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Networking with researchers and farmers to tackle herbicide-resistant weeds

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Outline

- Crop breeding technology
- Regulation of crop technologies
- Issues related to crop-to-weed gene flow
- Need for landscape-level studies

Crop Modification Techniques

Cross Breeding

Combining two sexually compatible species to create a variety with the desired traits of the parents

The Honeycrisp Apple gets its famous texture and flavor by blending the traits of its parents.

Mutagenesis

Use of mutagens such as radioactivity to induce random mutations, creating the desired trait

Radiation was used to produce a deeper color in the red grapefruit.

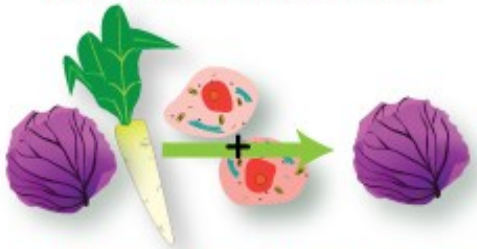
Polyploidy

Multiplication of the number of chromosomes in a crop to impact its fertility

Seedless watermelons are created by crossing a plant with 2 sets of chromosomes with another that has 4 sets. The seedless fruit has 3 sets.

Protoplast Fusion

Fusion of cells or cell components to transfer traits between species



Male sterility is transferred from radishes to red cabbage by fusing their cells. Male sterility helps plant breeders make hybrid crops.

Transgenesis

Addition of genes from any species to create a new variety with desired traits

The Rainbow Papaya is modified with a gene that gives it resistance to the Papaya Ringspot Virus.

Genome Editing

Use of an enzyme system to modify DNA directly within the cell

Genome editing was used to develop herbicide resistant canola to help farmers control weeds.

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By Layla Katiraee (@BiochicaGMO) in collaboration with Karl Haro von Mogel (@kjhvm)

BIOLOGY FORTIFIED

GMO

- Genetically Modified Organism
- Most commercial traits facilitate crop production
  - Insect resistance (Bt corn)
  - Herbicide resistance (Roundup)
- General scientific consensus that they are safe
- Public concerns persist

GM…..Oh?

- GMOs are regulated substances by USDA-APHIS
  - $80 to $150 million per genotype to get to market
- USDA-APHIS: Which biotech traits do we regulate?
- Commodity groups: Will we be regulated???

The special case of sorghum:

Massive international development as a biofuel

- **Better drought tolerance than corn**
- **Needs herbicide resistance to compete**

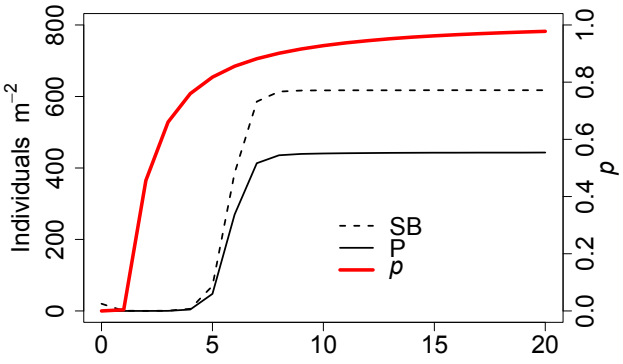
The special case of sorghum:

Evolution of herbicide resistance in related weeds

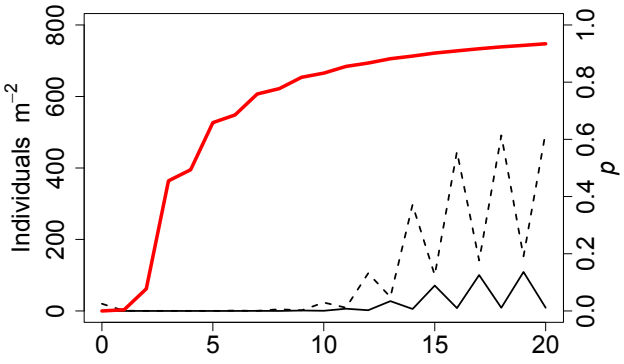
- Selective pressure
- Crop-to-weed gene flow

We got data!

