

# Practical Alternatives To MB For Use As QPS Treatments In North America.

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Agriculture and  
Agri-Food Canada

Agriculture et  
Agroalimentaire Canada

Canada

# Overview

- QPS in US and Canada
- Empty Ship Hold Treatments
- RF to Control Insects in Walnuts
- Low O<sub>2</sub> with Prevention
- Heat + Controlled Atmospheres (CATTs)

## QPS use of MB

Location	Year	% of total MB	Amounts (mt/y)
World	2000	20	10,500
USA	1996-98	1	294
Canada	2003	8	17

## QPS Use in Canada

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Sector	Use (%)
Imported commodities	75
Exported commodities	14
Empty ship holds	8

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## QPS Use in USA 1996-1998.

Sector	Commodity	Use (%)
Import	Fruits	31
	Vegetables	6
	Cotton	7
	Other	12
Export	Fruits/Nuts	25
	Dunnage	8
	Timber	6
	Cotton	5

Vick and Schneider 2002

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# Treatments

- Methyl bromide + recapture
- Phosphine, 500 ppm, ECO<sub>2</sub> FUME
- Phosphine, 1000 ppm, Generator with MgPH<sub>3</sub>
- Untreated

# Methyl bromide + Recapture



zeolite molecular sieve



# Phosphine, 500 ppm, ECO<sub>2</sub>FUME

- 2% phosphine gas in 98% CO<sub>2</sub>
- 9 cylinders used for 8000 m<sup>3</sup>

