling growers to check DD accumulation to best time the initial application. The DD calculator enables a fixed audit point for the different regions to be determined. The DD calculator is also colour coded to further advise growers of key DD accumulations (Table 1).

Table 1: An example from the web based DD calculator

Refer to:

http://www.pipfruitnz.co.nz/embed.aspx?URL=http://www.hortplus2.com/codling/codling.php ensure the season is set to the year of the spring in NZ e.g., the 2006 export season started in spring (Sept-Nov) 2005 so set the season year to 2005.

DATE FROM	DATE TO	MAX	MIN	MEAN	DD	ACCUM. DD	RAINFALL
Sat 29th Oct 8am	Sun 30th Oct 8am	20.8 °C	13.3 °C	16.5 °C	6.5	68.9	0.0
Sun 30th Oct 8am	Mon 31st Oct 8am	18.8 °C	10.3 °C	15.0 °C	5.0	73.9	0.0
Mon 31st Oct 8am	Tue 1st Nov 8am	18.9 °C	8.1 °C	13.3 °C	3.3	77.3	1.2
Tue 1st Nov 8am	Wed 2nd Nov 8am	20.1 °C	8.8 °C	15.0 °C	5.0	82.2	0.0
Wed 2nd Nov 8am	Thu 3rd Nov 8am	16.7 °C	3.9 °C	10.9 °C	0.9	83.1	0.0
Thu 3rd Nov 8am	Fri 4th Nov 8am	22.9 °C	8.4 °C	15.9 °C	5.9	89.1	0.0
Fri 4th Nov 8am	Sat 5th Nov 8am	21.0 °C	10.5 °C	16.5 °C	6.5	95.6	0.0
Sat 5th Nov 8am	Sun 6th Nov 8am	26.3 °C	10.7 °C	18.2 °C	8.2	103.8	0.0
Sun 6th Nov 8am	Mon 7th Nov 8am	16.7 °C	10.1 °C	12.9 °C	2.9	106.7	2.6

Mon 7th Nov 8am	Tue 8th Nov 8am	14.7 °C	7.0 °C	11.8 °C	1.8	108.6	0.8
Tue 8th Nov 8am	Wed 9th Nov 8am	20.9 °C	8.8 °C	14.6 °C	4.6	113.2	0.0
Wed 9th Nov 8am	Thu 10th Nov 8am	18.5 °C	6.8 °C	13.6 °C	3.6	116.8	0.0
Thu 10th Nov 8am	Fri 11th Nov 8am	26.6 °C	6.7 °C	16.9 °C	6.9	123.7	0.0
Fri 11th Nov 8am	Sat 12th Nov 8am	24.2 °C	11.4 °C	18.1 °C	8.1	131.8	0.0
Sat 12th Nov 8am	Sun 13th Nov 8am	23.7 °C	8.0 °C	17.5 °C	7.5	139.3	0.0

3.2.1.2 Moth flights

After the initial compulsory application, *C. pomonella* control in all districts must be based on pheromone trap catches.

Flights are monitored using pheromone traps. Whilst these are baited with caps impregnated with female moth sex pheromone and trap male moths they indicate the periods when female moths will be present and available for mating and subsequent oviposition.

Strict trap management regimes are in place and are audited. Traps are monitored weekly (see 3.1.2) and *C. pomonella* catches are recorded along with date of inspection. Thresholds, based of risk of *C. pomonella* laying eggs in the crop, are responded to within 6 days of trap reading.

3.2.2 Chemical control

All applications are recorded in audited spray diaries and cross referenced to trap records.

New Zealand growers operate under an integrated fruit production programme (PipSure) or a fully certified organic system (BioGro™/Demeter™).

For agrichemicals to be permitted under the PipSure programme they have to be registered through the New Zealand agrichemical registration process, compatible with integrated fruit production objectives, have to be efficacious against the target and have to be internationally accepted with clearly identified maximum residue levels set. Products used in organic production must be compatible with the certification body concerned.

Currently, PipSure approved *C. pomonella* control chemicals belong to the insect growth regulator groups of moulting accelerator compounds (MACs) or the chitin synthesis inhibitors (CSI); the Axonal blockers or are of biological origin. Organic products are of biological origin and certified for use in organic systems.

New products may be added to the programme as they become available through the New Zealand registration process <u>and</u> they meet the requirements of the production programmes.

