

Colorado  
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# Biological Pesticides

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# Why Bioinsecticides?

- Environmental impacts
- Safety concerns
- Resistance management
- Efficacy
- Economics
- Market concerns



# Biological Pesticides??

- Formulated products
  - Viral
  - Bacterial
  - Fungal
  - Protozoan



# Characteristics

- Reduced Risk Products
- Based on biological or
- Naturally derived chemistry
- Perform differently than conventional pesticides
- Efficacious when used properly
- Safety leads to fewer application restrictions
- Useful for resistance management
- Human and environmental safety benefits.

# Host specificity

- virus/protozoa < bacteria < fungus
  - Most virus & protozoan materials are very specific
  - Bacterial insecticides tend to be effective against groups of insects within an order
  - Fungal products are often relatively broad spectrum
    - some exceptions to this generalization

# Biological limitations

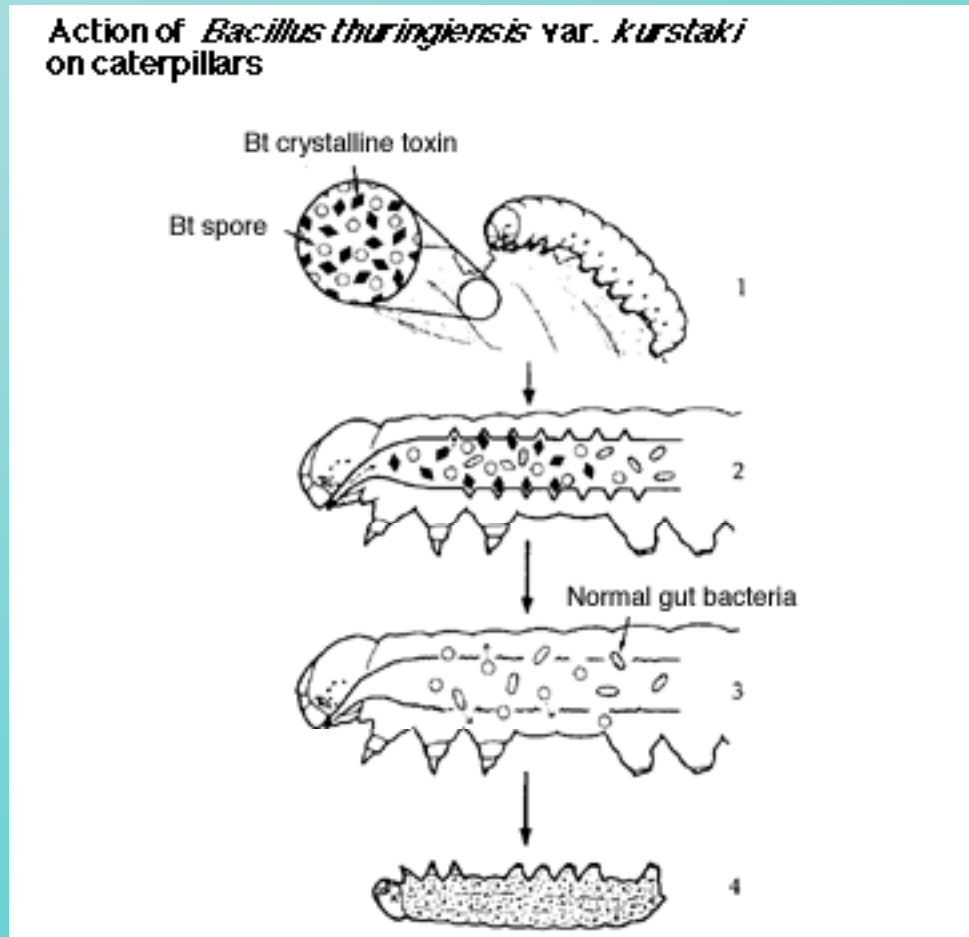
- Economic limitations for manufacturers
  - limited host range = limited market
- Limited production = higher prices
- Many products have short residual
  - UV sensitivity
- User learning curve
  - Different than traditional insecticides

