Quarantine Pests

“A quarantine pest is a plant pest of potential economic importance to an area that is not yet present there or that is present but not widely distributed and officially controlled.”

Follett & Neven, 2006

Overview

- World trade in agricultural commodities continues to increase
- Phytosanitary restrictions protect the agriculture in a region – Keeps bad bugs out
  - Should be based on a risk assessment, and not a zero risk
  - Should be based on scientific data, and not politics
- At times, phytosanitary regulations, without sound scientific support, are used as trade barriers
Overview

- If accepted disinfestation measures are not available, quarantine pests will prohibit marketing of fresh agricultural products
  - Between countries
  - And also between geographical areas within countries (e.g., between Florida and other states)

Overview

- Quarantine or phytosanitary treatments eliminate, sterilize, or kill regulatory pests in exported commodities to prevent their introduction and establishment to new areas

Overview

- Phytosanitary restrictions
  - Often a very high degree of insect control is required before commodities are allowed in
  - “Probit 9 mortality” = the treatment kills or sterilizes 99.9968% of the insect pests
    - 3 surviver in 100,000 insects, or no survivors in 93,613 insects

- See [http://www.aphis.usda.gov/ppq/manuals/online_manuals.html](http://www.aphis.usda.gov/ppq/manuals/online_manuals.html) for a list of approved treatments
### Treatments

- **Chemical**
  - Fumigation
  - Detergent washes
  - Insecticides

- **Physical**
  - Temperature
    - Cold treatments
    - Heat treatments
  - Irradiation
  - Controlled Atmospheres

### Fumigation

- **Most common** type of postharvest insect control
  - both for disinfection & storage
- Often easy to use and relatively inexpensive
- Future availability of some fumigants is questionable
  - Human health issues
  - Environmental impacts

### Methyl Bromide (MeBr)

- Most commonly used (general biocide)
- Under the Montreal Protocol (UN treaty):
  - 2005 phase out for developed countries
  - 2015 phase out for developing countries
  - Quarantine treatments & "critical uses" exempt
- In general, there is a time temperature relationship
  - Higher temperatures require shorter exposure to the fumigant
Phosphine
- Used for dried fruit and nuts
  - Fresh commodities often injured
- Slower to act than MeBr and does not penetrate as well
- On dried products, its use is often alternated with MeBr
- Phosphine is a potential carcinogen & its future is in doubt

Hydrogen Cyanide (HCN)
- Many commodities are injured by HCN exposure
- HCN is also very hazardous to people
- Thus, HCN is not used very often
  - Has been used for citrus

Physical Treatments
Temperature
- **Advantages:**
  - No residue left on the commodity
  - Relatively safe for workers
- **Disadvantages:**
  - Possible product injury
  - Higher energy costs
  - Treatment times potentially longer
Cold Treatments
• Approved for a variety of insects on many commodities
• Most effective on insects from subtropical and tropical environments
  – However, crops from these areas are chilling sensitive
  – Potential used of other conditioning treatments to help protect the crops from CI

Heat Treatments
• Hot water dips, vapor heat, and high-temperature forced air treatments
  – e.g., mango, lychee, papaya, citrus
• Vapor heat was one of the first postharvest insect control methods (1920’s)

Heat Treatments
• Often shorter treatments than cold treatments
  – Size of commodity will affect the rate of heating
Irradiation Treatments

- Gamma rays
  - Isotopic sources: cobalt-60 or cesium-137
- X-rays
  - Electrically driven machine source
- Electrons from E-beam
- Irradiation is approved on fruits and vegetables up to 1,000 Grays (Gy) (FDA 1986)

Irradiation Treatments

- Insect sterilization often requires doses < 300 Gy
- Decay control often requires doses > 1,000 Gy
- To get required levels of irradiation to the center of pallets, outside fruit receive much more than the minimum level

Irradiation Treatments

- When irradiation is used to sterilize insects, the receiving country must trust the exporters that the live insects they see are really harmless
- Social considerations:
  - US consumers are accepting more. Acceptance by other countries (not Japan, limitations for EU)?
  - Acceptance of irradiation facilities?
**Controlled Atmospheres**

- CA quarantine treatments involve raising the level of CO\textsubscript{2} and/or lowering the level of O\textsubscript{2} in combination with heat or cold to reduce the duration of the lethal treatment and help maintain commodity quality.

**Alternative Methods**

- **Systems Approach**
  - Integration of numerous biological & physical factors with operational procedures to provide overall quarantine security.
  - Can be time-consuming & costly to develop.
  - Developed so that if one of the mitigating measures fail, built in safeguards keep the overall risk to negligible levels.

- **Eradication**
  - Removal of all target pests from a geographical area, with little chance of normal re-infestation.

**Alternative Methods**

- **Declaration as a Nonhost** for all or part of its growth cycle.
  - E.g., Unblemished, mature green ‘Cavendish’ bananas from Hawaii can be harvested and shipped to the mainland as a nonhost commodity even though ripe bananas are a preferred host for fruit flies.
  - Mature green bananas are not a host for the flies.
  - This can be difficult because the physiological basis for host non-preference or non-suitability by a pest is often not understood.
Alternative Methods

- Establishment of Pest Free Areas (PFAs)
  - Officially identified or established areas in which a target pest does not occur and is maintained as such
  - The identity of the commodity must be maintained throughout to prevent mixing with non-certified product
  - Enhanced by geographic (e.g., mountains or large bodies of water) or temporal (i.e., developmental) barriers

Experimental Treatments

- New fumigants
  - E.g. methyle iodide, carbonyl sulfide, sulfuryl fluoride, & ozone
- New temperature treatments
  - E.g. used of radio frequency (RF) & conditioning treatments
- Hyperbaric pressure & Vacuum