Rates used are as per the NZ label on the product container (a legal document in New Zealand). Application, depending on product can be either dilute or concentrate.

3.2.3 Trap action thresholds

Trap thresholds have been set to identify cost effective control action points that minimise infestation of the crop and therefore minimisation of the risk of transfer of *C. pomonella* infested fruit to the packing facility.

Applications of approved agrichemical products are made when the following thresholds are exceeded:

> Five or more *C. pomonella* in any single trap in any one calendar week
> or
> An average of two or more *C. pomonella* over all the traps in the orchard
> or
> An accumulation of ten *C. pomonella* in any single trap since the last *C. pomonella* or leafroller insecticide application

Agrichemicals must be applied within 6 days of the trap threshold being exceeded. This minimizes adult and larval survival and maximises grower opportunity to complete the application that is dependent on suitable weather conditions. If cover is still present from a recent application then additional application is dependent on trap catches within six days of the 'reapplication period' for that product.

All applications of agrichemicals are recorded in a spray diary.

3.3 Mating Disruption

Mating disruption has proven to be a highly effective control strategy for *C. pomonella*.

Isomate C+™ dispensers are recommended as they do not suffer from declining release rates over the season. They are placed in the top 10%-20% of the tree at 1,000 dispensers per hectare.

They are applied in early-mid October in the North Island and late October in the South Island. These dates ensure mating disruption is in place before codling moth activity commences for the season.

The efficacy of mating disruption is monitored by using delta traps baited with 10x concentration pheromone dispensers placed in the pheromone plume region (i.e. the top 20% of the tree height).

Monitoring traps are managed and responded to as per sections 3.1 and 3.2.

3.4 Harvest

Fruit is harvested into field bins clearly marked as coming from a registered production site. Packers check the status of the production site when fruit is submitted at the pack-house. As required NZ pipfruit industry best practice guidelines fruit is not accepted without a spray diary audit report that states suitability (at harvest) for specific markets.

4.0 Pack house protocols

Each registered packing and cool store facility is given a unique identification code by Biosecurity NZ.

The facilities must meet Biosecurity NZ defined phytosanitary requirements for:

- Inspection lighting
- Staff competencies
- Systems and procedures
- Insecticide treatment

Additionally the pack-house has to have suitable fruit grading and sizing capability. There has to be control exercised during and post the packing procedures to decrease the risk of *C. pomonella* contamination by:

- Fruit grading and sorting prior to packing
- Suitable identification of packed product
- Removal of downgraded fruit from the pack house
- A contingency if *C. pomonella* is found in a line of fruit
    - Rejection of the grower line of fruit
    - Rejection of all fruit from that production site for the *C. pomonella* programme for the remainder of the season
    - IVAs to be notified of the find and a traceback initiated
    - Notification to the grower of removal from *C. pomonella* programme and reason why

Packing and coolstore facilities must have a system that enables full traceability (backward and forward) of all fruit. They must maintain an inventory system that records:

- Production sites
- Cool stores holding the fruit

- Registered exporters being supplied with packed fruit
- Documented post inspection product security measures

Facilities are independently audited before approval/registration to the programme is granted.

There are also labelling requirements for each carton of fruit:
- Inspection date or pack date
- Packer registration code
- Variety (and trade name) of packed fruit

Additionally the loaded pallets have to be clearly labelled as to destination.

Cool store inventory systems must also record:
- Inward and outward movement of stock
  - Stock identification
  - Dates of movement from packer
  - Dates of movement to exporter

Packed and palletised product must be segregated at all times from apples destined for other markets:
- Minimum of 100mm when in cool store
- Minimum of 1200mm when at ambient temperature

Packed apples must be transported (packer to cool store, cool store – sea containers, cool-store to wharf, cool-store to airport) in such a manner as to prevent contamination by pests.

5.0 Exporter protocol

All exporters are registered with Biosecurity NZ and only exporters registered to the C. *pomonella* programme can export to *C. pomonella* sensitive markets.

