Queensland
Government

Reference: **03951/12**

Department of
Agriculture, Fisheries and Forestry

18 JUN 2012

Dr Colin Grant
First Assistant Secretary
Biosecurity Australia
GPO Box 858
Canberra Act 2601

Dear Dr Grant

I refer to Biosecurity Australia's *Draft import risk analysis report for fresh ginger from Fiji*, subsequently referred to as the Draft Report and your request for comments by 15 June 2012.

The Draft Report proposes that the importation of fresh ginger from Fiji be permitted, subject to specific quarantine measures.

The Department of Agriculture, Fisheries and Forestry, Queensland (DAFF Queensland) notes that Biosecurity Australia (BA) has identified eight quarantine pests associated with the importation of fresh ginger from Fiji. The Draft Report proposes a specific biosecurity measure for a single pest that does not currently meet Australia's appropriate level of protection (ALOP). However, the Draft Report considers the existing biosecurity measures for the other seven pests meet Australia's ALOP. Therefore no specific risk management measures were proposed for those pests.

DAFF Queensland has reviewed the Draft Report and strongly differs with BA's unrestricted risk assessments for those seven quarantine pests. DAFF Queensland considers the unrestricted risk of these pests is above Australia's ALOP and therefore specific biosecurity measures are required to mitigate the risks posed by importation of fresh ginger from Fiji. Comprehensive comments on this and other issues are attached, along with a number of recommendations.

Thank you for the opportunity to comment on the Draft Report. DAFF Queensland would appreciate receiving feedback from BA on Queensland's recommendations.

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If you require any further information regarding this matter, please do not hesitate to contact Dr Abu-Baker Siddique, Senior Plant Health Scientist, Plant Biosecurity and Product Integrity, Biosecurity Queensland on telephone 07 3225 1678 or email siddique.abu-baker@daff.qld.gov.au.

Yours sincerely

Jack Noye
Director-General
Department of Agriculture, Fisheries and Forestry

Att (1)

Queensland
Government

Department of Agriculture Fisheries and Forestry, Queensland's response to the Draft import risk analysis report for fresh ginger from Fiji
Biosecurity Advice 2012/07
June 2012

General comments

The Department of Agriculture, Fisheries and Forestry (DAFF Queensland) presents the following comments on the Draft import risk analysis report for fresh ginger from Fiji (hereafter referred to as the Draft Report) for the consideration of DAFF Biosecurity.

DAFF Queensland is concerned that comments previously provided to DAFF Biosecurity by DAFF Queensland on the Draft Pest Categorisation Table have not been appropriately considered in the current Draft Report. DAFF Queensland wishes to reassert that these comments remain valid, and data demonstrating that Australian strains of *Radopholus similis* are much less severe than those found in Fiji are presented in this document (refer to comments on Section 3.2.1).

The Draft Report does not thoroughly consider soil adherence to processed ginger during the importation. It is the opinion of DAFF Queensland scientists that soil cannot be completely removed from commercial volumes of fresh ginger rhizomes and, as such, it must be considered in the analysis. A clear definition of "freedom from soil" is desirable.

DAFF Queensland is concerned that the information provided in Sections 3 and 5 of the Draft Report requires greater detail in both terms of quality and quantity in order to make an accurate risk assessment. Specific observations are made in subsequent sections of this response, but of particular note are:

- information about production areas, pest and disease management systems, post-harvest processes and supply-chains for fresh ginger to be imported into Australia.
- a writing style that is, in our opinion, open to misinterpretation.
- the desirability of more information on the composition of the operational system for the maintenance and verification of phytosanitary status in Fiji.

Given the absence of some information that DAFF Queensland considers to be significant it is unable to accurately assess the pest risk. At the stakeholder meeting of 31 May 2012, DAFF Biosecurity expressed the view that production processes reduce pest risks, however in our opinion production processes are also capable of increasing them. DAFF Queensland considers it vital for the Draft Report to contain detailed descriptions of all of the commercial practices used to produce ginger in Fiji.

Specific comments for each section are included below.

Section 1: Introduction

Page 2, Section 1.2.2 Scope, paragraph 2
"... this report does not consider the risks associated with the importation of seed ginger specifically for propagation purposes on a commercial scale."

The scope of this document and the attendant risks needs to be altered, as Australian ginger growers are known to use significant quantities of retail marketed ginger rhizomes for planting material – especially when supplies of commercially produced seed ginger are low (Hall and Ekman (2012) RIRDC Publication No 09/ in press). Growers often source this material from local produce markets, and even from markets in Sydney and Melbourne, where the original source of the rhizomes is/may not be not known.

"It is expected that volumes of ginger diverted to growing purposes by consumers would be small."

DAFF Queensland questions the basis for this statement and considers the attendant risks are understated. Queenslanders increasingly use ginger regularly in their cooking, with many of them growing ginger in their home and community gardens. Most ginger plants in gardens are started from rhizomes originally bought for cooking that sprout on kitchen benches/in cupboards. Of particular concern is the growing population of expatriate Fijian's, who use significant amounts of ginger in their cooking and prefer to grow their own plants. Once ginger rhizomes from Fijian cultivars are available in local markets and supermarkets, they are even more likely to start their own plants from this material.

The significant potential for ginger rhizomes from Fiji to be used as seed material for commercial, home and community gardens cannot be discounted, unless imported rhizomes are compulsorily treated (devitalised) to stop their germination.

Recommendation:
The Draft Report currently considers the amount of Fijian ginger that will be used as seed material to be small. DAFF Queensland considers this should be amended to moderate, to adequately take into account the use of this material by commercial businesses and the increasing use by everyday Australians.

Alternatively, the IRA should include a mandatory devitalisation process for imported ginger rhizomes to render them unable to germinate.

Page 2, Section 1.2.4 Contaminating pests
"These risks are addressed by existing operational procedures."

