



If You Build It Wrong... They Will Come

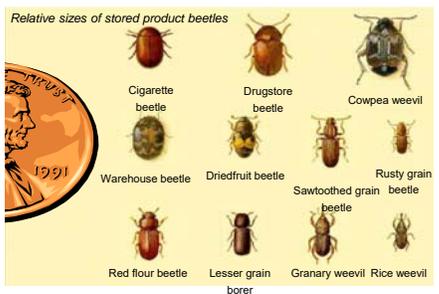
Chemical and Non-Chemical Choices
Ed Hosoda, Cardinal Professional Products

Topics of Discussion

- › Identification of Pest Species
- › Inspection and Finding the Source
- › Putting Together a Pest Management Program
- › Using Control Measures
- › Evaluation

2 

Relative sizes of stored product beetles



3 

Relative sizes of stored product moths

Indianmeal moth
Mediterranean flour moth
Almond moth
Angoumois grain moth
Tobacco moth

4

Why Is Identification Important?

Flies		Does Not Fly	
	Red flour beetle (<i>Tribolium castaneum</i>)		Confused flour beetle (<i>Tribolium confusum</i>)
	Merchant grain beetle (<i>Oryzaephilus mercator</i>)		Sawtoothed grain beetle (<i>Oryzaephilus surinamensis</i>)
	Cigarette beetle (<i>Lasioderma serricorne</i>) (strong flier)		Drugstore beetle (<i>Stegocium panicum</i>) (can fly)

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Why Is Identification Important?

6

Why Is Identification Important?



7



Why Is Identification Important?



8



What Is The Significance of This Insect?



9



What's The Issue Here?



10



Inspection & Finding The Source

Inspection Tools



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Monitoring Tools



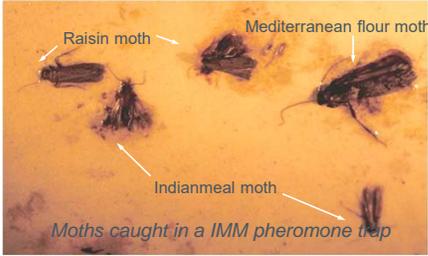
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Checking Pheromone Traps



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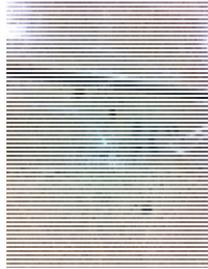
Identification of stored product moths



Moths caught in a IMM pheromone trap

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Checking Light Traps



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Spensa Z-Trap-IMM Detection



Trap counts

Trap	Pest	Sun 04/02	Mon 04/03	Tue 04/04	Wed 04/05	Thu 04/06	Fri 04/07	Sat 04/08
04F2	IMM	0	2	0	-	-	-	-
Average	IMM	0.0	2.0	0.0	-	-	-	-

Trap	Pest	Sun 03/26	Mon 03/27	Tue 03/28	Wed 03/29	Thu 03/30	Fri 03/31	Sat 04/01
04F2	IMM	0	0	0	0	0	0	0
Average	IMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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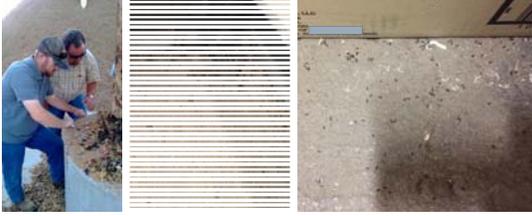
Visual Inspections



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Visual Inspections



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Visual Inspections



20



Visual Inspections



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22



mouse

rat

23

Visual Inspections



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Birds = Filth



Birds, Insects & Rodents = Filth



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Putting Together a Pest Management Program

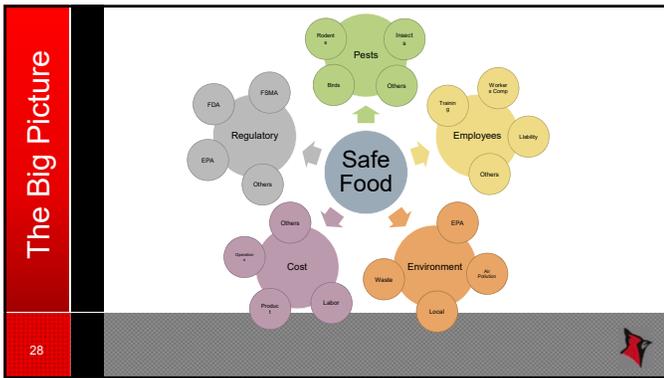
Minimizing Pests While...