# Bacillus thuringiensis

- Lepidoptera
  - *Bt aizawai* – several products
  - *Bt kurstaki* - many products
- Diptera
  - *Bt israeliensis* – many products
- Coleoptera
  - *Bt tenebrionis* - Novodor
  - *Bt San diego*

# *Bt* Mode of Action

- Target consumes spores & crystalline toxin
- Protein binds to receptors in gut wall
- Target stops feeding
- Gut wall breaks down
- Spores & gut flora enter body cavity
- Target dies within days of septicemia



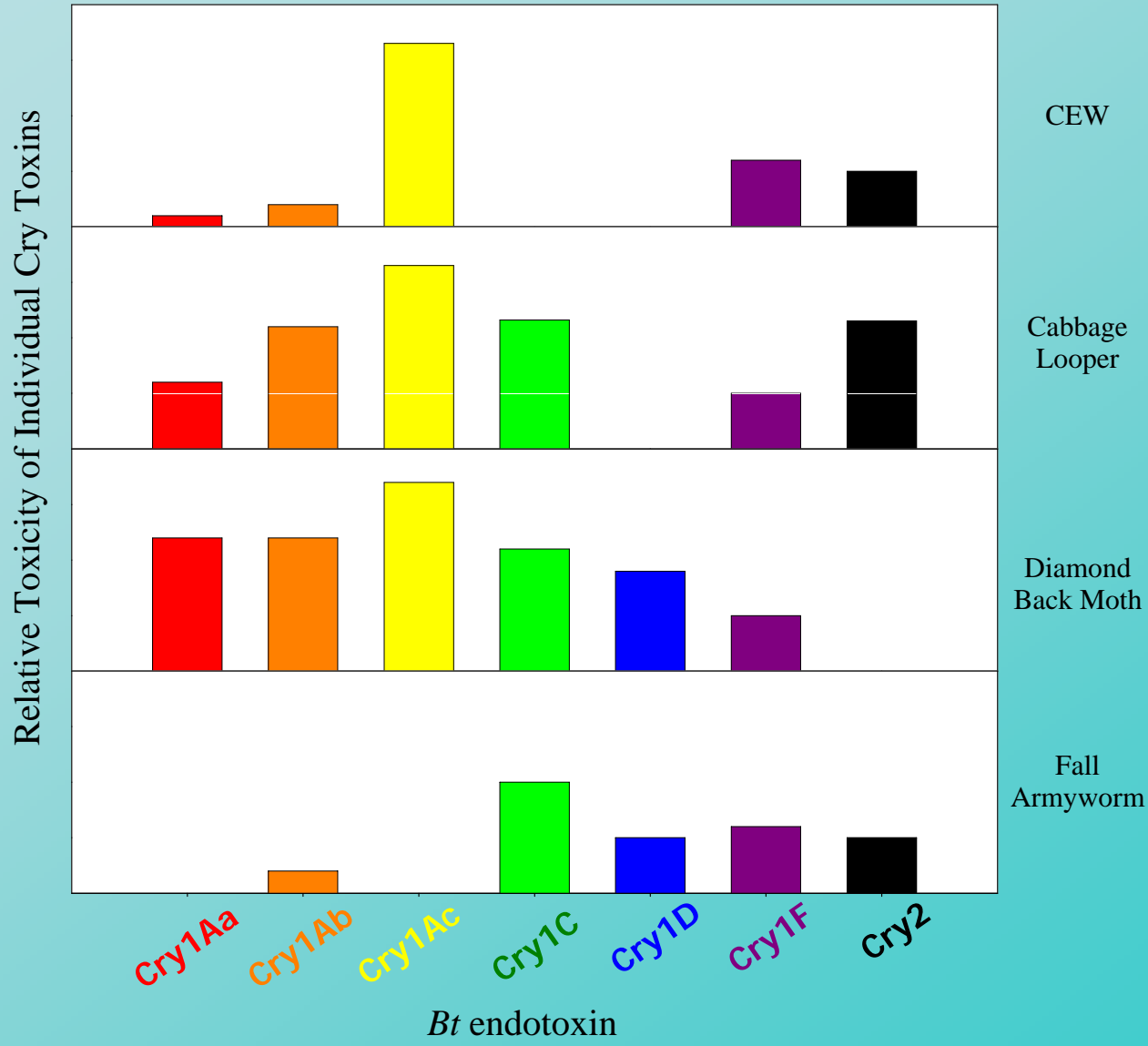
# CRY Proteins?