DAFF Queensland considers inadequate recognition is given to the potential for rhizomes to harbour soil, and the risks that this soil represents. Even very small amounts of field soil can contain plant pathogens, of which plant parasitic nematodes and soil-borne bacteria are of particular relevance to this Draft Report. Mention is made in Section 3.2.3 of rhizome washing techniques that we consider inadequate - specific problems associated with this cleaning process are dealt with in a subsequent part of this response – and so the substantial risks associated with soil remaining attached to/or held within ginger rhizomes must be addressed.

Recommendation:
Soil needs to be recognised as a significant contaminant of ginger rhizomes, which even thorough cleaning cannot adequately remove. Therefore contaminating soil, and all of the pests that this soil can harbour, need to be included in the Draft Report.

Alternatively, the concept "free from soil" needs to be more clearly (and strongly) articulated in the document, and a definition/description of what is meant by this term provided.

Section 3: Fiji's commercial production practices for ginger

Page 15, Section 3.1 Assumptions used in estimating unrestricted risk
"DAFF Biosecurity officers travelled to Fiji in September 2007 ... information [gathered] forms the basis for estimating unrestricted risk in this Import Risk Analysis."

DAFF Queensland considers the information reported in the 2007 Field Visit Report "Ginger production and processing in Fiji" from which most of the information contained in Section 3.2, does not fully demonstrate the quality standards employed and detail of information collected during the field visit.

Trip and final reports from the ACIAR funded project 'Improved farming systems for managing soil-borne pathogens of ginger in Fiji and Australia (PC/2004/049)' provide detailed descriptions of ginger pests and production techniques used in Fiji. These reports were prepared by a team of both Australian and Fijian agronomists, pathologists and nematologists. The Australian team travelled extensively throughout the ginger growing areas and visited farms, pack houses, fresh ginger export businesses and processors to assess the health status of Fijian ginger. Their assessment of current Fijian commercial production practices is significantly different to that presented in the Draft Report.

Upon request, DAFF Queensland is happy to provide detailed comments on the aspects of the Fijian ginger industry that we consider require further elaboration in the current trip report and Draft Report.

Recommendation:
That the information contained in the above mentioned ACIAR trip reports, along with consultation with DAFF Queensland experts, be used to inform revisions to Section 3 of the Draft Report.

Pages 15 – 20, Section 3.2 Ginger production
DAFF Queensland considers the data provided on Fijian industry practices in this section of the Draft requires significantly more detail in most subsections. DAFF Queensland found the information provided was not sufficient for reviewers to gain a thorough understanding of the Fijian ginger production industry. Most particularly, detailed information about the location and climatic conditions of production areas is required.

Recommendation:
A comprehensive description of the location, surrounding vegetation and climatic conditions under which ginger is produced in Fiji is required. The core information required is:

- A map of ginger production areas in Fiji
- Maps or detailed descriptions of key climatic parameters – such as rainfall, humidity, temperature – for each of these areas
- Descriptions of soil types for major production areas
- Details of vegetation types near to production areas – e.g. are production areas close to rainforest containing numerous other *Zingiber* or closely related species; or to urban areas; or within a large area of mainly commercial agriculture
- Details of farm infrastructure used, e.g. types of hand implements or machinery; methods for watering crops or applying chemicals.
- Additional information considered relevant.

Page 16, Section 3.2, second paragraph under Figure 3.2
"The importation of fresh ginger for further processing is currently permitted into Australia, subject to specific import conditions."

DAFF Queensland considers this statement requires elaboration. Does the term 'fresh ginger' refer to ginger "imported into Australia for processing in Quarantine Approved Premises" as per page 2, Section 1.2.3 Existing policy, second paragraph? If so, this could specified more clearly. If this statement does not refer to "Quarantine Approved Premises", what are the "specific import conditions" that are being referred to?

The Draft Report does not necessarily distinguish the end-uses of "baby" or immature ginger and mature ginger which are important aspects of the Fijian ginger industry. Fiji already exports brined and confectionery product to Australia which is harvested immature and which does not pose a biosecurity risk. It is the mature ginger destined for the fresh market that poses the risk, and because it is longer in the soil, it also has greater chance of infection and carries a greater chance of harbouring diseases and pests.

Recommendation:
The meaning of the terms "baby ginger" or "immature ginger" and "fresh ginger" need to be clarified and the consistency of use of the terms revisited.

Page 16, Section 3.2.1 Cultivation practices, paragraph 1
"Both cassava and taro are poor hosts of parasitic nematodes such as *Radopholus similis, Rotylenchus reniformis* and *Meloidogyne* spp. (ACIAR 2010), so this practice helps suppress pest nematode populations."

DAFF Queensland contests the accuracy of this statement and believe it has not been accurately interpreted from the original source. Planting a poor host for a particular nematode species does not "suppress" the population of that species. It simply means that that nematode species will not successfully infest that host plant. The suppression of a nematode species occurs when changes are made to the chemical, physical or organic nature of the soil that significantly reduce (or stop) that nematode species from being able to successfully infect a known host plant.

"In addition to the crop rotation, a fallow period of about six months is usually included in the program."

DAFF Queensland considers that significantly more detail is required to describe these pest and disease control measures used in Fijian ginger production. What program is this statement referring too? How long does the program run for – i.e. what proportion of the program is six months? What else is included in the program? Who instigates the program and how are the results evaluated?

It is also our understanding that Chinese ginger growers use vegetables and herbs in their rotation programs (ACIAR 2010), which creates new issues with regard to soil (and soil-borne pathogens) on exported rhizomes.

"Ginger production is very labour intensive, with much of the land preparation and harvesting done by hand (Buresova and McGregor 1990)".

DAFF Queensland suggests that a more recent reference is appropriate for cultural practices e.g. ACIAR 2010, or the trip undertaken by DAFF Biosecurity staff in 2007.