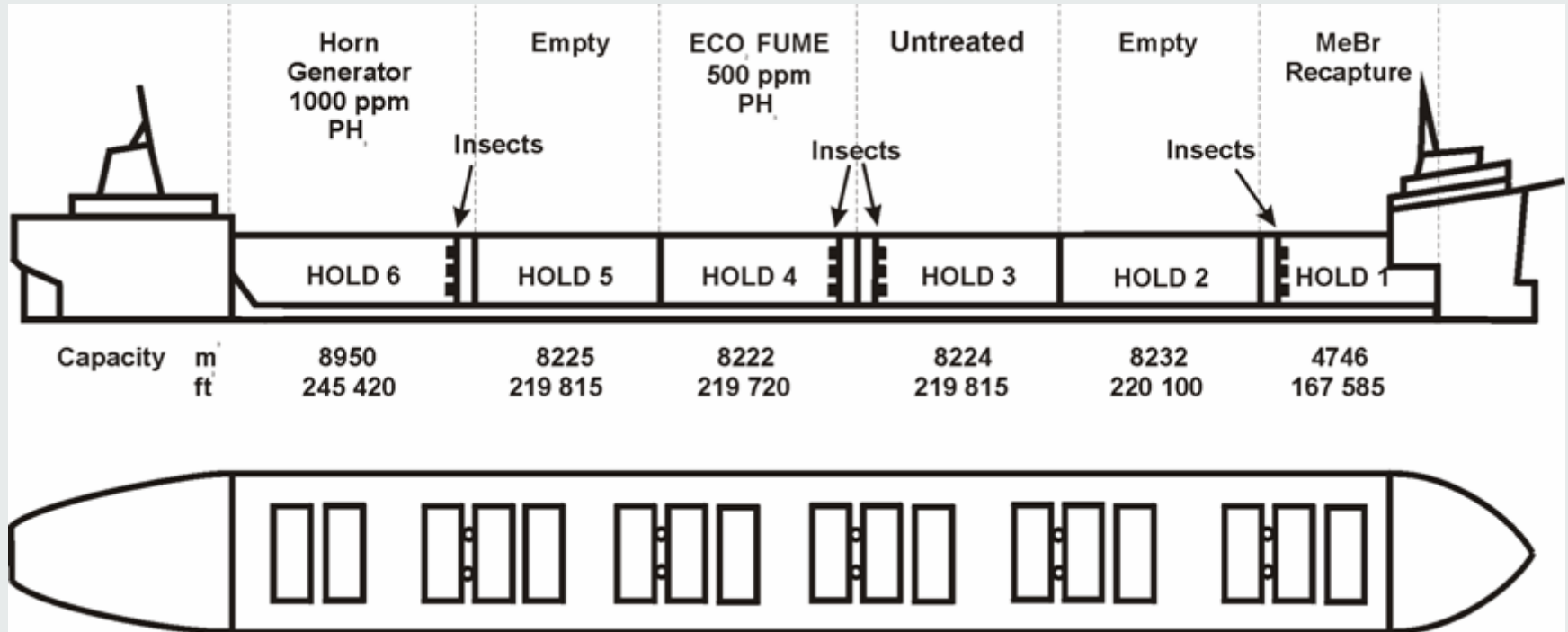


# Phosphine, 1000 ppm DEGESCH Generator with $MgPH_3$

- Requires water + power
- Some waste product

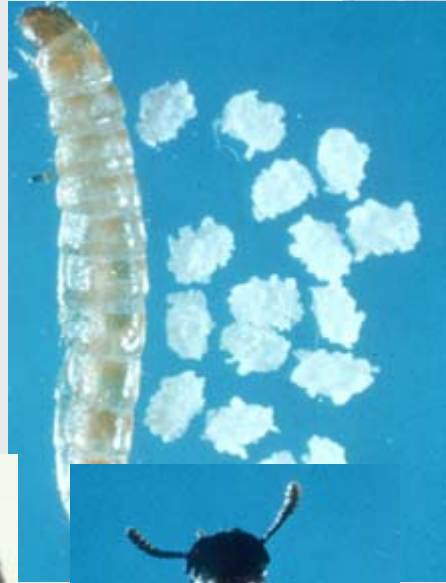


# Treatments of Ship Holds



# Insects in Ship Hold

- Insects pulled after 32, 48, 72 h
- 4 species



All adults dead after 32 h



# Survival of eggs in ship hold compared to eggs in untreated hold.

Duration (h)	Survival of lesser grain borer eggs (%)		
	MB	Phosphine 500 ppm	Phosphine 1000 ppm
32	0	6.4	3.4
48	-	0.4	0.3
72	-	0	0

Red flour beetle and rice weevil had lower survival than lesser grain beetle



# Ship Hold Conclusions

- 80% of MB was recaptured, no added time
- More could have been recaptured
- Phosphine generated quickly with ECO<sub>2</sub>FUME and DEGESCH generator
- Phosphine controlled all adults after 32 h and all eggs after 72 h.

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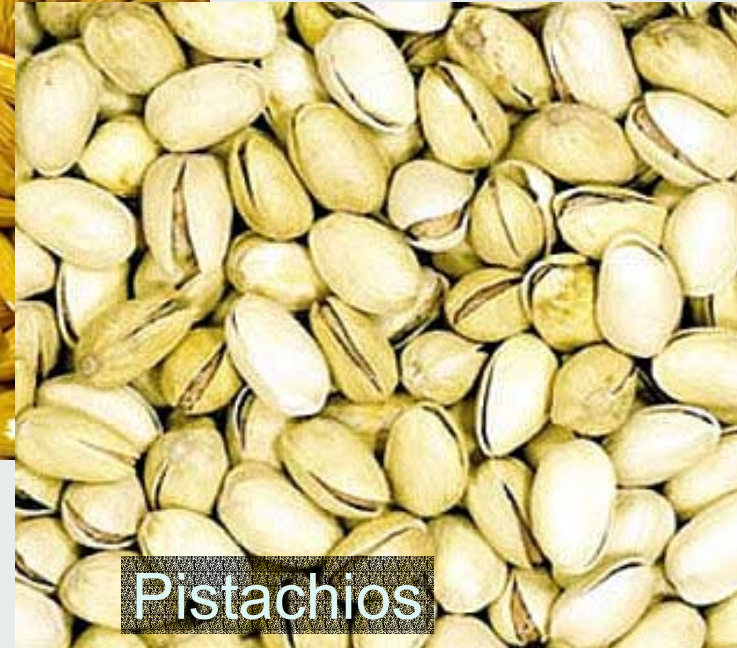
# California is a leading producer and exporter of nuts



