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Irradiation as an alternative quarantine treatment to control fruit flies in exported blueberries

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INTRODUCTION

Argentina produces a variety of temperate and subtropical fruits and vegetables, but export of these crops has been hindered due to limited market access, particularly to the United States, and lack of adequate quarantine treatments to meet the phytosanitary requirements of the importing countries, while maintaining quality. Irradiation has potential as an alternative quarantine treatment for blueberries, and as a new treatment for a variety of other fruits and vegetables. Irradiation is often less damaging to fruit than cold or fumigation quarantine treatments, providing a higher quality product that should compete well in the marketplace.

BLUEBERRIES

Fresh blueberries have seen a rapid increase in production during the past five years. Blueberries were grown on approximately 3,700 ha with exports of 8,847 tonnes from Argentina in 2007 (SENASA, 2008), and export production for 2008 is estimated at 14,000 tonnes. Production is expected to grow to 30,000 tonnes in three years.

Argentine blueberries are harvested and exported from September to December, just before Chilean blueberry exports begin, which provides a profitable market window. Before export to the United States, blueberries receive methyl bromide or cold quarantine treatment to control Mediterranean fruit fly, *Ceratitis capitata*, and South American fruit fly, *Anastrepha fraterculus*. Currently, approved imports into the U.S. from Argentina are treated with T107-a-1 cold treatment or T101-i-1-1 fumigation (APHIS-PPQ, 2008). The cold treatment schedule for blueberries to control the two fruit flies is 1.11ºC for 15 days or 1.67ºC for 17 days.

Cold treatment during transit is difficult to apply because temperature control on Argentine ships is not reliable and the cold temperature requirement is sometimes exceeded during transit. Methyl bromide fumigation treatment requires warming the fruit to 21ºC, effectively breaking the cold chain and resulting in loss of quality and reduced shelf life due to condensation and increased Botrytis. In other commodities exported to the U.S., Mediterranean fruit fly and *Anastrepha* spp. may also be treated with T105-a-1 irradiation treatment (APHIS-PPQ, 2008).

Irradiation is an alternative treatment for blueberries that could help ensure high fruit quality and eliminate treatment reliability problems. There is strong interest in irradiation from blueberry producers and exporters in Argentina.

GENERIC IRRADIATION TREATMENTS

In 2006, a rule was published in the United States approving a generic radiation dose of 150 Gy for all tephritid fruit flies and 400 Gy for all other insects except Lepidoptera pupae and adults (which may require higher doses) (Table 1). Generic irradiation treatments were possible because irradiation is broadly effective against insects at doses that typically do not harm commodity quality (Follett and Armstrong, 2004; Follett and Neven, 2006; Wall, 2008). The generic treatment rule will accelerate trade between the U.S. and other countries in fresh fruits and vegetables where irradiation can be used to control phytosanitary pests (Follett and Neven, 2006). Other countries will almost certainly follow the trend, approving generic irradiation treatments for broad groups of arthropods (Follett *et al*., 2007). For example, Australia has approved irradiation doses of 150 Gy for tephritid fruit flies, 250 for other insects, and 300 Gy for mites on mango and papaya from northern Queensland exported to New Zealand. The International

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Plant Protection Commission (IPPC) recently recommended to member countries approval of the 150 Gy for tephritid fruit flies and specific doses for a number of other pest species.

Argentina can take advantage of new rules governing the application of irradiation for phytosanitary uses if it can provide a regulatory framework and generate interest among producers and exporters in irradiation as an alternative to current phytosanitary treatments (e.g. cold, methyl bromide).

FRUIT FLIES

Mediterranean fruit fly and *Anastrepha fraterculus* are the significant quarantine pests of blueberries and other fruits (e.g. apples and pears) in Argentina. Quarantines for these pests are erected by importing countries, and quarantine restrictions are in place within Argentina for fruit shipped between infested (northern provinces) and fruit fly-free areas (Patagonia) or areas with ongoing area-wide suppressing programs (Cuyo). The generic radiation dose of 150 Gy can be used to export fruit to the U.S., and this treatment would be effective for interprovincial movement within Argentina.

The approved radiation dose for Mediterranean fruit fly and *Anastrepha fraterculus* (and other tephritid fruit flies) is 150 Gy, but this dose can almost certainly be lowered for both species. Lowering the dose would reduce costs and minimize any adverse effects on fruit quality. Research should be conducted to establish a radiation dose to control *A. fraterculus*. A radiation dose of 70 Gy is approved in the U.S. for *Anastrepha ludens*, *A. obliqua*, and *A. suspensa*, and 100 Gy, is approved for *A. serpentina* (Table 1).

