SUBMISSION ON:

BA Policy Memorandum 2008/23

- Draft import risk analysis report for fresh unshu mandarin fruit from Japan

MADE TO:

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ACG
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ACG would like to acknowledge the contributions made by: ACG Technical Officer Mrs. Pat Barkley in conjunction with **Executive Officer** ***SA Citrus Industry Development Board Mr. Andrew Green***

Introduction

Australian Citrus Growers Inc (ACG) was established in 1948 as the peak body of the Australian citrus growing industry. ACG membership and associates includes nine grower organisations and three state/regional citrus statutory authorities in mainland Australia and, through them, some 3,000 commercial citrus growers.

In turn, ACG is a member of the Australian Citrus Industry Council Inc where fresh fruit packing and juice processing associations are also represented, and liaises effectively with the Australian Horticultural Exporters Association.

It is an ACG directive to ensure the maintenance of Biosecurity controls to minimise the risk of disease and/or pest incursions and our opposition to this IRA are made on that basis.

It must be noted that in the interests of gaining global market access for Australian citrus it is accepted that we must apply reciprocal consideration to foreign markets seeking access to our own region. In making the assertions detailed herein ACG will contest that the Japan unshu mandarin IRA must be rejected on many grounds including, but not limited to:

- Conflicting standards in the proposed treatment of asymptomatic fruit from the four Japanese production areas when compared to asymptomatic fruit from the canker Pest Quarantine Area of Emerald (Qld). This IRA proposes to lower Australia's minimum standards for imported fruit, conflicting with the WTO/SPS agreement which clearly states that measures applied domestically to deal with a particular risk need to be applied in the same manner to international sources. Australia to date has not accepted fruit from any country with citrus canker. A change in the strategy to accept fruits from a canker country based on a systems approach to mitigate risk, would be a change in policy
- Divergent risk assessments between the Florida (PFA) IRA of June 2003 and the Japan unshu mandarin IRA especially when Florida at that time was claiming Pest Free Areas, a claim not made for the 4 areas in Japan
- The impression is created in the IRA that Japan unshu mandarins are resistant to citrus canker. A review of the literature does not support this, and shows data and pictures of canker lesions on Unshiu mandarins. Also scientific data has shown that freedom from canker symptoms does not guarantee that fruits are not infected.
- Inadequacy of the risk rating of the quarantine pest Pink Citrus Rust Mite *Aculops pelekassi* and the significant economic loss that would occur if it was to establish in Australia
- Inadequate consideration of the risk of entry of mealybugs with establishment posing major threats to our export markets. An establishment of *Plancocuss lilacinus*, *Pseudococcus cryptus* or *Planococccus kraunhiae* would impact on

Australia's trade to the USA. It is noted on Page 153 that the USA requires fumigation of Satsuma mandarins from Japan with Methyl Bromide specifically for *Planococccus kraunhiae*. On this basis the ACG expects the same protocol to be followed.

The most vigorous point of contention that ACG wishes to have clarified by Biosecurity Australia whether not there has been a change in BA policy in respect to acceptance of asymptomatic fruit from countries or areas with citrus canker albeit at low pest prevalence. This is of great concern when viewed in context of the Emerald outbreak. Legal interpretation under the WTO/SPS agreement is unequivocal that measures employed to deal with local and domestic control be identical - yet among other inconsistencies in this IRA it is proposed that Australia's policy is changed in that we accept fruit from an area that is not a pest free area in regard to citrus canker. This is in contradiction to the NMG decision that taking into account the judgement of all states, territories and industry, as well as international considerations, movement of harvested asymptomatic citrus fruit from the canker Pest Quarantine Area (PQA) in Emerald would not proceed to the Australian domestic market.

ACG is concerned at the downgrading of Australia's requirement for fruit imports from area freedom for citrus canker to low pest prevalence, which will establish a dangerous precedent that may be exploited to our detriment, potentially allowing asymptomatic fruit from any canker country..

<u>If there is to be a change</u> in DAFF policy allowing fruits from Canker countries, ACG must first be satisfied with the freedom of orchards in the export areas from citrus canker and the integrity of the systems approach being proposed. To our satisfaction this will only be achieved when:

1. Pat Barkley, in conjunction with Biosecurity Australia, has been allowed full access to the four designated areas to conduct a review of tree health and orchard and packing shed operations as occurred when an IRA was developed for Korean citrus.
2. MAFF has carefully inspected all trees <u>at specified optimal times for canker symptom expression including at harvest</u>.
3. Japan has supported its claims of orchard freedom from citrus canker by scientific data - advice and information provided by MAFF must be substantiated by data and or reports which are made freely available for scrutiny.

This is a non negotiable position for ACG.

ACG disputes the scientific methodology employed to arrive at critical recommendations and evaluations of risk levels and makes particular note of irregularities when compared with the risk analysis conducted for the IRA for fruit from Pest Free Areas in Florida in 2003.

In its detailed response to the IRA for Japanese unshu mandarins, ACG will highlight the many concerns it has with the methodology utilised by BA to arrive at its recommendations. ACG request that BA respond to each specific question, recommendation and conclusion drawn by our experts.

ACG submits the following comments on the pests and diseases associated with imported unshu mandarin fruit from Japan:

In 1991 Australia imported budwood of Okitsu and Miho Wase unshu mandarins from the Ministry of Agriculture at Okitsu Fruit Tree Research Station, Shizuoka. At the time Prof. Ron Brlansky of University of Florida was visiting Dr Patricia Barkley's laboratory. As he is an expert on immunogold labelling they used this technique and antisera to *Xanthomonas citri* (A strain) to test washings (taken by PQS, Rydalmere) from the budwood for the presence of the canker bacteria. There was no doubt that they were positive for *X.citri,* but as the budwood had been fumigated, isolations and leaf enrichments were negative.

APHIS refers to unshus (satsumas) being resistant but if you read M. Koizumi's paper on citrus canker in Citrus Diseases in Japan published by the Japan Plant Protection Association in 1981, you will see that he ranks satsumas as moderately resistant, producing a few medium lesions. See also Koizumi, M. (1972). Studies on the symptoms of citrus canker formed on Satsuma mandarin fruit and existence of causal bacteria in the affected tissues. Bull. Hort. Res. Sta., Japan, B-12, 229-243.

There is no published paper *in the western literature* of canker transmission on fruits, however this does not mean it does not occur.

Under WTO-SPS, equivalence is required between domestic and international standards. Australian state and Commonwealth plant quarantine officers rejected an approach made to allow asymptomatic fruits from the canker-infected area of Emerald access to Australian domestic markets[1] (See details in footnote from QDPI & F Submission to the

[1] *"In April 2005 Queensland informed the national Management Group (NMG) that a Pest Risk Analysis (PRA) had been completed in relation to the sale of citrus from PQA properties to domestic markets. The PRA used the standard methodology used by Biosecurity Australia in the Import Risk Analysis process. The pathway by which citrus canker might be carried on citrus fruit, and enter, establish and spread outside of the pest quarantine area was modelled and probability estimates were made for each step. It was found that, for restricted domestic market access of Emerald citrus fruit, the probability of entry, establishment and spread was 'extremely low', meeting Australia's appropriate level of protection of 'very low'. It was therefore recommended by Queensland that domestic market access for Emerald citrus fruit should be restored, on the condition of property freedom certification, inspection and approved fruit treatment and the continuance of the National Citrus Canker Eradication Program. The CCEPP convened on Wednesday 11 May 2005 to consider the proposal put forward by DPI&F, that restricted market access should be allowed for PQA citrus fruit. States and territories were required to provide responses and make a decision in relation to market access for produce from Emerald Growers. The Consultative Committee on Emergency Plant pests (CCEPP) noted preliminary advice from the Technical Market Access Strategy Branch that the export trade consequences of domestic movement of fruit from the PQA could range from no impact, through to an inability to continue to certify export citrus from Australia, to uncertainty as to whether citrus exports would proceed.*

CCEPP sought advice from Biosecurity Australia on what implications acceptance of the Pest Risk Analysis (PRA) and subsequent domestic market access would have, in terms of minimum standards that may subsequently be applied to import proposals for canker-infested countries or regions. Biosecurity Australia advised that:

- *legal interpretation under the WTO/SPS agreement is unequivocal. If you apply measures domestically to deal with particular risk then you are obliged to offer the same measures to deal with the same risk from an international source*
- *the application of measures to deal with the risk must be based on a risk assessment*
- *the PRA does conflict with the current policy, in that Australia now only accepts fruit from citrus canker free areas. Acceptance of this PRA would mean that we would accept fruit from within Quarantine Areas where the disease would be assumed to occur. So it would change Australia's current minimum standards*
- *if the Commonwealth engaged with other countries on the trade implications of domestic market access for the PQA, Australia would be dependent on response times from other countries, which based on past experience, would not be rapid. It is difficult to approach countries on a hypothetical basis.*

Senate Rural and Regional Affairs and Transport Committee Inquiry into the Citrus Canker Outbreak, July 2005). **So why should asymptomatic fruit from Japan (not a pest-free area) be accepted?**

BA is not proposing the 4 export areas in Japan as either Pest Free Places of Production or as Pest Free Production Sites. Instead BA recognizes the areas as of low pest prevalence[2] based on **freedom from symptoms of citrus canker**.
Freedom from symptoms does not guarantee that fruits are not infected (Fulton & Bowman, 1929; Kuhara (1982) Verdier *et al*.), as will be demonstrated later).

