Peach Genetics and Breeding for the Future

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USDA-AFRS Our Goals -

Develop New Fruit Varieties with:

-Improved Fruit Quality and novel fruit traits

- Improved Disease Resistance

- Improved Growth Habit

- Methods for genetic engineering of tree fruits

- New, more rapid and efficient breeding methods

What have we achieved in

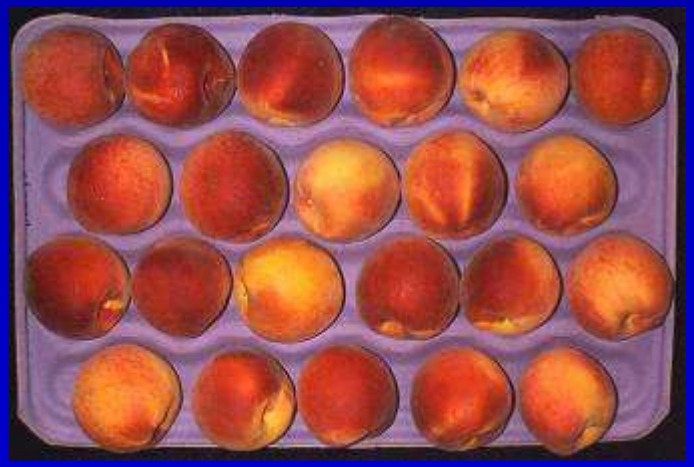
Stone Fruits released from AFRS

NectaFest (N) (UP) July 20-Aug 5

EarliScarlet (N) July 25-Aug 10

Sentry July 20-30

Crimson Rocket (PI) Aug 15-Aug 30



Bounty Aug 20-Sept 10

Flavrburst peach Aug 20-Sept 10

SummerFest (UP) Aug 30-Sept 20

Sweet-N-UP (UP) Aug 25-Sept 10

TruGold peach August 1 -10
(true from seed)

European (prune) plums

Bluebyrd
(black knot resistant)
early Sept

Orablue (extra large size)
Mid Sept-early Oct

HoneySweet
(PPV and black knot resistant)
early Sept

Pears

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CLASSICAL BREEDING - HIGH QUALITY FRUIT VARIETY RELEASES:

Blake's Pride

Gem

Potomac

Sunrise

Shenandoah

High Quality
Fire blight resistant


now
future
past

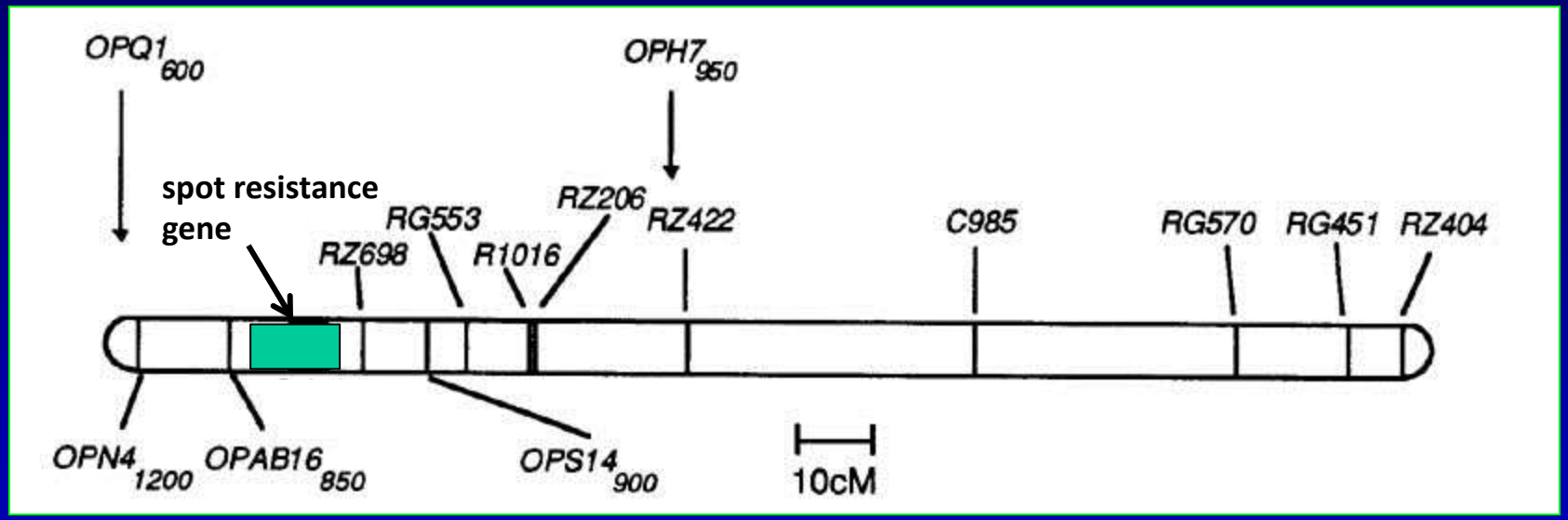
Improved Disease Resistance

Bacterial leafspot + “super-sweet” fruit

Past - Classical Breeding Approach:

Cross resistant by susceptible
Evaluate spot
Choose best resistant
+ fruit quality

Future – Use molecular markers



- Isolate DNA from seedlings in the greenhouse.
- Eliminate susceptibles based on markers.
- Plant only resistant types in the field, evaluate fruit quality.

(One marker probably not enough for all spot races.)

Present/Future – Genetic Engineering

Plum pox virus Resistance

Making Prunus resistant by inserting part of the PPV genome into the plant DNA

(strategy similar to vaccination, use the plants natural resistance mechanism)

'HoneySweet' is highly resistant to plum pox.

Tested in field plots in Europe for 20 years with no reported natural infections.

Approved for cultivation in the U.S.

Novel fruit attributes

….three recommendations for the fresh industry to increase consumption: **reduced inconvenience**, marketing beyond just health benefits and better cooperation along the supply chain. – Rabobank Report 2013

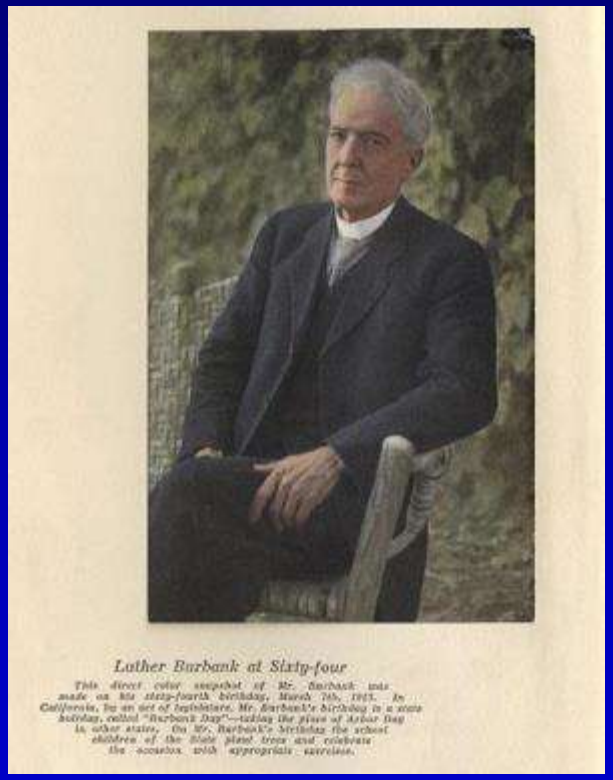
Not a bad peach. A bit messy though…..