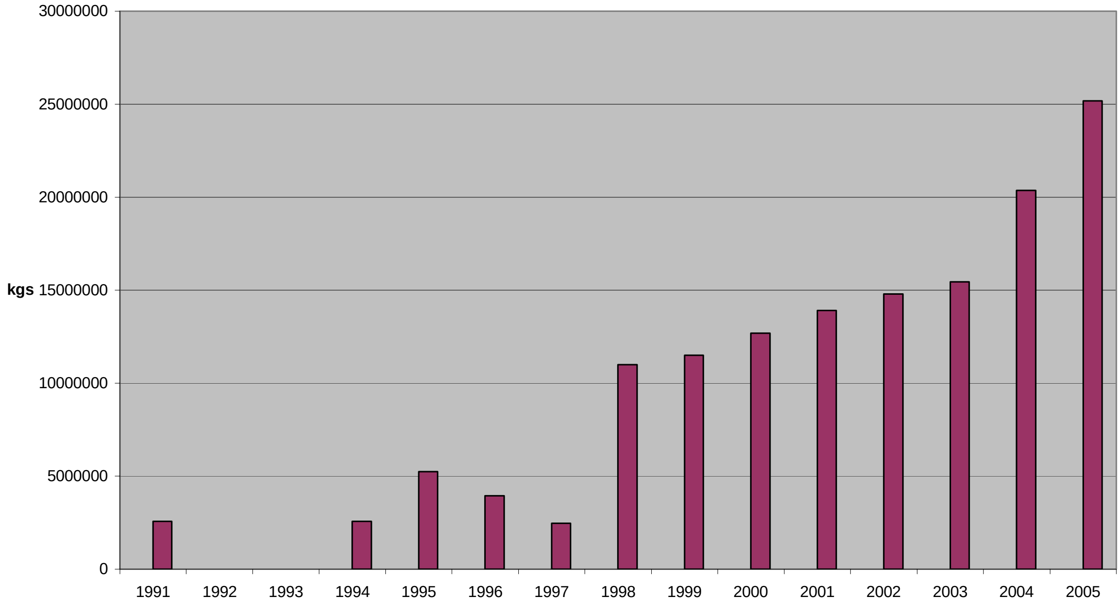
All exporters must have systems that ensure compliance with and maintain the integrity of producer, packer, cool-store requirements and full traceability.

6.0 Summary of Apples to Taiwan programme statistics

These statistics provide tangible evidence that the systems approach works very well and provides hard data on the negligible risk in an actual export trade scenario rather than hypothetical risk calculations.

During the period 1991-2005, 142 million kgs of apples have been produced and exported to Taiwan under this system approach (Fig. 1). That equates to approximately 790 million apples (assuming count 100 size profile). The market developed slowly initially but since 1998, 125 million kgs (700 million apples – count 100) have been exported.

Figure 1: NZ apple exports to Taiwan (kgs per annum)



Key varieties sent to Taiwan are Royal Gala, high coloured gala strains and in particular, Fuji. Small volumes of other high coloured varieties have also been included in consignments but usually to fill specific orders (Sciros/Pacific Rose™, Cripps Pink/Pink Lady™).

No *C. pomonella* have been detected from NZ apples by the Taiwanese BAPHIQ inspectors during the entire period since 1991, while at the same time BAPHIQ inspectors have been detecting apples from other producer nations that do not have the systems approach and integrated production-packer-marketer protocols employed by New Zealand. This confirms the robust nature of the NZ systems.

Taiwan BAPHIQ, audits of the procedures adopted by New Zealand for *C. pomonella* sensitive markets have taken place regularly and no issues have been reported.

APPENDIX 2

Crop Colonisation by Apple Leaf Curling Midge

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HortResearch (Lincoln, Havelock North, Nelson and Auckland)

INTRODUCTION

Adult apple leafcurling midge *Dasineura mali* (F. Cecidomyidae) are small flies ranging from 1.5-2.5mm in length. Little is known about adult flight dispersal distances and their ability to colonise apple trees. This study investigated the distance moved by adult female midges from an adjacent orchard into a large, newly established planting of young apple trees. This dispersal study was complimented by an analysis of female and male midge wing loadings as key factors influencing the distance of adult flight.

MATERIALS AND METHODS

Crop Colonisation

An experiment was undertaken in the Nelson region involving three replicated transects away from a mature block of apples into an adjacent very large (200 m x 260 m) two year old block. It involved infestation levels being assessed on 10 March 2006 across the two year old block. Three transect rows equidistant from each other and the long edge of the block and extended at row spacings of -3 rows (i.e. 15 m inside the mature block), 0, 2, 4, 8, 16, 32, and 64 rows away from the edge of the mature block (3 m row spacing in the young block). Shoot tip assessment for infestation of the insect consisted of the shoots on each of six adjacent trees being sampled at each point. The number of infested and un-infested shoots per tree was assessed. In the mature orchard block, the number of shoots assessed was limited to 20.