The only survey method that can provide confidence in canker freedom is an **Intensive Survey**, i.e., examining every tree in every row or at least every other row at a time when canker symptoms are likely to be present eg for Japan, both Kuhara (1978)[3] and Goto (1992)[4] agree this would be Sept-Oct. Intensive surveys for canker symptoms should be complemented by testing for presence of the canker bacterium eg by leaf and fruit washings followed by leaf enrichments, immunofluorescence serology, PCR or the bacteriophage test.

ACG recommends travel to the four designated export areas by ACG citrus pathologist Pat Barkley to conduct tests in conjunction with BA scientists. ACG notes that the timing of these visits is critical to the validity of the test results.

ACG also notes that previously Dr Barkley was able to identify citrus canker in Korea after BA scientists had been satisfied that its own research showed no evidence of canker. Agreeable by DAFF – same should occur

Australia to date has not accepted fruit from any country with citrus canker. **A change in the strategy to accept fruits from a canker country based on a systems approach[5] to mitigate risk, would be a change in policy (see earlier footnote) and other countries (where larger volumes of fruit would be involved) could ask Australia for market access. Can BA advise of any change in policy to support this irregularity?** It should be noted that the request from Korea for market access for unshu fruits was dropped when Korea could not meet

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The NMG decided that taking into account the judgement of all states, territories and industry, as well as international considerations, movement of harvested fruit from the Pest Quarantine Area (PQA) would not proceed to the domestic market at this point in time."

[2] *The IPPC (1997) defines an ALPP as "an area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures" (Article II).*

[3] *Kuhara, S. 1978. Present epidemic status and control of the citrus canker disease (Xanthomonas citri (Hasse) Dowson) in Japan. Rev. Plant Prot. Res. 11:132-142.*

[4] *Goto, M. 1992. Citrus canker. Pages 250-269 in: Plant Diseases of International Importance. J. Kumar, H. S. Chaube, U. S. Singh, and A. N. Mukhopadhyay, eds. Prentice-Hall, Englewood Cliff, NJ.*

[5] *The international standard ISPM No. 5 defines systems approach(es) as "The integration of different pest risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests. The international standard ISPM No 14 "provides guidelines for the development and evaluation of integrated measures in a systems approach as an option for pest risk management. A systems approach integrates pest risk management measures to meet the appropriate level of phytosanitary protection of the importing country"*

production freedom (in nurseries etc), as well as fruit to be free from symptoms. This significant change to accept fruits from a canker country necessitates an assessment of the scientific evidence which supports this development. The IRA for unshu mandarins from Japan attempts to demonstrate that "*requiring production area freedom as part of a systems approach may not be technically justified where asymptomatic fruit can be produced if asymptomatic fruit does not provide a pathway for introduction*". **This is debatable and not an argument accepted by the European Food safety Authority (EFSA).**

A pest risk assessment by EFSA (2008)[6] on *Xanthomonas axonopodis* pv. *citri (Xac)* reported that *"s*hould the current regulations governing the imports of citrus fruit and plant material be lifted in French Guiana, Guadeloupe and Martinique, the probability of entry of XCC into the PRA area on plant propagation material (rootstocks, grafted seedlings, scions, etc) **and citrus fruit** would be high. The probability of establishment of the pathogen in the PRA area would be high because:

(i) susceptible hosts are grown in the PRA area,

(ii) the climatic conditions in the PRA area are similar to those in areas of the pathogen's present distribution, and

(iii) control measures are not likely to be undertaken in the family gardens grown with host plants in the PRA area. The probability of the pathogen spread after establishment would be high for the PRA area.

The movement of citrus fruit, particularly the latently infected and those that show no external symptoms at harvest, constitutes a pathway for the entry of XCC into the PRA area (EFSA, 2006)[7].

It has to be scientifically verified that diseased fruit does not play a role in the spread of the disease. Das (2003) noted that commercial shipments of diseased fruits are potentially a means of long-distance spread, although he mentioned that there is no authenticated record of this having happened. However, according to Gottwald *et al*. (1997), spread of citrus canker in the Miami area due to human transport apparently included the movement of infected plant material, **fruit** and potted plants by homeowners and small backyard nurseries. Also various EU countries including Spain have intercepted commercial citrus fruit shipments recently, with *Xac* infections (Dr. Maria Lopez[8], pers. comm. to Pat Barkley; EUROPHYT[9]), which means that *Xac* survives orchard management practices (eg copper sprays), packing shed treatments and shipping. Bacteria may survive a maximum of 120 days

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[6] *Pest risk assessment made by France on Xanthomonas axonopodis pv. citri considered by France as harmful in French overseas departments of French Guiana, Guadeloupe and Martinique. Scientific Opinion of the Panel on Plant Health. The EFSA Journal (2008) 682, 1-22*

[7] *EFSA (European Food safety Authority) (2006). Opinion of the Scientific Panel on Plant Health on a request from the Commission on an evaluation of asymptomatic pathway for the introduction of citrus canker disease (Xanthomonas axonopodis pv. citrimade by the US Animal and Plant Health Inspection Service. The EFSA Journal 439: 1-41.*

[8] *From Instituto Valenciano de Investigaciones Agrarias. Apartado oficial, Moncada, Valencia, 46113, Spain and a member of the European and Mediterranean Plant Protection Organization (EPPO) panel developing diagnostic protocols for citrus canker.*

[9] *EUROPHYT – European Network of Plant Health Information Systems*

on decomposing plant litter (fallen fruit, leaves and limbs) (Graham *et al*., 1987; Civerolo, 1984; Leite and Mohan, 1990; Gottwald *et al*., 1997) implying that fruit may be a means of disease spread.

Cultivars:

"*Japan stated that citrus production in the export areas is limited to unshu mandarins, consisting of the Aoshima and Miyagawa Wase varieties. Fruit ripen during December".* According to Harty & Anderson (2000), Miyagawa Wase is an early clone maturing late October to late November, while Aoshima is a late clone maturing mid December to early January. ***So when will proposed exports to Australia occur?***

Cultivation practices:

- Why are trees pruned prior to a spring leaf flush? Is leaf miner present on the pruned material? Inspection of these prunings for canker over a 2 yr period before export begins should be part of the systems approach.

- Are there nurseries or budwood source blocks in the areas? From whence do they obtain new trees?

- Has there been any replanting? If so, where did the trees come from?

- Does BA have an age profile of trees in the 4 export areas?

- "*The export areas are uninhabited, but there is some habitation along the road within the production area*" – do any of these dwellings have citrus including citrus varieties other than Unshu? eg Are there any *Poncirus trifoliata* or *Murraya* sp. in the 4 export areas?
- Is there legislation to prevent entry of citrus fruit (potentially canker-infected) into the 4 production areas?
- The IRA states there is a single annual leaf flush during April (spring), yet Kuhara (1978)[10] states that "*after trees reach adequate size, the grower usually cuts off late summer and autumn shoots"* (as occurs in South Korea).

Post harvest:

- Have New Zealand and USA been contacted to determine if there have been any problems with fruit from this region? What are the import requirements for fruit from this region into these countries?[11]

- How is the fruit sorted for blemishes?

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[10] *Kuhara, S. 1978. Present epidemic status and control of the citrus canker disease (Xanthomonas citri) (Hasse) Dowson in Japan. Re. Plant Prot. Res. 11: 132-142.*

[11] *Am I correct in that the USA regulations for importing unshu oranges from Honshu Island, Japan, require fumigation using methyl bromide prior to exportation and allow the fruit to be distributed to additional areas of the United States, including citrus-producing areas?*

- Is there no waxing of fruit?

Quarantine pests for pest risk assessment:

- Why is *Mycoshaerella horii* not included in this list? Gray leaf spot in Japan is caused by *M. horii* and has somewhat different symptoms to the disease caused by *M. citri (Mondal & Timmer*[12]*, 2006)*. *M. citri* is considered to differ from *M. horii*; the former has smaller ascospores which are not constricted at the septa[13]. Does *M. horii* cause fruit symptoms, as *M. citri* does?

- Also what about Pseudo greasy spot caused by the yeast, *Sporobolomyces* sp. which occurs in southwestern Japan[14]?

Citrus canker (Xanthomonas axonopodis pv. citri*)*

Probability of entry:

A key component of every systems approach is accurate data on the level of pest or disease infestation. The IRA does not provide data to substantiate canker freedom: there is only a statement that "*there has been no reported incidence of X. axonopodis pv. citri on unshu mandarin in the designated export areas since monitoring for the pathogen commenced in 1968 (i.e. the commencement of the monitoring program for citrus canker as part of the export protocol for unshu mandarins to the USA)".*

Appendix F details the monitoring methodology:

- *The sentinel inspection points are 25–50 km from the export areas.*
- *The Pest Forecasting Program for citrus canker at the Shizuoka Prefectural level consists of monthly monitoring during the growing season from March to October. Each month <u>a combined, random sample of 100 leaves (old leaves and new leaves) and fruit is collected from one citrus tree at each of the 30 sentinel stations.</u> An equation is used for obtaining monthly statistics that report on the absence/presence of citrus canker*
- *Forecasting information is issued once per month and covers the status of the pest, the*
  predicted level of an emerging pest, and evidence and proportion of fields (orchards) requiring controls.
- *In addition, MAFF officers monitor unshu mandarin orchards exporting fruit*

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[12] *S. N. Mondal and L. W. Timmer (2006) Greasy Spot, a Serious Endemic Problem for Citrus Production in the Caribbean Basin . Plant Disease 90, Number 5: 532-538*

[13] *Sivanesan A, Holliday P. 1976. Mycosphaerella citri. [Descriptions of Fungi and Bacteria]. UK, CAB International IMI Descriptions of Fungi and Bacteria. No. 51. Sheet 510.*

[14] *Koizumi, M. 1989. Citrus diseases in Japan: their control and possible outbreaks in the rest of Asia. Extension Bulletin - ASPAC, Food & Fertilizer Technology Center No. 284:1-6.*

to the USA and New Zealand twice through the production cycle immediately after petal fall and prior to harvest: half of all orchards at petal fall and the other half of the orchards at the pre-harvest inspection. Within each orchard 30% of all unshu trees are inspected at random at both the petal fall and the pre-harvest inspection.