We consider a thirty year old reference is not appropriate when discussing current practices. This statement does not encompass the fact that at least two large ginger producers in Fiji are becoming increasingly mechanised, and that at least one of these producers is following similar practices as those used in Australia (personal communication Dr Mike Smith).

"Sourcing planting material from previous crops lessens the risk of pests and diseases being introduced from infected farms to new areas."

While this can be true, this practice can also increase and intensify levels of infection on farms where pests are currently present. Both effects of the same practice need to be considered. Research highlighted in the ACIAR annual report (2010) shows that most of the disease and pest problems in Fijian ginger were introduced on planting material. This indicates that the visual inspection and disinfestation treatments currently in use are not effective in reducing pests. In fact, the longer the crop remains in the ground, the greater the degree of pathogen build up in the soil and consequently the higher the levels of disease and pest infection of rhizomes.

Recommendations:
The statement about the suppressive nature of non-host plants on nematodes should be corrected or removed.

The crop rotation program used to mitigate pest problems needs to be described in detail. What crops are grown, in which order and for what period of time? Do all ginger growers use the same rotation program, and if not, what proportion of growers use which program?

The section on ginger cultivation practices in Fiji needs to be updated. DAFF Queensland is happy to provide further information from our industry experts if needed.

The risks, as well as the benefits, of using planting material sourced from previous crops needs to be presented and appropriately considered.

Page 16, Section 3.2.1 Cultivation practices, paragraph 2
"The ginger seed material may be dipped in hot water (51°C) for ten minutes to kill any nematodes that may be carried on the seed material."

While hot water treatment can be an effective treatment for nematodes in ginger seed material, this is only the case if the temperature of the water is maintained at 51°C. However, both ACIAR (2010) and Gonemaituba (2008) found that growers do not regulate the temperature of water during the treatment, and so the efficacy of the process can be compromised.

"However, since the cessation of the government assistance that supplied gas for the hot water treatment ... some farmers have bypassed this process."

ACIAR (2010) and Gonemaituba (2008) also report that only a few growers attempt hot water treatment of seed material. If this is the case, how can this treatment be used as a mitigating measure?

"... and the apparent absence of diseases affecting the planting material ..."

DAFF Queensland believes the report should state: which diseases are absent, how their apparent absence is assessed; and by whom.

Recommendations:
Clarification is needed as to what proportion of growers actually hot water treat their seed material; and what processes are used to ensure that the treatment is applied effectively. If it is confirmed that the proportion of growers' using this technique correctly is very low (ACIAR, 2010 and Gonemaituba, 2008), this method should be removed as a mitigating measure.

Page 16, Section 3.2.1 Cultivation practices, paragraph 3
"The seed pieces are left to dry for a few days before planting, further reducing the risk of introducing nematodes to the soil."

DAFF Queensland contests the accuracy of this statement. We are unaware of any research that shows that air drying host plant roots/rhizomes reduces the risk of introducing nematodes to soil. Rather, ACIAR studies (ACIAR 2010) have shown that nematodes and *Pythium* spp continue to cause damage in seed even after air drying.

Experiments undertaken by DAFF Queensland staff have demonstrated that ginger rhizomes washed thoroughly of soil and then air-dried before planting into sterilised standard potting mix, are infested with root-knot nematodes 16 weeks later. The only way for this to have happened was that the air dried rhizomes harboured eggs (and/ or juveniles of this plant-parasitic nematode) that hatched once the rhizome was planted into soil (Appendix 1: Preliminary Experiment Report, Jenny Cobon, 2012). This allows importation, distribution, establishment and multiplication of plant-parasitic nematodes via ginger rhizomes.

Recommendation:
That this statement be removed from the Draft Report, along with any further mentions of the benefit of air drying for reducing pest presence on rhizomes.

Further information is needed on the following aspects of ginger cultivation in Fiji:

- How are ginger crops in Fiji watered?
- Are chemical treatments applied to crops, and if so how?
- What sort of fertiliser or nutrients are used on the crop – if any?
- What is the standard pest and disease management program used?

Recommendation:
DAFF Biosecurity provide significantly more detailed information about ginger cultivation practises in Fiji.

Page 17, Section 3.2.2 Harvesting and postharvest handling
"Immature ginger is harvested within 6 to 6.5 months."

DAFF Queensland considers this statement is unclear. If the author means "... within 6 to 6.5 months of planting", then this should be stated. The reference used for harvesting dates is quite dated and we suggest a more recent reference might be found, as mentioned previously in the comments on Section 3.2.1 Cultivation practices, paragraph 1.

Recommendation:
DAFF Biosecurity provides significantly more detailed information about ginger cultivation practises in Fiji.

Page 17 Section 3.2.3 Packing House
"... ginger rhizomes are washed individually..."

This statement is not consistent with our interpretation of the image in Figure 3.4. The rhizomes in this image appear to be closely stacked up on top of one another in many places, making comprehensive cleaning of the whole surface of each individual piece neither possible nor likely. We suggest a more accurate statement would be that "...ginger rhizomes are spread out on wire racks and hosed thoroughly...".

Experimental data generated by DAFF Queensland staff (Appendix 2: Experiment Report, Dr M Smith) demonstrates that ginger rhizomes from a commercial operation in Australia washed on racks with a high pressure hose not only contain small quantities of soil, but that this soil contains relatively large organisms such as nematodes. If nematodes are present, then we consider even larger numbers of fungi and bacteria will be present. (This information will be presented at a Ginger Growers' Field Day next month and will be found in the field day notes).

Recommendation:
That the Draft Report be amended to reflect the fact that soil cannot be completely removed from ginger rhizomes by high pressure hosing; and soil adhering to rhizomes should be considered as a significant pathway for exotic pest entry.

