# *Nonchemical Postharvest Dried Fruits and Tree Nuts Disinfestation*

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# *Research Purpose and Scope*

- Dried fruit and nut processors usually use fumigants to keep product insect free
- Regulatory, environmental and safety concerns are making non-chemical alternatives more attractive
- Temperature treatments, vacuum treatments, and parasitoids are non-chemical alternatives being developed

# Target Products

# Target Insects

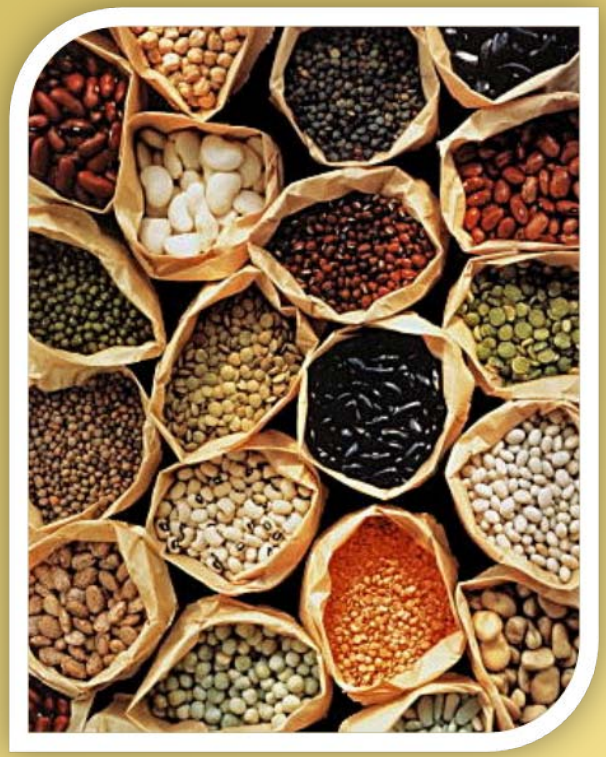





# *Current Research Projects*

- Radio frequency heat treatments of postharvest pulses (dry beans and peas)
- Vacuum treatments for postharvest insects in tree nuts
- Using parasites against overwintering populations of Indianmeal moth

# *Radio frequency heat treatments of postharvest pulses*

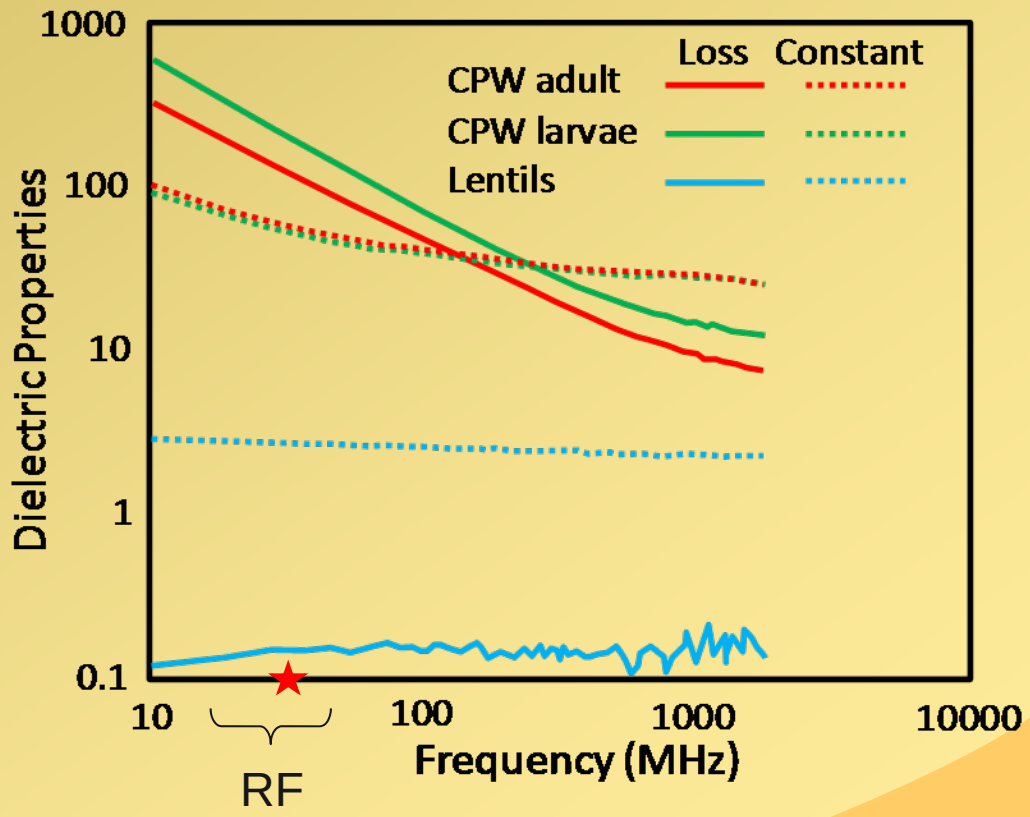


To meet the phytosanitary needs for both domestic and export markets, pulse crop processors in the western US  use chemical fumigants to control insect pests (cowpea weevil, bean weevil and Indianmeal moth). Pressure to find non-chemical alternatives has resulted in research into the use of radio frequency (RF) heating.