Anastrepha fraterculus response to irradiation has not been studied carefully. If research shows that *Anastrepha fraterculus* is controlled at 70-100 Gy, lowering the dose from 150 Gy would minimize irradiation injury to fruit during commercial treatment. The approved irradiation dose for Medfly is 150 Gy so this dose would be required for fruit grown in areas of the country infested with Medfly. Research has shown that a minimum dose of 100 Gy effectively controls Medfly (Follett and Armstrong, 2004); the IPPC has recommended 100 Gy for Medfly, but the treatment has not yet been lowered from the generic dose of 150 Gy in the U.S.

Table 1. Radiation doses approved for insects and insect groups by the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS).

Scientific name	Common name	Dose (Gy)
Anastrepha ludens	Mexican fruit fly	70
Anastrepha obliqua	West Indian fruit fly	70
Anastrepha serpentina	Sapote fruit fly	100
Anastrepha suspensa	Caribbean fruit fly	70
Aspidiotis destructor	Coconut scale	150
Bactrocera jarvisi	(none)	100
Bactrocera tryoni	Queensland fruit fly	100
Brevipalpus chilensis	False red spider mite	300
Conotrachelus nenuphar	Plum curculio	92
Copitarsa decolora	(none)	100
Cryptophlebia ombrodelta	Litchi fruit moth	250
Cryptophlebia illepida	Koa seedworm	250
Cylas formicarius elegantulus	Sweetpotato weevil	150
Cydia pomonella	Codling moth	200
Euscepes postfasciatus	West Indian sweetpotato weevil	150
Grapholita molesta	Oriental fruit moth	200
Omphisa anastomosalis	Sweetpotato vine borer	150
Pseudaulacaspis pentagona	White peach scale	150
Rhagoletis pomonella	Apple maggot	60
Sternochetus mangiferae	Mango seed weevil	300
Fruit flies in the family Tephritidae not listed above		150
Plant pests of the Insecta not listed above, except Lepidoptera pupae and adults		400

Sources:
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NEW INVASIVE PESTS

New invasive pests can interrupt trade until mitigation measures are developed. An advantage to irradiation is that interruptions due to new quarantine pests are prevented because generic doses provide a ready-made treatment and no new research is required (Follett and Neven, 2006). For example, the introduction of a new quarantine pest into Argentina, such as Mexican fruit fly or yellow peach moth, could disrupt blueberry exports until new quarantine cold treatments are developed, whereas generic radiation doses of 150 Gy and 400 Gy, respectively, are already approved to control these pests.

QUALITY OF BLUEBERRIES

Irradiation damage to blueberry is dependent on variety, maturity, time of harvest (early or late season), storage conditions, and other factors. The Comisión Nacional de Energía Atómica (CNEA) has been studying the radiotolerance of Argentina's two main blueberry cultivars. Quality parameters examined were water loss, firmness, pH, titratable acidity, and total soluble solids. A study was conducted with Star and Misty cultivars irradiated at 0, 150, 450, and 1000 or 2000 Gy and held in cold storage at 0ºC for 0, 7, 14, or 28 days. Irradiation generally did not affect quality parameters compared with untreated controls, but some mold appeared in mechanically damaged berries and berries damaged by bird feeding (Kairiyama *et al*., unpublished). Other studies suggest blueberries are generally tolerant of irradiation (Miller *et al*., 1994 a,b).

Tests should be conducted to better understand the effects of different factors such as irradiation dose, variety, harvest maturity, time of the season, and storage conditions, on blueberry quality. Irradiation tests should include 0 (untreated control), 100, 200, 400, and 600 Gy treatments to cover the range of doses typically applied under commercial conditions.

MARKET ACCESS

Generic irradiation treatments can accelerate the process of gaining market access. Once the irradiation Framework Equivalency Agreement is in place, Argentina can petition USDA-APHIS to add irradiation as a treatment option for blueberries, since it already has a trade agreement. Blueberry is an ideal export crop for Argentina using irradiation. USDA-APHIS recently published a document, “Pathway-Initiated Risk Analysis of the Importation on *Vaccinium* spp. Fruit from Central and South America in to the Continental United States” (February 5, 2008, revision 3) that highlights irradiation as a new quarantine treatment for blueberries. Interest is high among blueberry producers and exporters in Argentina to build an irradiator to alleviate problems with cold treatment in transit.

There are several key steps to ensure the success in opening export markets in the U.S. for premium-quality irradiated blueberries. Argentina must: (1) develop appropriate regulatory framework for the use of irradiation as a phytosanitary treatment for fresh commodities; (2) send an initiating letter to U.S. regulatory officials expressing interest in exporting the fresh commodities of interest using irradiation; (3) conduct fruit quality and shelf life studies and (4) refine currently approved insect irradiation treatments to lower the dose, thus ensuring optimal quality and reducing treatment cost. A similar process will open markets in other countries to Argentine blueberries and other fruits and vegetables if those countries accept phytosanitary application of irradiation for fresh horticultural products.

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