Inshell walnuts



Almond nutmeats



Pistachios





# California walnut industry relies heavily on the export market



# Postharvest insect pests are a major marketing issue

Navel orangeworm



Indianmeal moth



Red flour beetle



NOW most  
heat tolerant  
pest



Codling moth



# Radio Frequency Treatments

- Heating throughout the product is very rapid
- May result in greater heating of insect vs product
- Lower temperature of product may result in improved product quality
- Can be applied as a continuous process



# Comparing Heating Methods

Product and Method	Time (min)	Temp (°C)
Walnut - Hot Air	40	48
Walnut - Radio Frequency	3	53
Cherry - Hot Air	23	44
Cherry - Radio Frequency	2	50



# RF Studies with Infested Walnuts

Drilling walnuts



Stuffing walnuts



Drilled walnuts



# Mortality of NOW in RF Treated Walnuts

Treatment	Mortality (%)
Control	0
47°C	32
50°C	77
53°C	99
55°C	100

n= 193-333



# Factors Affecting Efficacy

- Product moisture content
- Product orientation
- Location of target insect
- Preconditioning temperatures



# Experimental RF Unit





# RF Conveyor Belt Unit



# Application to Fresh Fruit

- More difficulty with uniformity
- Most successful when treated in saline
- More quality problems (cherry stems)



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# Efficacy of Low O<sub>2</sub> Disinfestation Treatments

Insect	Commodity	Survival (%)	
		Untreated	0.4% O <sub>2</sub>
Navel orangeworm	walnuts	81	0.4
Navel orangeworm	almonds	97.5	5.0
Raisin moth	raisons	63	0



# After low O<sub>2</sub>, cold treatment, 10°C.



# Indianmeal moth damage (%) at end of test

Commodity	Untreated	Protective treatment after low O <sub>2</sub>		
		Virus	10°C	5% O <sub>2</sub>
Walnut	35.1	0.2	0	0
Almond	28.0	2.0	0.3	0
Raisin	13.2	0	0	0

test 12-40 wks



# Number of live Indianmeal moth found in final product.

Commodity	Untreated	Protective treatment after low O <sub>2</sub>		
		Virus	10°C	5% O <sub>2</sub>
Walnuts	1,270	3.3	1.0	0
Almonds	172	1.6	0	0
Raisins	31	0	0	0



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# Organic Quarantine Treatments for Pome and Stone Fruits

Lisa Neven,  
David Obenland,  
Stephen Drake,  
Guy Hallman  
**USDA-ARS**



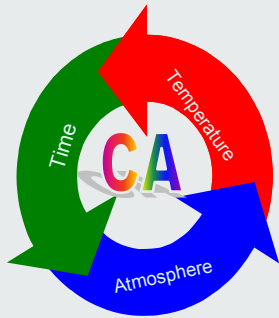
# Quarantine treatments to export USA fruit



Codling moth damage

# CATTS

Controlled  
Atmosphere  
Temperature  
Treatment  
System



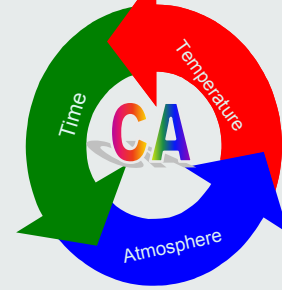
## Controls & Monitors:

O<sub>2</sub>, CO<sub>2</sub>, air speed,  
humidity, temperatures,  
(source, surface & core)



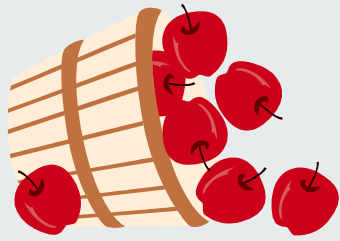
# Commercial CATTs at TechniSystems factory in Chelan, WA