# *RF for pulses: Accomplishments*

WSU Collaborators determined the dielectric properties of pulses and cowpea weevil, values critical to developing RF treatment protocols.

Comparing dielectric properties indicates that the insects will heat faster than the product.

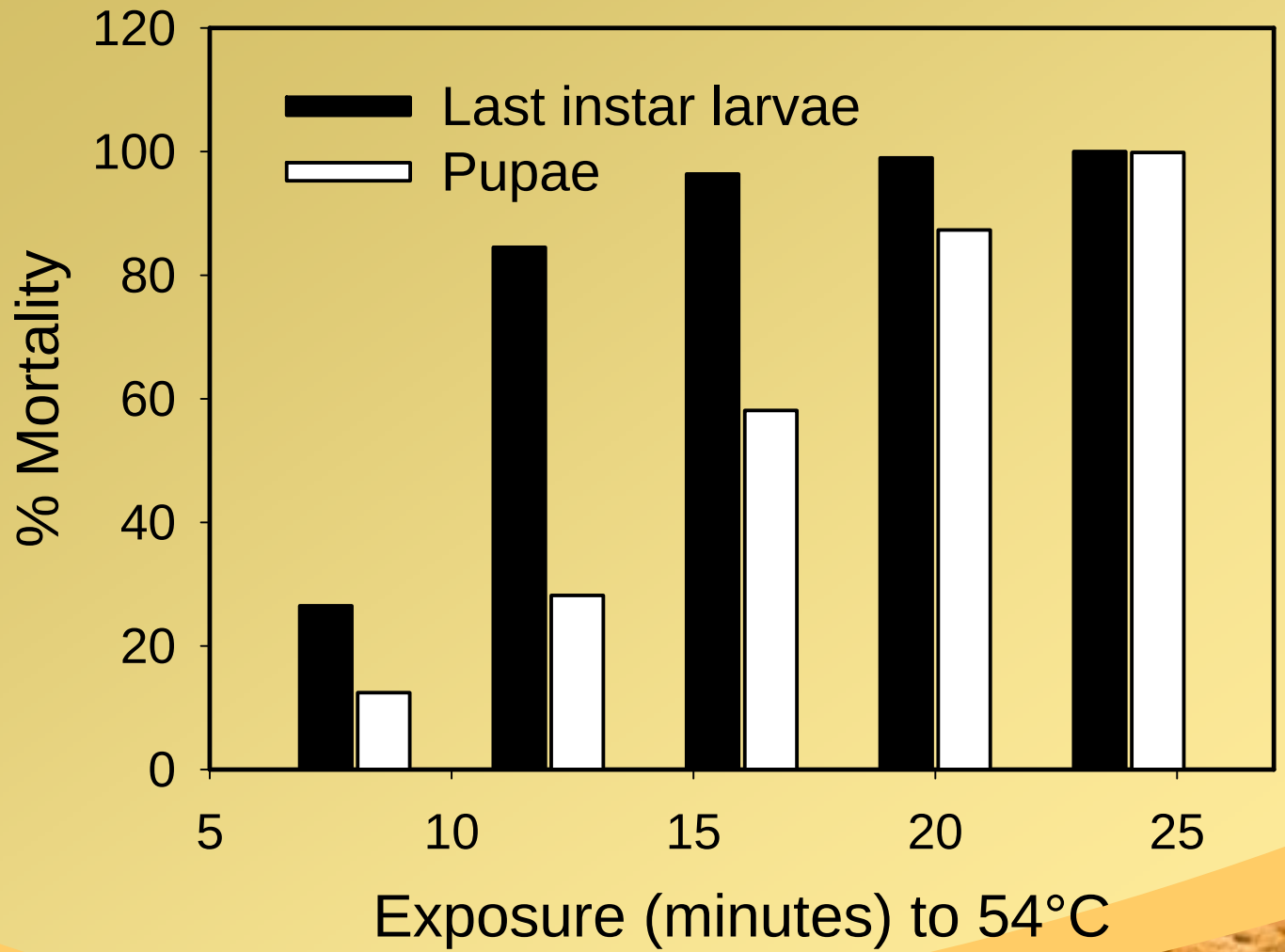


# *RF for pulses: Accomplishments*

Using a computer-controlled heat block system, the most heat-tolerant stage of the cowpea weevils was found to be the pupal stage.

