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# USDA-APHIS Research Updates

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Miami, Florida, USA

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# Outline

1. Phytosanitary Doses and Packaging
2. Low Energy X-Ray Irradiators in Research
3. Combination Treatments
4. Vectors and Irradiation

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# APHIS-Approved Irradiation Treatments

https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/treatment.pdf

| Pest | Dose (Gy) |
|---|---|
| All fruit flies of the family Tephritidae | 150 |
| All insects except adults and pupae of the order Lepidoptera | 400 |
| Eggs and larvae of the family Tortricidae | 290 |

| Pest | Dose (Gy) |
|---|---|
| *Rhagoletis pomonella* | 60 |
| *Anastrepha ludens, Anastrepha obliqua, Anastrepha suspensa* | 70 |
| *Conotrachelus nenuphar* | 92 |
| *Anastrepha serpentina, Bactrocera jarvisi, Bactrocera tryoni, Ceratitis capitata, Copitarsia declora* | 100 |
| *Aspidiotus destructor, Cylas formicarius, Euscepes postfasciatus, Omphisa anastomosalis, Pseudaulacaspis pentagona, Bactrocera cucurbitae, Bactrocera dorsalis* | 150 |
| *Sternochetus frigidus* | 165 |
| *Cydia pomonella, Grapholita molesta, Epiphyas postvittana* | 200 |
| *Cryptophlebia ombrodelta, Cryptophlebia illepida* | 250 |
| *Brevipalpus chilensis, Sternochetus mangiferae* | 300 |

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# Packaging Update

Modified Atmosphere Packaging (MAP) is a process that alters the gas composition surrounding a commodity.

- prolongs the shelf-life of perishable goods
- slows the speed of aerobic microorganisms

APHIS now allows oxygen levels of 10% or higher for irradiation packaging

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# Low Energy X-Ray Irradiators in Research

- X-Ray Research Irradiators
  - Low-energy (~160 keV)
  - Fewer security requirements
  - Require special dosimetry methods

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# Low Energy X-Ray Irradiators

- Cannot use calibration curves interchangeably for gamma and low energy x-ray
- Need special calibration curve for low energy x-ray dosimetry
- NIST (National Institute of Standards and Technology, USA) does not offer low-energy x-ray services