- › Operating efficiently
- › Operating legally
- › Minimizing risks to people, food, products, etc.
- › Understanding the "Big Picture"



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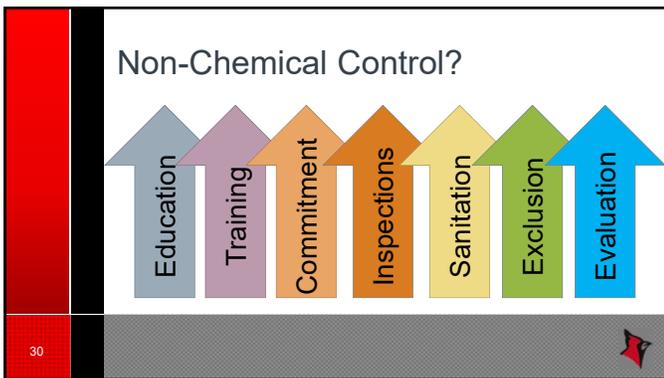


What Happens to Food With...

- > Insects, rodents or other filth above Food Defect Action Levels?
- > Commodities with pesticide residues not allowed?
- > Contains a poisonous or deleterious substance that renders the food injurious to health?

ADULTERATED

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Well Known CA Supermarket

We're Famous For Fine Produce - It's Our Passion!

The special relationships we have with our growers enable us to offer the very best fruits and vegetables to our customers. We feature California Grown produce as well as exotic selections from around the world.

Our exclusive Agri Check® Certified produce contains no detected pesticide residue above 0.05 parts per million. Look for this logo in our aisles and in our stores.

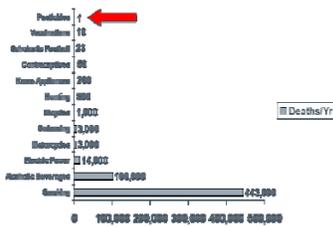


Organically Grown Produce

Did you know we carry the largest variety and selection of organic produce of any conventional supermarket in the area? Depending on the season, that means up to 100 choices or more.

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Toxicity of Common Items



- › Common Table Salt
– LD₅₀ = 3,000 mg/kg
- › Cyfluthrin (Tempo)
– LD₅₀ = 3,000 mg/kg

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Organic Treatments?

- › No synthetic inputs
 - Pesticides
 - Fertilizers
 - GMO's
 - Irradiation
 - Food additives



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OMRI List (Organic Materials Review Institute)





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OMRI List

- › *Bacillus thuringiensis*
- › *Beauveria bassiana*
- › Botanical products
- › Diatomaceous earth
- › Garlic
- › Limonene
- › Orange oil
- › Vitamin D₃

- › Neem cake
- › Neem extract oils
- › Pheromones
- › Pyrethrum
- › Soaps
- › Spinosad
- › Sticky traps
- › Carbon dioxide

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National Organic Program 7CFR Part 205

§ 205.105 "Agricultural (non-genetic) substances allowed in agriculture or on processed products derived from 'organic' or 'made with organic' specified ingredients or food groups."

The following non-genetic substances may be used in agriculture or on processed products derived from "organic" or "made with organic" specified ingredients or food groups if they are consistent with the conditions specified in this section.

Cautionary note: Read Warning and only.

Other notes:

1. PRODUCT AND COMPANY IDENTIFICATION

Trade Name: Protect-It®
 Company Name: Protect-It Technologies, Inc.
 Product: Protect-It®
 Address: 1000 West 10th Street, Suite 100, Grand Rapids, MI 49503
 Phone: (616) 233-1111
 Fax: (616) 233-1112
 Website: www.protect-it.com

Product Identification

Product # 001-001-001-001
 Date of Manufacture: 1/1/2017
 Lot Number: 123456789
 Expiration Date: 12/31/2018
 Net Weight: 1000g
 Net Volume: 1000ml



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What Are We Eating?



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Insects for Food...



