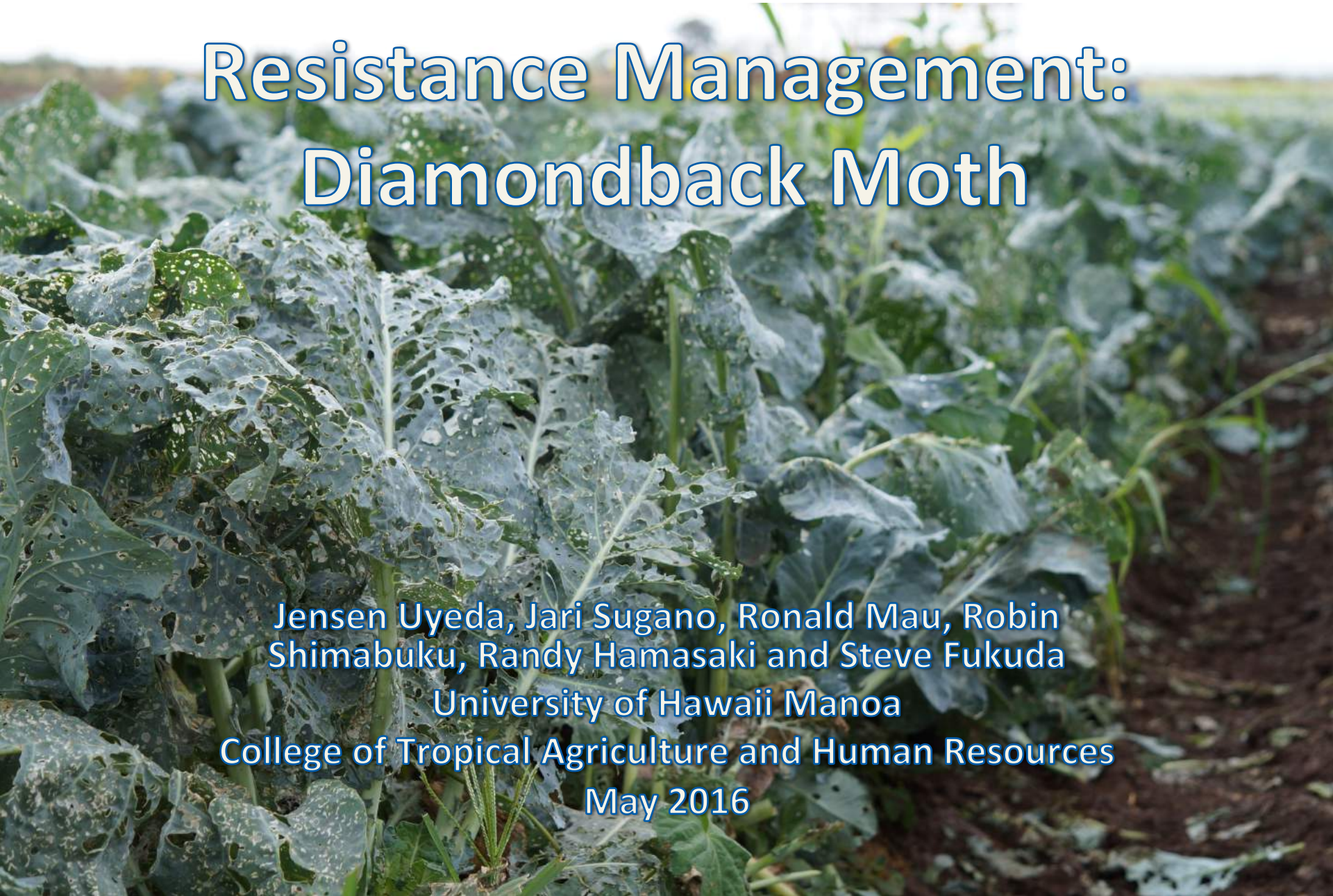
Resistance Management: Diamondback Moth



Jensen Uyeda, Jari Sugano, Ronald Mau, Robin Shimabuku, Randy Hamasaki and Steve Fukuda
University of Hawaii Manoa
College of Tropical Agriculture and Human Resources
May 2016

Pesticide Resistance

- Natural ability of a pest to survive exposure to pesticides that would normally kill that pest.
- Pest species develop pesticide resistance via natural selection
  - Most resistant species survive and pass on their genetic traits to offspring
  - Dominate the population

Pesticide Resistance Management

- Effort to slow down/prevent the development of resistance
- Chemical rotations
  - Mode of Action Groups
- Effective Coverage
  - Use of adjuvants
  - Spray equipment
- Timing
- Concentrations

Insecticide Resistance Action Committee (IRAC) Groups

- Important for resistance management
- 30 Main Groups
- 5 Modes of Action (MoA) Groups
  - Nerve & Muscle
  - Growth Regulators
  - Respiration
  - Midgut
  - Unknown