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# Calibration Process


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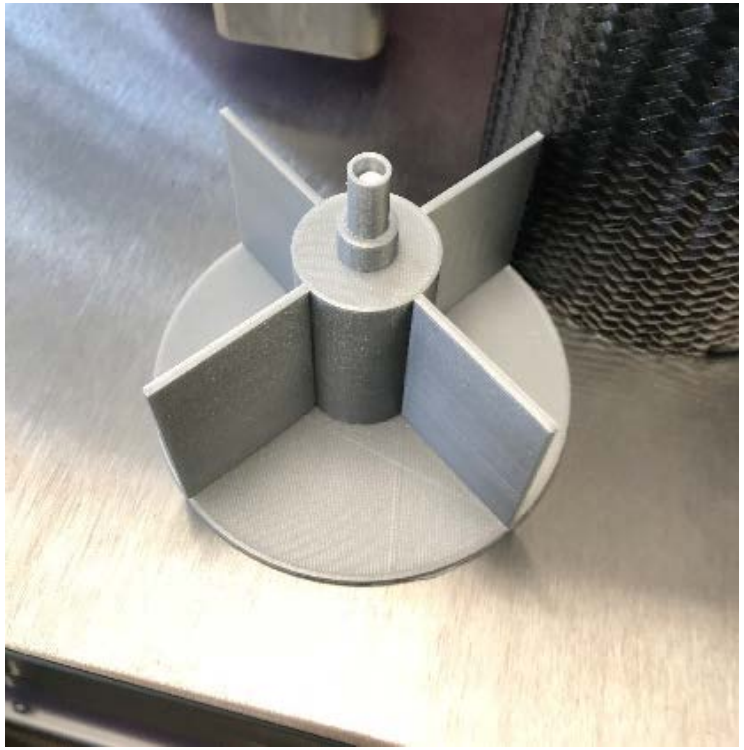
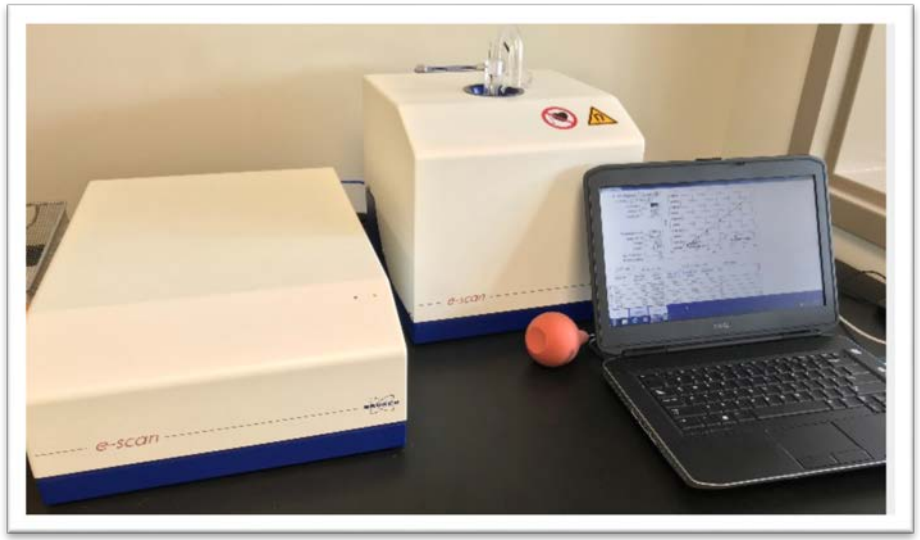
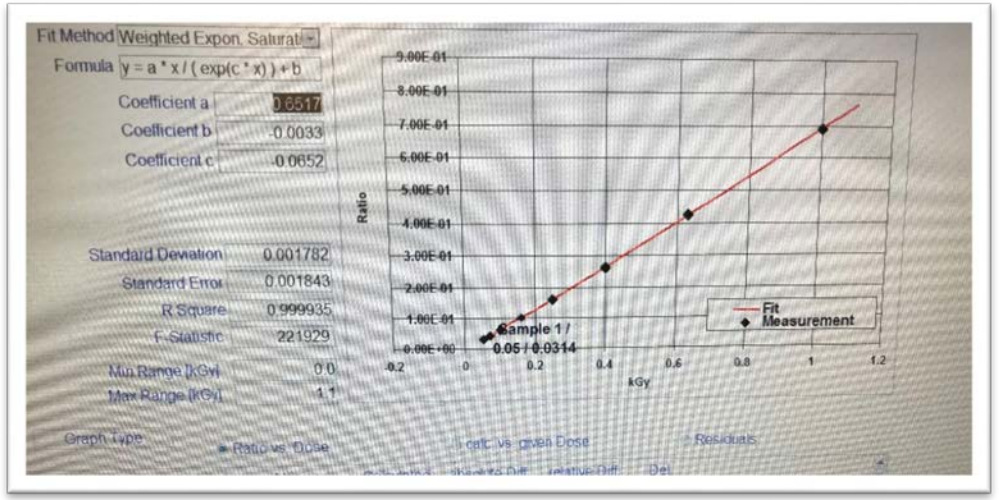
# Calibration Process





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# Combination Treatments

- Combine low dose irradiation (30-100 Gy) with short cold treatment (5 days)
- Citrus can be sensitive to irradiation
  - Peel pitting


Figure 1. Control, 150 Gy and 1000 Gy pummelos after 4 weeks of storage; 3 weeks at 12° C and 4th week at 20° C. 1000 Gy pummelos had maximum damage

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# Previous Research

| Host | Pest | Dose (Gy) | Cold Treatment Temp | Cold Treatment Period | Result | Citation |
|---|---|---|---|---|---|---|
| Clementine | Med fruit fly | 30 | $1^0$ C | 2 days | No adult emergence | Palou et al. 2007 |
| Papaya | Med fruit fly, Melon fruit fly | 30 | 4 or $11^0$ C | 11 days | No adult emergence | Follett & Snook 2013 |
| Grapefruit | Carib fruit fly | 50 | $1.1^0$ C | 5 days | No adult emergence | Von Windeguth & Gould 1990 |
| Navel orange | Med fruit fly | 30 | $5.5^0$ C | 14 | No adult emergence | Ohta et al. 1989 |

Medfly requires 100 Gy alone

For Medfly in clementine, cold treatment is 14 days (1.11°C) or 18 days (2.22°C)

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# Methods

- Mandarin oranges (‘Cuties’) and Valencia oranges (n=96)
- Irradiation doses: 50 Gy and 150 Gy
- Cold treatment: 2° C for 5 days (120 hrs)
- Observe fruit for signs of damage for 2 weeks at room temperature