DAFF Queensland considers the core information required is:

- The quality of the water used for washing. Is it clean or recycled water? Is it chlorinated, or disinfected in some other way?
- Who grades and inspects the root removal process?
- What grading scale is used to determine what constitutes "free from roots"?
- What grading scale is used to determine "free from soil"?
- Who decides which pieces are "unsuitable for export" and what criteria is applied?
- How is the ginger packed into boxes? By hand or machine? How much ginger is packed into each box? Are any other packing materials included? Is there only one size of box?
- What are the packing boxes made of? Are they clean or reused?

Section 4: Pest risk assessments for quarantine pests

Fiji ginger weevil (*Elytroteinus subtrucantus*)

As stated in the Draft Report, detailed information on the life cycle of *E. subtrucantus* is lacking. However, the time taken for adults to develop from eggs has been reported as 5-8 weeks for the subfamily Cryptorhynchini (Woodruff and Fasulo 2009). It must be noted that developmental times for insects are heavily influenced by climatic temperatures and some species within the sub-family Molytinae, Tribe: Cryptorhynchini are know to have much longer maturation times than 5-8 weeks (personal communication David Astridge). Therefore the 6 week development assumptions in the document could be significantly longer, even up to 12 weeks; thereby in increasing the likelihood of pest survival and spread.

Recommendation:
Assumptions on the lifecycle of the Fiji ginger weevil based on inferences from related organisms should be treated very cautiously. This is especially important as this organism has not been reported from sub-tropical or temperate countries, and the effect of these climates on its lifecycle is unknown.

Page 22, Section 4.1.1 Probability of entry
Probability of importation:
The probability of importation for Fiji ginger weevil is currently rated as 'HIGH based on pest biology, mechanism of infestation and interception records from New Zealand and the United States. DAFF Queensland agrees with this rating.

Recommendation:
The probability of importation for this pest must not be reduced from HIGH, as above mentioned intercepted records prove this insect is likely to be present on ginger consignments sent to Australia.

Page 23, Section 4.1.1 Probability of distribution:
Currently rated as 'MODERATE based on the following facts:

- The weevil larva will remain within the ginger rhizome for some time, as pupation occurs at the feeding site inside the ginger (Mau and Martin Kessing 1992a). Emergence of adult weevils may not occur until some time after arrival in Australia.
- Ginger will be distributed to many localities by wholesale and retail trade and by individual consumers.
- Ginger will be distributed by consumers to the areas where ginger or other host species e.g. taro, lemons, avocado or sugarcane grow.
- Infested rhizomes that escaped detection during pre-export processing and importation are likely to be distributed in the wholesale and retail supply chain.
- An infested ginger rhizome could be planted by a consumer, potentially providing a living host for the developing weevil. However, signs of weevil infestation such as tunnels, frass or rotting would lessen the likelihood that affected rhizomes would be used as planting material.
- The adults of other species of Cryptorhynchinae are known to live for up to two years and to hibernate or aestivate when suitable host plants are not available (Woodruff and Fasulo 2009).

DAFF Queensland is in agreement with the above mentioned facts. However, after considering the aggregated impact of many individual factors, e.g. larval presence inside the rhizome, wide host range, the undetermined lifespan, the difficulty in detecting infested rhizomes, that ginger rhizomes will be distributed widely in Australia and planted near many potential host areas, considers the rating should be increased.

Recommendation:
The probability of distribution of Fiji ginger weevil should be increased to 'HIGH'.

Page 24, Probability of entry (importation x distribution):
Based on the new importation and distribution assessments made above, DAFF Queensland recommends that the probability of entry should be increased to 'HIGH'..

Page 24, Section 4.1.2 Probability of establishment:
"On lemons, Miller (1923) .... It is not known if this behaviour also occurs on ginger rhizomes, but it is considered likely."

DAFF Queensland considers that lemon fruit and ginger rhizomes have no significant physiological similarities on which to base this comment. Furthermore, it appears the assumption of females laying one egg per fruit is based on an unknown lifecycle, relating to an unrelated and possibly non-preferred host, at a particular point in time. At the end of the season, it is quite normal for many insect species (normally based on unfavourable climatic conditions) to produce gravid females that promote egg shed before they die. More then one egg per fruit can be laid under the right conditions and time of the year. This insect may perform differently with the preferred host. This is not known (personal communication David Astridge, DAFF Queensland).

As there are no published studies for this pest (including lifecycle and flight) it is difficult to accurately estimate factors "pertinent to their survival and reproduction". This is evidenced by the fact that the only scientific information provided in this section is extrapolated from lemon fruit.

Given the information previously presented by DAFF Queensland (response to Section on 1.2.2) that Australian commercial ginger growers use rhizomes designated for consumption through consumer markets as planting material.

As previously outlined, the movement of infested plant material under refrigerated conditions can result in reduced development rates, increasing lifecycle length and allowing more possibilities for the insects to move to an area that has a suitable host. This increases the likelihood of establishment. The probability of all of these events happening is higher rather than lower.

Recommendation:
Due to insufficient information on the ability of Fiji ginger weevil to establish in subtropical and temperate environments, DAFF Queensland considers that a more conservative approach is warranted. This, taken in conjunction with use of retail ginger rhizomes by Australian ginger growers for seed material, means that the probability of establishment should be increased to 'MODERATE'.

Page 24, Section 4.1.3 Probability of spread:
The probability of spread for Fiji ginger weevil is currently rated as 'MODERATE', based on pest biology, host range, commodities movement, and similar climatic conditions. DAFF Queensland agrees with this rating with the following notes.

- An increased lifecycle due to the impact of storage and transport refrigeration could increase survivability of Fiji ginger weevil individuals, allowing movement to regions where the pest will continue to develop and possibly come in contact with preferred hosts.
- Some areas of northern Queensland have similar climatic conditions to those in Fiji, and are likely to provide ideal conditions for the survival of Fiji ginger weevil. As the climatic tolerance of this pest is unknown, it is possible that Fiji ginger weevil could have serious impacts on other more temperate areas of Queensland and Australia as well. The wide host range of this pest only increases the chances of it survival and spread. Restricted distribution of this pest in Hawaii may result from specific pest management practices used there, rather than the natural behaviour of the pest.