Nerve and Muscle Targets

- Affects the nervous system and muscles of insects.
- Typically fast acting
- Groups
  - 1-6,9,14,19,22,28,29
- Examples
  - Group 1 – Organophosphates (Diazanon)
  - Group 3 – Pyrethroids (Cypermethrin)
  - Group 28 – Diamides (Belt)

Growth Regulator Target

- Affect the growth of insects by disturbing lipid biosynthesis.
- Typically slow acting
- Groups
  - 7,10,15-18,23
- Examples
  - 15 Novaluron – Rimon
  - 18 Methoxyfenozide – Intrepid
  - 23 Spirotetramat – Movento

Respiration Group

- Interferes with mitochondrial respiration by inhibiting electron transport
- Fast top moderate acting
- Groups
  - 12,13,20,21,24,25
- Examples
  - Group 21 – Tolfenpyrad (Torac)
  - Group 25 – Cyflumetofen (Sultan Miticide)

Midgut Group

- Lepidopteran-specific microbial toxins
  - Caterpillars
- Group 11
- Example
  - Bacillus thuringiensis – Dipel

Unknown/Non-specific Group

- Insecticides that act nonspecifically
- Group 8
  - Example: Borates (Boric Acid)
- Group UN
  - Example: Azadirachtin – Molt-X

IRAC http://www.irac-online.org/modes-of-action/

Insecticide Resistance Action Committee

Search SEARCH

Resistance Management for Sustainable Agriculture and Improved Public Health

Modes of Action

Nerve & Muscle Growth Respiration Midgut Unknown or Non-Specific

filter by mode of action, chemical class or active...

1 ACETYLCHOLINESTERASE (ACHE) INHIBITORS

A CARBAMATES

Alanycarb, Aldicarb, Bendiocarb, Benfuracarb, Butocarboxim, Butoxycarboxim, Carbaryl, Carbofuran, Carbosulfan, Ethiofencarb, Fenobucarb, Formetanate, Furathiocarb, Isoprocarb, Methiocarb, Methomyl, Metolcarb, Oxamyl, Pirimicarb, Propoxur, Thiodicarb, Thiofanox, Triazamate, Trimethacarb, XMC, Xylylcarb

B ORGANOPHOSPHATES

Acephate, Azamethiphos, Azinphos-ethyl, Azinphos-methyl, Cadusafos, Chlorethoxyfos, Chlorfenvinphos, Chlormephos, Chlorpyrifos, Chlorpyrifos-methyl, Coumaphos, Cyanophos, Demeton-S-methyl, Diazinon, Dichlorvos/ DDVP, Dicrotophos, Dimethoate, Dimethylvinphos, Disulfoton, EPN, Ethion, Ethoprophos, Famphur, Fenamiphos, Fenitrothion, Fenthion, Fosthiazate, Heptenophos, Imicyafos, Isofenphos, Isopropyl O-(methoxyaminothio-phosphoryl) salicylate,

2 GABA-GATED CHLORIDE CHANNEL BLOCKERS

A CYCLODIENE ORGANOCHLORINES

B PHENYLPYRAZOLES (FIPROLES)

3 SODIUM CHANNEL MODULATORS

A PYRETHROIDS, PYRETHRINS

B DDT, METHOXYCHLOR

4 NICOTINIC ACETYLCHOLINE RECEPTOR (NACHR) COMPETITIVE MODULATORS

A NEONICOTINOIDS

B NICOTINE

C SULFOXIMINES

D BUTENOLIDES

E MESOIONICS

5 NICOTINIC ACETYLCHOLINE RECEPTOR (NACHR) ALLOSTERIC MODULATORS

SPINOSYNS

6 GLUTAMATE-GATED CHLORIDE CHANNEL (GLUCL) ALLOSTERIC MODULATORS

AVERMECTINS, MILBEMYCINS

7 JUVENILE HORMONE MIMICS

A JUVENILE HORMONE ANALOGUES

B FENOXYCARB

C PYRIPROXYFEN

8 MISCELLANEOUS NON-SPECIFIC (MULTI-SITE) INHIBITORS

A ALKYL HALIDES

Diamondback Moth: Case Study

Identification: Diamondback Moth (DBM)

- *Plutella xylostella*
- Life Cycle is 17-51 days depending on temperature
- Host Plants
  - Cruciferae Family
  - Broccoli, cabbage, etc.
- Plant damage caused by larval feeding on foliage

Larvae

Pupae

Chemical Group

Active Ingredient

BELT® SC

INSECTICIDE

Net Contents:

1 Gallon

GROUP 28 INSECTICIDE

ACTIVE INGREDIENT:
Flubendiamide (*N*²-[1,1-dimethyl-2-(methylsulfonyl) ethyl]-3-iodo-*N*¹-[2-methyl-4-[1,2,2,2-tetrafluoro-1-(trifluoromethyl)ethyl]phenyl]-1,2-benzenedicarboxamide) 39%
OTHER INGREDIENTS: 61%
TOTAL: 100%

BELT SC Insecticide contains 4 pounds of flubendiamide per US gallon (480 grams per liter).

