

“Traditional and New Grain Protectants and their Application”

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IOAM Annual Conference

Wichita, KS

May 14, 2004

Grain Protectants

Current/ Traditional:

- Malathion
- Reldan®
- Actellic® *
- Diatomaceous Earth*
- Diacon® *
- Storcide™

Future:

- Storcide™ II
- Secure™

*To be discussed by other speakers

“TRADITIONAL PRODUCTS”

- Malathion
 - 6% Dust
- Reldan 4E
- Storcide

Malathion

- Registered since the early '60s as a grain protectant
- For several years it was an effective product, but today most stored grain insects are resistant to Malathion
- CROPS-Wheat, Corn, Sorghum, Oats, Rice, Barley, and Sunflowers
- Currently registered as a 6% Dust Product Only

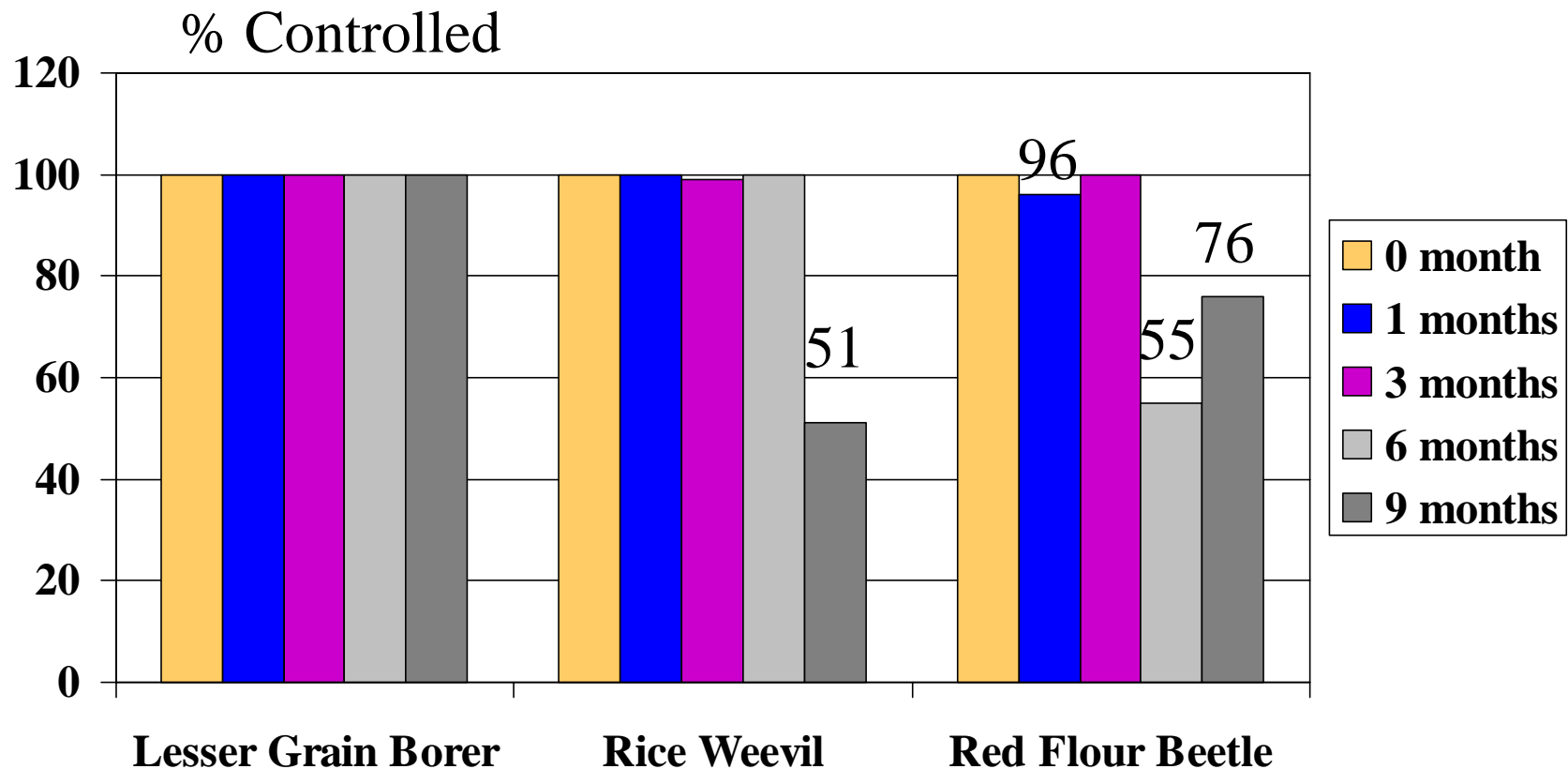
Reldan 4E

- Chlorpyrifos-methyl is the active ingredient
- Registered in 1985
- CROPS- Barley, Oats, Rice, Sorghum, and Wheat
- Does not have the Lesser Grain Borer on the label
- Reldan 4E - 6 ppm use until December 05
- Reldan 4E - 3ppm past 2005