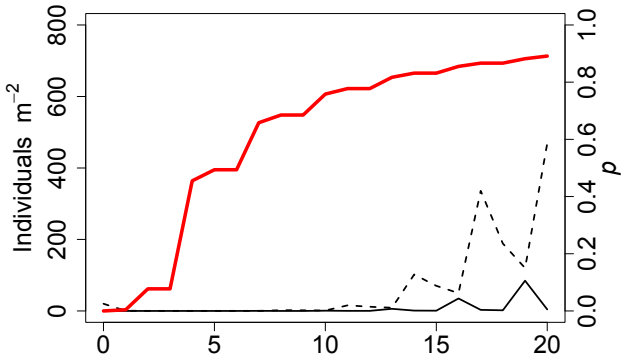
1. Inzen *fb* Inzen



3. Inzen *fb* Soybeans

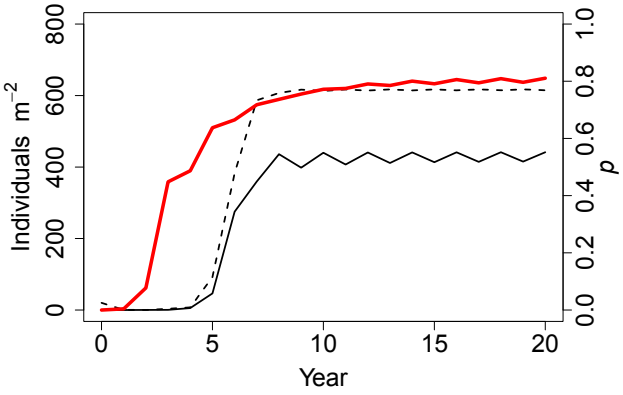


5. Inzen *fb* Fallow *fb* Wheat

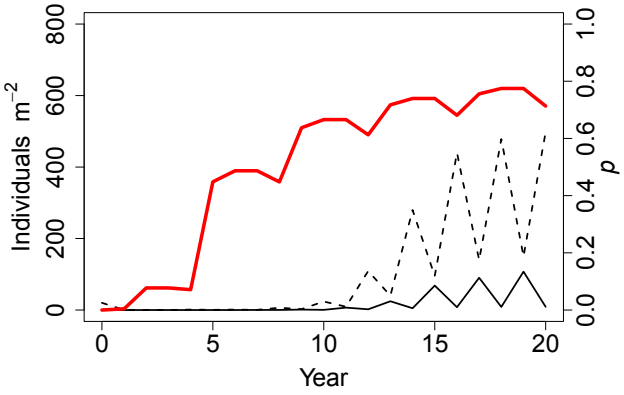


Rotation, Rotation, and Rotation!

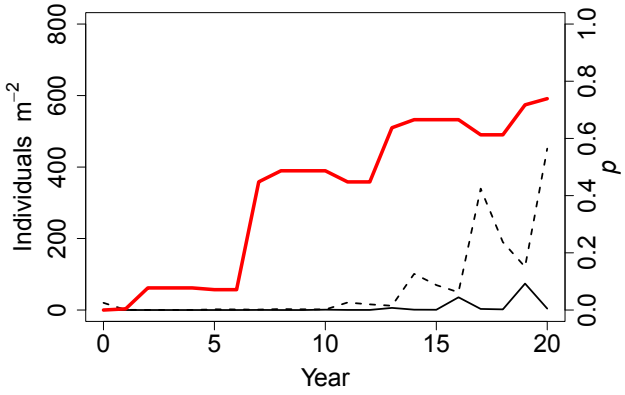
2. Inzen *fb* Sorghum



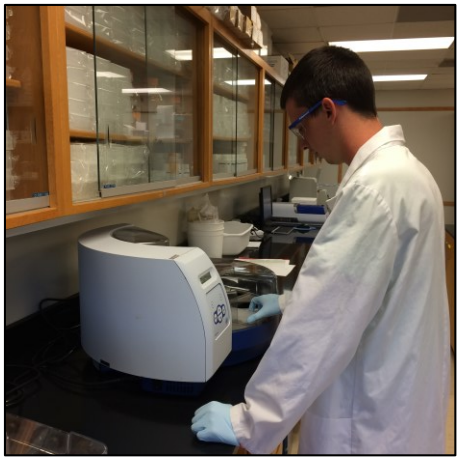
4. Inzen *fb* Soybeans *fb* Sorghum *fb* Soybeans