EPA Reg. No. 264-1025

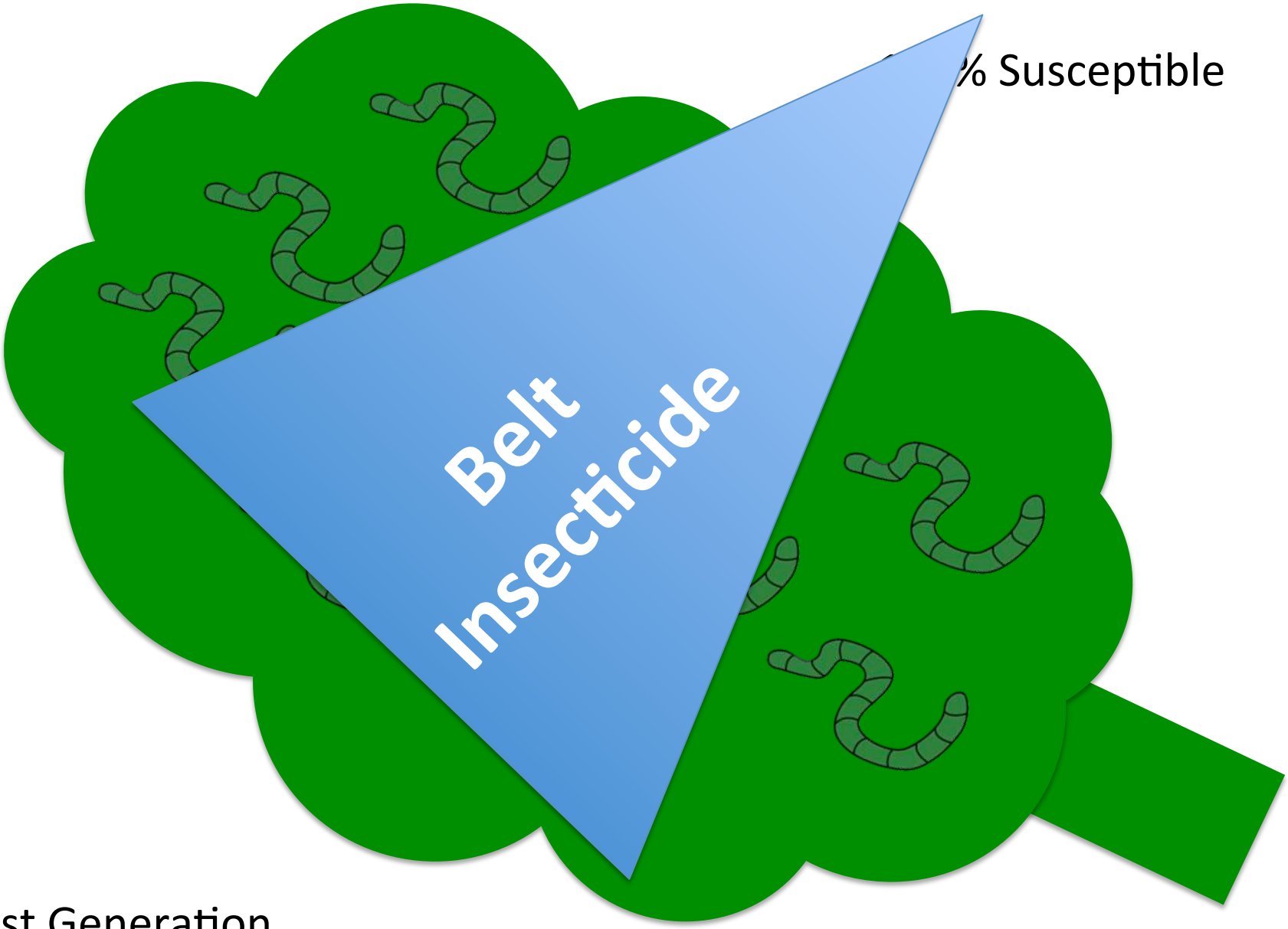
STOP – Read the label before use
KEEP OUT OF REACH OF CHILDREN
CAUTION
FOR ADDITIONAL PRECAUTIONARY STATEMENTS: See Inside Booklet.