The temperatures and exposures needed to kill all stages of this critical pest will be determined and used to develop RF treatment protocols.

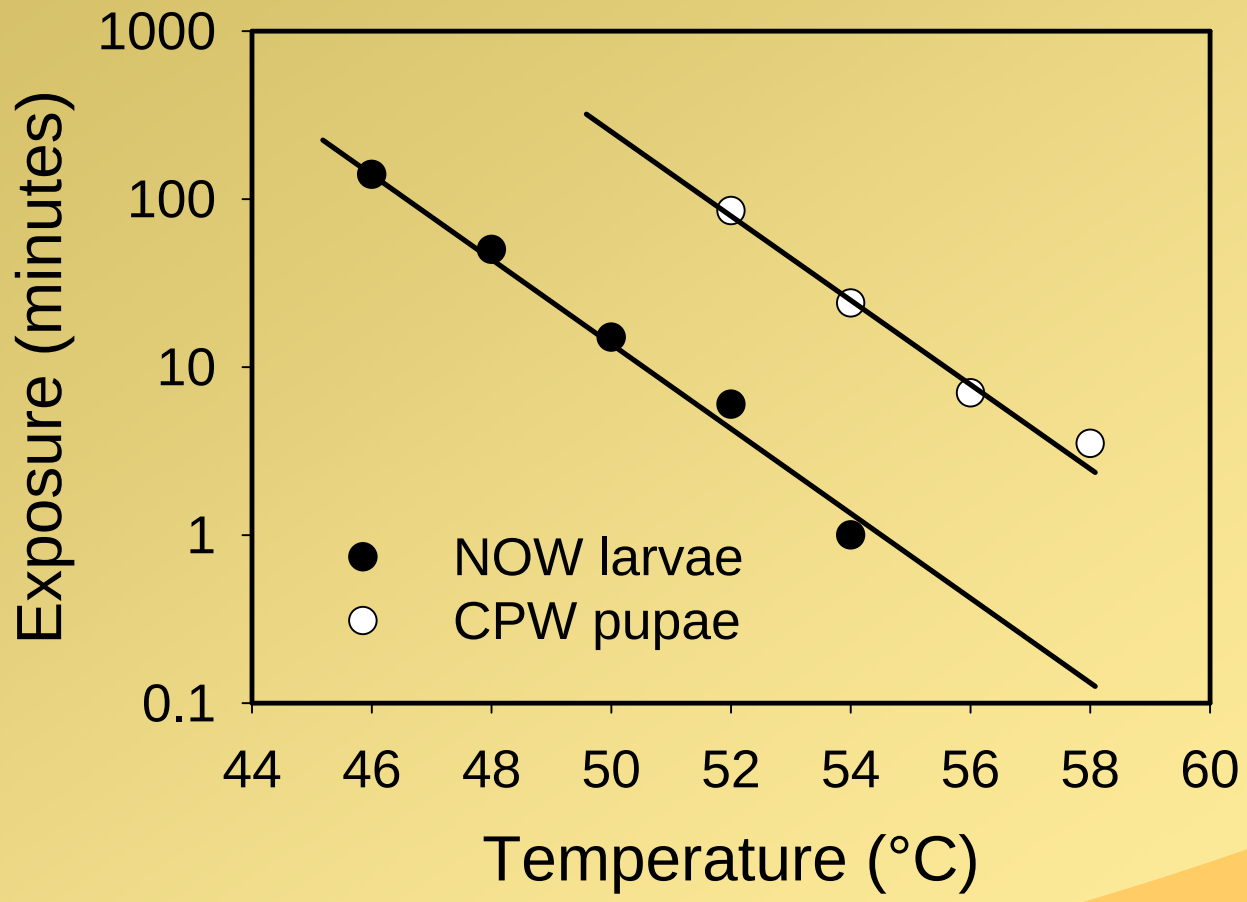
# Most heat tolerant life stage



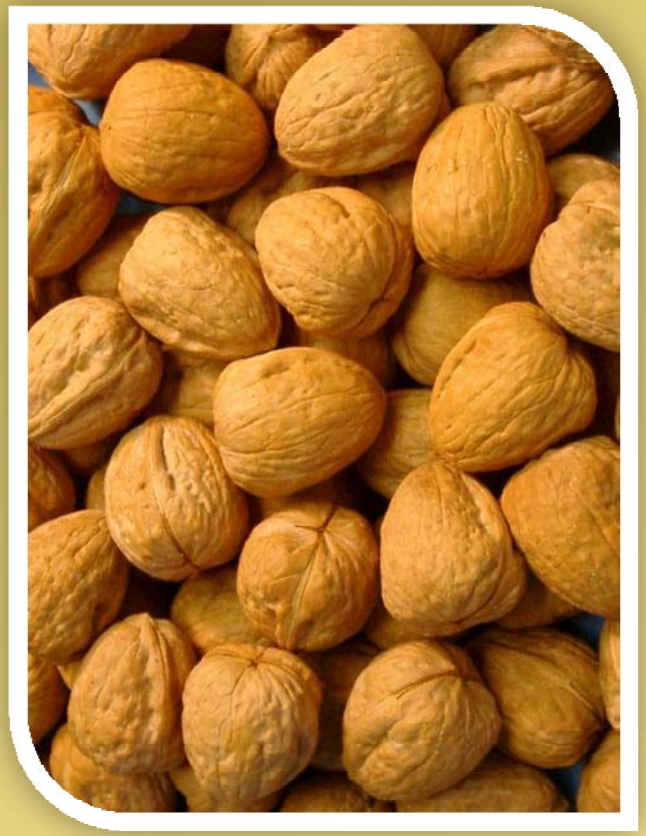
# *RF for pulses: Accomplishments*

Small beans reduce the effects of insulation, and only beans with at least one hatched egg are used.

# Heat tolerance of CPW compared to other insects



# *Vacuum treatments for postharvest insects in tree nuts*



Regulatory action, insect resistance, and the needs of the organic industry has generated research into non-chemical alternatives for California tree nuts.

Development of flexible PVC treatment containers has made the use of vacuum treatments much more practical.

# *Vacuum Treatments: Accomplishments*

Laboratory studies have determined the exposures needed to kill the most common tree nut insects at 25 and 30°C, and demonstrated the effect of product moisture on efficacy.

This information is used to develop treatment protocols.

# Vacuum exposures needed for 95% mortality

| Stage | $LC_{95}$ (hours) | |
|---|---|---|
| | 25°C | 30°C |
| IMM eggs | 34.8 | 17.9 |
| IMM diapausing larvae | 35.5 | 17.0 |
| CM eggs | 26.7 | 19.8 |
| CM diapausing larvae | 28.9 | 14.7 |
| NOW eggs | 32.4 | 22.7 |

Treatment pressure = 50 mm Hg

# Effect of relative humidity on % mortality

| Stage | Relative Humidity | | |
|---|---|---|---|
| | 30% | 45% | 80% |
| Non-diapausing IMM larvae | 99.6 | 99.6 | 11.9 |
| Diapausing IMM larvae | 54.9 | 6.2 | 0.4 |

Treatment pressure = 50 mm Hg, exposure = 10 hours