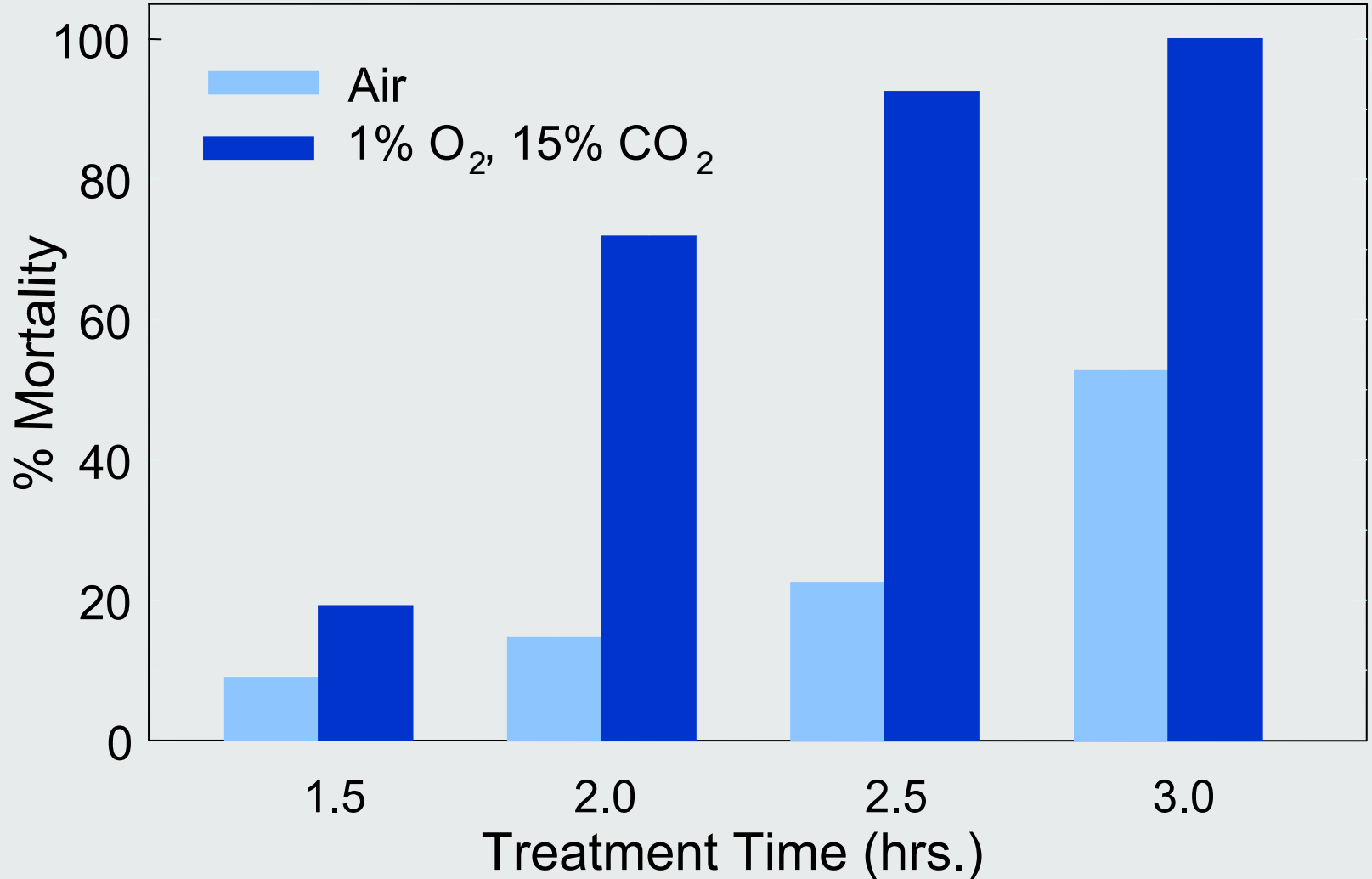


# Why CATTs?

- Heat can kill insects, but can damage fruit
- Fruit can do without oxygen
- Insects need oxygen
- Insects need oxygen to respond to heat loads
- High CO<sub>2</sub> impairs insect response to heat
- **THUS:** High temp + low O<sub>2</sub> + high CO<sub>2</sub> = fast kill!
- Faster control, shorter treatment, better for fruit

