

Trap Plants





Crop rotation





#### Bare/cover crop



#### Crop rotation





#### Mechanical removal





#### Exclusion







### Biological

- Conservation
- Classical
- Augmentation
- Rear/purchase and release
- Insect pathogens (i.e. Bt)
- Pheromone traps/mating disruption
- Sterile Insect Release



Conservation, Classical and Augmentation

Conservo	ition	Classical	Augmentation
<ul> <li>Consel enemic</li> <li>Reduct</li> <li>Better t</li> <li>Keep r habitat alternc</li> </ul>	rve natural es e sprays timed sprays natural enemy ts and ative hosts	<ul> <li>Introduce an 'alien' predator for control of an invasive pest</li> <li>Establish predator-prey interaction</li> </ul>	<ul> <li>Supplemental release of natural enemies</li> <li>Inundative vs. inoculative</li> </ul>



Release of natural enemies





#### Bt spray/GMO Bt





Oils, soaps, and diatomaceous earth





#### Vendors of North America

Six-Legged Aggie			HOME	NEWS	RESOURCES -	ABOUT	CONTACT	
		<b>Biological Control</b> Vendors of Beneficial Organisms in North America <u>University of</u>	Kentuck	¥				
		Software Tools						
	sixlegg	Free Software Connect to Word to generate citations. Premium features include	anizing, a syncing p	/lin	ing up PDFs. C	an s.		
		<u>Mendeley</u>   Similar to ReadCube in function, Mendeley is for organ generating organized references tables. Allows for creation of an your paper titles/information with you on any device or computer free syncing of paper titles across devices.	nizing res online pr away fro	search pa ofile, so om the of	apers, PDFs and you can take ffice. Allows for	d r		
		<u>Open Office</u>   Alternative solution to the Microsoft Office suite. C	Open-sou	rce.				
		<u>VirtualBox</u>   Virtual Machine software for running other operating similar to <u>Parallels</u> and <u>vmware</u> . Great for those few applications operating system. Disclaimer: requires a copy of the operating sys install.	g systems that don' stem whi	s within y t run on y ch you ar	your current O your current re wanting to	S,		
			1					



#### Biological control agents





Predatory mite (mites)



Parasitic wasp (whitefly)

#### Parasitic wasps (aphid)



Predatory mite (thrips)



Predator (aphids/other)

### Hyperparasitism



















#### Mosquitoes

#### **Dengue Fever**

- 50 100 million cases of dengue fever per year
- 500,000 dengue hemorrhagic fever per year
- 22,000 deaths per year (mostly among children)

#### Malaria

- 219 cases in 2010
- 660,000 deaths in 2010, mostly in African countries

WHO





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Home » News and Views » PRESS RELEASE: Oxitec report 96% suppression of the dengue mosquito in Brazilian trials



#### PRESS RELEASE: Oxitec report 96% suppression of the dengue mosquito in Brazilian trials

1 Tracy Thompson 21st May 2013 H

News, Oxitec in the news

Mandacaru field trial report - press summary





**RNAi** 

From: Using GMO Crops to Target a Pest





### Chemical Pesticide Control

#### Role of chemical control in IPM

Yes	Νο
<ul> <li>Use judiciously based on monitoring data</li> <li>Time sprays to prevent harm to beneficials</li> <li>Time sprays for effectiveness</li> <li>Use low persistence high specificity pesticides</li> <li>Target infestation area only if infestation is localized</li> <li>Rotate chemicals to prevent resistance</li> </ul>	<ul> <li>Spray based on calendar spray schedule</li> <li>Spray when flowers are in bloom</li> <li>Spray them when you see them</li> <li>Spray with the most effective pesticide over and over again</li> <li>Feed your plants pesticides for breakfast, lunch and dinner (and dessert, if they deserve it).</li> </ul>



## Pesticides





## What are pesticides?

- Any substance or mixture of substances used for controlling, preventing, destroying, repelling, or mitigating pests.
  - insecticides, herbicides, fungicides, bactericides, repellents, attractants





## Pesticide modes of action

- Nervous system poisons
- Metabolic inhibitors
- Hormone mimics
- Physical poisons
- Repellents
- Attractants





### Not all pesticides are equally hazardous!



### Everyone wants to know How safe is this pesticide?





### The dose makes the poison

• Paracelsus (1493-1541)



 "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy."