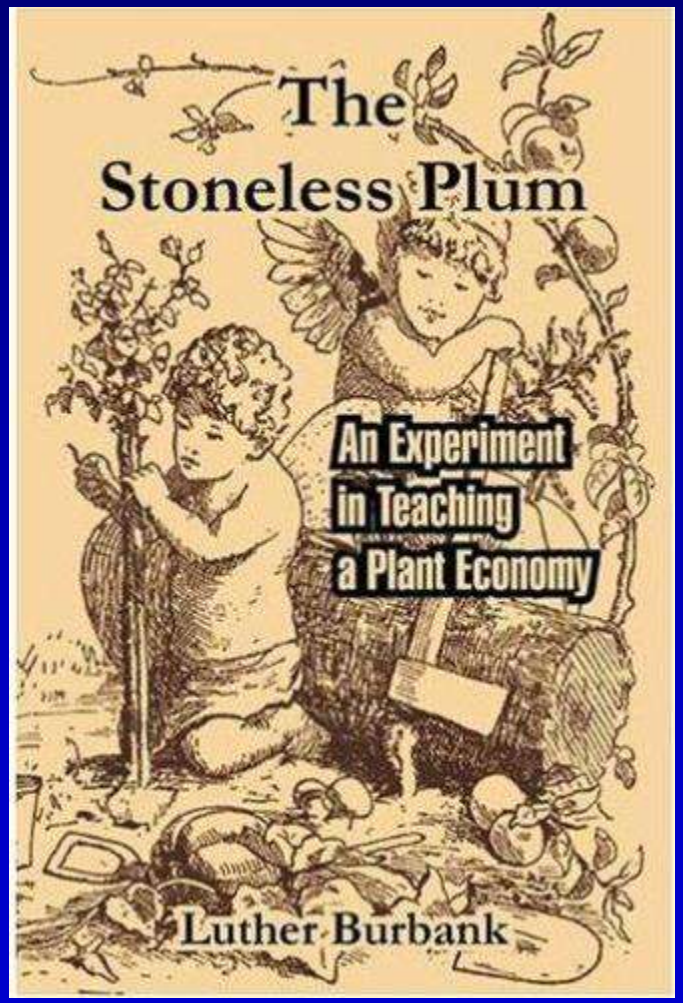
Why do I always sit in the wrong seat !

Oops, now a sticky phone ☹

A candy bar would have been so much neater…….

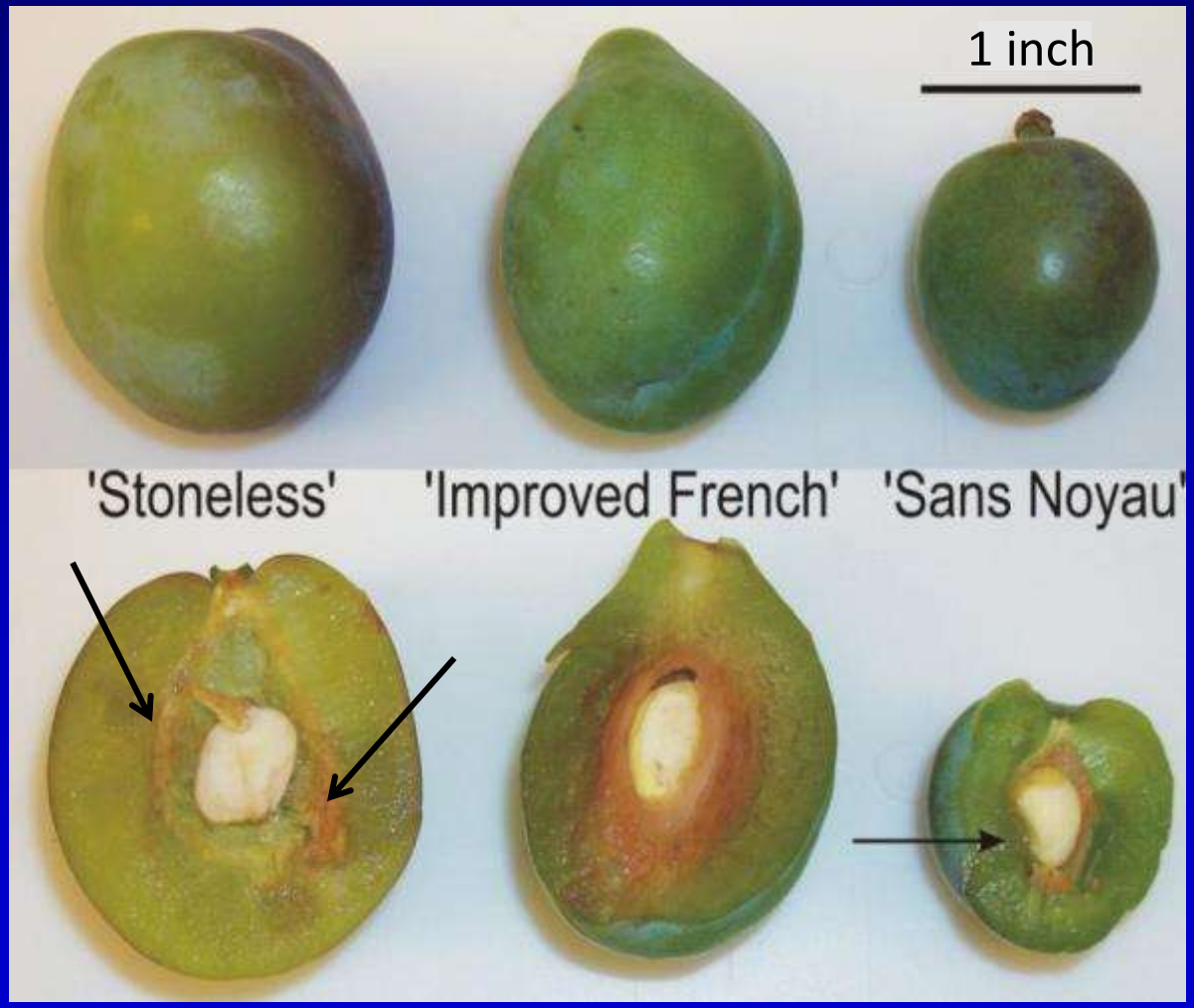
In the late 1800s and early 1900s, Luther Burbank took on the challenge of creating a series of stoneless plums through a classic breeding approach of combining a poor quality fruit, nearly stoneless plum with commercial quality plums.





