Strategies for Reducing Antibiotic Use in Tree Crops

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Antibiotic use in plant agriculture – tree diseases

- Fire blight of apple, pear
  - Streptomycin, Kasugamycin, Oxytetracycline

- Citrus canker -- citrus
- Huanglongbing (HLB) – citrus
  - Streptomycin, Oxytetracycline

- Recent Kasugamycin registrations, emergency use exemptions
  - Bacterial canker of sweet cherry
  - Walnut blight
  - Almond

Antibiotic use in plant agriculture – tree diseases

- Goals of antibiotic use are to reduce inoculum (population size) of bacterial pathogens to reduce infection potential

- Plant pathogens cannot be treated after infection as the antibiotics do not penetrate host tissue

- Disease prediction methods used to time application(s)
  - Maximize efficiency of use
  - Minimize overuse

Antibiotic use in plant agriculture – tree diseases

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Antibiotic use in plant agriculture – tree diseases

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‘Gala’

‘Fuji’

Question: can we produce disease-resistant cultivars to significantly reduce a reliance on antibiotics?

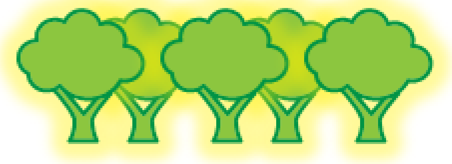
Answer: resistance genes to fire blight do exist, but are present in crabapple varieties that make traditional breeding difficult and lengthy

ca. 20-25 years for traditional breeding

Specialty Crops Research Initiative grant

Sundin + 10 other PIs

Disease resistant cultivar (Scab and fire blight resistance)



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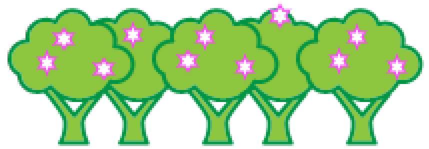
Reduced juvenility T1190 (*Transgenic apples with early flowering gene*)



Good fruit quality cultivar (Crispiness e.g., HoneyCrisp, SnapDragon)

Reduced juvenility ~ 3-8 months, enables one generation cycle per year.

Awais Khan
Cornell Univ.

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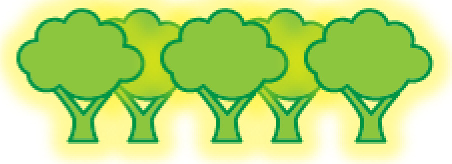

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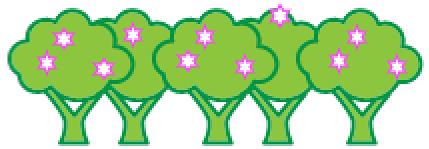

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Marker-assisted selection is used to track resistance genes, quality genes, and the early flowering transgene in progeny.

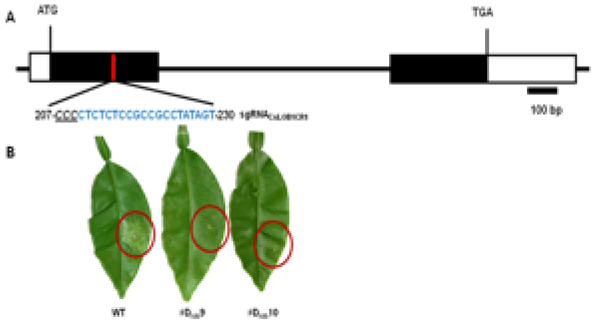
At the end, in the last cross, the transgene is selected against.

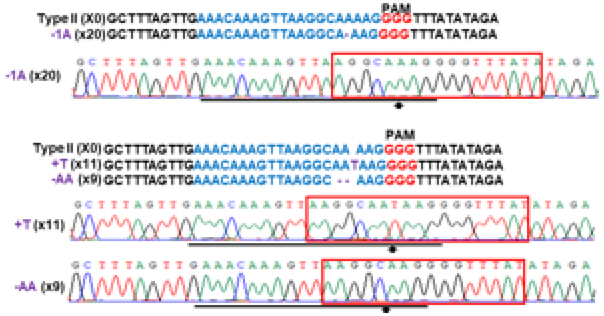
Final cultivar is not transgenic, and is of high quality and contains R genes.

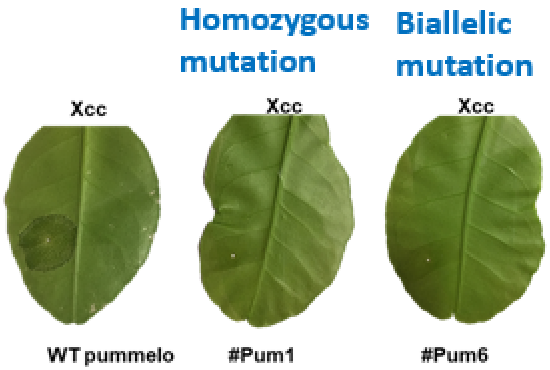
Awais Khan
Cornell Univ.

Generating canker resistant citrus

Nian Wang, Univ. of Florida
Identifying susceptibility genes of citrus; silencing them using CRISPR technology







Duncan grapefruit, 89.36%, coding region

Homozygous canker-resistant citrus, 100%, T0 generation, Pummelo , promoter region

Gene editing the promoter region and coding region of the canker susceptibility gene CsLOB1 generates canker resistant citrus.

Nian Wang, Univ. of Florida
Similar approach ongoing for HLB disease

Jia and Wang 2020 Plant Biotechnology
Jia et al. 2017 Plant Biotechnology

Incorporating disease resistance into fruit trees

- **Relies on new genetic technologies**
  - **Sped-up breeding using an early flowering gene**
  - **Identification of susceptibility genes**
  - **Gene silencing approaches**
- **Breeding in multiple resistance genes**
- **Silencing a susceptibility gene**

- **Goal: to generate hosts where antibiotic use is unnecessary – use methods such as biological control for disease control**
- **Time horizon: 10-20 years apple; < 10 years citrus**