Adult midge wing-loadings

Infested apple foliage was collected and the adult midge emerging from cocoons were weighed. The body weights and wing length measurements were recorded for 40 female midge and 40 male midge.

RESULTS

Movement and Crop Colonisation

Shoot infestation was higher at the edge near the mature infested block and declined rapidly over the first 30 m into the young block. There was a background of low infestation which did not change with increasing distance. Some of this background of the pest may have been due to low level infestations brought with the new trees or their associated soil and leaf litter. Some of this background of low infestation could also be associated with small numbers of individuals that established an internal population in the previous season. The effective colonisation of the block therefore appears to be about 30 m from the edge and this distance represents the likely maximum distance that female midges move within any one season. Individual female midges would disperse over shorter distances during their lifetime.

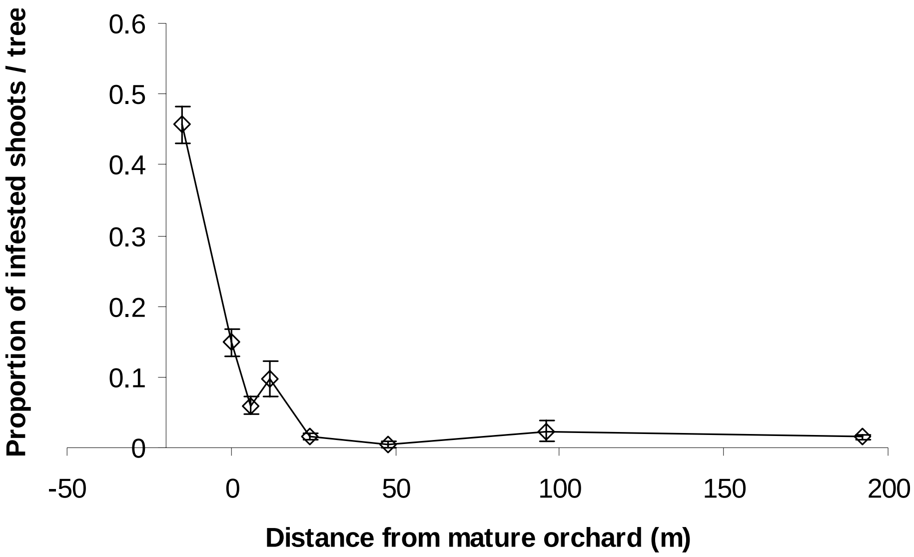

Fig.1. Shoot infestation rate per tree of *D. mali* in a young block of apple trees, with distance from an adjacent mature infested orchard. Error bars show one standard error.

Wing loading

The weight of female midges was 3.54 x 10^{-4} g (SEM 1.91 x 10^{-5}), compared to 1.15 x 10^{-4} g (SEM 1.04 x 10^{-5}) for males. Female wings measured 1.635 mm (SEM 0.024) in length and 0.75 mm (SEM 0.011) in width, compared to male wings of 1.445 (SEM 0.0212) length x 0.5 mm width (SEM 0.007). Thus, after correction for wing shape using image analysis, the wing loadings were c. 2.41 N/m^2 for females and 1.33 N/m^2 for males. Female wing loadings were therefore 1.8 fold higher than for males.

DISCUSSION

This study examined movement of adult female midge from large populations in mature trees into an adjacent newly established orchard. Oviposition and subsequent leaf damage data provides information that suggests the dispersal flight of female midges is highly localised. It suggests that few, if any, female midge fly further than ~30 metres to colonise new plantings and lay eggs on unfurling leaf shoots.

When the model fitted to this data is used as predictor the probability of adult female movement can be used as a predictor of the risk associated with much smaller populations of midge, such as those that might occur when spoilt fruit, which might be infested with some viable cocoons, is dumped in a landfill.

The information presented on wing loadings shows that female wing loadings are 1.8 times greater than they are for male midges. This data provides additional support for the likely shorter distance of female flight, probably half the distance that might be expected of male midges with lower wing loadings. This information is consistent with estimates of male distance movements to female sex-pheromone baited traps as communicated by Cross (*pers. comm.*) and in Cross 2005.

Reference

Cross, J. 2005. Personal communication from Jerry Cross as reported on p 329 of Revised Draft Import Risk Analysis Report for Apples from New Zealand.