While he came close he was not entirely successful

Improving Burbank's 'Stoneless' cultivars by identifying the gene(s) responsible for stone development



THE FUTURE

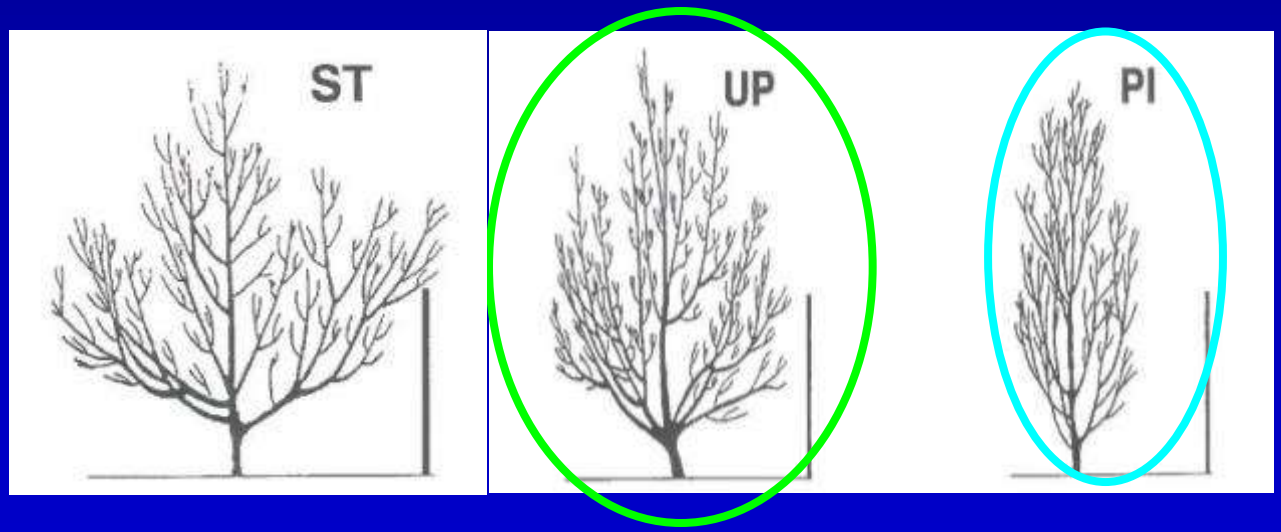
Stoneless/seedless stone fruits

nectarines, peaches, plums, cherries, apricots, almonds!!!!