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Food Defect Action Levels*

*CFR, Title 21, Part 110.110

- › Ground pepper...475 insect fragments and 2 rodent hairs per 50 grams ...is OK!
- › Sauerkraut...2 tablespoons can contain 15 thrips!!!
- › Jar of Pizza Sauce can contain 220 fruit fly eggs!!!
- › 10 oz. box of frozen spinach can contain 22 caterpillars

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› Did you know about these regulations???

Food Defect Action Levels*

*CFR, Title 21, Part 110.110

- › Cocoa Beans...10 mg of mammalian excreta per pound is OK!
- › Hops = 2,500 aphids per 10 grams is OK!
- › Jar of Peanut Butter...4 rodent hairs is OK!
– 18 oz. jar, 150 insect fragments is OK!
- › Fig Newtons...13 insect heads per 100 grams is OK!



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Pheromones



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Order of Effectiveness*

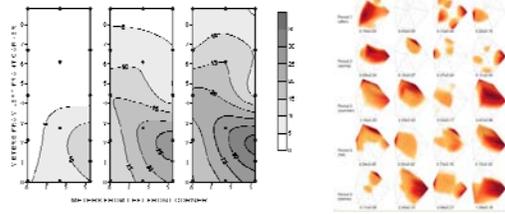
1. Indian meal moth
Almond moth, Warehouse moth, Mediterranean flour moth, Raisin moth
2. Warehouse beetle
3. Cigarette beetle
4. Red & Confused flour beetle

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*George Okumura, Chief of Lab Services, CDFA



Spatial Mapping*

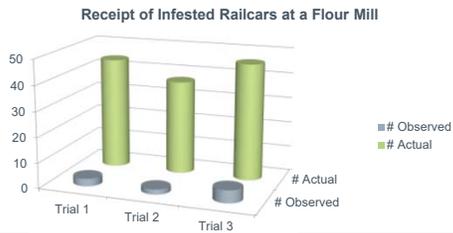


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*Dr. Jim Campbell, USDA-ARS, Manhattan, KS



Monitoring... Visual Inspections



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Using Control Measures

Using Control Measures

1. Use the right product
2. Read & understand the label
3. Check for MRL's
4. Training & education
5. Proper applications, equipment, and use of PPE



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Using Control Measures

Use The Right Product



Food products

Contractor sentenced: A former contractor was sentenced to 11 years in prison for spraying an unapproved pesticide on almost 19 million bushels of oats owned by the nation's No. 2 breakfast cereal maker, George Roggy, the owner of Fumicon Inc. in Edina, Minnesota, was given the maximum penalty possible by U.S. District Judge Michael Davis. A federal jury convicted Roggy on Nov. 15 of 11 mail fraud counts, one of adulterating food and another of using the unapproved chemical.

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Using Control Measures

Use The Right Product



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Using Control Measures

Use The Right Product

Bird Control Solutions
• The comprehensive line

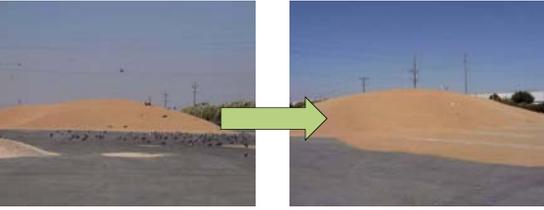


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Using Control Measures

Use The Right Product



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Using Control Measure:

Use The Right Product



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Using Control Measures Use The Right Product



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Using Control Measure Use The Right Product



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NPMA Survey



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NPMA Survey

WHAT TIME OF YEAR DO THE PROBLEMS OCCUR?



45%
Fall and Winter



29%
Spring



28%
Summer

WHERE IN THE COUNTRY ARE RODENT PROBLEMS FOUND IN HOMES?



WHERE IN THE COUNTRY ARE RODENT PROBLEMS FOUND IN HOMES?

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Using Control Measures

(2) Read and Understand the Label



RESTRICTED USE PESTICIDE
DUE TO ACUTE ORAL AND DERMAL TOXICITY OF SULPHUR FLUORIDE

Profume®
Use Directions:
For control of roach, insect, and other household pests.

