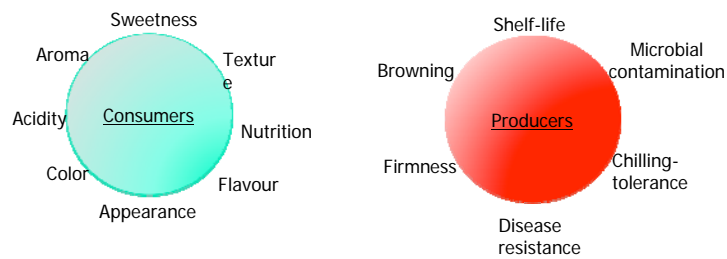




Postharvest Quality

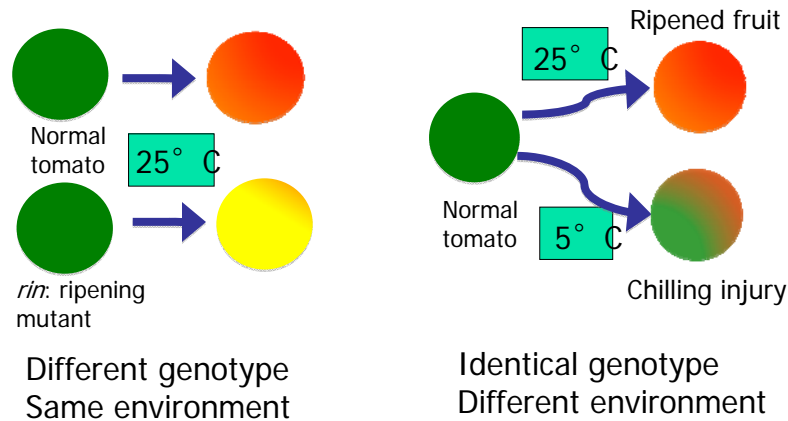
- The factors that ensure maximum income for producers as well as meeting the nutritional and aesthetic needs of the consumer after horticultural crops are harvested.
 - Producers and consumers often have opposing wants



Genotype

- The genetic composition of an organism.
- Contains all of the information that determines final characteristics.

Postharvest traits are due to the interaction of the environment and genotype



Power of biotechnology

Biotechnology can be used to change the gene composition and create genetically engineered organisms (GEOs) with enhanced traits - including those with improved postharvest qualities.



Desirable traits for improving Postharvest Quality of produce

- Improved flavour, texture, colour
- Long storage
- Delayed ripening
- Enhanced nutrition and health benefits
- Better food processing
- Nutraceuticals

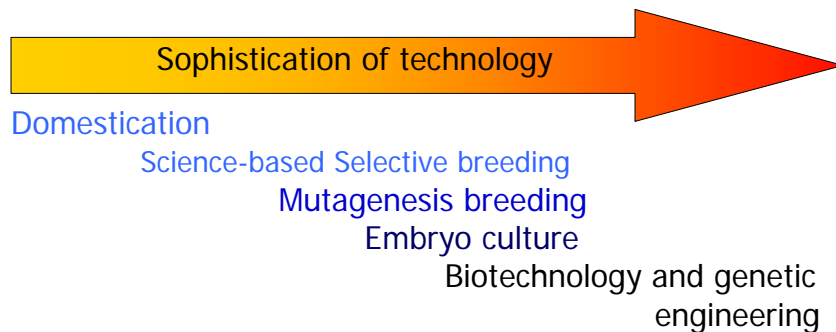


MYTH: Genetic modification of crop plants is new

False: All crop plants have been genetically modified



Biotechnology is another (more sophisticated) tool used to genetically modify crop plants





Genetic modification of crop plants

- 1. Domestication.
- 2. Selective breeding.
- 3. Mutagenesis breeding.
- 4. Embryo culture.
- 5. Biotechnology.



Domestication: cultivated vs wild tomato



Wild
tomato

Modern cultivated
tomato

From Frary et al., 2000 Science

Wild banana vs modern cultivars



Wild banana with seeds

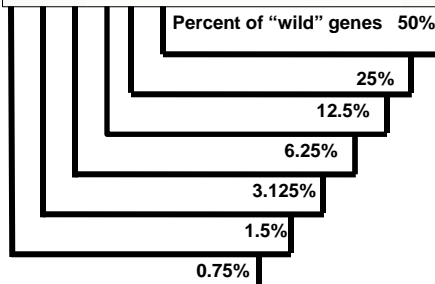


Cultivated banana- sterile

Genetic modification of crop plants

- 1. Domestication
- 2. Selective breeding
- 3. Mutagenesis breeding
- 4. Embryo culture
- 5. Biotechnology

2. Selective breeding



Using the wild tomato species as a source of genes for nematode resistance

Six or more generations of backcrosses to the cultivated parent, selecting for resistance at each generation