- *The pre-harvest inspection for the USA consists of a joint field inspection of MAFF and APHIS personnel.*

Comment: From what Pat Barkley saw and was told of canker incidence in unshu mandarin orchards on Cheju island, South Korea, the above inspection protocol in Japanese orchards (with similar climate, variety and management to Cheju) could not be relied upon to determine presence or absence of canker. ALL trees would need to be carefully inspected at the optimal period for symptom expression augmented by leaf and fruit washings followed by leaf enrichments, PCR or bacteriophage testing to determine possible presence of the bacterium (as occurs in the South Korea protocol to USA).

Kuhara (1978)[15]noted that high rainfall (1700-2000 mm) during the citrus growing season, typhoons occur at least once per year, severe defoliation of infected leaves of susceptible varieties occurs in mid-summer and severe infection of young shoots and green branches and epidemic cycle continues through late autumn; growers cuts off late summer and autumn shoots to reduce overwintering of pathogen. The peak of the rainy season is late June or in the beginning of July when heavy rains often occur; late July to late August is hot with little rain. In Sept (early Autumn) there is a period of rain during which new infections affect summer or autumn shoot and fruit. Typhoons during August and early Sept. cause heavy infection. Goto (1992)[16] also indicated that heavy infection occurs in Aug. – Oct. Populations of *Xac* are highest after typhoon (Kuhara (1978):

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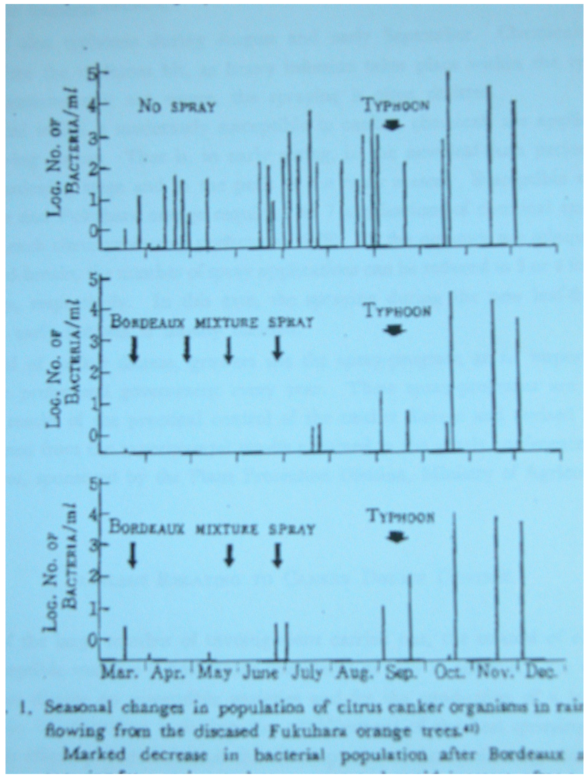
[15] *Kuhara, S. 1978. Present epidemic status and control of the citrus canker disease (Xanthomonas citri) (Hasse) Dowson in Japan. Re. Plant Prot. Res. 11: 132-142.*

[16] *Goto, M. 1992. Citrus canker. In: Plant Diseases of International Importance: Diseases of Fruit Crops (Vol. III) Ed. by J. Kumar,*



Also Koizumi (1972)[17] in Japan found that the development of lesions on unshu fruit inoculated in early and late September appeared to be increased by strong winds and hot weather and they contained more bacteria at harvest.

It is noted that the IRA states that: "leaf and fruit damage of unshu mandarin due to wind/weather events that would promote infection is not known to occur in the designated export areas". **Wind-driven rain (greater than 8m/sec) (Serizawa 1981[18] - work done in Shizuoka prefecture) aids infection, but wind is not necessary for infection via wounds (Gottwald et al., 1988; Gottwald et al., 2001). Infection can be achieved through wounds caused by leafminer injury (Chagas et al., 2001)[19]. Bergamin-Filho and Hughes (2000)[20] showed that wounds, caused by the Asian leaf miner, remain susceptible for a longer period (7-14 days) than those caused by thorns, pruning or wind (24 h).**

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[17] Koizumi, M. 1972. Studies on citrus canker symptoms on Satsuma fruit and the occurrence of the causal bacteria in the affected tissues. Bull. Hort. Res. Stn. B Shizuoka 12: 229-243.

[18] Serizawa, S. 1981. Recent studies on the behavior of the causal bacterium of the citrus canker. Proc. Int. Soc. Citriculture 395-397.

[19] Chagas, MCM, JRP Parra, T. Namekata, JS Hartung and PT Yamamoto. Phyllocnistis citrella Stainton (Lepidoptera: Gracillariidae) and its relationship with the citrus canker bacterium Xanthomonas axonopodis pv. citri in Brazil. Neotropical Entomology 30: 55-59.

[20] Bergamin-Filho A and Hughes G 2000. Citrus canker epidemiology - Methodologies and approaches. A moderated discussion session. Proc Int Citrus Canker Res Workshop, June 20-22, 2000, Ft. Pierce Florida, pp. 24-25

Susceptibility of unshu mandarin to citrus canker:

Peltier & Frederich (1920)[21] tested 3 clones of Satsuma mandarin in the field for susceptibility to canker and found that Satsuma was not readily infected, with canker symptoms limited to the foliage. However Koizumi and Kuhara (1982)[22] found variability in disease susceptibility among **clones** of Unshu mandarin, most of which were "moderately resistant". In a later review paper, Koizumi (1981)[23] referred to early Satsuma mandarin as "resistant" and Satsuma as moderately resistant. Matsumoto and Okudai (1990)[24] showed that resistance to citrus canker is conferred by a single dominant allele and Satsuma is dominant homozygous. Goto (1992) quoting other authors gives foliage of *Citrus unshu* as resistant and fruit as susceptible. **Has the susceptibility of Aoshima and Miyagawa clones to *Xac* been tested?**

In Japan, mature trees of Satsuma mandarin are generally free of canker, in contrast to the occasional occurrence in young trees less than 10 years old (Koizumi, 1981)[25]. This is attributed to the irregular leaf flush of younger trees, as well as physiological changes. Goto (1962)[26] showed that a rapid formation of meristematic tissue caused the restriction of the lesion on resistant Satsuma mandarin twigs.

It is well known however that the combination of leafminer and *Xac* can lead to significant field infection even on highly resistant cultivars and species such as calamondin and cumquat (regarded as more resistant than Satsuma) (Gottwald, Graham and Schubert (2002)[27]. Plants with 2nd and 3rd instar larvae or pupae of *P. citrella* show higher percentages (94, 98 and 100 % resp.) of bacterium-infected leaves, with the damage responsible for the increase in canker infestation (Chagas et al., 2001)[28].

[21] Peltier, G.L.and W.J. Frederich. 1920. Relative Susceptibility to Citrus-Canker of Different Species and Hybrids of the genus Citrus, Including the Wild Relatives. Journal of Agricultural Research. 19: 339-362.

[22] Koizumi, M. and S. Kuhara. 1982. Evaluation of citrus plants for resistance to bacterial canker disease in relation to the lesion extension. Bull. Fruit Tree Res. Stn. D 4: 73-92.

[23] Koizumi, M. (1981) resistance of citrus plants to bacterial canker disease: a review, Proc. Int. Soc. Citriculture 402-405.

[24] Matsumoto, R. and N. Okudai. 1990. J. Jap. Soc. Hort. Sci. 59 (1), 9-14.

[25] Koizumi, M. (1981) Citrus Canker. In: Citrus Diseases in Japan. T. Miyakawa and A. Yamaguchi (eds). Japan Plant protection Assoc. 64 pp.

[26] Goto, M. 1962. Studies on citrus canker. I . Bull. Fac. Agr. Shizuoka Univ., 12: 3-72.

[27] Gottwald, TR, JH Graham and TS Schubert. 2002. Citrus canker: the pathogen and its impact. APSnet. Feature Story September 2002.

[28] Chagas, MCM, JRP Parra, T. Namekata, JS Hartung and PT Yamamoto. *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) and its relationship with the citrus canker bacterium *Xanthomonas axonopodis* pv. *citri* in Brazil. Neotropical Entomology 30: 55-59.