Improved growth habit

Past and Present - Classical Breeding:

Development of peach tree growth habits more suited to high-density production systems and mechanical thinning and harvesting.



Crimson Rocket,
Sweet-N-UP
SummerFest
NectaFest
were released and new selections are in the pipeline.

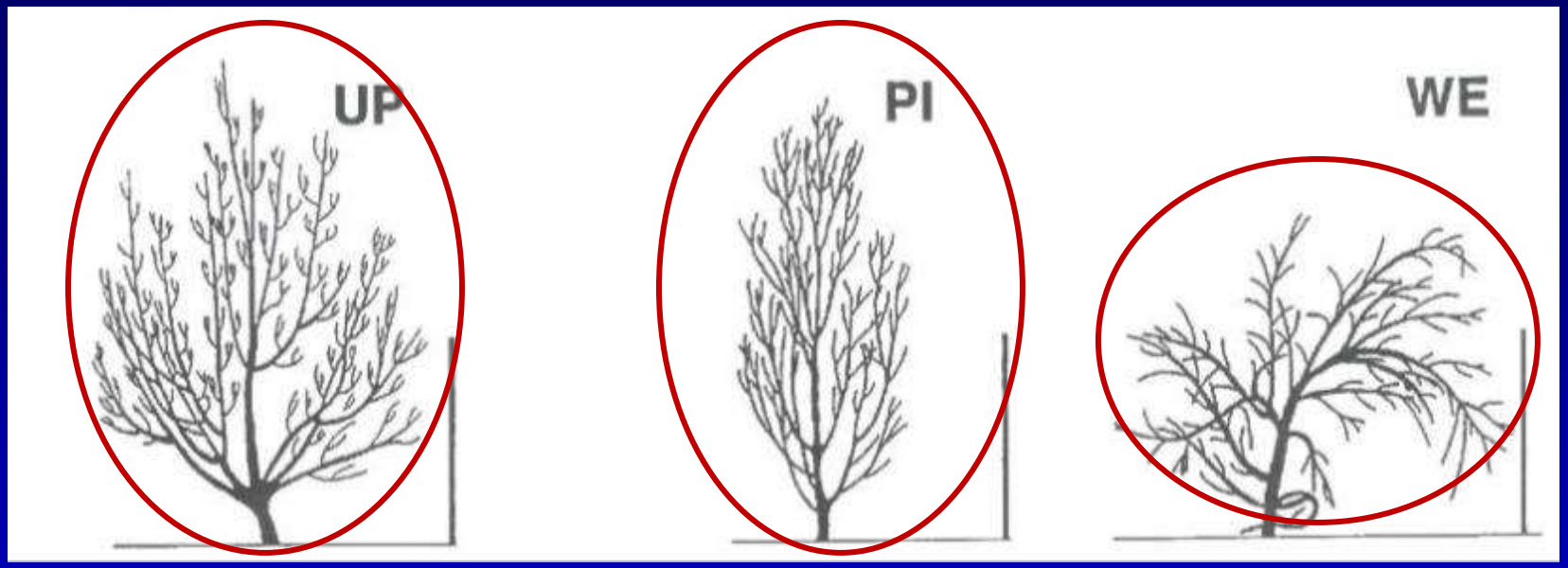
Improved growth habit

Extract DNA of PILLAR TREES → Gene Sequencing

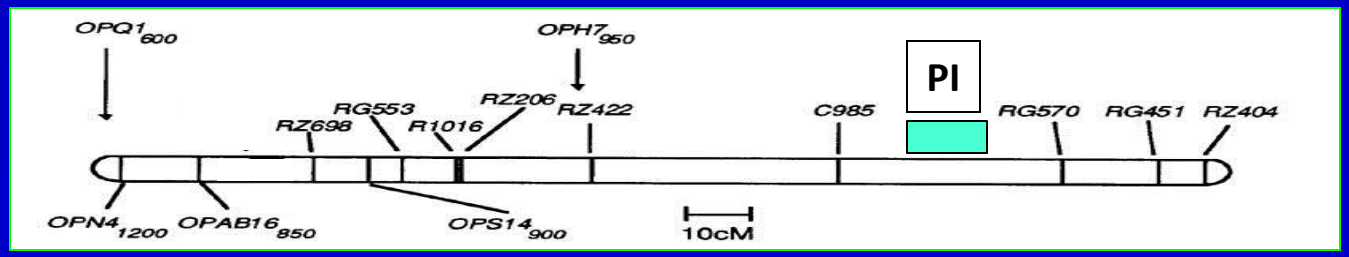
FIND THE DNA THAT IS ONLY
IN THE PILLAR TREES
AND NOT IN THE STANDARD TREES
<u>OR</u> ONLY IN THE STANDARD TREES
AND NOT IN PILLAR TREES

Improved growth habit

We now know the genes that cause pillar, upright, weeping and dwarf peach tree growth!



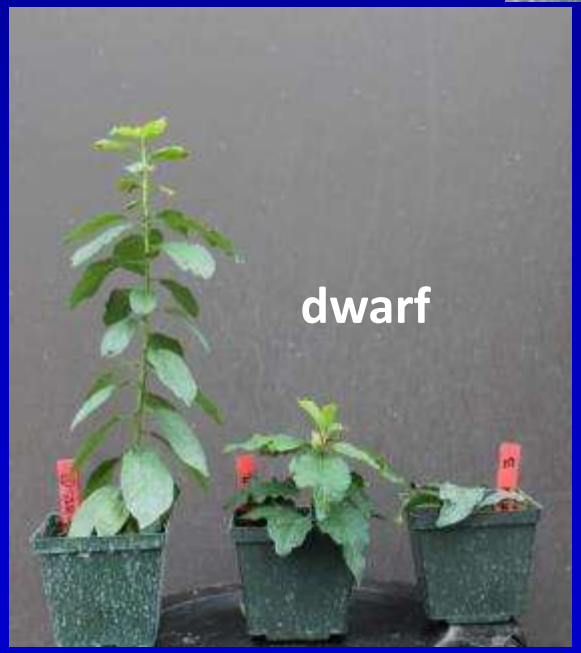
We can use these genes as markers for growth habit in conventional breeding and for genetic engineering to produce trees in the desired shapes.



Improved growth habit

Improved growth habit

We are now entering a stage in technology where we can foresee changing tree growth through genetic engineering by single gene engineering or by using multiple genes to create entirely new forms for specific growing systems.



Hollender et al., Unpublished

Improved growth habit

We are also investigating the development of GE dwarfing rootstocks in order to take existing popular rootstocks and add a dwarfing component.

Bartlett Pear grafted to :

Control rootstock GE 1 GE 2 GE 3

New breeding methods

Traditional breeding of stone fruits is a 3 - 7 year cycle. Breeding, carried out in the field, is affected by climate, diseases, and insect pests. Not every year is successful.