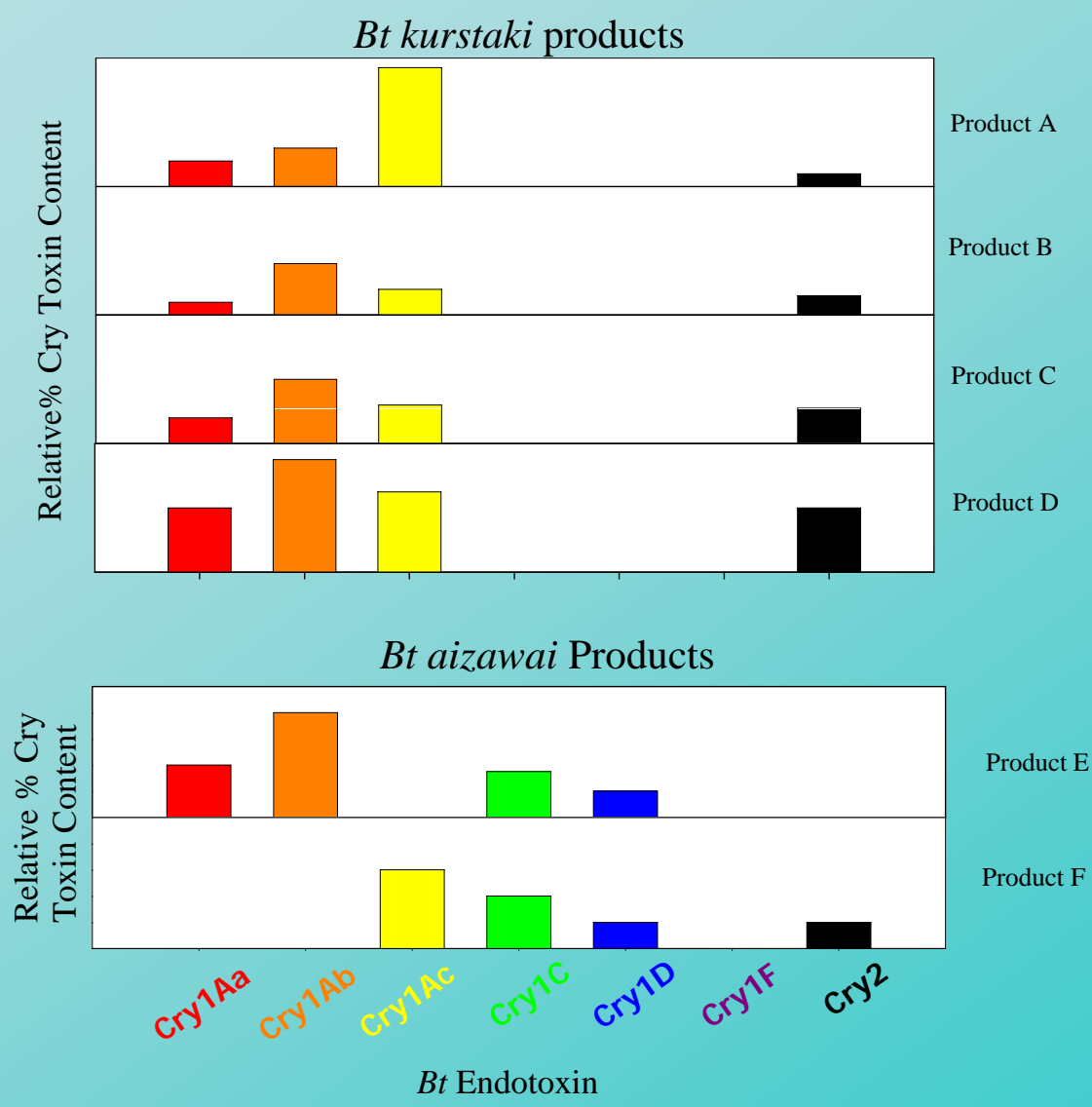
- CRYstalline proteins are the toxic ingredient
- Each Bt species/strain produces a unique set of CRY proteins
- Each CRY protein has unique activity
- CRY proteins are usually designated with a series of numbers and letters:
  - Cry1Aa, Cry2
- CYTolitic proteins are sometimes toxins which act in a slightly different manner than CRY's