In regard to fruit susceptibility, in one experiment Fulton and Bowman (1929)[29] compared infection of Satsuma mandarin fruits with those of Pineapple orange. The latter developed normal symptoms of canker and the Satsuma, none with stomatal infections. But with invasion through wounds, the subsequent multiplication of canker bacteria was closely parallel. In another experiment, fruits of various citrus varieties were inoculated by wounding or through the stomates. Of 37 satsuma fruits inoculated by wounds, 32% became infected with the optimal fruit size for infection being 28mm. Via stomatal infection only 3 fruits became infected. Fulton and Bowman (1929) found that fruit of intermediate size showed best development of canker lesions with the majority of infections occurring at visible wounds, although stomatal infections occurred in smaller fruits. Fulton and Bowman (1929) further stated: "*The multiplication of bacteria in the tissues is independent of the development of external evidences of canker. In many instances where there were no visible symptoms of canker the bacteria had multiplied just as freely as where there was normal canker development. Such a condition may be referred to as quasi immunity or quasi resistance".*

Koizumi (1972)[30] in Japan produced lesions on young (60% developed) satsuma mandarin fruits when they were inoculated before late August: collapsed cells were cut off by phelloderm and at harvest few *Xac* bacteria were present. The development of lesions on fruit inoculated in early and late September appeared to be increased by strong winds and hot weather and they contained more bacteria at harvest.

According to Canteros (1992)[31], susceptibility is high in fruits of 'Satsuma' and 'Murcott' until they are 25-30% of final size and become very resistant after they reach 45-50% of that size

According to Koizumi and Kuhara (1982) in Gottwald *et al*. (2002)[32], mature citrus fruit could be infected without developing lesions. Also Verdier *et al*[33]., observed that Xac can survive and persist on fruit with no visible symptoms. These fruit will also be undetectable during monitoring or field culling.

[29] Fulton, HR and JJ Bowman. 1929. Infection of fruit of citrus by *Pseudomonas citri.* J. Ag. Res. 39 (6) 403-426.

[30] *Koizumi, M. 1972. Studies on citrus canker symptoms on Satsuma fruit and the occurrence of the causal bacteria in the affected tissues. Bull. Hort. Res. Stn. B Shizuoka 12: 229-243.*

[31] *Canteros BI 1992. Changes in the resistance of developing citrus fruit to canker. Proc Int Soc Citriculture, Vol. 2: 825-827.*

[32] *Gottwald TR, Graham JH and Schubert TS 2002. Citrus canker: The pathogen and its impact. Online Plant Health Progress doi: 10.1094/PHP-2002-0812-01-RV. Available from: http://www.plantmanagementnetwork.org/pub/php/review/citruscanker/*

[33] *Verdier E, Zefferrino E and Méndez S no date. Xanthomonas anoxopodis pv. citri survival in citrus fruit submitted to post harvest treatment using detecting by semi-selective culture media and bioassay (Short report).*

Furthermore Schubert *et al*. (2001)[34] stated that the bacterium can survive in lesions for as long as the host cells in the vicinity of the lesion remain viable.

Of epidemiological concern is the scenario where bacteria are located in protected sites where their longevity and their subsequent potential to cause infection on other host material is significantly increased. Extracellular polysaccharides produced by Xac, protect the bacterial cells from desiccation in air (Goto, 1985 in Das, 2003[35]; Goto and Hyodo, 1985[36]).

<u>Conclusion:</u> ***While Satsuma mandarin fruits may not show canker symptoms, there is the potential for the presence of epiphytic bacteria (requiring effective surface disinfestations of fruit) or asymptomatic presence of bacteria internally (which would be unaffected by SOPP or chlorine dips). Presence of the organism on fruit may be associated with lesions, injuries, or blemishes (contamination). The prevalence of infected or contaminated fruit will depend primarily on environmental conditions and field treatment regimes.***

Timing for infection:

Has BA obtained information from MAFF on infection periods for canker in Shizuoka Prefecture?

See above information on timing of surveys by Kuhara (1978).

Conditions promoting infection:

"*Leaf pruning of trees in the export areas occurs about March in early spring at leaf flush, which is prior to flowering and fruit set".* **Is this correct?**

Existing commercial control program:

Are the chemicals applied (Table 3.5) acceptable for fruit imported into Australia? Would they be acceptable for use on fruit into Australia?

According to Table 3.5 only 2 sprays for canker are applied – late December to mid-January or March and mid to end May (early petal fall period). Timing and numbers of sprays does not agree with Kuhara (1978). Given the rainfall that occurs during summer and early autumn (May to October), (Table 3.4), it is surprising that no control sprays for canker are applied during this period.

"Orchardists may or may not use chemicals in the production area". **An effective canker spray program should be part of any systems approach for canker.**

But it should be recognized that copper is less effective against canker when:

a. there is an Asian citrus leaf miner (*Phyllocnistis citrella* Stainton) infestation (Schubert *et al*., 2001),

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[34] Schubert TS, Rizvi S, Sun X, Gottwald TR, Graham J and Dixon W 2001. Meeting the challenge of eradicating citrus canker in Florida-again. Plant Dis 85: 340-345.

[35] Das AK 2003. Citrus canker – a review. J Appl Hort 5(1): 52-60.

[36] Goto, M., and Hyodo, H. 1985. Role of extracellular polysaccharides of Xanthomonas campestris pv. citri in the early stage of infection. Ann. Phytopathol. Soc. Japan. 51:22-31.

b. fruits are at the susceptible stage of growth (28 mm: Fulton & Bowman, 1929; Stall *et al*., 1980[37]),
c. strains resistant to copper have developed (Canteros, 2004[38]),
d. bacterial invasion occurs quickly, for example as water soaks the leaves when rain falls during windy conditions (Stall *et al*., 1980)
e. persistent or heavy rainfall removes copper residues and
f. fruit expands leaving areas of fruit unprotected (Albrigo et al., 2005)[39].

Culling of fruit in orchard and packing shed?

Why isn't this being considered in the systems approach for canker control?

Accuracy and reliability of infected fruit removal by field culling and mechanical/visual packing house inspections is debatable. Although it is likely that these methods remove a substantial amount of symptomatic fruit and wounded fruit (possibly harbouring bacteria, Stapleton, 1986[40]), they cannot reasonably be expected to remove all such fruit. This is especially true when lesions are very small (i.e. <1 mm diam.) or copper compounds have been used in field treatments (masking the symptoms). There is evidence that suggests that blemished fruit do enter into commerce despite such controls.

Conditions for transport:

Various EU countries including Spain have intercepted commercial citrus fruit shipments recently, with *Xac* infections (Dr. Maria Lopez[41], pers. comm.. to Pat Barkley; EUROPHYT[42]), which means that *Xac* survives shipping.

RISK OF IMPORTATION:

"The unknown status of citrus canker and its hosts in the production area outside the designated export areas, moderated by the protected position of orchards, the low susceptibility of unshu mandarin to citrus canker and the expected low volume of imports, support a risk rating for importation of 'Low'."

The **Opinion of the Scientific Panel on Plant Health on an evaluation of asymptomatic citrus fruit as a pathway for the introduction of citrus canker disease** (*Xanthomonas*

[37] *Stall RE, Miller JW, Marco GM and de Chenique BIC 1980. Population dynamics of Xanthomonas citri causing cancrosis of citrus in Argentina. Proc Fla State Hort Soc, 93: 10-14.*

[38] *Canteros BI 2004. Management of citrus canker in Argentina. A review. Proc Int Soc Citriculture. Paper No 90. 19 pp.*

[39] *Albrigo, L. G., H. W. Beck, L. W. Timmer, and E. Stover. 2005. Development and testing of a recommendation system to schedule copper sprays for citrus disease control. Journal of ASTM International 2(9):1-12.*

[40] *Stapleton, JJ. 1986. Effects of postharvest chlorine and wax treatments on surface microflora of lime fruit in relation to citrus bacteriosis disease. Plant Disease 70: 1046-1048.*

[41] *From Instituto Valenciano de Investigaciones Agrarias. Apartado oficial, Moncada, Valencia, 46113, Spain and a member of the European and Mediterranean Plant Protection Organization (EPPO) panel developing diagnostic protocols for citrus canker.*

[42] *EUROPHYT – European Network of Plant Health Information Systems*

axonopodis **pv.** *citri*)[43] **states** *"Even if the fraction of infected fruit shipped to a suitable habitat is small, the inoculum level may be epidemiologically significant".*

ACG would contest BA's conclusion as BA has not:

- **provided data to demonstrate freedom from canker in the export areas or that canker is under "official control" in the area**
- **shown that canker was eradicated from the area.** As stated in the Table on page 66: "Once the pathogen has caused infection of a host, it cannot be eliminated from the tree by chemical or other treatment (Stall *et al.* 1987). Eradication of infected and exposed host plants is general practice".
- **demonstrated that despite protection from typhoons, the export areas do not have climates conducive to canker development**
- **provided evidence that the Aoshima and Miyakawa clones of unshu are highly resistant.** Koizumi and Kuhara (1982)[44] found variability in disease susceptibility among clones of Unshu, but did not test these two newer clones.
- **demonstrated the efficacy of sprays used to control canker in Japan**
- **demonstrated the efficacy of post harvest treatments of chlorine to reduce possible inoculum on fruit.**

This assessment of the risk of canker entry as low is contrary to the determination for canker entry from Florida (from Pest Free Areas) in 2003 as high!

Probability of distribution: (isn't it establishment?)
"Infected fruit peel would need to be discarded in close proximity (generally within one metre) of a susceptible host plant".