Pollination

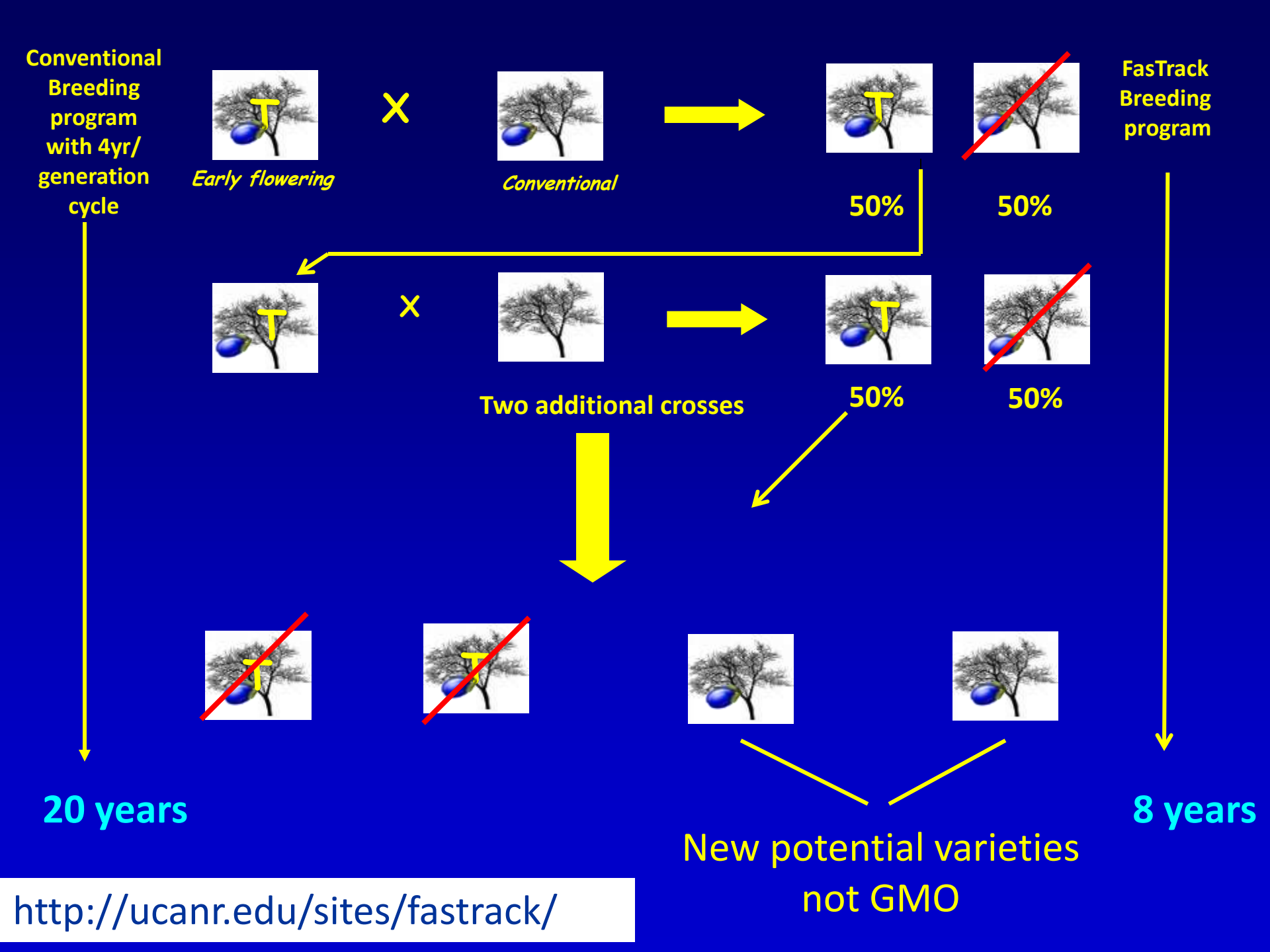
Protecting pollinations

Field planting seedlings

The Future

- Developing breeding systems based on genetically engineered early flowering parents, rapid cultivar development with a final product that is not genetically engineered.

Plum with a rapid flowering gene produces ripe fruit 9-12 months from seed.
Normally, plum fruiting requires 4-6 years from seed planting.



http://ucanr.edu/sites/fastrack/

Simultaneous Development of Flowers and Fruit

‘FasTrack’ plums flowering and fruiting in the field April - August

Early summer

Mid summer

September

Early and continuous flowering and fruiting allows 'FasTrack' Breeding to be carried out in green- or screen-house

We use genetic engineering to speed the breeding process but in the final set of crosses we only select the trees that are not genetically engineered for variety development.

We are working with plum breeders in California to more quickly develop improved prune varieties.

Why we need more rapid tree breeding

Citrus greening

Chestnut blight

Plum pox virus

Dutch elm disease

Hemlock woolly adelgid

African Fig Fly

Pine Shoot Beetle

Spotted Wing Drosophila

Emerald ash borer

Oriental fruit fly

Asian longhorn beetle

White pine blister rust

Citrus canker

Brown marmorated stink bug

Better Fruit Trees Through Research

We need to hear from you with your questions, comments and hopefully your support