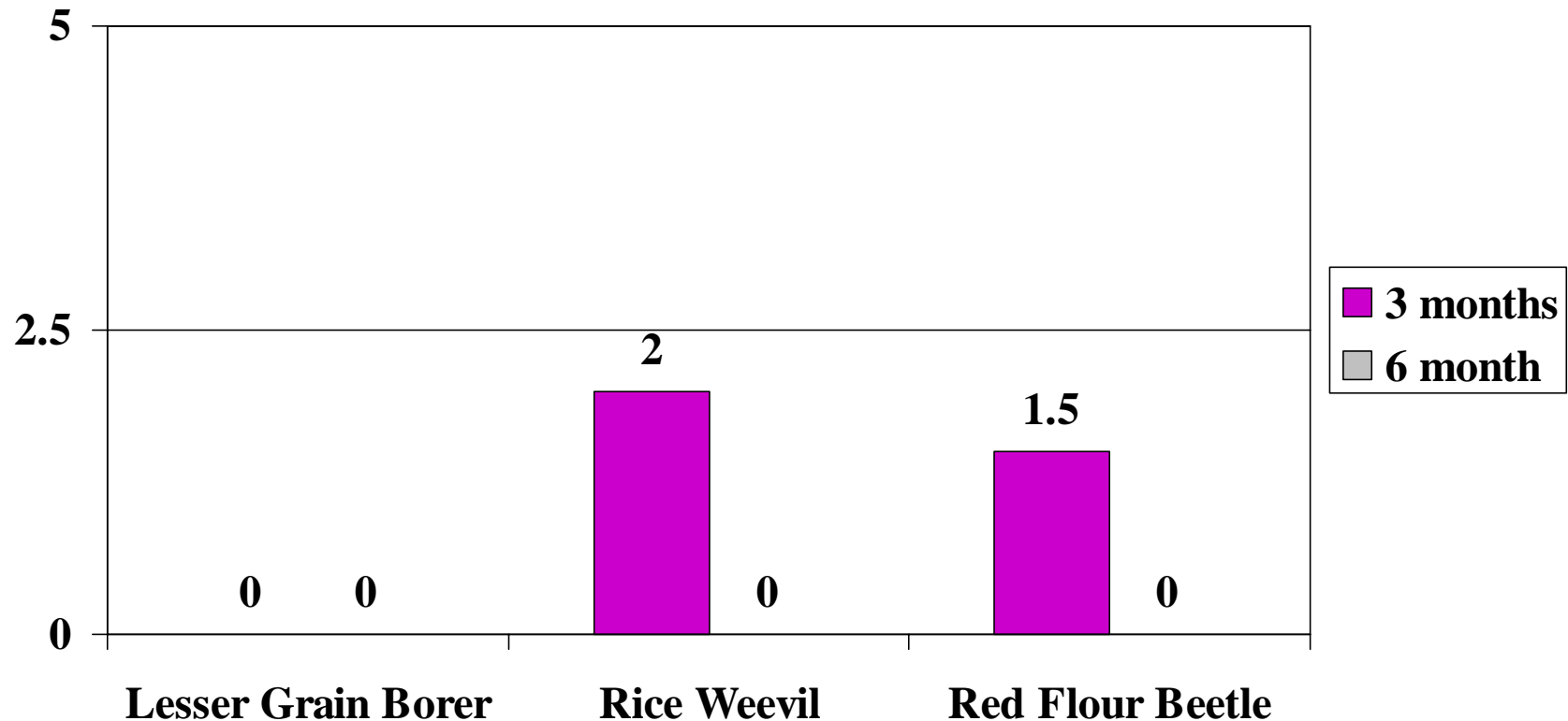
Storcide

- Contains chlorpyrifos-methyl + Cyfluthrin
3 ppm + 2 ppm
- Registered in 2002
- Registered on Barley, Oats, Rice, Sorghum, and
Wheat
- Controls most Stored Grain Insects
- U.S. tolerance only – Not in other countries

Storcide Stored Grain Insect Control Adult Insect Control-project 91837



Storicide Stored Grain Insect Control Number of Progeny Produced



“NEW PRODUCTS”

- Storcide II
- Secure
 - Flowable
 - Dry
 - 80 WP

STORCIDE II

- Contains: Chlorpyrifos-Methly + Deltamethrin
3 ppm + 0.5 ppm
- To be registered in 2004
- Registered on Barley, Oats, Rice, Sorghum, and
Wheat
- Effective against all stored grain insects
- Tolerances in most foreign countries

Mortality of adults exposed for 14 days to various concentrations of Reldan+Deltamethrin*

24 weeks post-treatment and number of F1 progeny

<u>Treatment Description</u>	<u>Mean % Adult Mortality</u>				<u>Mean Number of F1 Progeny</u>				
Chlorpyrifos-methyl/ Deltamethrin In ppm's	<i>Red Flour Beetle</i>	<i>Lesser Grain Borer</i>	<i>Rice Wee vil</i>	<i>Rusty Grain Beetle</i>	<i>RFB (T. castaneum)</i>	<i>LGB (R. dominica)</i>	<i>RW (S. oryzae)</i>	<i>RGB (C. ferrugineus)</i>	
0 / 0	0.5	15.4	0	6.5	225.0	1303.5	131.08	201.3	
3 / 0.5	99.0	100	100	100	0.5	0	0	0	
0 / 0.5	89.1	100	66.0	65.9	0.5	0.3	331.0	1.0	
3 / 0	26.3	44.3	100	94.9	0.8	134.0	26.0	0	

*Bon Jour, Edwin and Tom Phillips, 2004, Oklahoma State University, Dep of Entomology, Stillwater, OK

Secure®

- Contains Spinosad (Spinosyn A+Spinosyn D)

1996 - One of the First Products Classified by the US EPA as a Reduced Risk Product.