# *Vacuum Treatments: Accomplishments*

Field tests have been done with almond nutmeats, inshell almonds and inshell walnuts.

These studies show that efficacious vacuum treatments are possible at exposures comparable to treatments with phosphine, especially at warmer temperatures.

# Field Trials with inshell walnuts

| Exposure | Pressure | Temp | IMM | |
|---|---|---|---|---|
| (hours) | (mmHg) | (°C) | DL | Eggs |
| 48 | 46.7 | 21.0 | 97.4 | 81.8 |
| 48 | 46.9 | 23.6 | 100 | 100 |
| 48 | 57.4* | 25.7 | 99.0 | 100 |
| 72 | 42.1 | 16.0 | 58.7 | 99.8 |
| 72 | 47.3 | 19.1 | 91.0 | 99.8 |
| 72 | 46.8 | 27.2 | 100 | 100 |

* Pressure level not met because of leaks

# *Using parasites against overwintering populations of Indianmeal moth*

The parasite *Habrobracon hebetor* was found to actively attack overwintering Indianmeal moth, suggesting that release of the parasite during winter may reduce the number of adult Indianmeal moth emerging in the spring. Data is necessary to obtain an exemption for the release of these parasites into bulk-stored dried fruits and nuts.

# *Parasitoids: Accomplishments*

Release of *Habrobracon hebetor* during the winter was shown to reduce emergence of Indianmeal moths in the spring.

Competition between *H. hebetor* was found to reduce the number of *H. hebetor* progeny produced without affecting control of Indianmeal moth.

# *Future Planned Projects*

- Develop better recommendations for use of freezing to control postharvest insects in tree nuts
- Develop data for radio frequency quarantine treatments for codling moth
- Determine vacuum and radio frequency treatment schedules for raisin moth and peach twig borer

# Questions?