#### **Dose-Response Curve**





#### **Dose-Response Curve**







## Some terms

- LD<sub>50</sub> (Lethal Dose 50) The amount of material needed to kill half of a test population
- Mg/Kg The amount of toxin (in milligrams) per Kilogram of body weight of the test subject (equals parts per million)





### **EPA Pesticide Toxicity Classes**

	Extremely Toxic	Very Toxic	Moderately Toxic	Slightly Toxic
Toxicity Category				IV
Signal Word	Danger	Warning	Caution	Caution
Oral LD <sub>50</sub> (mg/Kg)	0 – 50	50 – 500	500 – 5,000	> 5,000
Equivalent Lethal Dose for 150 lb human	Less than a teaspoon	Teaspoon to an ounce	Ounce to a Pint	Pint to a quart or more



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#### roSciences

10.8 lb active ingredient per gallon (liquid in cylinder)

EPA Reg. No. 62719-376

Keep Out of Reach of Children

## 

Si usted no entirende la etiqueta ni el manual de fumigacion del y unigante ProFume, busque a alguien para que se la explique a talle. (If you do not understand the label nor ProFume gas fur migation Manual, find someone to explain it to you in detail.)

#### **Precautionary Statements**

to Humans and Domestic Animals

 Causes kreversible Eye Damage -Isposed Skin - May Be Fatal If Swit

#### 

#### Herbicide

\*Trademark of Dow Aproficiences ULC

#### For selective postemergence grass weed control in rice

Active immediately	
columbia 2.14.14 comp. 3. Burentumore)	
alternand enterenes and	
Sadd ander (B)	200-1
bet ingradients	70.
Yond	6407

Containe 2.56 b of active improduce par gallon. Containe patroleum: distillates.

EPs. Rug. No. 62716-367

#### Keep Out of Reach of Children

#### WARNING

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AVISO

Precautionary Statements

Hazands to Humans and Domestic Animals

application. When handlers use closed systems, enclosed calls, or alread in a manner that meets the requirements labed in the Worker Protection Standard (MPS) for agricultural pesticides (40 CFR 170,240 (6) (4-0), the handler PPE requirements may be reduced or modified as specified in the WPS.

#### User Safety Recommendations laws should • Wash hands before eating, direting, chewing purs, using bibacco, or using the tablet. Remove clothing immediately if peeticide gets inside. Then each theroughly and put on clean-clothing.

Store.

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#### Pesticide Safety



#### Acute toxicity

Rapidly produced toxicity, usually resulting from a single exposure

### Chronic toxicity

Toxicity due to slow-action or long-term exposure to a poison



#### Pesticide Safety



Possible chronic effects: Carcinogenicity-cancer Mutagenicity-genetic mutation Teratogenicity-birth defect **Oncogenicity-tumors Reproductive effects** Delayed neurological effects



### Tests required to register a pesticide

- Acute oral toxicity
- Acute dermal toxicity
- Acute inhalation
- Acute intraperitoneal
- Eye irritation



- Acute delayed neurotoxicity
- 90-day rat feeding study
- 12-month dog feeding study
- 21 & 90-day dermal
- Lifetime rat feeding study
- Lifetime mouse feeding study
- Teratology (rat)
- Teratology (rabbit)
- Reproduction
- Excretion/metabolism & accumulation
- Antidote
- Mutagenicity



# It is impossible to provide experimental evidence that anything is ABSOLUTELY safe!







## Pesticide labeling