1999 - Winner of Presidential Green Chemistry Challenge Award

2002 - Certified by USDA National Organic Standards Board as an Organic Product for Controlling Insect Pests in Organic Farming

Spinosad

- Essentially non-hazardous to terrestrial birds, mammals, and some aquatic species
- Acute oral LD₅₀ levels
 - Rat >3738 mg/kg
 - Bobwhite Quail >2000 mg/kg
 - Rainbow Trout 30 mg/l
 - Earthworm >970 mg/kg
- Reported to have minimum disruption of beneficial insects and non-target organisms



Regulatory Profile

- **Low mammalian toxicity**
 - EPA hazard class: “Caution” (Class III/IV)
 - No evidence of oncogenicity, mutagenicity, teratogenicity, or neurotoxicity in acute, sub-acute and chronic studies
 - Readily metabolized and excreted by mammals
- **Low environmental impact**
 - Low mobility in soil, degrades quickly
 - *Soil half-life = 9 - 15 days*
 - *Soil sorption $K_d = 129$ (low mobility)*
 - Low acute toxicity to fish, aquatic invertebrates, and algae
 - Low acute and chronic avian toxicity
 - Minimal impact on beneficial arthropods relative to alternative protectants.

Secure Products

Pending

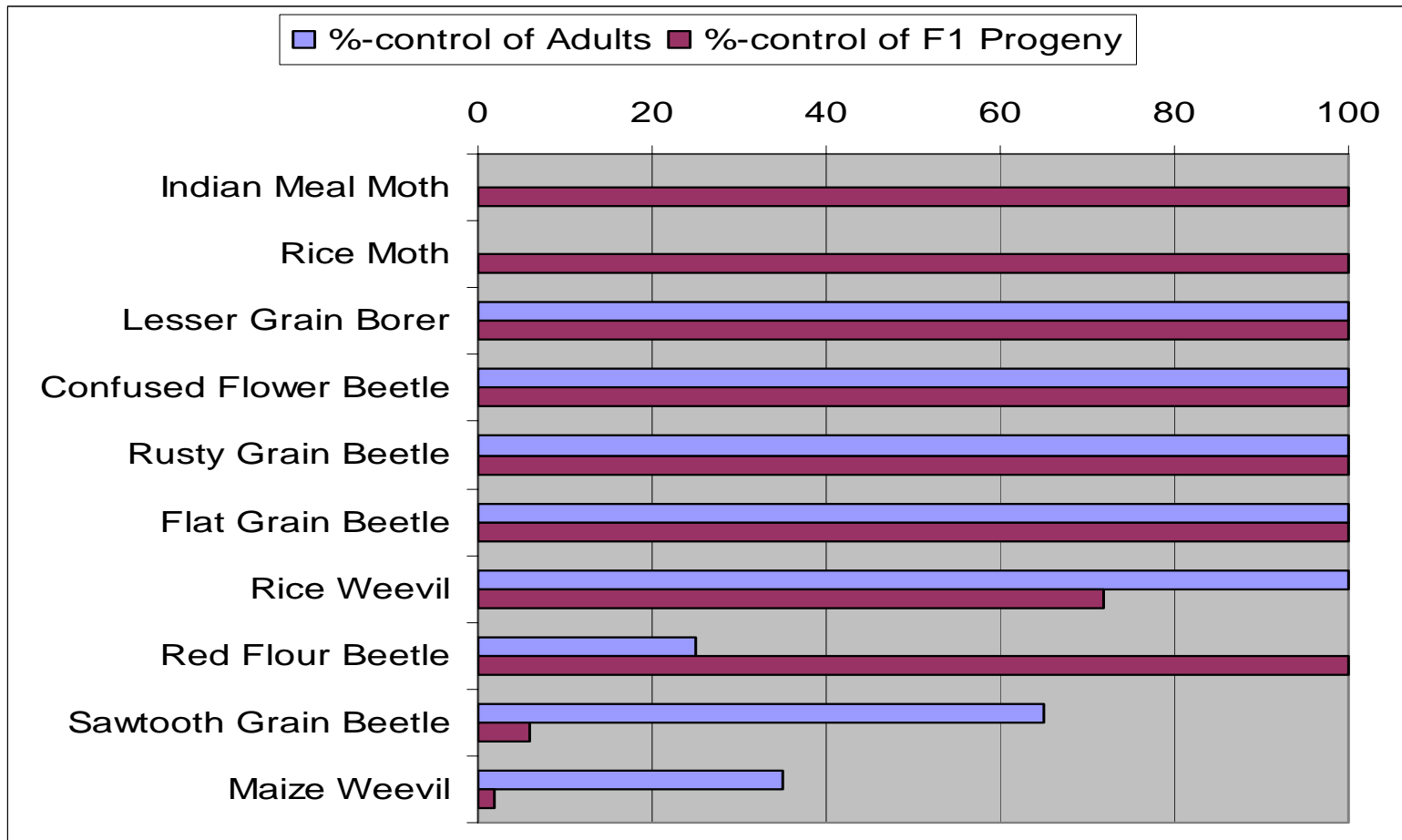
- **Secure Flowable – 0.75 lb ai/gal**
 - 9.5 fl oz/ 5 gal of water for 1000 bushels of wheat
- **Secure Dry – 0.5% Dry product**
 - 12 lbs/1000 bu of wheat
- **Secure 80W**
 - 1.2 oz/5 gal of water/1000 bushels of wheat