For **MEDICAL** And **TRANSPORTATION** Emergencies **ONLY** Call 24 Hours A Day 1-800-334-7577
For **PRODUCT USE** Information Call 1-866-99BAYER (1-866-992-2937)

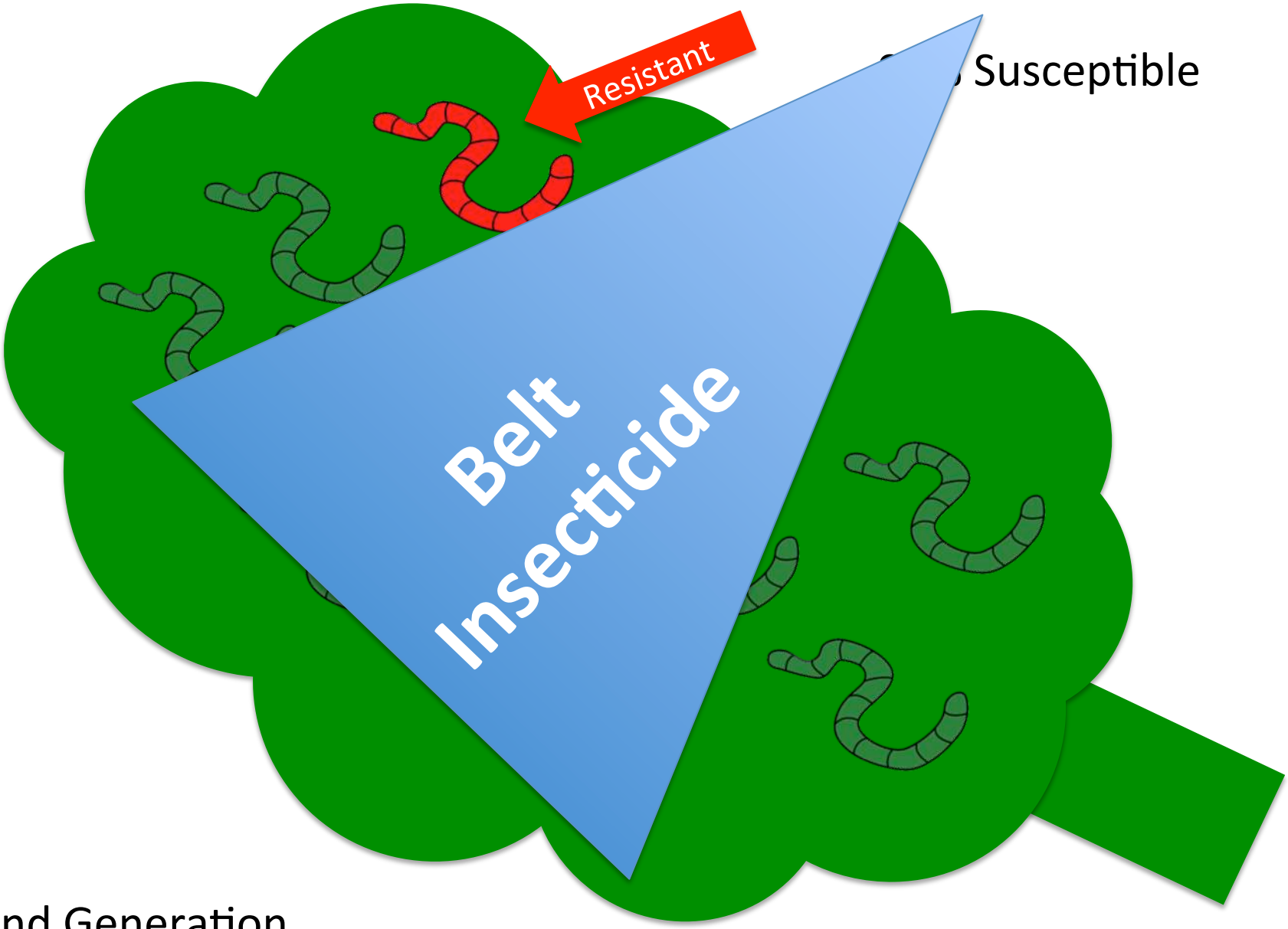
121114Fv2 02/13

US7939788 7F

Produced for:
Bayer CropScience LP
P.O. Box 12014, 2 T.W. Alexander Drive
Research Triangle Park, North Carolina 27709