Keep Out of Reach of Children

PELIGRO

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Using Control Measures

(2) Read and Understand the Label

- › Sites of application, or commodities
- › Rates of application
- › Exposure or re-entry periods
- › Health and environmental hazards
- › Personal protective equipment (PPE)

4 children die when pesticide mix creates toxic gas

By John Nemmery and Brian Worthington, CNN

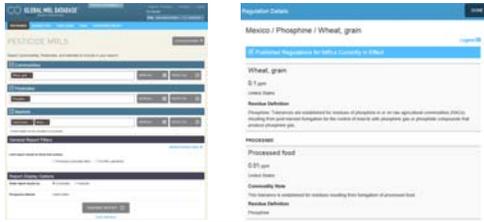


The incident has been ruled an accidental poisoning and is still under investigation

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Using Control Measures (Pesticides)

(3) Check for MRL's at www.globalmrl.com



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Using Control Measures (Pesticides)

(3) Check for MRL's at www.globalmrl.com

40 CFR §180.905

Mangos, postharvest	#
MIL, fat	0.25
Anthracnose, postharvest	#
Oil, postharvest	#
Orange, postharvest	#
Peach, postharvest	#
Peanut, postharvest	#
Pine, postharvest	#
Pineapple, postharvest	#
Pine, white, fresh, postharvest	#

- › Recent Issue With Pistachios
- › Piperonyl Butoxide
- › Pyrethrin
- › Check For Tolerances Specific For Your Commodity and Country of Export

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Using Control Measures

(4) Training & Education

- › Dr. Linda Mason, Purdue University
- › Dr. Spencer Walse, USDA-ARS, Parlier, CA USA
- › Dr. Frank Arthur, USDA-ARS, Manhattan, KS USA
- › Dr. James Campbell, USDA-ARS, Manhattan, KS USA
- › Dr. George Opit, Oklahoma State University USA
- › Dr. Thomas Phillips, Kansas State University



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Using Control Measures*

(4) Training & Education

- › Attend seminars
- › Attend conferences
- › Listen to your researchers
- › Read publications
- › Attend local/district meetings
- › Join associations



*Dr. Frank Arthur, USDA-ARS, Manhattan, KS

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Using Control Measures*

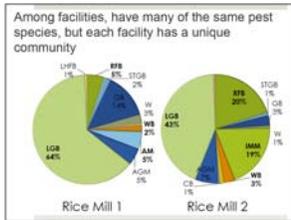
(4) Training & Education



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Using Control Measures*

(4) Training & Education

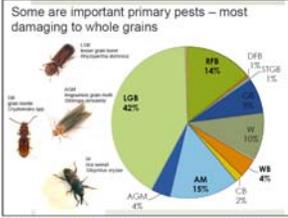


*Dr. Jim Campbell, USDA-ARS, Manhattan, KS

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Using Control Measures*

(4) Training & Education



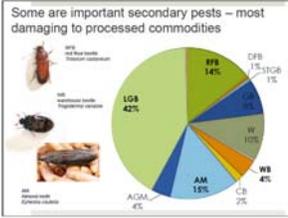
64

*Dr. Jim Campbell, USDA-ARS, Manhattan, KS



Using Control Measures*

(4) Training & Education



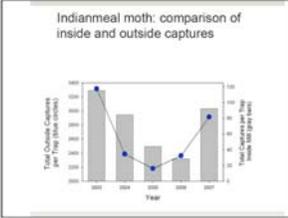
65

*Dr. Jim Campbell, USDA-ARS, Manhattan, KS



Using Control Measures*

(4) Training & Education



66

*Dr. Jim Campbell, USDA-ARS, Manhattan, KS

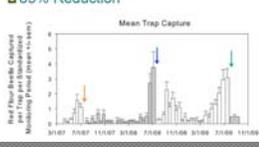


Using Control Measures*

(4) Training & Education



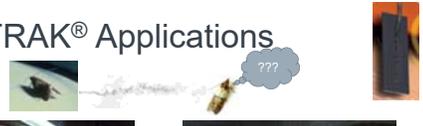
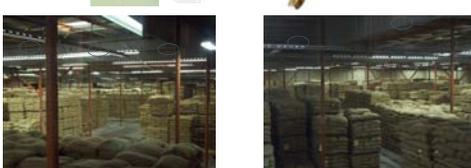
- Mean Trap Capture
- 80% Reduction
- 93% Reduction
- 85% Reduction



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*Dr. Jim Campbell, USDA-ARS, Manhattan, KS

CIDETRAK® Applications

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Using Control Measures

(4) Training & Education

Extremely Low Application Rates



ppm	ppb	ppt
1 inch in 16 miles	1 inch in 16,000 miles	1 inch in 16 million miles
1 minute in 2 years	1 second in 32 years	1 second in 320 centuries



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IGR Application Rates of 0.01-1.0 ppm!!!