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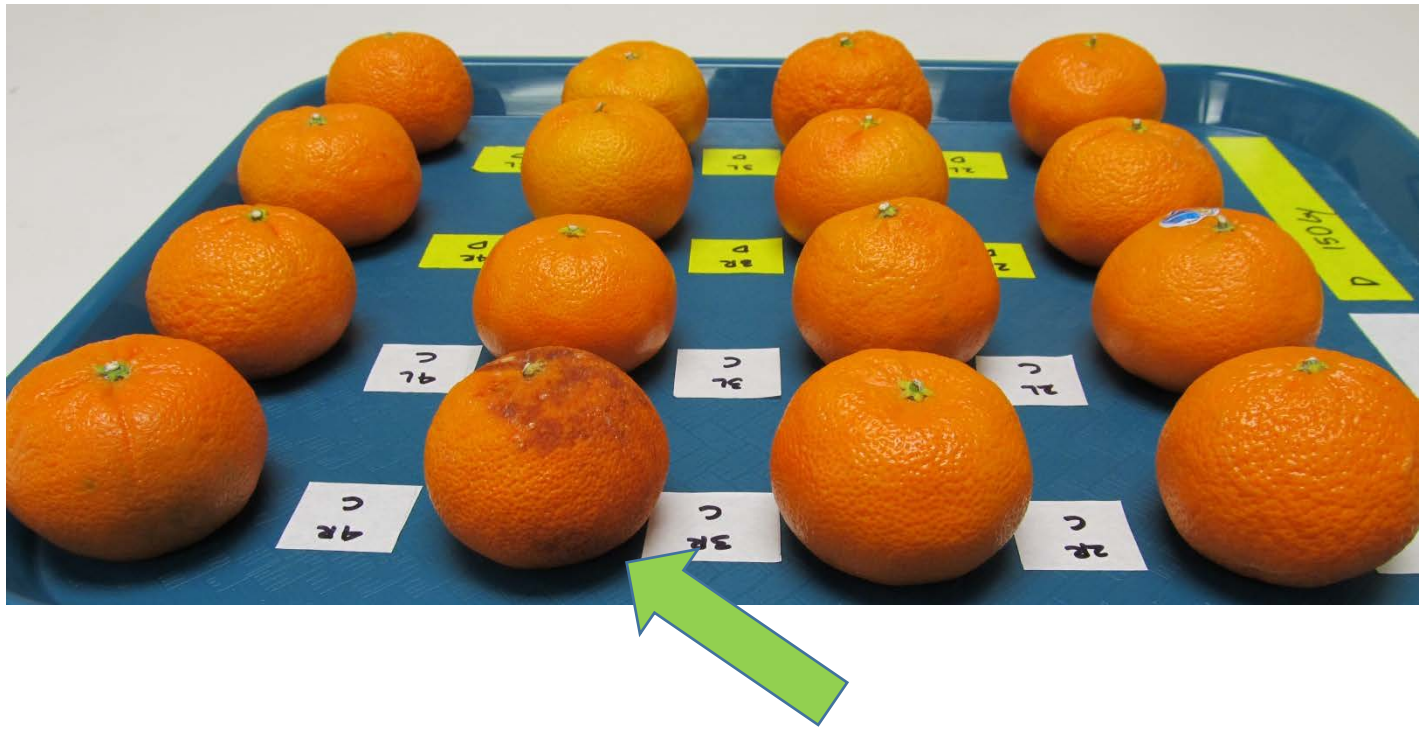
# ‘Cutie’ mandarin



Pre-irradiation Post-treatment (150 Gy)

| Dose (Gy) | °Brix post-treatment (mean) | Weight post-treatment (g) | % unsalable |
|---|---|---|---|
| 150 | 13.75 | 84.33 | 3.12 |
| 50 | 14.56 | 82.22 | 0 |
| 0 | 14.66 | 79.84 | 0 |

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# Valencia oranges

| treatment | °Brix (mean n=10) | Weight final (g) | % unsalable |
|---|---|---|---|
| Pre-treatment | 12.89 | --- | 0 |
| 150 Gy | 13.20 | 173.33 | 3.13 |
| 50 Gy | 12.56 | 172.37 | 6.25 |
| 0 Gy (control) | 12.90 | 174.51 | 15.63 |


150 Gy + cold


Control (0 Gy)

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# Conclusions and Next Steps

- Conclusions
  - Imperfections before treatment became worse post-treatment
  - Irradiation plus cold treatment did not substantially affect fruit salability
- Next Steps
  - Evaluate quality effects and insect efficacy together on larger scale
  - Cooperative agreement with University/Collaborators in USA and Mexico
  - Consider effects of irradiation first vs. cold treatment first

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# Effects of Irradiation on Potato/Tomato Psyllid and Disease Transmission

- Potato psyllid vectors ‘Zebra Chip’ disease
  - Similar to bacteria that causes citrus greening
- Cooperative agreement with Texas A&M University, USA
  - Dr. Keyan Zhu-Salzman

Zebra chip disease
Photo: USDA ARS

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# Effects of Irradiation on Potato/Tomato Psyllid and Disease Transmission

## Objectives

1. Evaluate the effects of irradiation on psyllids.
2. Determine whether irradiation prevents psyllid-vectored disease transmission.

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# Questions?