Kent Bradford, Depart Plant Sciences, UC Davis

Selective breeding



Cauliflower and broccoli were derived from the same genetic ancestor *Brassica oleracea*

California Agriculture vol 58 #2; <http://CaliforniaAgriculture.ucop.edu>



Genetic diversity



From : "What is Biotechnology?" by Dr. Peggy Lemeaux; University of California, Berkeley



Genetic modification of crop plants

- 1. Domestication
- 2. Selective breeding
- 3. Mutagenesis breeding
- 4. Embryo culture
- 5. Biotechnology

3. Mutational breeding



Radiation breeding: Texas red grapefruit variety Rio Red
Developed by mutation of Ruby Red. There are more than 2000
Crops which were produced by radiation

Chrispeels and Sadava, 2002 Plant, Genes and Crop Biotechnology: ASPB

Genetic modification of crop plants

- 1. Domestication
- 2. Selective breeding
- 3. Mutagenesis breeding
- 4. Embryo culture
- 5. Biotechnology

4. Embryo rescue- laboratory culture of plant embryos

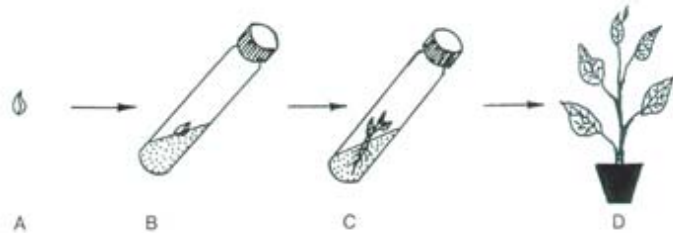


FIG. 8.4. Embryo culture. (A) Proembryo dissected 3 to 5 days after pollination. (B) Proembryo cultured on solid agar medium. (C) Plantlet developing from embryo. (D) Plantlet transplanted into soil.

- Inter-species crossing
- Embryo cannot naturally develop into a mature plant
- Embryo must be dissected and nurtured on media

Fruits cultivated by embryo rescue



Suplemeleven



Suapriseven



- Early-ripening stone fruit varieties
- All seedless grape varieties
- Small immature embryos that must be cultured individually in test tubes to grow a hybrid seedling.



Genetic modification of crop plants

- 1. Domestication
- 2. Selective breeding
- 3. Mutagenesis breeding
- 4. Embryo culture
- 5. **Biotechnology**



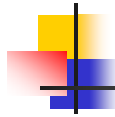
5. Biotechnology

- Manipulations done at molecular level.
- Specific genes may be changed.
- Gene function usually understood.
- Genes can be transferred between species.



Tenets

- All living organisms characteristics determined by DNA.
- DNA code broken – functions known for most DNA sequences.
- DNA is fundamentally the same in all organisms
- DNA should be interchangeable between species.



Gene identification

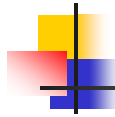
- Genes encoding important traits
 - Extended shelf-life
 - Insect, disease resistance
 - Uniform ripening
 - Increased sugars
 - Enhanced Aroma
 - Antioxidants



Gene manipulation

Gene expression in crop is altered in various ways

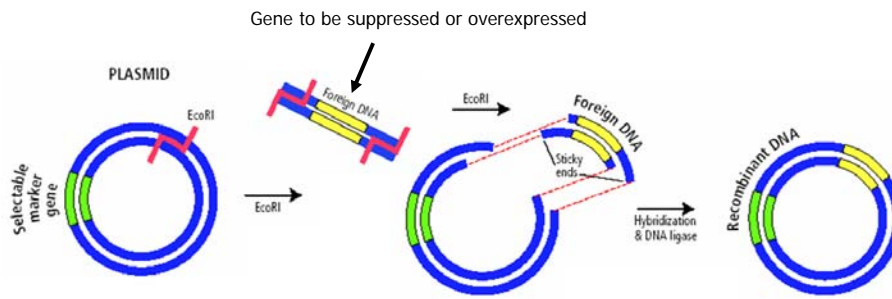
- Suppression (a deleterious gene)
- Over-expression (favourable gene)
- Modification (enhancing a characteristic)
- Transgene expression (introducing new function)



How genetic engineering of plants works

- A gene of known function in plant is identified (e.g. gene controlling fruit ripening) and isolated.
- The gene must be stably incorporated into plant.
- The gene must be heritable.