Proposed Crops on Label

- Barley
- Bird Seed
- Corn
- Cotton
- Millet, foxtail
- Millet, pearl
- Millet, proso
- Oats
- Peanuts (in shell)
- Rice
- Sorghum/milo
- Soybeans
- Sunflowers
- Wheat

Laboratory Efficacy Results Secure as a Grain Protectant (1mg/kg)

Data from: Subramanyam, Toews, Fang 2002



Secure Persistence and Stability in Treated Grain

Data from: Fang, Subramanyam, Dolder 2002; Fang, Subramanyam, Arthur 2002

- Spinosad 1 ppm chemical residues in treated grain were stable for up to 1 yr under Kansas farm grain bin conditions.
- No significant loss in residues despite grain bin temperatures ranging from -10 to 32 C (14 to 94 F) over this same 1-yr period.
- Spinosad was equally effective on wheat with a moisture content ranging from 12.5 to 14.5%.
- Simultaneous bioassays showed these 1 ppm residues provided 100% control of Lesser Grain Borer for up to 1 yr under these widely varying temperature and moisture conditions.

Secure Lab Susceptibility – Contact Activity

Contact Mortality of grain beetle adults exposed on spinosad-treated glass surfaces for 24 hr at 0.1 mg/cm ²				
	<u>Concrete</u>	<u>Unwaxed Floor Tile</u>	<u>Galvanized Steel</u>	<u>Waxed Floor Tile</u>
Lesser Grain Beetle	100%	100%	100%	100%
Rice Weevil	100%	100%	100%	100%
Sawtoothed Grain Beetle	100%	100%	100%	100%
Rusty Grain Beetle	100%	100%	100%	100%
Merchant Grain Beetle	100%	100%	100%	100%
Warehouse Beetle	100%	100%	100%	100%
Confused Flour Beetle	100%	81%	92%	84%
Red Flour Beetle	98%	88%	78%	77%

Data from: Toews and Subramanyam 2003; Toews, Subramanyam, Rowan 2003

- ***Secure at rates of 0.05 – 1.0 mg/cm² is highly contact-active to adult grain beetle species.***
- ***Raises the possibility of using spinosad for clean-out or crack-and-crevice surface treatments.***

Secure Bin Studies



Oklahoma State Bin Studies Secure

Data from: Phillips and Bonjour 2003

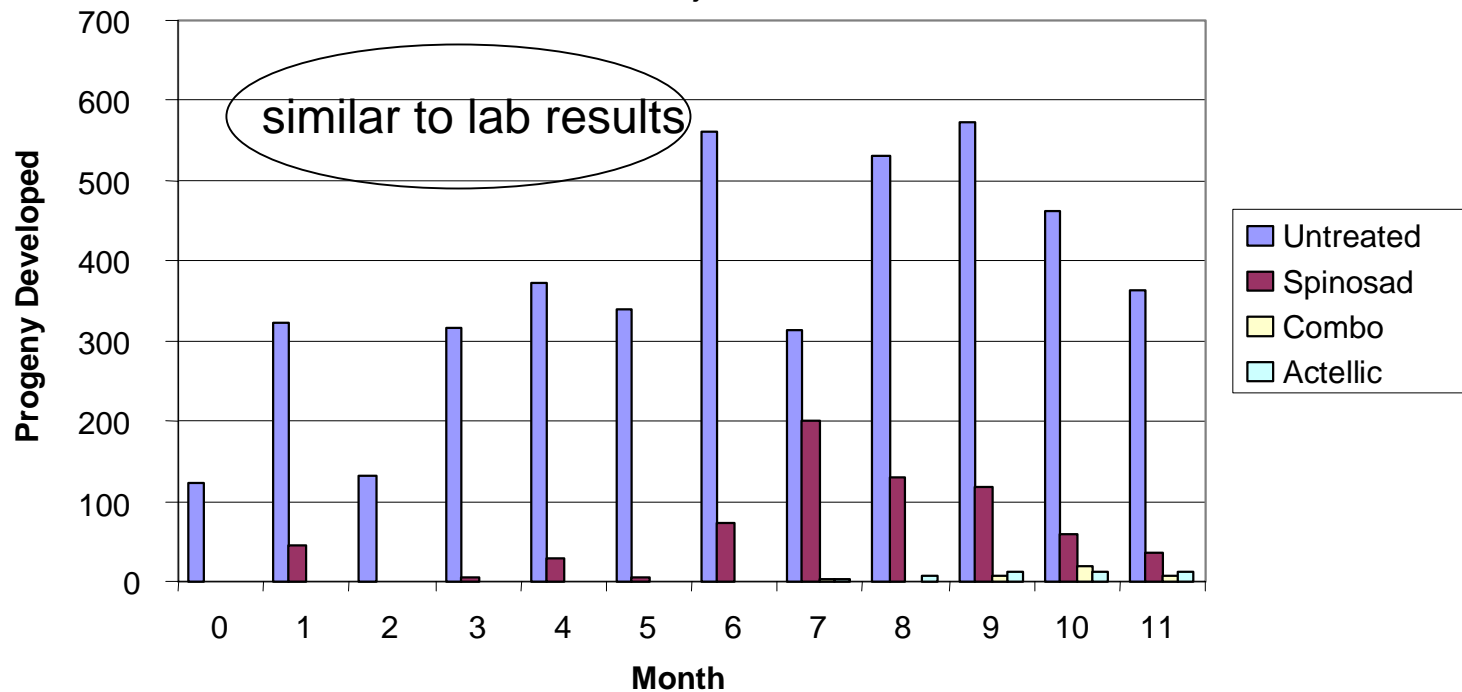
Percent control of Adult Beetles & Progeny