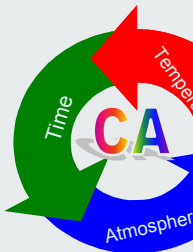
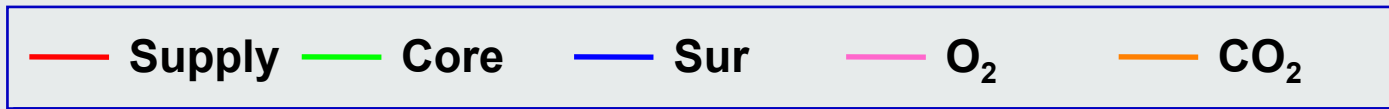
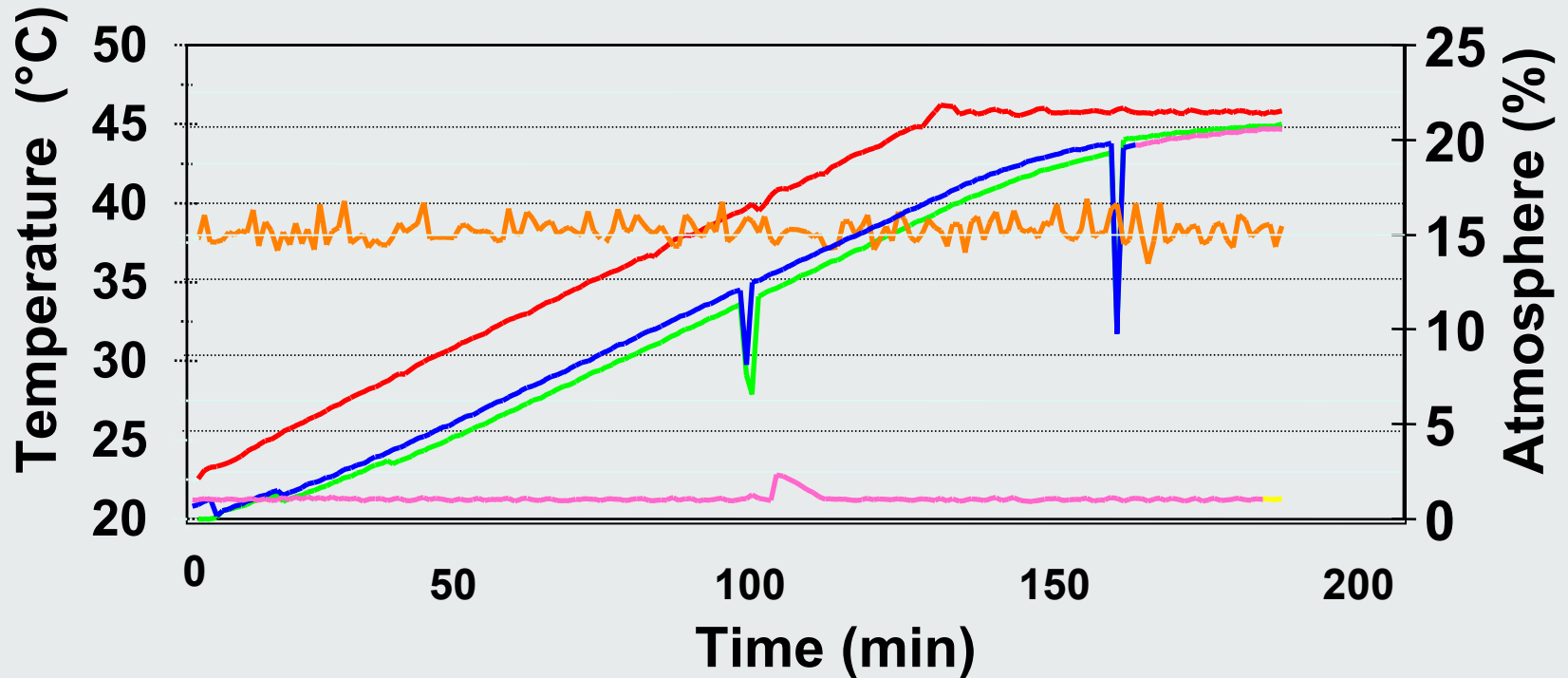