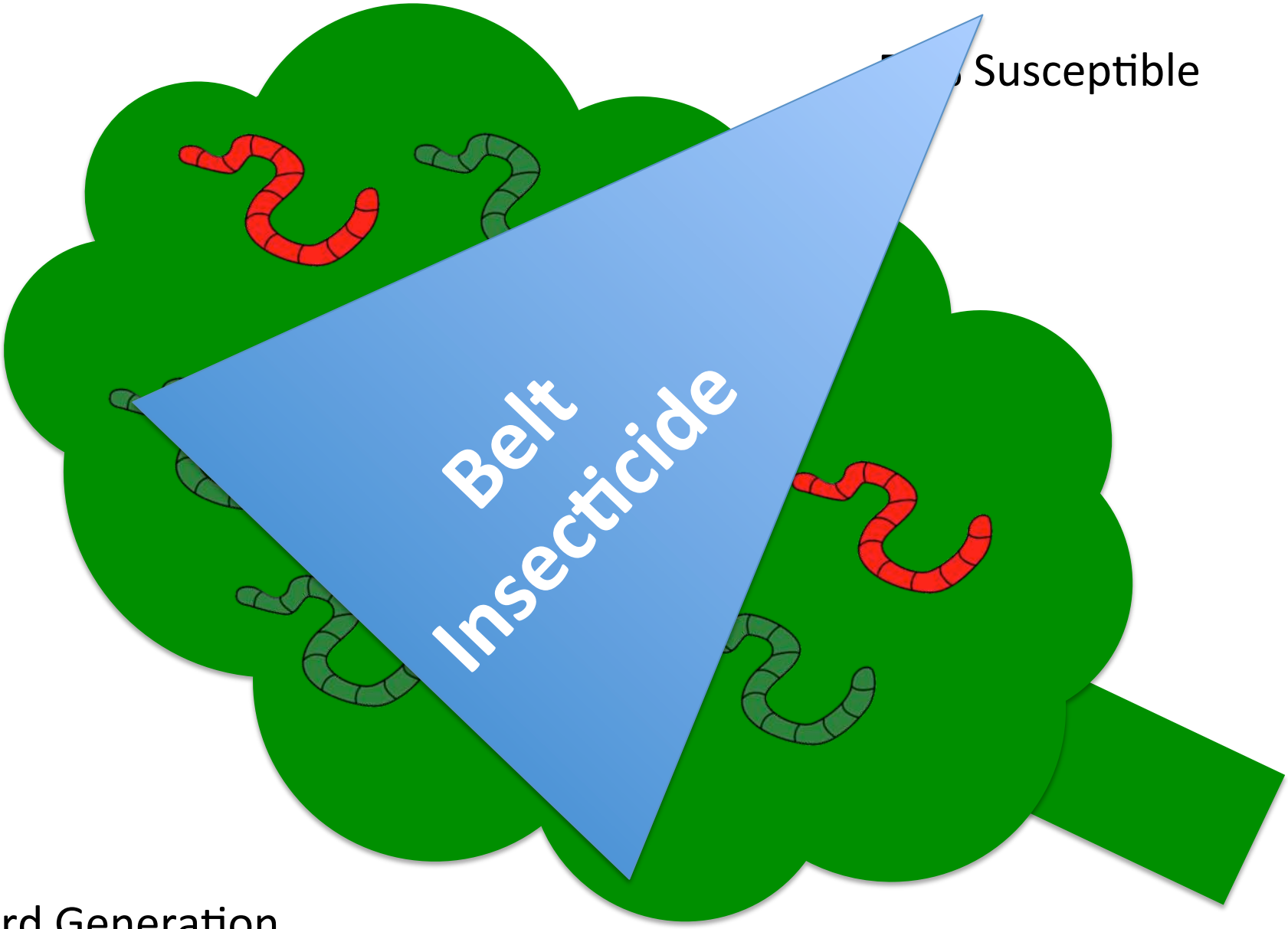
1st Generation



2nd Generation

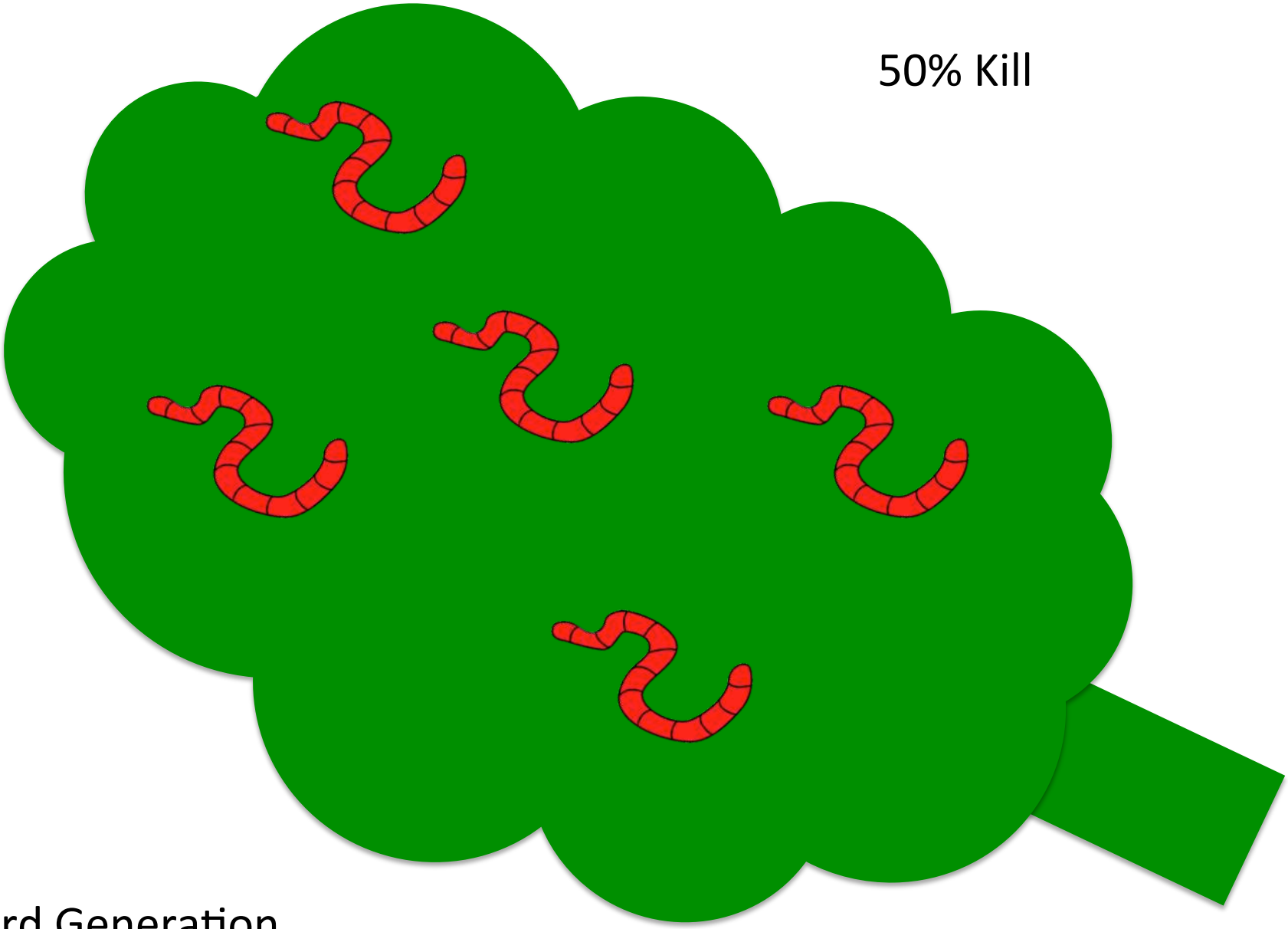
2nd Generation

Susceptible



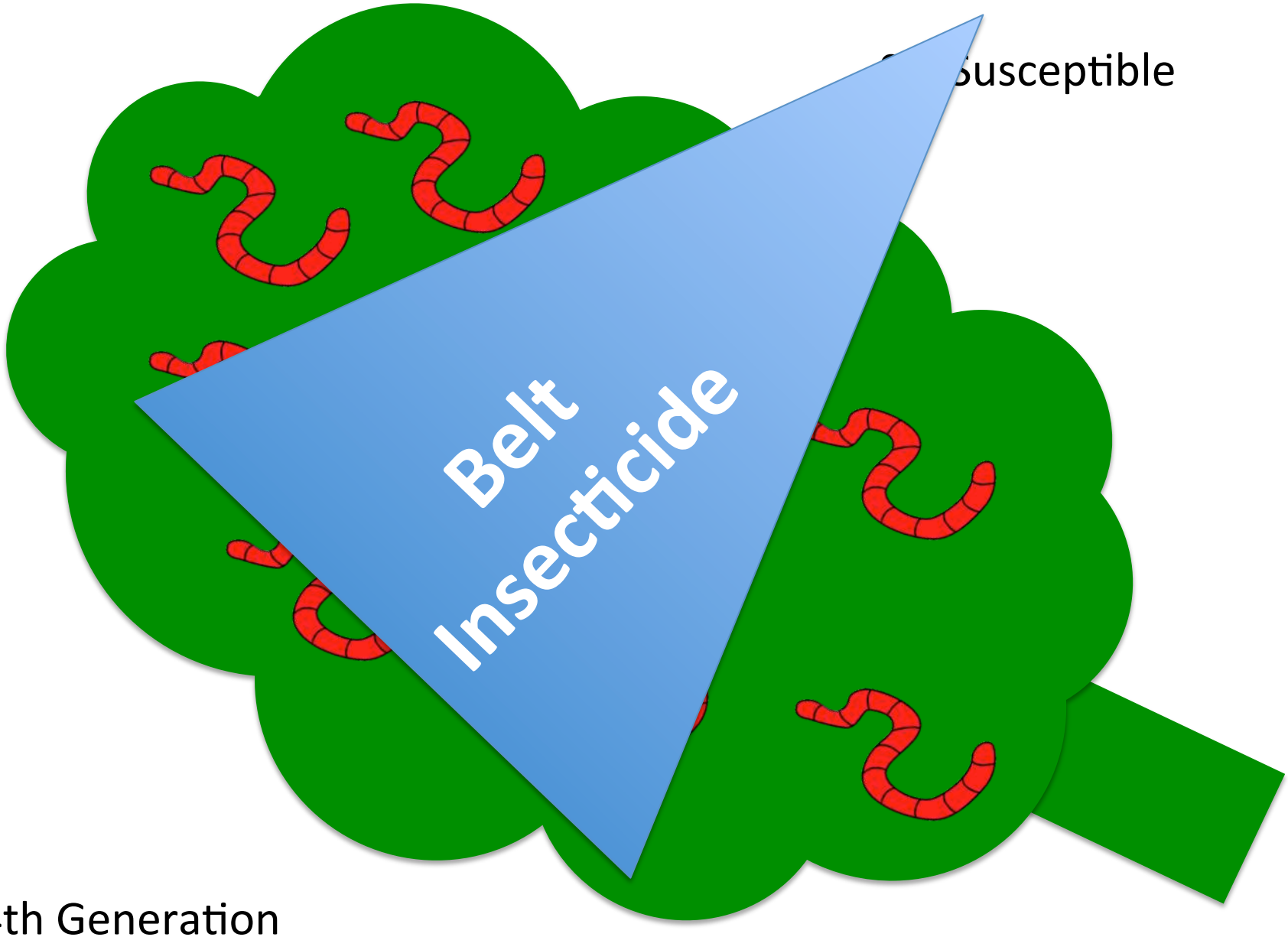
3rd Generation

50% Kill

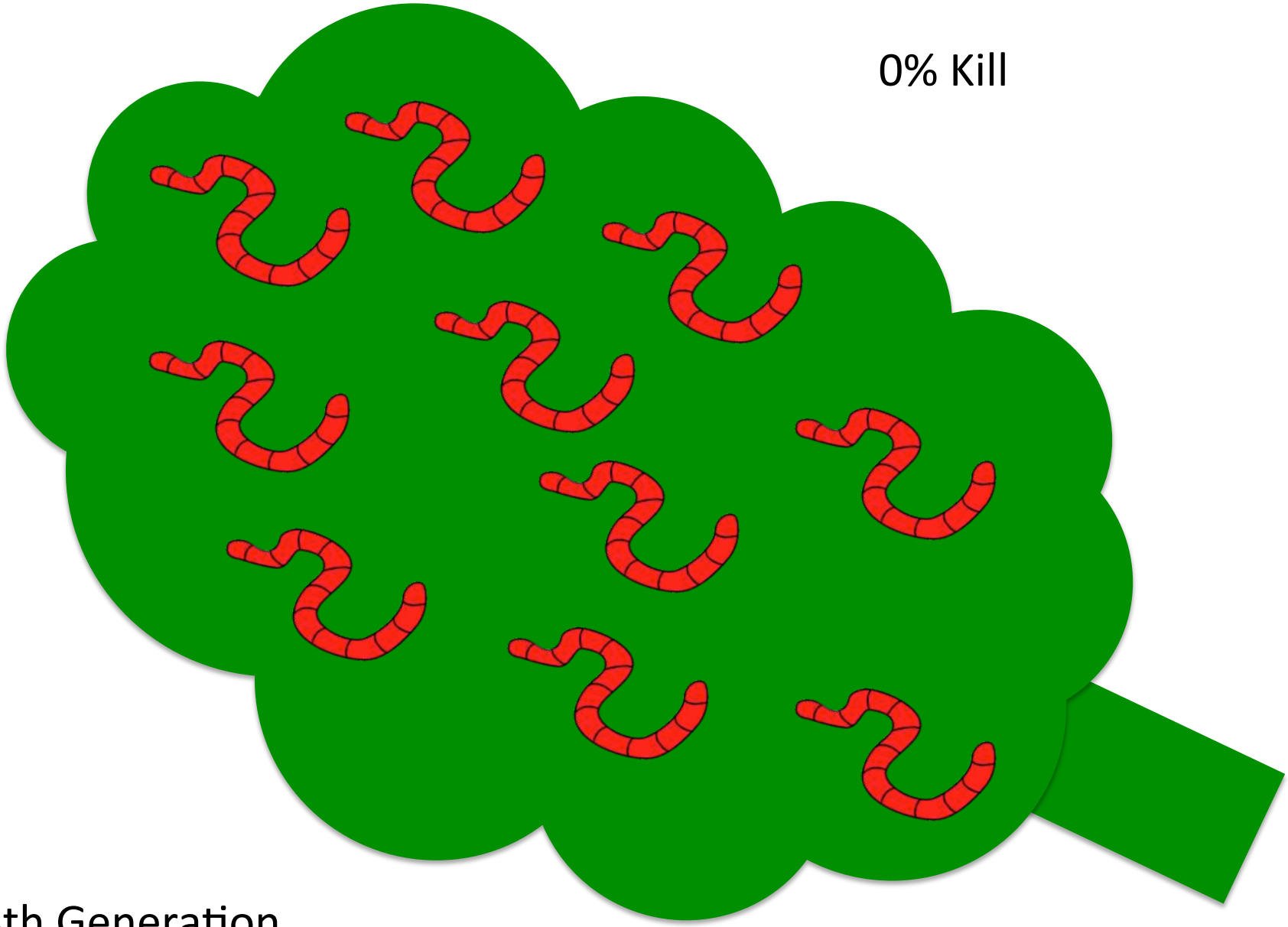