Genes are introduced into the plant using bacterial plasmid as vectors



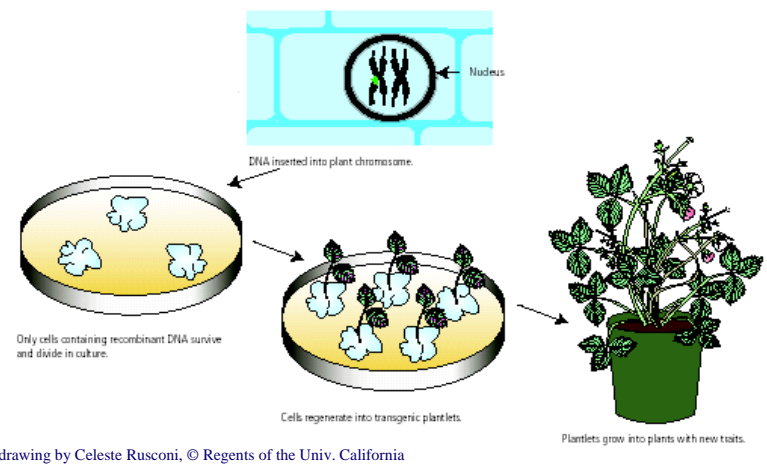
Plasmids are circular molecules of DNA found in bacterial cells. They confer survival to antibiotics

How to get the DNA into the plant

- *Agrobacterium tumefaciens* (more precise).
- Particle bombardment (random insertion of genes).



Regeneration from single cell to whole plant



Biotechnology & Postharvest biology

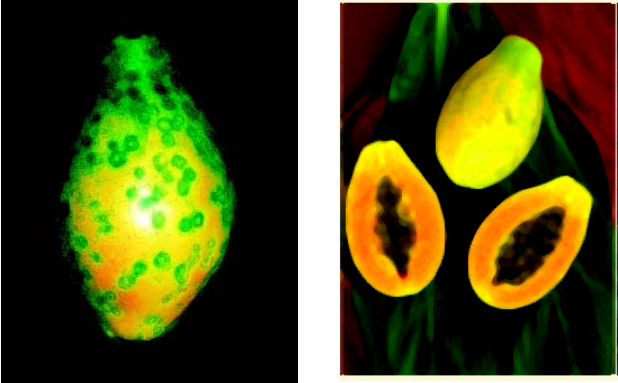
- Can we use these tools to improve the postharvest quality of horticultural crops?



Adel Kader, Dept Plant Sciences, UC Davis

Yes.....maybe

Transgenic papaya resistant to papaya ringspot virus



Non-transgenic Transgenic

California Agriculture vol 58 #2; <http://CaliforniaAgriculture.ucop.edu>

The image contains two side-by-side photographs of papayas. The left photograph shows a single papaya with a mottled, yellowish-green surface, characteristic of ringspot virus infection. The right photograph shows three papayas: one whole and two cut in half, revealing a healthy, bright orange-red flesh. The background of the images is dark, making the papayas stand out.



Transgenic plums resistant to plum pox virus



Non-transgenic fruit



Transgenic fruit

California Agriculture vol 58 #2: <http://CaliforniaAgriculture.ucop.edu>



Novel ornamentals



Florigene Moonshadow transgenic carnations; produces intense blue-violet colour.

Flavr Savr tomatoes – extended shelf-life



Chrispeels & Sadava, 2002 Plant, Genes and Crop Biotechnology: ASPB

Uniform/delayed ripening



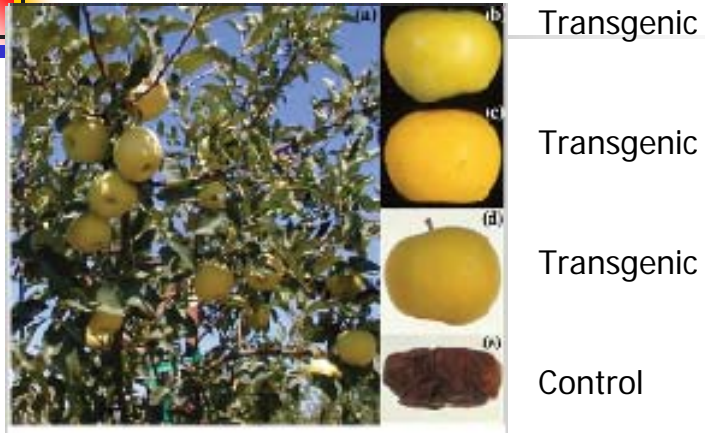
Non-transgenic
4-colours

Transgenic fruit
2-colours

- Transgenic tomatoes with altered ethylene production.
- Harvest can be done every 2 days instead of twice a day.
- Fruit stays in field longer without deteriorating.

From : "What is Biotechnology?" by Dr. Peggy Lemeaux; University of California, Berkeley

Delayed softening/ripening in transgenic apples



Dandekar et al (2004) Transgenic Research 13 373-384

What's the problem with GE?

Polarizing and disparate views of
the technology