	<u>12 wk</u>	<u>24-26 wk</u>	<u>36 wk</u>	<u>48 wk</u>
Lesser Grain Borer				
Adults	100	100	100	99
F1 Progeny	100	99	99	100
Red Flour Beetle				
Adults	3	2	0	0
F1 Progeny	99	99	100	90
Rusty Grain Beetle				
Adults	99	100	100	98
F1 Progeny	99	99	100	100
Rice Weevil				
Adults	100	97	-	100
F1 Progeny	96	90	-	82
Sawtooth Grain Beetle				
Adults	61	53	-	2
F1 Progeny	97	98	-	19

Laboratory Bioassay Results

Progeny Developed - Maize Weevil Adults After 8 Weeks for Three Farm Sites (PHERC, Mohawk, and Reynolds)

Data from: Maier and Ileleji and Szabela, 2003



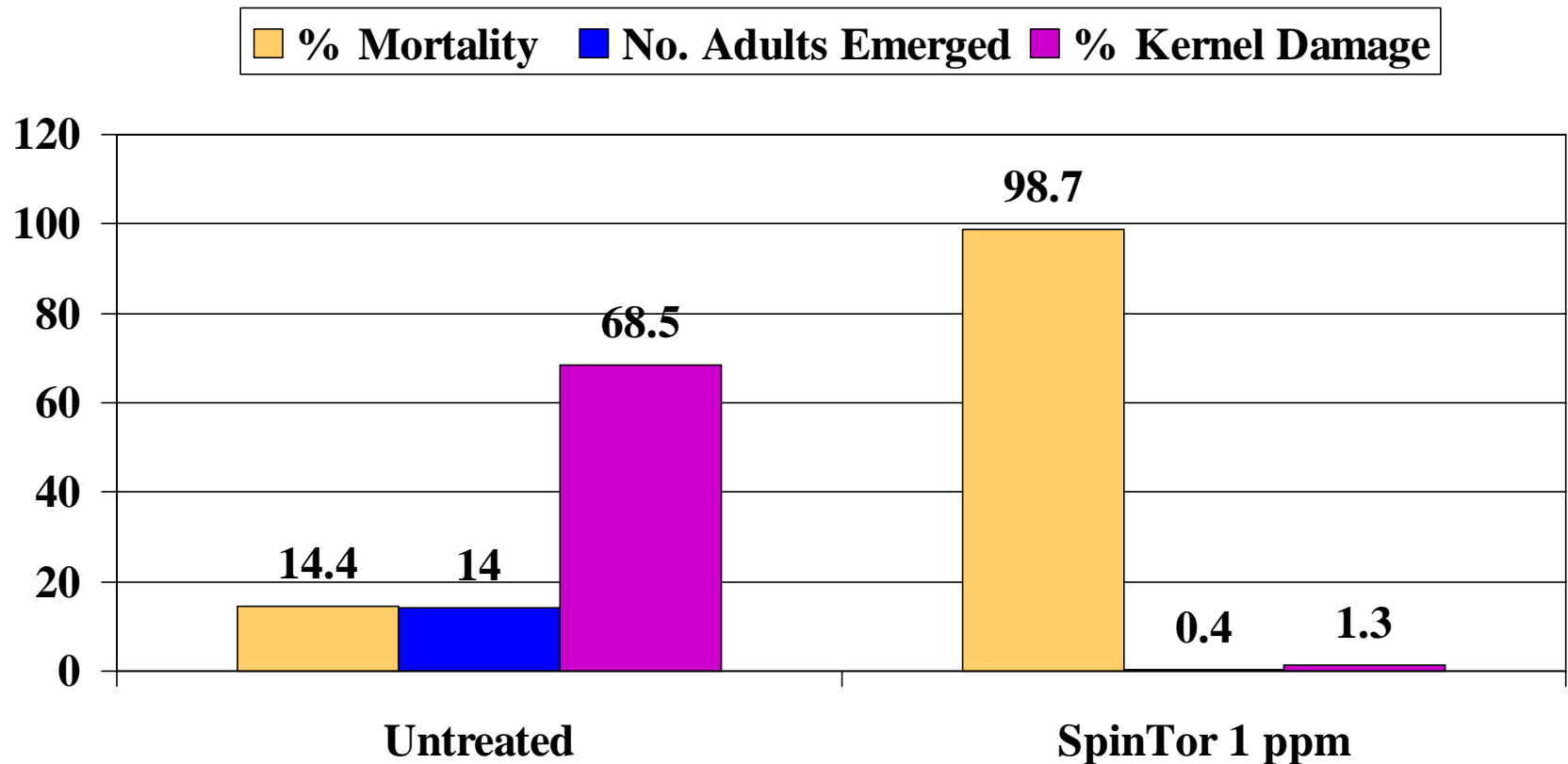
Laboratory Efficacy Results on *Corn* Secure as a Grain Protectant (1mg/kg)