# *Bt* strains

- Many strains can exist with a *Bt* species
- Different strains produce CRY proteins in different proportions
- Strains are designated “strain XXABCD”
  - *Bacillus thuringiensis* subspecies *kurstaki* strain EG7841

# Endotoxin Performance Differences





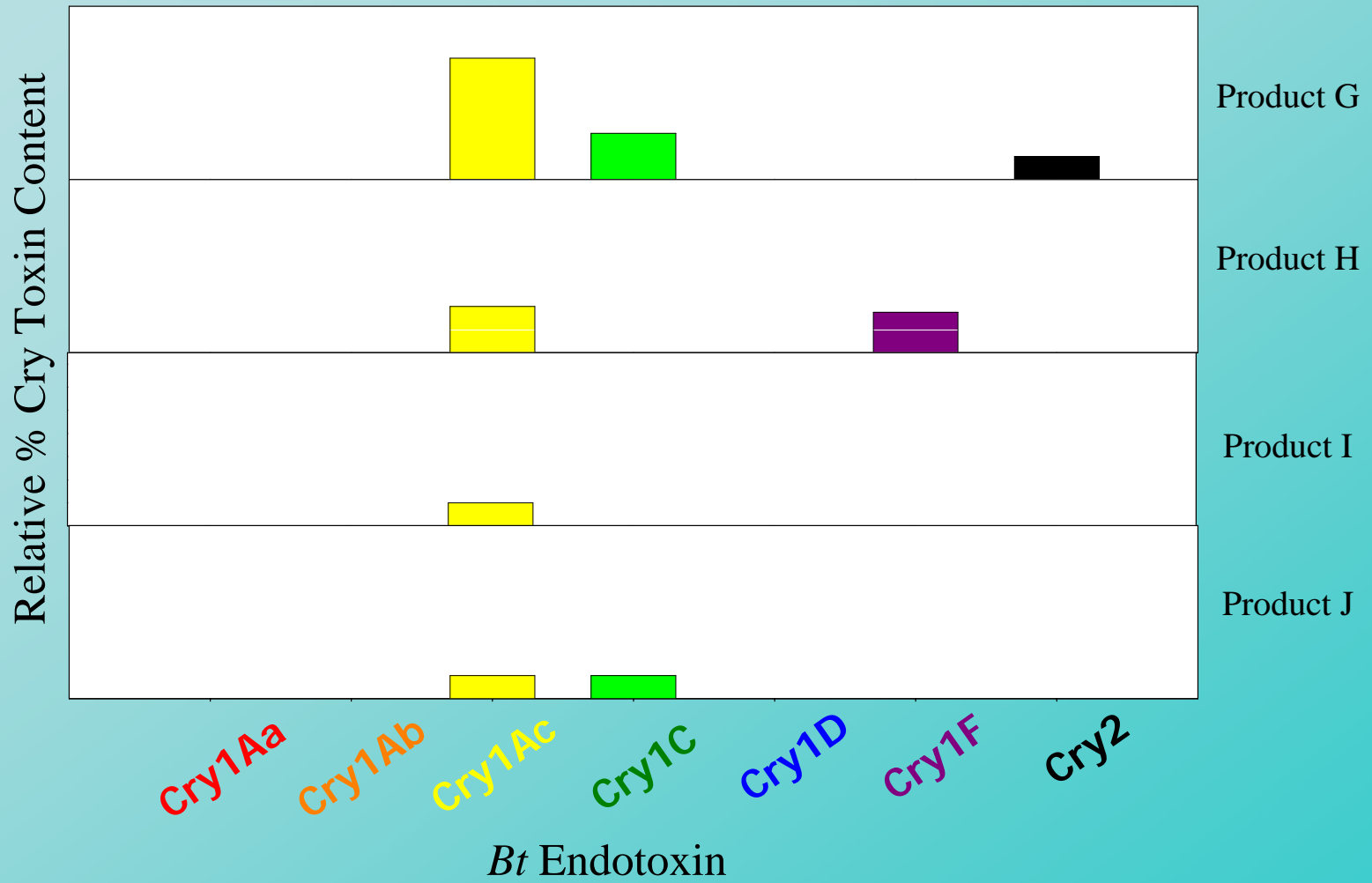
# Genetically Modified Bt

- A few Bt products are genetically modified to produce several CRY proteins
- Genes are taken from one Bt species or strain and inserted into another
- GM Bt's are not allowed in organic production