- There is no published paper *in the western literature* of canker transmission on fruits. But in China there is the widely held perception by pathologists that canker is spread to new areas by infected fruit peel thrown from cars or along walking tracks (Barkley et al., 1979).
- Smith et al., 1997 state that there is no authenticated record for diseased fruit playing a role in the epidemiology of citrus canker disease. But the **Opinion of the Scientific Panel on Plant Health on an evaluation of asymptomatic citrus fruit as a pathway for the introduction of citrus canker disease (***Xanthomonas axonopodis*

[43] *Opinion of the Scientific Panel on Plant Health on an evaluation of asymptomatic citrus fruit as a pathway for the introduction of citrus canker disease (Xanthomonas axonopodis pv. citri) made by the US Animal and Plant Health Inspection Service (APHIS) (Question N° EFSA-Q-2006-054) Opinion adopted on 15 December 2006. The EFSA Journal (2006) 439, 1-41*

[44] *Koizumi, M. and S. Kuhara. 1982. Evaluation of citrus plants for resistance to bacterial canker disease in relation to the lesion extension. Bull. Fruit Tree Res. Stn. D 4: 73-92.*

pv. *citri*)[45]… is that there is no scientific evidence either for this or for the opposite statement.

- There is no record that either infected fruit with lesions or asymptomatic fruit are epidemiologically significant with respect to the initiation of new infections (Jetter et al., 2000[46]; Canteros, 2004). - There is no scientific evidence either for this or for the opposite statement (EFSA 2006).
- No study has been undertaken to assess the epidemiological significance of asymptomatic fruit where disease pressure is low. There is evidence to suggest that mature fruit may be infected without expressing symptoms. The concept of "asymptomatic fruit" has not been addressed in this IRA. Quantitative data are needed to assess the risk of asymptomatic fruit.
- Graham et al., 1992[47] postulated that because the survival of bacteria on non-attached citrus fruit is significantly reduced, the likelihood of spread of citrus canker through bacteria on harvested commercial fruit is considered very low.
- Schubert et al., 1999[48] stated that if the peel of a canker-infected citrus fruit is left near a host plant, in a compost pile, or in a trash can in close proximity to a susceptible host there is a very small chance of successful transmission. But Schubert et al., 1999 is a report and not a scientific paper

Survival in leaves and peel:

- Koizumi (1981)[49] states that "some bacteria which drop to the soil by defoliation or dispersion can survive saprophytically for one year or more, especially in the rhizosphere of citrus trees and some kinds of herbaceous plants.
- Goto (1992) states that *X. a* pv *citri* usually dies quickly in tissues of diseased leaves which fall to the ground and become moist. The population of bacteria decreased as mesophyll rotted after infected leaves were defoliated and disappeared when the lignocellulose was rotted (Koizumi and Yamada, 1972). The bacteria survived for a longer period in leaves on the soil surface and during the winter when the leaves rotted gradually (Goto, 1981).
- The causal bacterium died within 3 weeks in lesions of grapefruit and citrange leaves that were wetted either by placing them on the soil surface or by burying them in

[45] *Opinion of the Scientific Panel on Plant Health on an evaluation of asymptomatic citrus fruit as a pathway for the introduction of citrus canker disease (Xanthomonas axonopodis pv. citri) made by the US Animal and Plant Health Inspection Service (APHIS) (Question N° EFSA-Q-2006-054) Opinion adopted on 15 December 2006. The EFSA Journal (2006) 439, 1-41*

[46] *Jetter, KM, Sumner, DA and Civerolo, EL. 2000. Ex ante Economics of Exotic Disease Policy: Citrus Canker in California. Conference: "Integrating Risk Assessment and Economics for Regulatory Decisions," USDA, Washington, DC.*

[47] *Graham JH, Gottwald TR, Riley TD and Bruce MA 1992b17. Susceptibility of citrus fruit to bacterial spot and citrus canker. Phytopathology 82: 452-457.*

[48] *Schubert TS, Miller JW, Dixon WN, Gottwald TR, Graham JH, Hebb LH and Poe SR 1999. Bacterial citrus canker and commercial movement of fresh citrus fruit. An assessment of the risks of fresh citrus fruit movement relative to the spread of bacterial citrus canker (Xanthomonas axonopodis pv. citri). A report prepared for the Citrus Canker Risk Assessment groups for Manatee, Collier, Miami/Dade, and Broward Counties. Florida Department of Agricultural and Consumer Services. 14 July, 1999. 17 pp.*

[49] *Koizumi, M. 1981. Resistance of citrus plants to bacterial canker disease: a review. Proc. Int. Soc. Citriculture I: 402-405.*

soil at a depth of 3-6 inches (Peltier and Frederich, 1926)[50]. A rapid disintegration of the buried leaves took place so that by the end of the 3rd week the identity of the leaf was almost lost.

- However Goto (1992) states that the bacterium can survive for 2-3 months in lesions if the diseased leaves are maintained under dry conditions either *in vivo* or *in vitro* if leaf moisture quickly decreases to <20%. Within canker lesions, the bacteria are buried in a thick matrix of extracellular polysaccharides and the bacteria can survive for fairly long periods if the extracellular polysaccharides around them dry and are left intact.
- Robbs and Deslandes (1968, cited in Rossetti, 1977[51]) in Brazil, reported laboratory experiments in which the pathogen survived on infected fallen leaves for an average of 4 months. In a few cases, viable cells were found after 6 months and exceptionally after 8 months.
- Pathogenic *X. a* pv *citri* was detectable in leaf lesions of grapefruit and sweet orange at least 90 days after defoliation under relatively dry conditions in the spring of 1986 in Florida (Graham *et al*., 1987[52]). Under similar conditions in Argentina, *X. a* pv *citri* was detected after 120 days in lesions of grapefruit leaves placed on the soil surface, but only up to 85 days when leaves were buried (at this time they had decomposed beyond recognition).

Sufficient inoculum would need to be present to cause infection:

- You only have to consider the spread of canker at Emerald by a weather event and by equipment moving down a row (Gambley et al., in preparation) to postulate that very little inoculum is required under Australian conditions to initiate infection.
- The statement "*Wet, warm weather simultaneously with wind speeds exceeding 8.7 m/s, such as experienced during rain storms, not only aid in the release of bacteria from infected tissue and their transfer and penetration through stomata or wounds but also aid infection",* ignores the effect of irrigation on splash dispersal of bacteria. Bacteria could be splash-dispersed onto the tree canopy from discarded infected peel and infect leaves and fruit. It is not correct to extrapolate the conclusion on the role of wind in the tree to tree transport to the transport from litter to the tree.
- *"The natural infection period of hosts is limited"* is a spurious statement. Citrus plants are susceptible several times in the year because of the occurrence of several

[50] Peltier, GL and WJ Frederich. 1926. Further studies on the overwintering of Pseudomonas citri. J. Agr. Res. XXXII (4) 335-345.

[51] Rossetti, V. 1977. Citrus canker in Latin America: a review. International Citrus Congress (2nd : 1977 : Orlando, Florida), Orlando, Florida USA, 1977.3 918-924.

[52] Graham, JH, RG McGuire and JW Miller. 1987. Survival of Xanthomonas campestris pv. citri in citrus plant debris and soil in Florida and Argentina. Plant Disease 71: 1094-1098.

leaf flushes all along the year. Citrus plants in nurseries are very susceptible. Moreover, some agricultural practices increase plant susceptibility (fertilisation, vigorous rootstocks, irrigation). Citrus trees infested with the Asian citrus leaf miner, independently of their resistance to the pathogen, will be susceptible throughout the year (Gottwald *et al*., 2002; Schubert *et al*., 2001).

- A 2007-08 study that placed infected fruit inches away from seedling citrus plants, which are most vulnerable to catching the disease, showed canker bacteria had oozed out of some of the fresh fruit but had not spread to the seedlings after six to eight weeks of exposure (Schubert, The Ledger, Sept. 11, 2008).The research also showed the bacteria oozing out of the fresh fruit was an uncommon event, even for heavily blemished fruit.
- Clive Bock (USDA Fort Pierce showed minimal traces of bacteria in wounded fruit after 29 days and no transmission from discarded infected fruit peels (The Ledger, Sept. 11, 2008).
- USDA researchers found one case of canker spreading to the nearby plants from fruits where there were wind speeds of 55 mph and infection occurred through a wounded leaf (The Ledger, Sept. 11, 2008).

RISK RATING FOR ESTABLISHMENT OF 'HIGH': Agreed

Probability of spread:

"The bacterium, *Xanthomonas axonopodis* pv. *citri* (*Xac*), that causes Asiatic citrus canker (ACC) can be dispersed in gentle rain, rain with wind, rain storms, tropical storms, and hurricanes. These meteorological events are progressively more effective at dispersing inoculum over greater distances. Apart from dispersal during meteorological events, inoculum can be dispersed mechanically from within-trees to very long distance dispersal through human activities, including the movement of infected plant material over short distances (local) to long range dispersal (global = among countries and continents). From an epidemiological point of view, epidemics of ACC are composed of a series of discontinuous pulses of inoculum that first introduce *Xac* to the host population, with a combination of multiple meteorological and mechanical events that further disperse inoculum and exacerbate the epidemic.