Species	Spinosad @ 1 ppm		
	%-mortality of adults 12DAT	%-mortality of progeny 49DAT	%-kernel damage 49DAT
Red Flour Beetle	84%	94%	2.4%
Rusty Grain Beetle	100%	100%	0%
Lesser Grain Borer	100%	100%	0%
Sawtoothed Grain Beetle	100%	100%	0%
Rice Weevil	100%	100%	0%
Maize Weevil	100%	100%	0%

Data from Rowan, Huang, and Subramanyam, KSU, 2004

In this 2004 corn study, we see much better control of Red Flour Beetle, Sawtooth Grain Beetle, Rice Weevil, and Maize Weevil than previously seen on wheat.

Indian Meal Moth Control with Secure

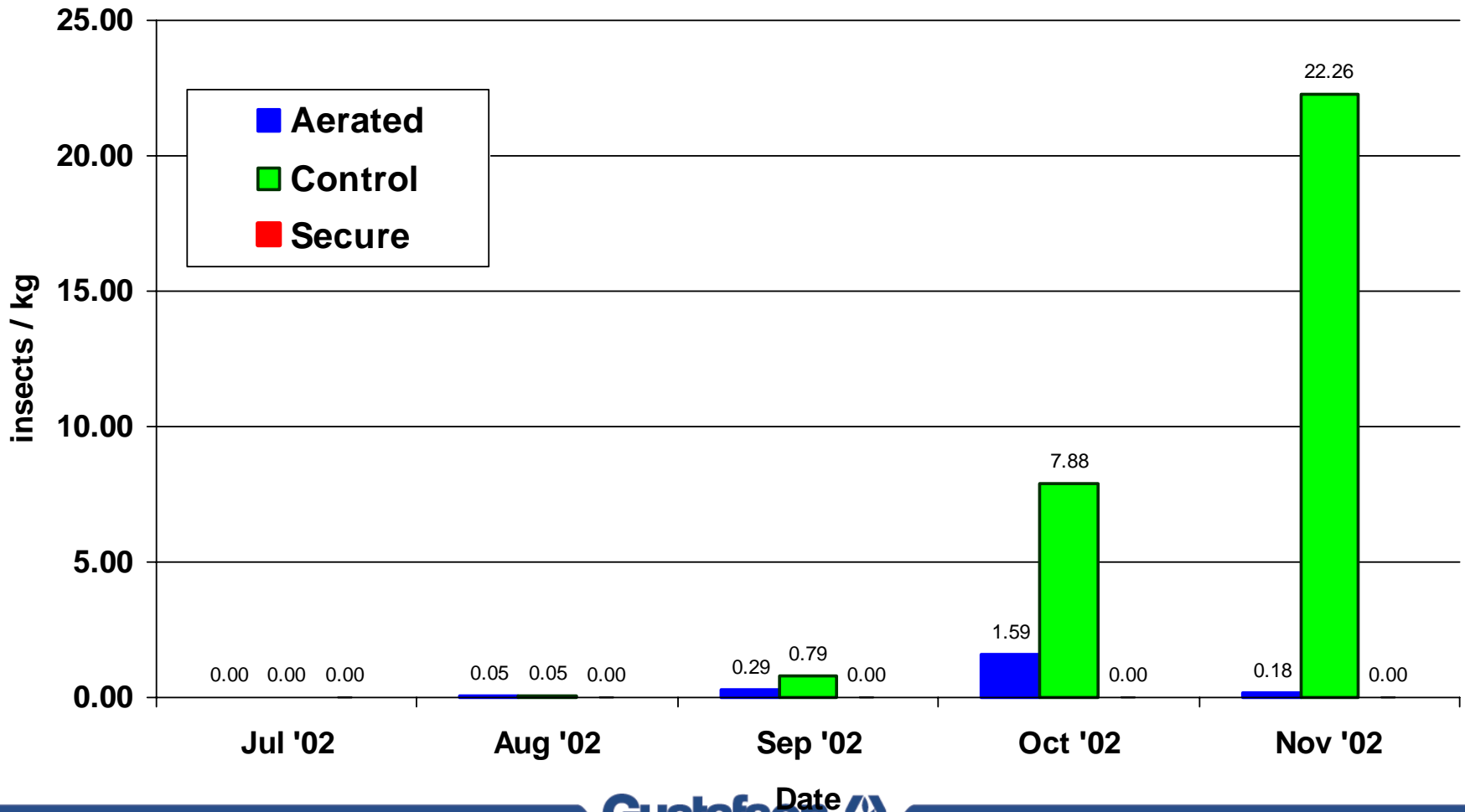


Average Value of 4 Wheat Classes

Kansas State University

Red Flour Beetle

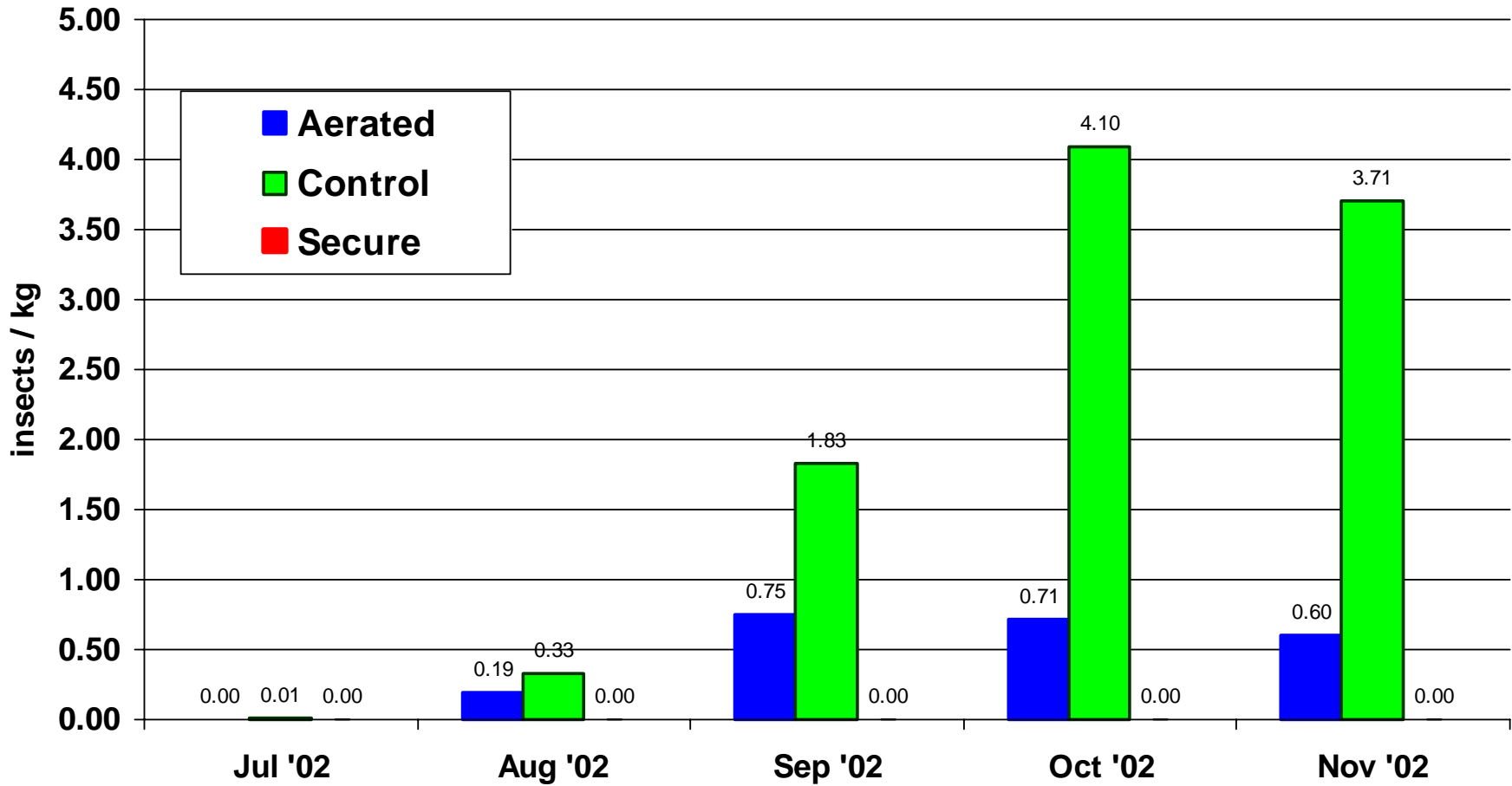
Average Number of Insects/kg
Dr. Paul Flynn, USDA, Manhattan, KS 2002