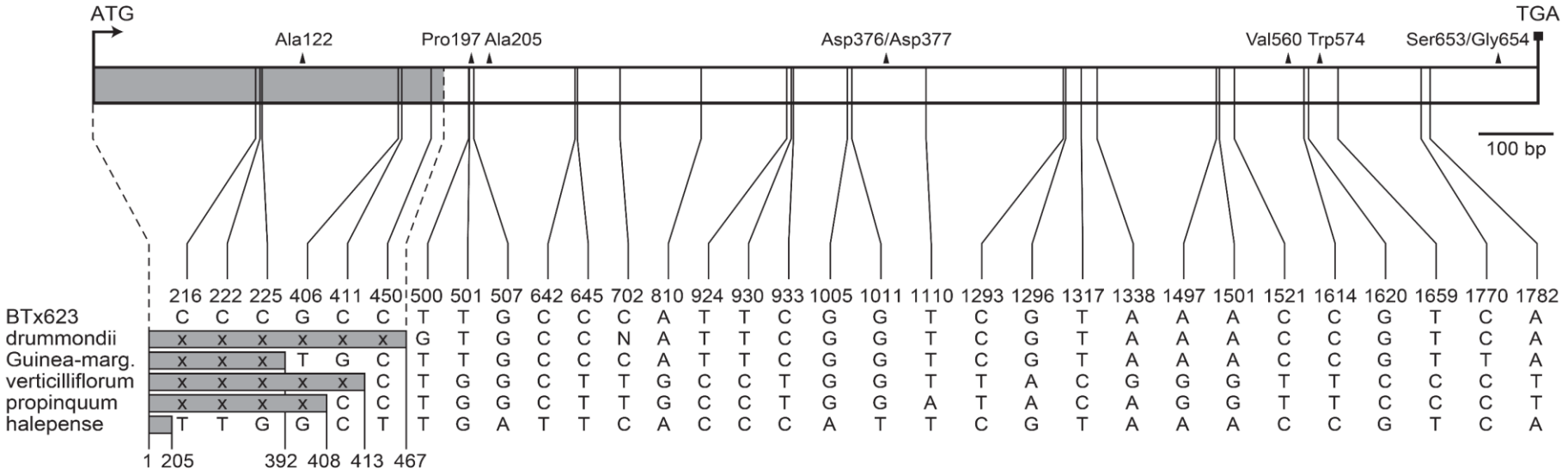
6. Inzen *fb* fallow *fb* Wheat *fb* Sorghum *fb* Fallow fb Wheat



We got the tools!



- High-throughput DNA extraction
- Molecular markers quantitatively distinguish gene flow vs. mutation



Rationale for using them in large-scale monitoring of weed resistance:

- Environmental impacts documented from Inzen commercialization can inform responsible deployment of future nuclear traits in sorghum.

- Such traits are needed to make sorghum more competitive with maize and reduce the inputs (fertilizers + irrigation) needed for grain and biofuels production.

- Identifying best-management practices to delay resistance evolution and minimize population densities of resistant weeds will prolong the lifespan of Inzen technology.

Our many stakeholders…

- ***Extension collaborations***
  - Disseminate grower surveys to identify baseline presence of resistant weeds are currently located
  - Educate growers about the special challenge of crop-to-weed gene flow
  - Advertise monitoring program and no-cost population sampling at extension meetings

Our many stakeholders…

- ***Growers surveys***
  - Follow-up surveys after 3, 5, 7, 10 years to track agro-ecosystem choice dynamics
  - Identify populations of interest to use in detailed molecular ecology analysis

Our many stakeholders…

- Provide data to USDA-APHIS, industry, and commodity groups for reference when future technologies are released
  - First quantitative data on the relative rates of herbicide resistance evolution due to gene flow vs. herbicide selection in crop wild relatives

Thank you!

Questions?