**Crymax, produced by Certis USA, contains genes from *Bta* inserted into a *Btk* background**

# Genetically Engineered Products



# Bt Events

- Genetically modified corn, cotton, potato and other crops have been created using *Bt*'s
- Genes that code for CRY proteins are inserted into the host plant
- The GM plant produces the toxic proteins which kill the target insect when they are ingested
- The specific placement of the foreign gene in the host plant genome is referred to as an event
- Events using the same foreign gene sequence can vary significantly in performance

# Tips for Using *Bt*

- Use the correct product!!!!
- Must be ingested by target pest so:
  - Good coverage is essential!!!
- Most effective versus early instars:
  - Treat early
- Residual affected by UV radiation
  - Multiple applications may be necessary
- Use fresh product, *Bt* has limited shelf life

## *Bacillus sphaericus*

- Widely used mosquito control
  - Sphericide, Vectolex

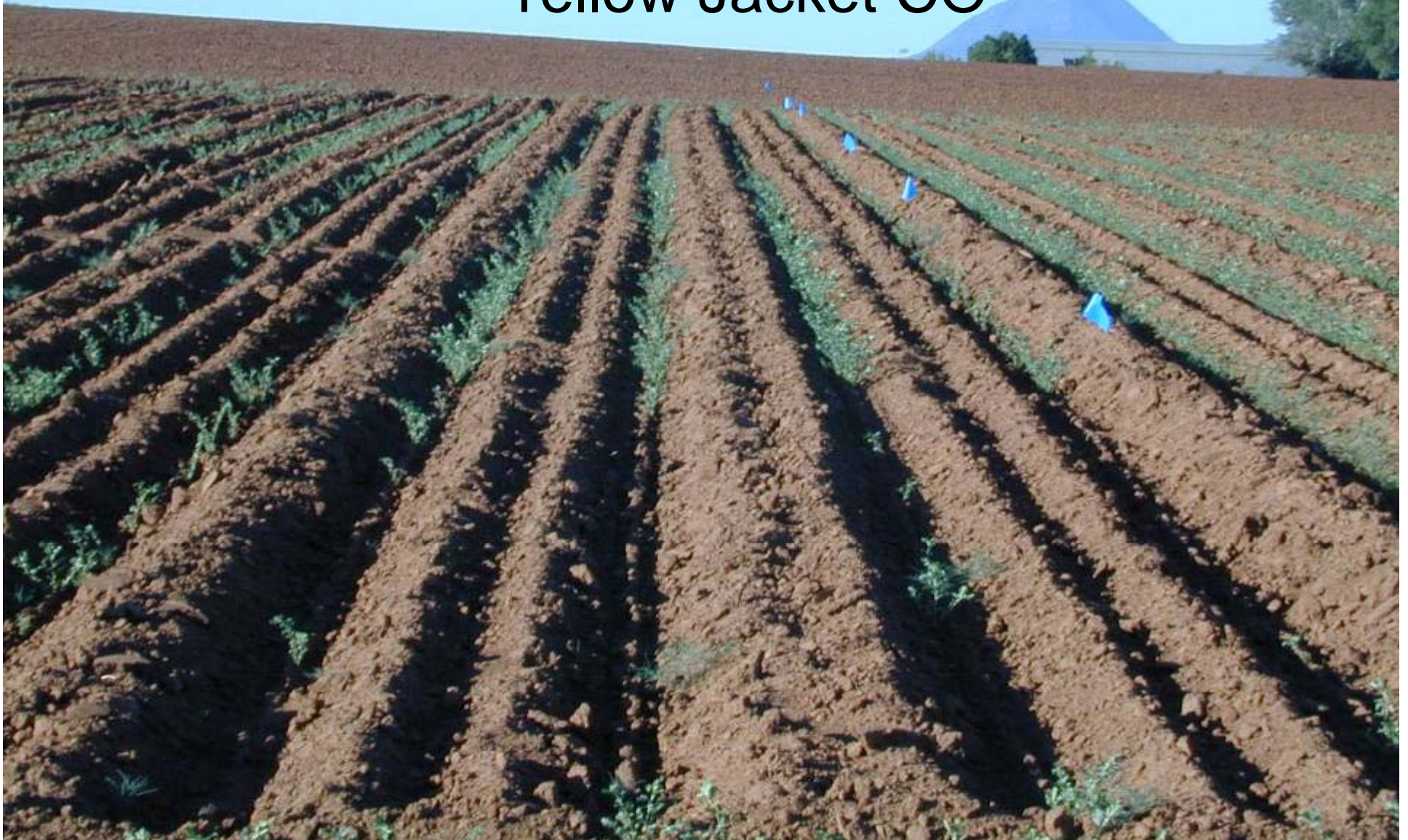
## *Bacillus firmus*

- Nematicide
  - Bionem, Biosafe
  - Used in Israel

## *Bacillus (Paenibacillus) popillae*

- Milky spore disease of Japanese beetle
  - Product formulation has issues!

Kodiak seed treatment in Chickpeas  
*Bacillus subtilis*  
Yellow Jacket CO



# Spinosad

- Byproduct of bacterial fermentation
  - *Saccharopolyspora spinosa*
  - a mix of 2 or more compounds
- Very safe, semi-broad spectrum
  - Lepidoptera, diptera, thrips, some beetles
  - Relatively easy on beneficials
- Many products
  - Success, Conserve, Spintor, Tracer
  - Now available on home use market



# Spinosad Baits

- Ant baits
- GF 120
  - Cherry fruit fly bait
  - Application with large droplet size
  - Complete coverage not required



# Spinetoram

- Modification to spinosad molecule
- Enhanced activity & residual
- Maintains product safety
- Relatively beneficial friendly