Rusty Grain Beetle

Dr. Paul Flynn, USDA, Manhattan, KS

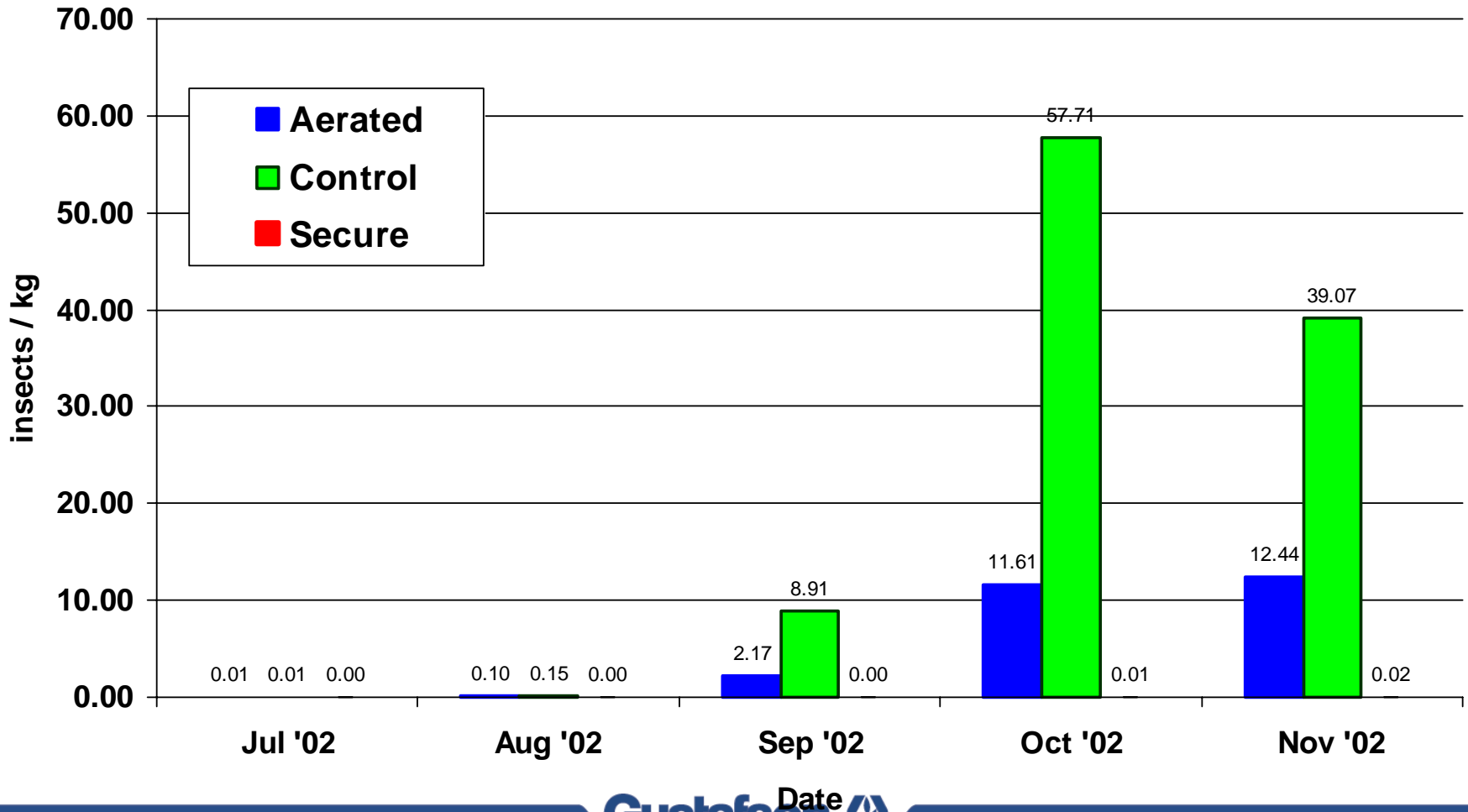
Average Number of Insects/ kg



Lesser Grain Borer

Dr. Paul Flynn, USDA, Manhattan, KS

Average Number of Insects/ Kg



Efficacy Summary - Secure

	Adult Control	Progeny Control
Indian Meal Moth	-	+++
Rice Moth	-	+++
Almond Moth	-	+++
Angoumois Grain Moth	-	+++
Lesser Grain Borer	+++	+++
Confused Flower Beetle	+++	+++
Rusty Grain Beetle	+++	+++
Flat Grain Beetle	+++	+++
Rice Weevil	+++	++ - +++
Red Flour Beetle	+	+++
Sawtooth Grain Beetle	++	+ - +++
Maize Weevil	+++	+ - +++
*** = nearly complete control at 1 ppm (1 mg/kg)		

- Broad spectrum of control
- Susceptibility varies, but most species are controlled at 1 ppm either as adults or larvae
- Very long residual compared to current standards
- No resistance issues
- level of control can vary with commodity type

Laboratory characterization nearing completion and large scale field trials have validated performance in multiple geographies

Proposed US Grain Protectant Label

Commodities: Barley, Birdseed, Corn, Cotton Seed, Oats, Peanuts (in shell), Rice, Sorghum/Milo, Soybeans, Sunflower, Wheat.

Pests: Including but not restricted to adults and larvae of Lesser grain borer, Indian meal moth, Angoumois grain moth. Also Rice weevil, Granary weevil, Maize weevil, Red flour beetle, Sawtooth grain beetle, Flat grain beetle.

Maximum Rate: 1 ppm (1mg/kg)

Secure: Stored Grain Conclusions

- Efficacious on key pests
- Potential to set new standard for length of protection
- A new mode of action to rotate with
- Formulation options (liquid and dry)
- Organic options
- Low Residues
- No odor
- Non-Toxic to Mammals, applicator friendly, etc.
- Unaffected by Heat and Moisture
- Does not effect the physical characteristics of the grain
- Accepted by millers, bakers, brewers, etc.
- CODEX or Import Tolerances established
- Consumer Accepted

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