Using Control Measures

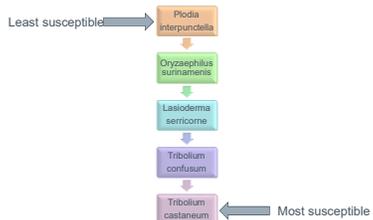
(4) Training & Education



70 IGR's Are Very Effective In Controlling Stored Product Insects

Using Control Measures*

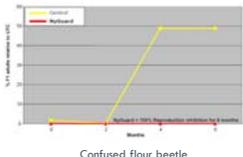
(4) Training & Education



IGR Order of Susceptibility
Residual efficacy of pyriproxyfen and hydroprone applied to wood, metal and concrete for control of stored-product insects
Frank W Arthur, Sooki Liu, Baige Zhai and Thomas W Phillips
Pest Manage Sci 2006; 62: 791-797

Using Control Measures*

(4) Training & Education



Residual Efficacy of Aerosol Insecticides
Author: F.H. Arthur
Submitted to: International Association of Operative Millers-International Miller
The insect growth regulator pyriproxyfen (NyGuard®) can be used as an aerosol insecticide inside structural facilities, or as a surface treatment. However, there is little information regarding residual control offered by pyriproxyfen. In field trials inside a commercial facility, an aerosol combination of pyrethrin + pyriproxyfen gave effective residual control for about ten weeks by preventing normal growth and development of insect larvae. Laboratory studies also show residual control when pyriproxyfen is used as a surface treatment. Additional trials are being conducted to help evaluate the residual control from insect growth regulators, either used alone or in combination with other insecticides.
Contact: Frank Arthur, telephone 785-776-2783, email fran.arthur@usda.gov

Confused flour beetle

72 *Dr. Frank Arthur, USDA-ARS, Manhattan, KS

Using Control Measures*

(4) Training & Education

ORYZAEPHILUS SURINAMENSIS

Populations	% Survival		
	Rep 1	Rep 2	Rep 3
Sus.	0	0	0
Box A	4	0	2
Box BR	98	98	100
Box BF	100	94	80

PLODIA INTERPUNCTELLA

Populations	% Survival
	Rep 1
Sus.	0
Box E	90
Box F	78

*Dr. George Opit, Oklahoma State University
Dr. Thomas Phillips, Kansas State University
Dr. Sandipa Gautam

Using Control Measures

(4) Training & Education

Circadian rhythm

› Knowledge of the physiological cycles of insects

–Assists in the pest management program

Using Control Measures*

(4) Training & Education

Temperature (°F)	Foreign GB (%)	Rusty GB (%)
63.5	1.1	0
68	8.7	2.0
77	82.1	51.0
81.5	82.3	29.8
86	54.4	29.0

*Insect Flight Patterns
J. stored Prod. Res. Vol. 31, No. 4, pp. 311-316

Using Control Measures*

(4) Training & Education

Time From Sunrise	% of Daily Catch
-4	1
0	5
4	13
8	4
12	2

*Daily Flight Patterns, Warehouse beetle
J. stored Prod. Res. Vol. 31, No. 3, pp. 177-184, 1995

Using Control Measures*

(4) Training & Education

Time From Sunset	% of Daily Catch
-8	1
-4	5
0	18
2	1
8	1

*Daily Flight Patterns, Lesser Grain Borer
J. stored Prod. Res. Vol. 31, No. 3, pp. 177-184, 1995

Using Control Measures*

(4) Training & Education

Flight Activity, Red Flour Beetle

Time	Total Hourly Catch
1200	0
1400	50
1600	150
1800	600
2000	450
2200	150
2400	50
2600	10
2800	5
3000	2
3200	1
3400	0
3600	0
3800	0
4000	0

Tarp Now

*Flight Patterns Affecting Re-Infestation of a Rice Warehouse
J. economic entomology