Recommendation:
The rating for the probability of spread for Fiji ginger weevil be maintained at 'MODERATE'.

Page 25, Section 4.1.4 Probability of entry, establishment and spread:
The rating for probability of entry, establishment and spread should be increased to 'MODERATE' due to rating changes for both 'probability of entry' and 'probability establishment' (section 4.1.1 and 4.1.2).

Page 25, Section 4.1.5 Consequences:
Given the following observations, DAFF Queensland contends that the consequences for the entry establishment and spread of ginger weevil (*E. subtruncatus*) to Australia need to change from 'VERY LOW' to 'LOW':

- Ginger weevil has a wide host range, including many commercially important crops (e.g. sugarcane, avocado, lemon) and common garden plants.
- Control measures in the field and packing shed seem to consist only of basic hygiene measures (removal of affected plants).
- Eradication would likely be impossible due to its wide host range.
- Both domestic and international trade will be significantly affected due to movement restrictions on a wide range of commodities and nursery stock.

Recommendation:
In the light of the above mentioned factors, the parameter value for 'Plant life and health' in table should be increased to 'D' as rated for other quarantine pests in the document. This change will result overall consequences impact to 'LOW' for this pest.

Page 26, Section 4.1.6 Unrestricted risk estimate:
The unrestricted risk estimate for Fiji ginger weevil is currently rated as 'NEGLIGIBLE' based on ratings in Sections 4.1.4 and 4.1.5. Subsequent to the increased ratings suggested by DAFF Queensland for these sections, the unrestricted risk estimate for Fiji ginger weevil should be increased to 'LOW'.

Recommendation:
The 'LOW' rating for unrestricted risk estimate requires risk mitigating measures for Fiji ginger weevil during importation.

Section 4.2 Yam Scale

DAFF Queensland supports the assessment made for yam scale.

Recommendation:
The unrestricted risk estimate for yam scale should be maintained at 'LOW', with mitigating measures required.

Section 4.3 Ring Nematodes

Page 32, Section 4.3.1 Probability of entry
Probability of importation:
The probability for entry for ring nematodes is currently rated as 'LOW' based on biology, ecology, feeding mechanism and rhizome processing (cleaning and inspection) before packaging. However, DAFF Queensland believes that the effectiveness of the rhizome cleaning and root removal processes described in the Draft Report has been over estimated by DAFF Biosecurity.

DAFF Queensland has provided data (response to Section 3.2.3) demonstrating that washed ginger rhizomes not only contain small quantities of soil, but this soil can contain relatively large quantities of microscopic organisms including nematodes. Visual inspections alone are unlikely to adequately detect these organisms.

Recommendation:
Attached soil and roots with exported rhizomes contain nematodes that could be missed by visual inspections. Therefore, the probability of importation should be increased to 'HIGH'.

Page 33 Probability of Distribution:
The probability of distribution for ring nematodes is currently rated as 'LOW', primarily based on the rhizomes being "free from soil". DAFF Queensland disagrees with this rating because of following facts extracted from the draft IRA (page 32 - 33).

- Ring nematodes have a wide host range and are reported in more than 65 plant hosts (Orton Williams 1980) including many common cultivated crop like cabbage, capsicum, pawpaw, tomato, sugarcane etc.
- Imported ginger may be widely distributed within Australia via retail distribution to supermarkets and greengrocers, and by individual consumers.
- Consumers will carry small quantities of ginger to urban, rural and natural localities. Small amounts of ginger waste could be discarded in these localities.
- Some ginger may be distributed to areas where ginger and other host plant species grow.
- Small amounts of ginger waste could be discarded in domestic compost.
- Living nematodes in discarded ginger waste may be able to find a compatible host in the area where they are discarded.
- As DAFF Queensland has previously described (response to Section 1.2.2), Australian ginger growers are known to use retail marketed ginger rhizomes for planting material.

Recommendation:
The probability of distribution for ring nematodes should be altered to 'HIGH'.

Page 34, Probability of entry (importation x distribution):
Based on the changes to importation and distribution risk assessments described above, the probability of entry should be increased to 'HIGH' from 'VERY LOW'.

Page 34, Sections 4.3.2 and 4.3.2 Probability of establishment and Probability of spread The probability of establishment and the probability of spread are both currently rated as 'HIGH'. DAFF Queensland agrees with both ratings.

Page 35, Section 4.3.4 Probability of entry, establishment and spread
With the rating for probability of entry increased to 'HIGH', the final rating for entry, establishment and spread will also increase from 'VERY LOW' to 'HIGH'.

Page 35, Section 4.3.5 Consequences
The consequences of ring nematodes for Australia are currently rated as 'LOW'. DAFF Queensland supports this rating.

Page 35, Section 4.3.6 Unrestricted risk estimate:
Given the increase of the probability of entry, establishment and spread rating to 'HIGH', the unrestricted risk estimate for ring nematodes would also increase to 'MODERATE' (based on the risk estimation matrix table 2.5 in page 12).

Recommendation:
The ratings for the probability of entry (Section 4.3.1), probability of entry, establishment and spread (Section 4.3.4) and unrestricted risk estimate (Section 4.3.6) need to be amended as detailed above, and mitigating measures implemented for ring nematodes.

Section 4.4 Spiral nematodes

Page 38, Section 4.4.1 Probability of entry
Probability of importation
The probability of importation of spiral nematodes is currently rated as 'LOW' based on very similar information and expectations (i.e. that exported rhizomes would be soil and root free after the washing and inspection process) provided for ring nematodes in the document. As for ring nematodes, DAFF Queensland has provided data (response to Section 3.2.3) demonstrating that washed ginger rhizomes not only contain small quantities of soil, but this soil can contain relatively large quantities of microscopic organisms including nematodes. Visual inspection alone is unlikely to detect these organisms.