However, dispersal events vary greatly in distance and quantity of inoculum dispersed" (Irey et al., 2006)[53]. Peltier & Frederich (1926)[54] state that citrus canker could develop in all citrus regions of the world, sometime during the growing season. Rising temperatures and increased rainfall provide conditions which stimulate rapid host growth and increase

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[53] *Irey, M., Gottwald, T. R., Graham, J. H., Riley, T. D., and Carlton, G. 2006. Posthurricane analysis of citrus canker spread and progress towards the development of a predictive model to estimate disease spread due to catastrophic weather events. Online. Plant Health Progress doi:10.1094/PHP-2006-0822-01-RS.*

[54] *Peltier, GL and Frederich WJ (1926). Effects of weather on the world distribution and prevalence of citrus canker and citrus scab. J. Agr. Res. 22: 147-164.*

susceptibility. The estimated minimum and maximum temperatures for the occurrence of disease were 12 ° C and 40° C, respectively (Dalla Pria et al., 2006)[55].

RISK RATING FOR SPREAD: 'HIGH': Agreed
PROBABILITY OF ENTRY, ESTABLISHMENT AND SPREAD: 'VERY LOW'

CONSEQUENCES: Assessment of the potential consequences (direct and indirect) of *X. axonopodis* pv. *citri* for Australia is: **'HIGH'**. Agreed

"*Favourable conditions for the establishment and spread of citrus canker occur in the tropicaland subtropical regions of Australia year round"*. Somewhere but not at all times.

"*Citrus relatives are widely distributed in Australia and some of these species have been shown to be susceptible to citrus canker when inoculated under laboratory conditions".* In relation to *Citrus (Eremocitrus) glauca* as a field host of citrus canker, it should be noted that plants of *C. glauca* underwent field inoculation by spraying in an isolation field in southern Alabama in the early 1900's. Some natural infection also took place after canker had been established. The following quotations from 2 early scientific papers are of interest:
Peltier and Frederich (1920)[56] wrote: **"**All plants (of *Eremocitrus glauca*) have shown infection varying with their condition. Canker has been observed on the leaves, thorns, **twigs and old wood.** A considerable degree of susceptibility is shown".
Peltier and Frederich (1924)[57] wrote: "plants of *Eremocitrus glauca* were quite easily infected both in the greenhouse **and field. ...***Microcitrus* and *Eremocitrus glauca* have proved susceptible enough under controlled conditions to be naturally infected in their native habitat, if a source of infection was present. Both of these genera are native to the east coast of Australia, and while citrus canker has only been reported from the northern territory of Australia, should canker be introduced at any time into the citrus districts of Queensland, there is a bare possibility that citrus canker might be disseminated to the native growths *of Microcitrus* and *Eremocitrus*".
Also see Reinking (1921)[58] which showed *Eremocitrus glauca, Microcitrus australasica* and *M. garrowayi* as hosts of canker under field conditions.

Domestic trade – BA should cite what happened to trade from Emerald and also trade from the Central Burnett until area freedom was established.

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[55] *Dalla Pria, M, R. C. S. Christiano, , E. L. Furtado , L. Amorim and A. Bergamin Filho. 2006. Effect of temperature and leaf wetness duration on infection of sweet oranges by Asiatic citrus canker. Plant Pathology 55, 657–663.*

[56] Peltier, G.L.and W.J. Frederich. 1920. Relative Susceptibility to Citrus-Canker of Different Species and Hybrids of the genus Citrus, Including the Wild Relatives. Journal of Agricultural Research. 19: 339-362.
[57] Journal of Agricultural Research XXVIII page 228

[58] Reinking 1921 Citrus diseases of the Philippines, Southern China, Indo-China, and Siam pages 122-153.pdf

International trade: *"An outbreak of citrus canker in the larger production areas in south-eastern Australia would lead to the complete loss of production for a number of years until replanting and full fruit production would be re-achieved"*. **That is assuming the canker outbreak can be eradicated!**

The question has to be asked why the risk assessments for citrus canker for Florida (Draft Import Risk Analysis Report July 2003) and for Japan (this report) are so divergent, especially when Florida at that time were claiming Pest Free Areas, a claim not made for the 4 areas in Japan?

Country	Probability of			Overall probability	Consequences	Unrestricted risk
	Entry	Establishment	Spread			
Florida	high	high	high	high	high	high
Japan	LOW	high	high	VERY LOW	high	LOW

Pest risk management:

- What evidence has MAFF provided that the 4 unshu mandarin production areas are free from citrus canker other than absence of visible symptoms?
- "*The designated export areas are areas of low pest prevalence (i.e. absence from visual symptoms of the disease), rather than pest free areas. Low pest prevalence status recognises that visual symptoms of the disease have not been reported from the export areas (Areas 1–4) for the past 40 years during surveys that are timed to coincide with optimal symptom expression. However, for the reasons stated above, the pathogen may be present in the production area"*. **And as stated earlier unshu fruit could be infected without necessarily developing lesions** (Fulton and Bowman (1929)[59], Koizumi (1972)[60], Canteros (1992)[61], Koizumi and Kuhara (1982) in Gottwald *et al*. (2002).
- The Phytosanitary measures proposed for canker for fresh unshu mandarin fruit from the designated export areas are:
  - Freedom from symptoms of citrus canker in the designated export areas for a minimum of two years prior to registration of orchards for export to Australia
  - Freedom from symptoms of citrus canker during the growing season based on monitoring in the designated export areas at petal fall and prior to harvest

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[59] *Fulton, HR and JJ Bowman. 1929. Infection of fruit of citrus by Pseudomonas citri. J. Ag. Res. 39 (6) 403-426.*

[60] *Koizumi, M. 1972. Studies on citrus canker symptoms on Satsuma fruit and the occurrence of the causal bacteria in the affected tissues. Bull. Hort. Res. Stn. B Shizuoka 12: 229-243.*

[61] *Canteros BI 1992. Changes in the resistance of developing citrus fruit to canker. Proc Int Soc Citriculture, Vol. 2: 825-827.*

- An additional survey of the export areas if a typhoon should be recorded at the meteorological station in Shizuoka City before the end of August

It does not mention the pathological assays of fruit for *X. axonopodis* pv. *citri* using bacteriophages or joint inspections of orchards by Japanese and Australian phytosanitary officers (before harvest) and of export fruit at packing proposed in 1999.

- *"mandatory copper sprays in accordance with the unshu mandarin spray calendar for Japan"* – BA should determine (a) the numbers of sprays applied and their timing relative to weather events, (b) if resistance of *Xac* has been found in Japan and (c) control measures (chemical and timing) for leaf miner.
- Japan indicated that the four export areas have a combined size of 25 hectares, consist of 150 orchards and 25 518 unshu mandarin trees. "*A sampling regime of 600 randomly selected unshu mandarin trees (including fruit) for each of the designated export areas, or equivalent, is proposed".*

Export areas are of differing sizes. Why is this fact not reflected in the sampling methodology?

- At Emerald, initial surveys were conducted at an intensity of 600 trees per 10 hectare sub-area (5000 trees) and this was revised[62] to an intensity of 600 trees per 5 hectare sub-area when the initial survey methodology failed to pick up infections at IP2 in line with FAO (2002) "Draft Guidelines for surveillance of specific pests: *Xanthomonas axonopodis* pv. *citri"*. The International Phytosanitary Standards for Canker survey were developed from Hughes, H. Gottwald T. R., and Yamamura, K. 2003. Survey methods for assessment of Citrus tristeza virus incidence in urban citrus populations. Plant Disease: 86:367-372. Gottwald (pers. comm. to Pat Barkley 23 March 2005): "*The level or reliability of detection is **not sufficient** to detect low incidence, residual, or subclinical infections".* Yet in this IRA it is proposed that **2400 trees will be inspected per 25,518 trees, whereas in Emerald 600 trees were inspected for every 2500 trees** ie at 2-3 times the level proposed for Japan**,** where symptoms in Japan may be more difficult to find due to close planting of trees, host resistance etc.
- "*Field surveillance for symptoms of the disease be carried out at two sampling times, immediately following petal fall and immediately prior to harvest*". Why were these times chosen? **Were optimal periods of fruit susceptibility and leafminer incidence taken into account?** Fulton and Bowman (1929) found that Satsuma fruit of intermediate size showed best development of canker lesions with the majority of infections occurring at visible wounds, although stomatal infections occurred in

[62] *National Citrus Canker Eradication Program Strategy Paper: basis for implementation of ongoing surveillance strategies for citrus canker within the PQA" Dec. 2004.*

smaller fruits. Koizumi (1972)[63] in Japan produced lesions on young (60% developed) satsuma mandarin fruits when they were inoculated before late August.