Using Control Measures*

(4) Training & Education

- › Identification key for psocids
- › Helped to identify species for control issues
- › Psocids have been a serious food pest over the last few years



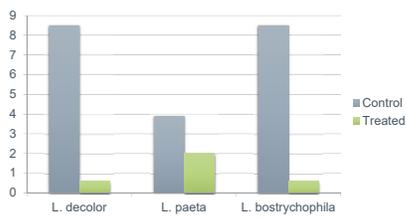
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*Dr. George Opit, Oklahoma State University



Pyriproxyfen

CHRISTOS G. ATHANASSIOU, FRANK H. ARTHUR, NICKOLAS G. KAVALLERATOS, AND JAMES E. THRONE
 J. Econ. Entomol. 104(5): 1765D1769 (2011); DOI: <http://dx.doi.org/10.1603/EC10424>



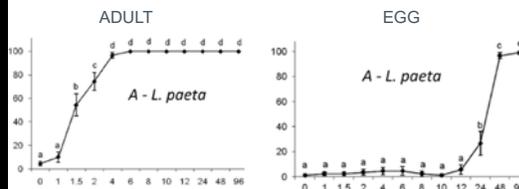
In a recent study, Athanassiou et al. (2010b) found that methoprene was not able to control the psocids *L. decolor*, *L. bostrychophila*, *Liposcelis entomophila*

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ProFume® & Psocids-Tom Phillips

J Econ Entomol. 2012 Feb;105(1):282-7.



L. Paeta is the most SF tolerant species

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&
Dr. Frank Arthur

- › Improving efficacy of aerosol insecticides
- › Food Safety Laws require "prevention", aerosols are considered an important IPM tool
- › Field studies to measure efficacy based on pest species, aerosol product, dose & temperature

Spatial Pattern in Aerosol Insecticide Deposition Inside a Flour Mill
 JAMES F. CAMPBELL, 1,2 FRANK H. ARTHUR, 1 AND KUN YAN ZHUS
 J. Econ. Entomol. 107(1): 440-454 (2014); DOI: <http://dx.doi.org/10.1603/EC13423>

1. Pyrethrin Cylinderized
2. Pyrethrin Bulk
3. DDVP-Dichlorvos

Spatial Pattern in Aerosol Insecticide Deposition Inside a Flour Mill
 JAMES F. CAMPBELL, 1,2 FRANK H. ARTHUR, 1 AND KUN YAN ZHUS
 J. Econ. Entomol. 107(1): 440-454 (2014); DOI: <http://dx.doi.org/10.1603/EC13423>

Insect Activity & Temperature

60° F 80° F

Using Pesticides

(5) Proper Applications, Equipment and use of PPE



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Using Pesticides

(5) Proper Applications, Equipment and use of PPE

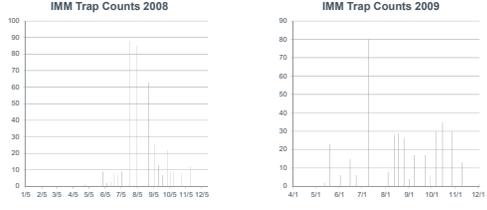


Almond Processing Facility, CA

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Using Pesticides

(5) Proper Applications, Equipment and use of PPE

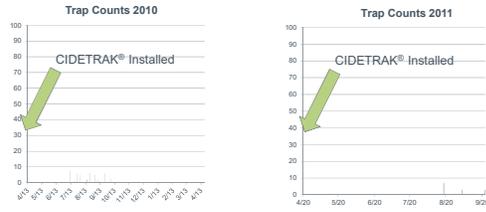


Almond Processing Facility, CA

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Using Pesticides

(5) Proper Applications, Equipment and use of PPE



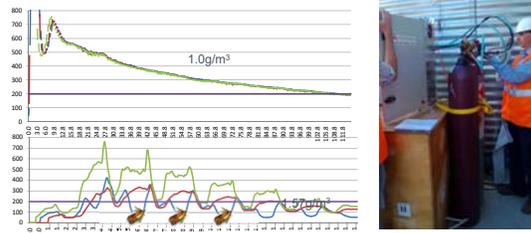
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Almond Processing Facility, CA



Using Pesticides

(5) Proper Applications, Equipment and use of PPE



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Managing Phosphine Resistance Through GFP's