Recommendation:
Soil and roots attached with exported rhizomes contain nematodes that can easily miss detection during visual inspections. Therefore, the rating for the probability of importation should be increased to 'HIGH'.

Page 38, Probability of distribution
The probability of distribution of spiral nematodes is currently rated as 'MODERATE' based on very similar information and expectations (i.e. that exported rhizomes would be soil and root free after washing and inspection process) provided for ring nematodes in the document. As for ring nematodes, DAFF Queensland disagrees with this rating because of following facts extracted from the draft IRA (Page 37-39).

- Spiral nematodes are polyphagous plant parasitic root feeders .
- Spiral nematodes are usually ectoparasitic feeders on roots, but they can sometimes feed inside the roots (Kazi 1996; Luc et al. 1990).
- All life stages can be found in the soil and root cortex.
- They have a wide host range including common agricultural plant species in Australia (IRA page 37)
- The are difficult to detect on hosts due to their small size.
- Eggs are laid free in the soil.
- The most likely pathway for entry would be via infested soil attached to poorly cleaned rhizomes.
- Dispersal over long distances is most likely to occur in rhizomes accompanied by moist soil.
- Imported ginger will be distributed to many localities within Australia by wholesale and retail trade, and by individual consumers.
- Individual consumers could carry small quantities of ginger rhizomes to urban, rural and natural localities. Small amounts of ginger waste could be discarded in these localities.
- Some ginger rhizomes may be distributed to areas where host plants are grown.
- Small amounts of ginger waste will be discarded into domestic compost.
- Helicotylenchus species are polyphagous (Luc et al. 1990), increasing the likelihood that introduced nematodes could locate a suitable host. Known hosts such as sugarcane, oranges, lemons, carrots, oats, cabbages, potatoes, tomatoes, maize and onions (Zeidan and Geraert 1990; Van den

Berg and Kirby 1979; Orton Williams 1980; Kazi 1996) are widespread and common.

- Nematodes in discarded ginger waste may be able to find a compatible host in the area where they are discarded, but their ability to move from the rhizome to locate a new host is very limited and dependant on factors such as soil moisture.
- Some spiral nematodes could potentially be introduced to the soil if consumers planted rhizomes in backyard gardens.

DAFF Queensland has provided data (response to Section 3.2.3) demonstrating that washed ginger rhizomes not only contain small quantities of soil, but this soil can contain relatively large amount of microscopic organisms including nematodes. DAFF Queensland has also demonstrated that washed, air-dried rhizomes harbour plant-parasitic nematode eggs that can hatch once ginger rhizomes are planted.

Recommendation:
Based of the above mentioned facts probability of distribution should be increased to 'HIGH'.

Page 39, Probability of entry (importation x distribution):
Based on the new importation and distribution assessments made above, the probability of entry for spiral nematodes should be increased to 'HIGH'.

Page 39, Sections 4.4.2 and 4.4.3 Probability of establishment and Probability of spread: The probability for establishment and spread of spiral nematodes are both currently rated as 'HIGH'. DAFF Queensland supports both ratings.

Page 35, Section 4.4.4 Probability of entry, establishment and spread
With the increase of the rating for probability of entry to 'HIGH', the final rating for entry, establishment and spread will also increase from 'VERY LOW' to 'HIGH'.

Page 40, Section 4.4.5 Consequences:
The consequence of the unrestricted importation of spiral nematodes is currently rated as 'LOW'. DAFF Queensland supports this rating.

Page 41, Section 4.4.6 Unrestricted risk estimate:
Given the increase of the probability of entry, establishment and spread rating to 'HIGH', the unrestricted risk estimate for spiral nematodes would also change to 'MODERATE' (based on the risk estimation matrix table 2.5 in page 12).

Recommendation:
The ratings for the probability of entry (Section 4.4.1), probability of entry, establishment and spread (Section 4.4.4) and unrestricted risk estimate (Section 4.4.6) need to be increased as detailed above, and mitigating measures implemented for ring nematodes.

Section 4.5 Cystoid nematodes

Page 42 Section 4.5.1 Probability of entry
Probability of importation:
The probability of importation for cystoid nematodes is currently rated as 'MODERATE' in the Draft Report. DAFF Queensland disagrees with this rating for the following reasons:

- Adult females could be present on any roots not removed from the rhizomes.

- The females are embedded in the root tissue, with only the posterior protruding from the surface, so may not be removed during postharvest cleaning processes.
- If any roots were present on the rhizomes, it is possible that some eggs, juveniles and males could be present, protected within a gelatinous matrix underneath sloughed layers of cortical cells (Eisenbeck and Hartmann 1985).
- *Sphaeronema* spp. nematodes are very small and would be difficult to detect unless the roots were inspected under a microscope (Eisenbeck and Hartmann 1985).
- *Sphaeronema* spp. are internal as well as external feeders and can be found within ginger rhizomes (Mike Smith, personal communication).

These points combined with the previously stated impacts of soil being present on rhizomes, would greatly increase the probability of entry for cystoid nematodes.

Recommendation:
The probability of importation of cystoid nematodes should be altered to 'HIGH'.

Probability of distribution:
The probability of distribution of cystoid nematodes was rated as 'MODERATE' in the Draft Report. But DAFF Queensland disagrees with this rating based on the facts given above for both ring and spiral nematodes (page 10-12).

Recommendation:
The probability of distribution of cystoid nematodes should be altered to 'HIGH'

Page 43, Section 4.5.1 Probability of entry (importation x distribution):
Based on the increased importation and distribution risk assessments made above, the probability of entry for cystoid nematodes should be increased to 'HIGH'.

Pages 44 and 45, Section 4.5.2 Probability of establishment and 4.5.3 Probability of spread:
The probability of establishment and the probability of spread are both currently rated as 'HIGH'. DAFF Queensland supports both ratings.