# Fungal Insecticides

- *Beauveria bassiana*
  - Mycotrol, Botanigard, Bio-power, Naturalis
- Activity with many sucking and chewing insects
- Needs humidity to maximize effectiveness
  - Greenhouse uses in the arid west



# ***Metarhizium anisopliae***

- Many strains have been isolated
- Strain F52 is in commercial production
  - Taenure
  - Thrips, root weevil adults, white grubs, flies
- Other strains may come into production

# *Verticillium lecanii*

- Used primarily in European greenhouses
- Vertalec, Mycotal, Ecocill
- Aphids, mealybugs, scale, thrips, whiteflies
- Needs 85-90% humidity for 10 to 12 hr!

# Viral Insecticides

- Nuclear Polyhedrosis Virus
  - species specific
- Gemstar for *Helicoverpa zea*
- Used in local sweet corn
  - Tank mix with traditional spray program
  - Organic, in rotation with Btk
- Needs to be tested under high pest pressure

# Codling Moth Granulosis Virus

- Cyd-X, Granupom, Virosoft, Carpovirusine 2000
- Natural microencapsulation
  - Within occlusion body (OB)
  - OB's must be ingested
  - OB's dissolve in gut, virus invades cell nuclei
  - Virus replicates within cells
  - Feeding stops in days
- LD<sub>50</sub> is 2 OB. 1 oz product contains a trillion OB's
- Horizontal, vertical & latent transmission

# Microsporidian Insecticides

- *Nosema locustae*
  - Specific to grasshoppers / Mormon crickets
  - Nolo bait
  - Formulated on apple pumice bait
  - Slow acting
  - Most appropriate for long-term management
  - Limited shelf life



# Is a Biological Insecticide Your Best Choice?

- Have you properly identified the target?
- Why are you considering a biological?
- What growth stage is your target pest?
- At what stage is the infestation?
- What is your application method?
- Are you choosing the correct product?
- What is the product manufacture date?



# Questions?

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