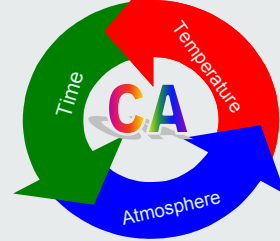
# Codling Moth Mortality 46°C @ 12°C/hour



# CATTS Conditions for Quarantine Treatment

12°C/hr

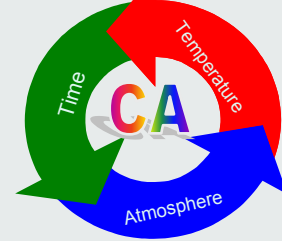




# Treatments Developed

- Sweet Cherries: codling moth & Western cherry fruit fly
- Peaches & Nectarines: codling moth & oriental fruit moth
- Apples & Pears: codling moth, oriental fruit moth, apple maggot, plum curculio





# Treatments Developed

- Oxygen = 0.5 - 1.0%
- Carbon dioxide = 15%
- Relative Humidity = 100%
- Temperature = 44 - 46°C
- Time = 0.5 – 6.0 hours

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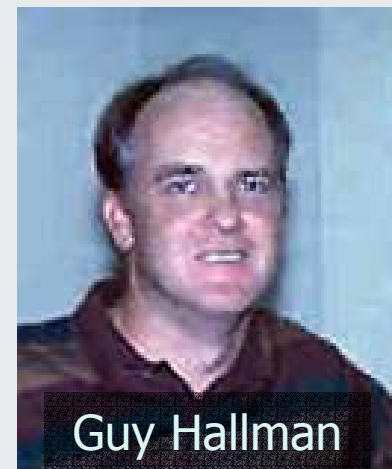
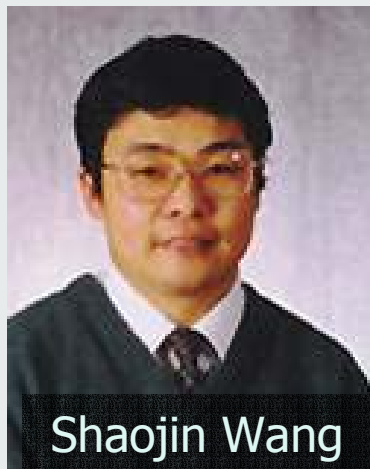
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# Ship Hold Alternatives

- Abell Pest Control Ltd.
- Adalia Preventive Services Ltd.
- Robert Brigham
- Cryo-Line Supplies Ltd.
- Cytec Canada Inc.
- Degesch America Inc.
- Fumigation Service and Supply Inc.
- PCO Services Inc.
- Mahueu and Maheu Inc.
- Upper Lake Group Inc.

# Radio Frequency Team Members



# Heat + Controlled Atmospheres (CATTs)

- Techni-Systems LLD
- Food Pro International
- Commercial Dehydrators
- PacOrganic
- California Tree Fruit Agreement
- USDA-APHIS
- Washington Tree Fruit Research Committee
- Inland-Joseph
- The hard working technical and support personnel at the Yakima Agricultural Research Laboratory

# Contact information

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