3rd Generation

Susceptible



4th Generation



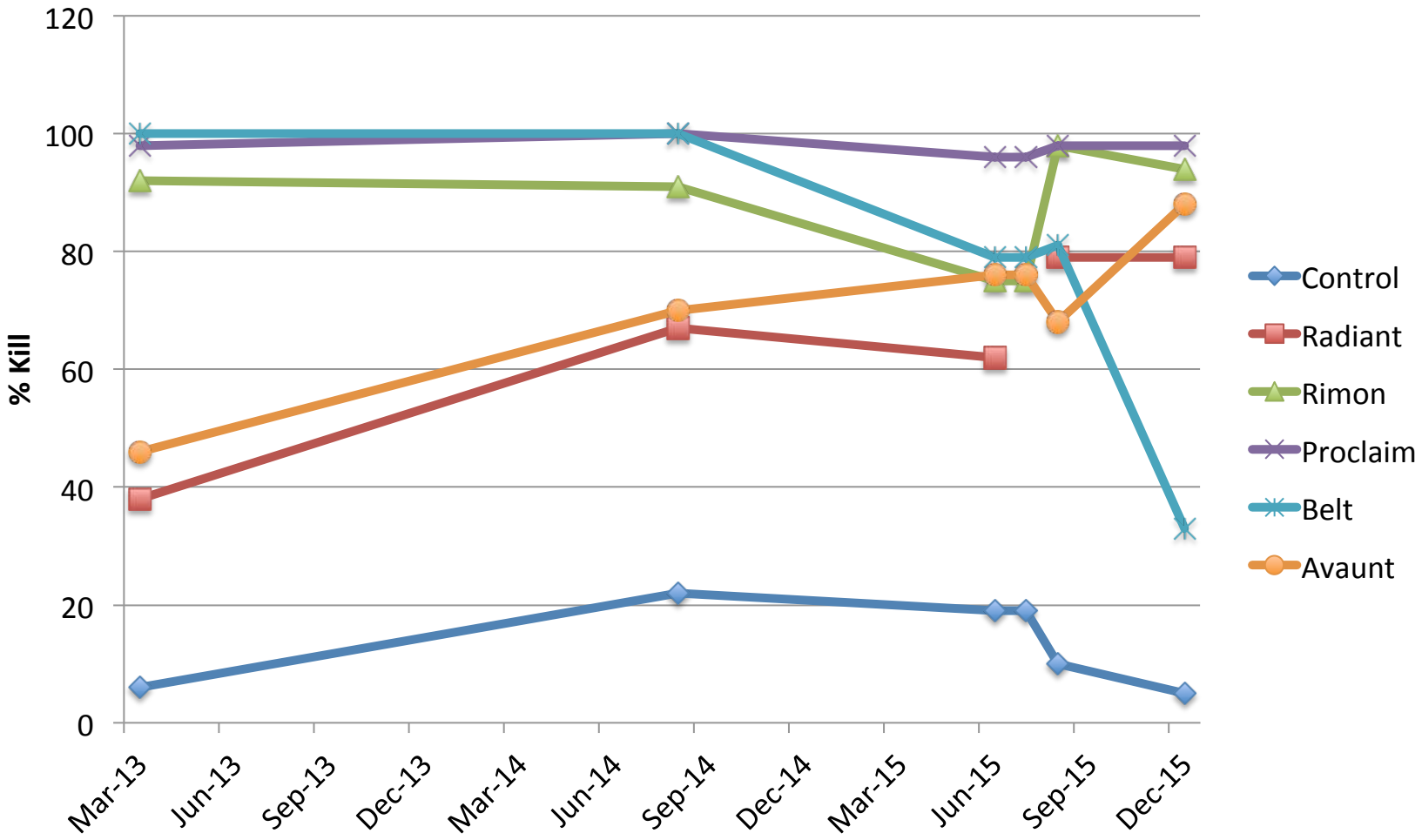
4th Generation

DBM Bioassays

Chemical List

Product	Group	Active
Proclaim	6	Emamectin benzoate
Avaunt	22	Indoxacarb
Radiant	18	Spinetoram
Rimon	15	Novaluron
Belt	28	Flubendiamide
Coragen	28	Chlorantraniliprole
Vetica	28 & 16	Flubendiamide and Buprofezin
Synapse	28	Flubendiamide

Oahu DBM Population



Oahu 2016 Rotation

Month of:	Rotation Product
January	Avaunt
February	Proclaim
March	Radiant
April	Rimon
May	Avaunt
June	Proclaim

Other Rotational Products

- Bacillus Thuringiensis (Group 11)
  - Xentari
  - Dipel
- Dibrom (Group 1B)
- Thionex (Group 2A)
- Lannate (Group 1A)

For More Information:

Jensen Uyeda
Wahiawa Extension Office
808-622-4185
juyeda@hawaii.edu