Page 45, Section 4.5.4 Probability of entry, establishment and spread:
The probability of entry, establishment and spread was calculated as 'LOW' based on the previous rating of 'LOW' for probability of entry. The increase in the rating for probability of entry to 'HIGH' will increase this rating to 'HIGH'.

Page 45, Section 4.5.5 Consequences:
The consequences of cystoid nematodes for Australia are currently rated as 'LOW'. DAFF Queensland supports this rating.

Page 46, Section 4.5.6 Unrestricted risk estimate:
Given the increase of the probability of entry, establishment and spread rating to 'HIGH', the unrestricted risk estimate for cystoid nematodes should also increase to 'MODERATE' (based on the risk estimation matrix table 2.5 in page 12).

Recommendation:
The unrestricted risk estimate for cystoid nematodes should be increased to 'MODERATE', and risk mitigation measures implemented.

Section 5: Pest risk management

DAFF Queensland considers that more information and detail is required in the section in order to make an assessment.

The proposed phytosanitary measures in this Draft Report appear to be based on limited information surrounding pest biology, production methods in Fiji and vector pathways for entry establishment and spread in Australia.

Page 49, 5.1.1 Management for yam scale paragraph 3

"The proposed risk management measure is:

- Inspection to ensure that ginger rhizomes infected with *Aspidiella hartii* are identified and subjected to appropriate remedial action."

DAFF Queensland requires more detailed information in order to evaluate this proposal, particularly given that frequent interceptions of this pest on rhizomes exported to New Zealand from Fiji (page 28, 4.2.1 Probability of entry), indicate current production practices are insufficient.

Recommendation:

DAFF Queensland considers the minimum information needed is:

- Where, when and by whom these inspections will take place.
- The method of inspection – will this be a visual inspection, and if so will microscopes or hand lenses by used? Will the inspection involve destructive sampling, or will only the surface of rhizomes be viewed?
- How and by whom the inspection process will be audited.

Pages 49-51, 5.1.2 Operational system for the maintenance and verification of phytosanitary status

"A system of operational procedures is necessary to maintain and verify the phytosanitary status of fresh ginger from Fiji."

DAFF Queensland requires more detail on the form and composition of this system to assess effectiveness. Key parts of the system need to be described in detail.

Recommendation:

DAFF Queensland considers the minimum information required on audit and verification methods is:

- When audits will take place, and by which agency, and how farms and packing houses will be registered
- Confirmation of adherence to freedom from soil, trash and other regulated item protocols
- Remedial actions for non-compliance

Page 51, On-arrival Biosecurity inspection, dot point 2

- "consignments are inspected using the standard inspection protocol, which includes optical enhancement where necessary"

Unless the every rhizome in the 600 sample units is individually inspected with a microscope then yam scale will be very difficult to find and could be missed in the consignments. Similarly, due to the tendency of rhizomes to fold over on themselves unless they are destructively sampled it will not be possible for the entire surface of the rhizome to be examined.

Recommendation:
That the standard inspection protocol be amended to stipulate that the entire surface (using destructive sampling when required) of all 600 rhizomes inspected must be examined using a microscope, or equivalent measure.

Alternatively, if the range of techniques used in standard on-arrival inspections is too broad to be stipulated for inclusion in the Draft Report, detailed information on these techniques could be provided in a separate document.

Appendix 1:

An experiment to examine the pathogenicity of an Australian isolate of *Radopholus similis* on ginger

Jenny Cobon, Department of Agriculture, Fisheries & Forestry, EcoSciences Precinct, Boggo Road, QLD 4001, Mike Smith, DAFF, Maroochy Research Station, Nambour QLD 4560 and Graham Stirling, Biological Crop Protection, Moggill QLD 4070

Aim: To investigate the pathogenicity of the Australian isolate of the burrowing nematode on ginger and compare our results with similar pathogenicity studies conducted with a Fijian isolate.

Method: Forty 2 L planter bags were filled with autoclaved potting mix and planted with a *Radopholus*-free 'seed piece' of 'Queensland' ginger. Pots were then transferred to a glasshouse and 12 weeks later half the pots were inoculated with 2,000 *R. similis*. The nematode was obtained from a banana farm at Pimpama, Queensland and had been multiplied in the laboratory on sterile carrot tissue. Sixteen weeks after pots were inoculated, the number of yellowing or dead shoots in each pot was recorded, above-ground biomass in ten inoculated and ten control pots was measured and symptoms on seed pieces, newly-developing rhizomes and roots were assessed. Nematodes were extracted by slicing the seed piece and rhizome finely and placing in a misting chamber for 7 days. Roots were chopped finely and placed in the misting chamber for the same length of time. Nematodes were recovered on a 38µm sieve. To check that the nematode were extracted successfully using the misting chamber, a subsample of rhizomes were macerated in a blender and sieved using a 38µm sieve. Sixteen extra nematodes were extracted from the rhizome, so the misting method was considered successful at extracting the nematodes form the plant tissue.

Results: Both inoculated and non-inoculated plants grew normally and after 16 weeks they had several healthy green shoots up to 90 cm long. No yellowing or necrosis of shoots was noted. Yellowing and necrosis were not associated with damage caused by *R. similis*. Plant biomass was not significantly different between the control and inoculated plants (Table 1).

Observations on tissue collected from affected plants showed that *R. similis* was causing minor damage to the base of the shoot, and in rhizome tissue at the point where shoots emerged from the rhizome. The nematode was also recovered from the occasional sunken lesion and blackened tissue on the rhizome surface, from discoloured tissue that extended 1-3 mm into the rhizome, and from seed pieces. However in no case was the nematode population in a seed piece or rhizome higher than 22 or 105 *R. similis*/100g, respectively. In fact the total burrowing nematode population recovered was, on average, lower than that introduced during inoculation of pots (1,423 vs. 2,000). Estimates of the number of *R. similis* recovered after 16 weeks indicated that some nematode multiplication had occurred in roots, seed pieces and rhizomes (Table 2).