- "*Late summer coincides with early fruit development* *when fruit is most susceptible to citrus canker".* This surely incorrect as according to Harty & Anderson (2000), Miyagawa Wase is an early clone maturing late October to late November (autumn), while Aoshima is a late clone maturing mid December to early January.
- *"Fruit harvested for export are to be placed in clean bins and transported to the designated packing house under quarantine security if the conveyance has to pass through a non quarantine area. Vehicles must be appropriately decontaminated if they have been used to transport citrus canker infected material".* **These requirements should be spelt out as per the QDPI procedures that were in place for Emerald.**

POST HARVEST CHEMICAL TREATMENT

Obata et al., 1969[64] found sodium hypochlorite to be far superior to sodium orthophenylphenate (SOPP). 100 ppm chlorine for 2 minutes was effective, but bacteria survived instant dipping at 500 ppm chlorine. It must be realized that these experiments were carried out with artificially inoculated fruit. Would the same results have been achieved with naturally infected fruit, with the canker organism present either in a minute lesion or as a sub-clinical infection? Repeated dipping of fruit markedly reduced the NaOCl concentration and these authors provided a starch-iodine procedure for checking the concentration. **How will NaOCl concentration be checked in the Shizuoka packing shed?**
In studies by Stapleton (1986), naturally occurring *Xanthomonas* spp. were not recovered from lime fruit washings, of fruit treated for 2 min with 200 or 400 ppm Cl, although *Xac* artificially inoculated in high concentrations were recovered on lime surfaces 2 weeks later. The efficacy of disinfectant treatments appears quite variable and does not achieve the complete eradication. In some cases, disinfectant treatments only reduced bacterial populations by 77% (Stapleton, 1986). Additionally, bacterial populations were found to survive at chlorine concentrations of 900 ppm, well in excess of the 200 ppm used commercially (Stapleton, 1986). Furthermore, increase of Cl concentration above 500 ppm may cause fruit damage (Schubert *et al*., 2000; in: 2000 Florida Citrus Pest Management Guide: Citrus Canker, p. 30.1.4.).
Stapleton (1986) also made the following remarks:

(i) The failure of NaOCl to completely disinfect fruit allows the possibility of pathogen dissemination on Cl-treated fruit.
(ii) Both intact and wounded fruit surfaces may provide bacteria with protected sites, allowing them to avoid the effects of Cl treatment. In addition, fruit enter dip-tank

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[63] *Koizumi, M. 1972. Studies on citrus canker symptoms on Satsuma fruit and the occurrence of the causal bacteria in the affected tissues. Bull. Hort. Res. Stn. B Shizuoka 12: 229-243.*

[64] *Obata, T, F. Tsuboi and S. Wakimoto. 1969. Studies on the detection of Xanthomonas citri by phage technique and the surface sterilization of Unshu orange for export to the United States. Res. Bull. Pl. prot. Japan 7: 26-37.*

solutions with some associated detritus and organic matter, which greatly reduce the bactericidal properties of Cl.

(iii) Although the NaOCl treatment is a relatively effective biocide, it is not an eradicant of fruit surface microflora.

The efficacy of disinfectant treatments is dependent on a number of factors including pH, disinfectant concentration, presence of organic matter (Dychdala, 1983[65]), and frequency of renewal of the disinfectant solution. Even when these factors are optimized, bacteria have still been shown to survive. Brown and Schubert (1987)[66] using *Xanthomonas campestris* pv *vesicatoria* as the test organism, sprayed onto fruit, found much of the applied chlorine (41 µg/cm^2 out of 45.4 µg/cm^2 of fruit surface) was inactivated by the large amount of organic matter commonly present on Florida citrus fruit. **Is Japanese fruit covered in lime at harvest as Korean fruit was?**

For Cl treatments to be effective, they must be applied under certain conditions, such as

(i) the pH of the water should be maintained within a range of 6 to 7.5,

(ii) the concentration of Cl should be maintained within a range of 150 to 250 ppm, and

(iii) the wash water/sodium hypochloride solution should be changed daily or more frequently, as dirty water reduces free/available Cl (Schubert *et al*., 2000).

Is there evidence that these procedures (guidelines) are followed by the export packing houses?

Although Canteros, Naranjo and Rybak (2000)[67] have reported on the efficacy of the joint use of SOPP (sodium orthophenylphenate) and sodium hypochlorite (SH) on the survival of Xac, their experiments were conducted *in vitro* (on semi-selective medium amended with SOPP+SH) and not on fruits. Therefore, their results cannot be extrapolated to the effects of SOPP+SH on the viability of *Xac* in lesions of fruits. It is also worth mentioning that the number of two replicates, used in their test, is not adequate to draw safe conclusions.

A study by Verdier et al., in Uruguay showed that of 141 asymptomatic fruits, *Xac* could be detected in 67% (no postharvest treatment) and in 3% of treated fruits. *Xac* could be recovered from 79% of artificially infested fruits (no postharvest treatment) and 12% of treated fruits.

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[65] *Dychdala GR 1983. Chapter 19 Chlorine and chlorine compounds. In: Disinfection, sterilization and preservation. 3rd Edition, Block EE (ed), Lea and Febiger, Philadelphia, PA, pp. 157-162.*

[66] *Brown, GE and TS Schubert (1987). Use of Xanthomonas campestris pv vesicatoria to evaluate surface disinfectants for canker quarantine treatment of citrus fruit. Plant Disease 71: 319-323.*

[67] *Canteros BI, Naranjo M and Rybak M 2000. Production of fruit free of Xanthomonas axonopodis pv. citri in selected plots in areas of endemic canker in Argentina. Proc Int Soc Citriculture, IX Congr: 1136-1137.*

Gottwald (USDA, Fort Pierce) reported at the Florida Annual Packinghouse Day on August 18, 2006, that a mixture of apparently healthy and canker-infected grapefruit, after passing along a packing shed line, still had viable *Xac* associated. Gottwald mixed 107 canker-infected grapefruit with asymptomatic fruit and ran the fruit through a simulated packinghouse that included treatment with several kinds of disinfectants. There were several limitations to the study eg fruit were not cleaned before treatment and the asymptomatic grapefruit were not tested for *Xac* before the experiment. Repeat trials have been carried in Florida, Brazil and Argentina.
"The objective of these combined measures is to reduce the likelihood of importation of X. axonopodis pv. citri to at least 'very low'. The restricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP". **What is "very low"? Is it the 3% as in Verdiere's studies?**

The efficacy of disinfectant treatments is quite variable and does not achieve complete eradication. In some cases, disinfectant treatments only reduced bacterial populations by 77% (Stapleton, 1986). Additionally, bacterial populations were found to survive at chlorine concentrations of 900 ppm, well in excess of the 200 ppm used commercially (Stapleton, 1986). The efficacy of disinfectant treatments is dependant on a number of factors including pH, disinfectant concentration, presence of organic matter, and frequency of renewal of the disinfectant solution. Even when these factors are optimized, bacteria have still been shown to survive.

Jan Narciso, (Winter Haven lab,) looked at canker bacterial growth on wounded fruit treated with common coatings, including waxes, used at Florida packinghouses and showed that canker was still present on some fruit even two weeks after treatments (The Ledger, Sept. 11, 2008).

Citrus Scab

Citrus scab caused by the fungus *Elsinoe fawcettii* and is easily confused with citrus canker. Scab lesions may form on leaves, branches and fruit and are light brown, raised and corky. Unlike citrus canker, leaves affected by citrus scab are typically distorted

"Tan et al. (1996, 1999) suggested that, because unidentified pathotypes may exist in localised areas, strict quarantine precautions should be taken to avoid moving the citrus scab fungi into Australia from other countries. In 2008, Japan advised that the pathogenic form of the species that is present in Japan is not known".
What will be the <u>mandatory</u> fungicidal spray program to prevent infection by *S. fawcettii?*

Other pests

INTRODUCTION:

The draft import risk analysis report for fresh unshu mandarin fruit from Japan identifies 14 pests that require quarantine measures including pink rust mite, mealybugs (four species), leafroller moths (three species), thrips (three species), apple heliodind, exotic pathotypes of citrus scab and citrus canker.

Proposed quarantine measures include systems approach restricting exports to designated areas, recognition of pest free areas, monitoring of export areas, post-harvest chemical treatment and/or visual inspections. This is to be supported by an operational system to maintain and verify the quarantine status of consignments and pre-clearance by AQIS.

Specific measures include:

- Product sourced from registered orchards in designated export zones.
- Freedom from symptoms of canker for two years prior to export
- Freedom from canker symptoms during the grower season monitoring at petal fall and prior to harvest.
- Additional monitoring if a typhoon strikes before August.
- Mandatory copper sprays.
- Restricted movement of host material in export area.
- Post-harvest chemical treatment.

Quarantine measures for citrus scab include monitoring, orchard control and freedom from symptoms. Quarantine measures for insect pests include inspections and remedial action. The area is recorded as free form Japanese orange fly which will be verified by on going trapping and monitoring.

GENERAL ISSUES:

1. **Planting densities and location**

The proposed export area has a combined size of 25 hectares, consisting of 150 orchards and 25, 518 unshu mandarin trees. This equates to approximately 1,000 trees per hectare resulting in extremely high density plantings. Furthermore information supplied indicates that plantings are located on hill sides making access to trees difficult.

Based on the above information it is highly unlikely that effective spray coverage is possible and the use of modern spray equipment limited. The draft report does not provide information on the type of equipment used to spray orchards and or application rates. This information is necessary to gauge the likely effectiveness of orchard treatments, which are listed as an important step in the systems approach used to ensure “low prevalence” of pests. Experience from professional Citrus IPM consultants in Australia is that high volume applications from 8,000 litres per hectare are required to provide adequate coverage which includes sufficient wetting of citrus trees to ensure that hiding sites found under the sepals are sufficiently wetted to control pest contained in these hiding sites. In particular mealy bugs are known to shelter under the sepals.

What types of spray equipment are being used to maintain low pest prevalence and what is the volume of spray applied?

2. **Orchard and fruit surveys**

Information presented in the documentation focuses on presence or absence of various pests based primarily on literature reviews; however some of the information is dated or does not necessarily relate to implications under commercial trade.

Has there been a recent survey to confirm what insect pests are currently present in the proposed export area? Is it possible to obtain details of exports to countries such as the USA or NZ to quantify the species of insect pests detected, their location and densities?