Using Pesticides

(5) Proper Applications, Equipment and use of PPE

Temperature	PH ₃ Concentration Maintained (ppm)/ Rate of ECO ₂ FUME® (lb) per 1,000 ft ³ of Area		
	Minimum	Maximum	Minimum Duration
Below 32°F (0°C)	Do not fumigate		
32-39° F (0-4° C)	200 ppm/0.88 lb	3.625 ppm/16.0 lb	6 days
40-53° F (5-12° C)	200 ppm/0.88 lb	3.625 ppm/16.0 lb	4 days ^a
54-59° F (12-15° C)	200 ppm/0.88 lb	3.625 ppm/16.0 lb	3 days
60-79° F (16-25° C)	200 ppm/0.88 lb	3.625 ppm/16.0 lb	2 days
80° F & Above (≥26° C)	500 ppm/2.20 lb	3.625 ppm/16.0 lb	24-36 hours

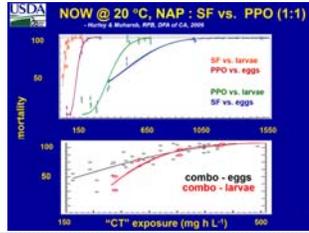
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Managing Phosphine Resistance
New ECO₂FUME® & VAPORPH₃OS® Labels



Using Pesticides*

(5) Proper Applications, Equipment and use of PPE

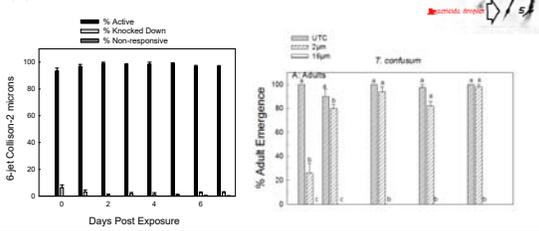


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*Dr. Spencer Walse, USDA-ARS, Parlier, CA

Using Pesticides*

(5) Proper Applications, Equipment and use of PP

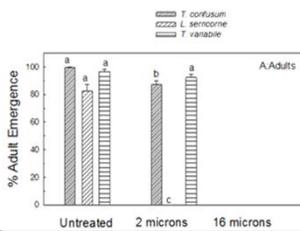


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*Dr. Frank Arthur, USDA-ARS, Manhattan, KS

Using Pesticides* - Pyrethrin + Diacon

(5) Proper Applications, Equipment and use of PPE



Pyrethrin + Diacon
Application...exposure
to larval stages

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*Dr. Frank Arthur, USDA-ARS, Manhattan, KS

Thermal Foggers

Particle Sizes Are Too Small <1 μm



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● ~1 μm ● ~5-15 μm

Using Pesticides

(5) Proper Applications, Equipment and use of PPE



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How To Manage PH_3 Resistance



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654 ppm for 72 Hr. Exposure, *Tribolium castaneum* control

Pyre-X™ Trials – Plodia

1.0% Pyrethrin 5.0% PBO

Table 3

Trial	Dose	Control Plodia** Adults	Control Plodia** Larvae
Pyre-X™ Alone	0.25 oz/MI ³	100%	0%
Pyre-X™ Alone	0.5 oz/MI ³	100%	0%
Pyre-X™ Alone	1.0 oz/MI ³	100%	0%
Pyre-X™ + Diacon IGR	0.3 ml/MI ³	100%	100%





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New DDVP Label Instructions

› “Apply with remotely operated fogging or misting equipment at the rates given above. When using in food processing, handling and storage areas: (a) apply only when the building being treated is unoccupied, not in operation and when no food products are exposed...”

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Remote Applications Through Hose



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Remote VAP-X™ Applications



103



Worker & Bystander Safety



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Buffer Zones



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Minimizing Pesticide Use

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Minimizing Pesticide Use

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Evaluation

- Execute**
 - Transfer technology
 - Perform excellent applications
 - Use highly trained employees
 - Use high quality products
 - Use support that is available
- Review**
 - Product quality issues?
 - Pest sightings?
 - Customer complaints?
- Evaluate**
 - Why? What? Where?
 - Improvements needed?
 - Increased sanitation?
 - Better applications?
 - Different control methods?
- Educate**
 - Better training?
 - Pest identification?
 - Better understanding of the pest?
 - Better application methods?

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The Future???



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