Table 1. Effect of *Radopholus similis* on ginger 16 weeks after plants growing in potting mix were either inoculated with the nematode or left uninoculated

Treatment	Fresh wt. shoots (g)	Fresh wt. seed piece (g)	Fresh wt. rhizome (g)
Control	130.5	30.4	202.1
R. similis	114.0	34.9	220.0

Results are not significantly different (P= 0.05)

Table 2. Numbers of *Radopholus similis* recovered 16 weeks after ginger plants were inoculated with 2,000 nematodes or left uninoculated

	No. *R. similis*		
	/100 g seed	/100 g rhizome	/100 g seed+rhizome +roots
Control	0	0	0
Inoculated	11	19	428

Discussion: The Australian isolate of *Radopholus similis* is capable of invading and feeding on ginger roots and rhizome, but it is not an aggressive pathogen and caused little to no damage to the ginger plant. In contrast, Turaganivalu *et al.* (2009) found that a Fijian isolate was capable of killing plants and destroying rhizomes under very similar conditions to those reported here. In the Australian pathogenicity experiment, of 2,000 nematodes added to the pot, and average of 1,423 *Radopholus similis* were recovered after 20 weeks. In the Fijian experiment, of 1,500 nematodes added to the pot, an average of 15,638 were recovered indicating clearly that the Fijian *Radopholus similis* isolate can quickly and aggressively colonise and multiply on ginger rhizomes.

There is a growing body of evidence in the literature (Sarah *et al.* 1993, Hahn *et al.* 1996, Quiros and Araya 2008) that describes large variability between geographically isolated populations of *R. similis* in both their ability to reproduce and their ability to cause damage Clear differences in reproductive potential and the degree of host response have been demonstrated. The results from this study with the Australian isolate provide compelling evidence that it is a different strain of *Radopholus similis* to the more pathogenic strain found on ginger in Fiji. Furthermore Smith et al. (2007) did not find *R. similis* in banana roots or soil in Fiji, despite extensive sampling of banana plants growing adjacent to severely infected ginger crops. This raises questions about the host preference of *R. similis* in these situations and the potential risk of introducing a pest that is adapted to, and has a preference for, feeding on ginger roots and rhizomes.

Conclusion: Importing an isolate of *R. similis* from Fiji that has a different host range or greater pathogenicity than already present in Australia would present significant risks to the ginger and other industries.

References:

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Turaganivalu, U., Stirling, G.R., Reddy, S. and Smith, M.K. (2009) Pathogenicity of *Radopholus similis* on ginger in Fiji. In, 'Proceedings: 17th Australasian Plant Pathology Society Conference, Newcastle, 29 September-1 October 2009'. p. 218.

Appendix 2:

An experiment to examine the effect of packhouse washing of ginger rhizomes on soil retention and consequences of soil-borne pathogens being moved on fresh ginger for export

Mike Smith, Department of Agriculture, Fisheries & Forestry, Maroochy Research Station, Nambour QLD 4560

Aim: To investigate whether soil is retained on ginger destined for household consumption following washing and packing into cartons or containers in a commercial operation.

Method: 'Queensland' ginger was harvested on 9 May 2012 from beds that had not been top-dressed with sawdust mulch and placed in bins (ca. 500 kg capacity). A bin was emptied into a wire tray, suspended over a frame (0.6 m high) and rhizomes spread evenly (2-3 hands deep) and washed with a high pressure hose for 15 min. The ginger was hosed at 18 psi thoroughly from above, below and from the sides. This procedure was used commercially prior to the packhouse upgrading its washing facilities and was very similar to the operations shown in Fiji from the draft IRA.

20 hands of ginger were randomly selected and inspected for soil that may have been retained in the many cavities and creases formed by the complex morphology of the ginger rhizome. Soil was removed with a spatula and placed in a Petri dish for weighing and pictures. A separate dish was used with each hand that contained traces of soil.

Soil removed from the ginger rhizome was also taken back to the laboratory to make a nematode count from each sample to determine if the soil could potentially harbour plant parasitic nematodes.

Results: Of the 20 hands sampled soil was not found in only 3 hands. In another 3, there was sufficient overlap of hands that in a commercial operation the hands would have been separated and the rhizomes re-washed. In other words, they represented 2 hands that were joined and overlapping, however they constituted the greatest risk, with 9.01g, 18.75g and 45.41g of soil being collected (please note that these samples have not been used in the calculations that follow).

Of the remaining samples, an average of 0.88g of soil was collected from an average weight of rhizome of 275g. The range of weights was 0.05g – 4.51g of fresh soil collected from the rhizomes (see photos).

Nematode counts revealed that soil that was over 5 g contained hundreds of nematodes; 1-5g contained between 2-50 nematodes; and soil less than 1 g contained between 0-17 nematodes. Of those soils less than 1 g, 82% contained at least 1 nematode.

Discussion: Using the data collected from this experiment it is possible to extrapolate the figures and estimate how much soil (potentially carrying serious pathogens of ginger) may be found in average consignments of ginger destined for the fresh market.

For instance, a 10kg carton may be expected to contain 32g of soil. Even if only 70% of the rhizomes contain traces of soil, this still means 22.4g of soil will be found on rhizomes in a 10kg carton. Take this further and 2.24kg of soil could be found in a 1 tonne air-freight consignment and 22.4kg in a 10t sea-freight consignment.

Conclusion: Due to the morphology of the ginger rhizome it is not possible to remove all traces of soil from ginger destined for the fresh market in a commercial operation. Therefore soil, and soil-borne pathogens, can be moved on rhizomes for the fresh market and these, in turn, can eventually be planted in home gardens or commercial ginger farms.

Acknowledgements: I thank the Templeton family for allowing me to conduct this study at their farm and packhouse at Eumundi.

Figure 2.1: "Best case" ginger

Figure 2.2: "Worst case" ginger rhizome and soil.

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