3. **Pesticide program**

Information supplied indicates that many types of insecticides are applied and often multiple applications of the same product. This could indicate that application techniques are not adequate and or insecticide resistance could be a problem. **It is also noted that some of the products listed are not approved for use in Australia by the APVMA.** There is also no detail provided on the chemical rates applied for each pesticide associated with the target pest and the mortalities achieved.

Is any information available to confirm the true effectiveness of the spray program detailed? What are the implications related to use of products not registered for use in Australia?

Some of the products not registered for use in Australia are being used to control insects which would be considered difficult pests to control in the orchard. Loss of these products could result in high level of quarantine pests present at harvest time.

4. **Packing shed measures**

Post harvest treatment of citrus at the packing shed provides a potential effective means to reduce levels of quarantine pests and an important link in a systems approach. The document provides insufficient details of what practices are used except those treatment or processes used to target citrus pathogens. Simple additions in packing procedures such as high pressure washes and additives can have a dramatic impact on reducing insects present of fruit.

What if any types of mechanical and chemical procedures are applied to remove insect pests in the packing shed?

Armoured scales such as *Parlatoria ziziphi* are highly likely to be present on export fruit. High pressure de scaling equipment would assist in reducing numbers.

5. **Detection and remedial action**

The documentation talks about the application of remedial actions when quarantine pests are detected, but does not provide any details about what the options are. Furthermore it is noted that unshu mandarin from a number of Japanese areas cannot be shipped to USA states in which commercial citrus production occurs (California, Florida, Arizona, Hawaii, etc) unless it has been fumigated with methyl bromide. The treatment is required against Japanese Island Fly. Similarly page 153 suggests that all Satsuma mandarins from **all regions** shipped to the USA require methyl bromide fumigation prior to shipping as a treatment against Japanese mealybug which does not occur in Australia either.

What are the proposed remedial treatments? Shouldn't Australia request methyl bromide treatment similar to the arrangements required to ship to the USA? This could also help to resolve our citrus canker concerns.

QUARANTINE INSECTS:

1. **Pink Citrus Rust Mite**

Very little detail is provided on Pink Citrus Rust Mite *Aculops pelekassi* in the document provide except that it is given a LOW rating as a quarantine risk.

This risk assessment is disputed as mites in the Eriophyidae family are extremely difficult to detect. They are not visible to the naked eye or with a hand lens and very difficult to detect with a low powered stereo-microscope. They can also explode in numbers causing serious crop damage and develop pesticides resistance quickly. **Very few affordable citrus IPM compatible pesticides are available to control Eriophyidae mites and if established in Australia would result in considerable economic loss.**

Furthermore the Australian Eriophyidae Brown Citrus Rust Mite *Tegolophus australis* **with a similar biology to *Aculops pelekassi* is given the highest quarantine priority behind fruit flies by USDA-APHIS** with respect to trade of Australian citrus to the USA.

Recommendation: that BA reconsider the risk rating of this insect with respect to unshu from Japan and provide further details about effective measures to prevent this pest form arriving and establishing in Australia.

2. **Armoured Scales**

While it is agreed that the probability of distribution of armoured scales is LOW and their spread MODERATE it is highly probably that significant numbers will enter into Australia.

In particular concerns are express about the entry of Black Parlatoria scale *Parlatoria ziziphi,* which has a reputation world wide as a serious pest to control often highly resistant to many insecticides. Furthermore its ability to adhere firmly to fruit means that it is very difficult to remove during the packing process and will no doubt occur on export fruit. While it is acknowledged that application of "machine oil" will assist in reducing orchard populations **it is recommended that de scaling equipment (high pressure washes) is included in the packing shed process to reduce its presence.**

3. **Mealybugs**

The mealybugs listed are highly polyphagous, have cryptic habits and mobile. These three traits have resulted in mealybugs becoming significant pests on many crops including citrus around the world. Indeed in some citrus crops and citrus varieties found in Australia commercial production has become unviable due to the presence of mealybugs.

It is therefore suggested that ratings do not accurately reflect the above. The probability of entry, establishment and spread should be HIGH and the consequence of establishment HIGH.

Pseudococcus cryptus in particular is a very serious pest of citrus in Japan and Israel. Even with the latest spray equipment and pesticides this mealybug has been extremely difficult to control in Israel and are listed as one of their most serious pests causing major crop damage and loss.

Under the growing conditions found in Japan it is highly likely that mealybugs are not being adequately controlled due to sloping orchards and dense plantings. Furthermore it is noted that mealybugs are not listed as a target pest in the spray calendar table 3.5 raising concerns about effective controls. Page 42 of the document suggests existing biological control programs and insecticides will help limit these pests but no details are provided and the credibility of this comment is disputed based on our Australian experience. It would be helpful if details mealybug densities in the orchard could be provided, when they occur and what numbers and species are detected on citrus exported to other countries.

If established in Australia these mealybugs would ruin our essentially "mineral oil based" citrus IPM programs forcing growers to use pesticides with debatable effect. In the longer term the Australian citrus industry would be forced to import biological control agents at high cost again with questionable impact.

Furthermore there could be major implications for our export markets. *Plancocuss lilacinus*, *Pseudococcus cryptus* and *Planococccus kraunhiae* do not occur in the USA and their establishment in Australia would impact on trade to the USA, which is based on an understanding that only three mealybug species are found in the Riverland, Sunraysia and Riverina areas. **Indeed on page 153 it is noted that the USA require fumigation of Satsuma mandarins from Japan with Methyl Bromide specifically for *Planococccus kraunhiae*. On this basis it might not be unreasonable for the Australia Citrus Industry to request the same which would also help to resolve the citrus canker issue.**

4. **Leafroller Moths**

The family Tortricidae is known for some serious citrus crop pests including Light brown apple moth in Australia, False codling moth in South Africa and Orange tortrix in the USA. **While it is noted that Japanese plant quarantine records show that between 1989 – 1998 no Tortricids were found on citrus exports, there is no mention of more recent years. It is not known why this information is not provided but should be made available to help dispel industry concerns.**

Furthermore strong dispersal methods and very wide host range including various significant Australian horticultural crops and many Eucalyptus species mean that if established in Australia these moths would cause serious damage. While it is noted that that the presence of silken threads and surface grazing provide good indicators about the presence of the pest to assist with detection there is no information about the possible presence of these moths under the sepals. It would be helpful to clarify if these moths shelter under the sepals as this area would then need appropriate inspection to ensure larvae are not present on exported unshu.

Finally there are no comments provided on possible entry via eggs deposited on cartons, pallets and containers. This applies to all other moth species not specifically mentioned in the IRA. Possibly the most serious is Asian gypsy moth. What inspection procedures are planned to address hitchhiking insects?

5. Bagworms

It is agreed that the probability of entry and establishment of bagworms is low. The larvae at the time of harvest are very large (25mm) and most will be over wintering. Furthermore due to their size they are likely to be removed during packing provided adequate washing and brushing occurs.

6. Apple Heliodinid

According to the IRA document the biology of this insect has not been recorded on citrus. It is unclear from this statement if they have never been observed directly on citrus fruit or simply not been studied in detail on citrus. **Further clarification of this point would be useful**

Regardless the minute size of the eggs and the potential to be deposited on citrus means that effective inspection procedures will be required to detect this pest. Furthermore appropriate packing procedures will be necessary to remove eggs including application of high pressure washes and brushing methods.

7. Thrips

Taiwan flower thrips *Frankliniella intonsa* is not present in Australia and of considerable concern. *Frankliniella intonsa* appears to mostly damage vegetable type crops in Asia and Europe but has also been recorded as causing moderate damage to citrus in Korea. Its wide host range could result in significant crop losses in Australia over many important crops.

Again while details of the unshu mandarin spray calendar have been provided in table 3.5, the details are for the control of *Scirtothrips dorsalis* only and as with all thrips it's debatable if orchard sprays are capable of reducing thrips to any meaningful level when addressing quarantine concerns. **For the above reason and other listed in the IRA it is agreed that probability of entry is HIGH. On the aspect of probability of distribution it is felt that the**

rating has been understated and should be listed as HIGH, as these thrips have a wide host range and while they are weak flyers can be transported by many other methods. They are also likely to be present in higher numbers then most other insects found on citrus apart from mites. The sepals are likely to provide a very useful hiding site.

It is therefore recommended that MAFF and AQIS inspections pay more attention to the possible presence of thrips by designing adequate detection methods including remove of sepals and use of appropriate magnification equipment.

8. Fruit Fly pests

There is a need for a pest risk assessment for Japanese orange fly (*Bactrocera tsuneonis*). This is a significant pest of citrus that is present in some Japanese production areas. The males are not responsive to synthetic lures and as such it is understood that protein traps are required to be used. Of concern is the indicated 2km grid of traps (12 sites) across the urban and production areas. As a minimum, the draft Annex 1 to ISPM 26 (Establishment of Pest Free Areas for Fruit Flies (Tephritidae)) specifies that "Detection for exclusion" should be 1 per sq km for production areas and 2-5 / sq km in urban areas.

9. Other insects

The IRA suggests that the leafhopper species associated with Japanese citrus are unlikely to be an issue as they only occur as nymphs and adults on the citrus and therefore should be removed during packing. **Are any of the leafhoppers listed ever know to lay eggs on citrus?**