



Apple Botany and History and Production

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Apples

- High diversity in cultivars (~ 20,000)
- High in vitamins, fiber, and antioxidants
- Intensively managed
- Can be picked ripe off the tree and eaten without any preparation



Botany and History

- Family: Rosaceae
- Genus: Malus
 - ~ 28-55 species
- Domesticated apple:
 - *Malus x domestica*
- Latest believed progenitor
 - *Malus pumila*
 - *Malus sylversii*



Figure 4. On arrival in the Tian Shan, the neo-apple likely resembled the tiny, long-stalked, bitter apple *Malus baccata*, the Siberian crab. (Illustration courtesy of Rosemary Wise.)

Botany and History

- Temperate zone tree fruit
 - In an area of the world ~ 30° north of the equator
 - Areas with cold winters



Botany and History

- Mechanisms for winter survival
 - Deciduous, loose their leaves in the fall
 - Dormancy
 - Chilling requirements

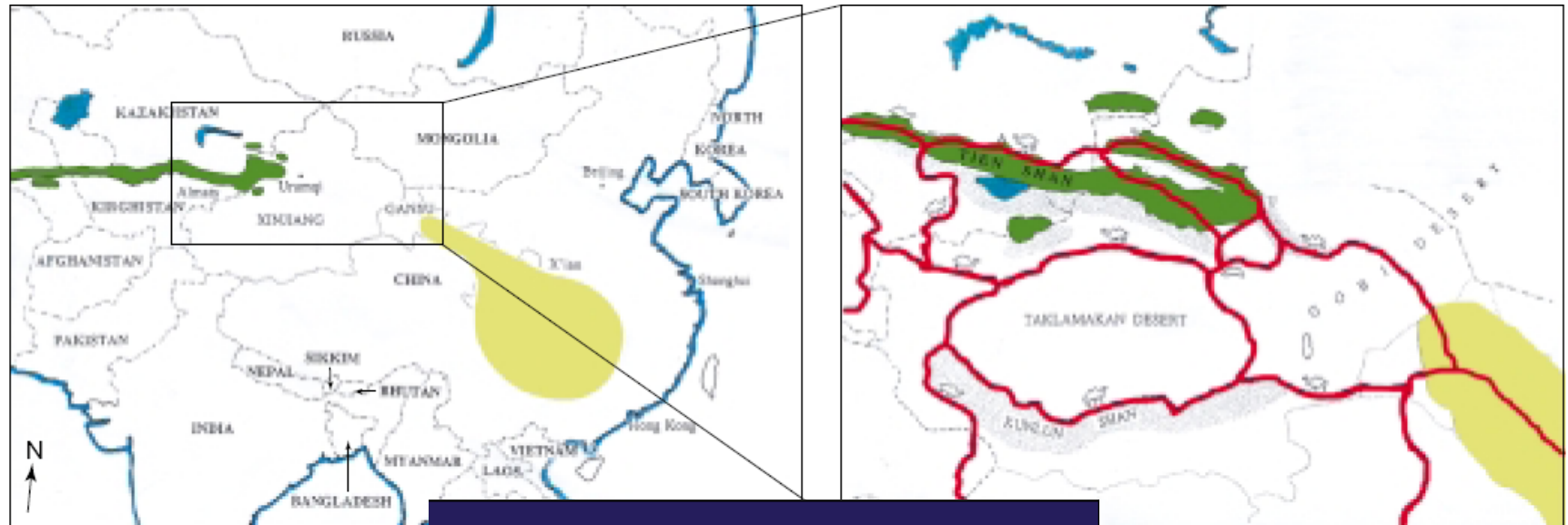


Botany and History

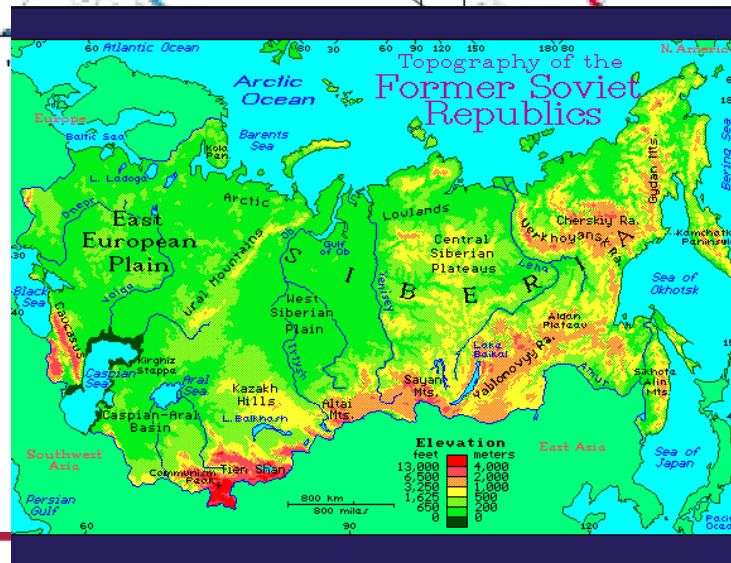
- Generally adapted for animal dispersal
 - Colorful fruit
 - Red is not the prominent color in the wild
 - High sugar content
 - It is believed the bear contributed much to its dispersal



Possible Center of Origin



Regions of high concentrations of



of *Malus sieversii*

'Silk roads'
TRENDS in Genetics

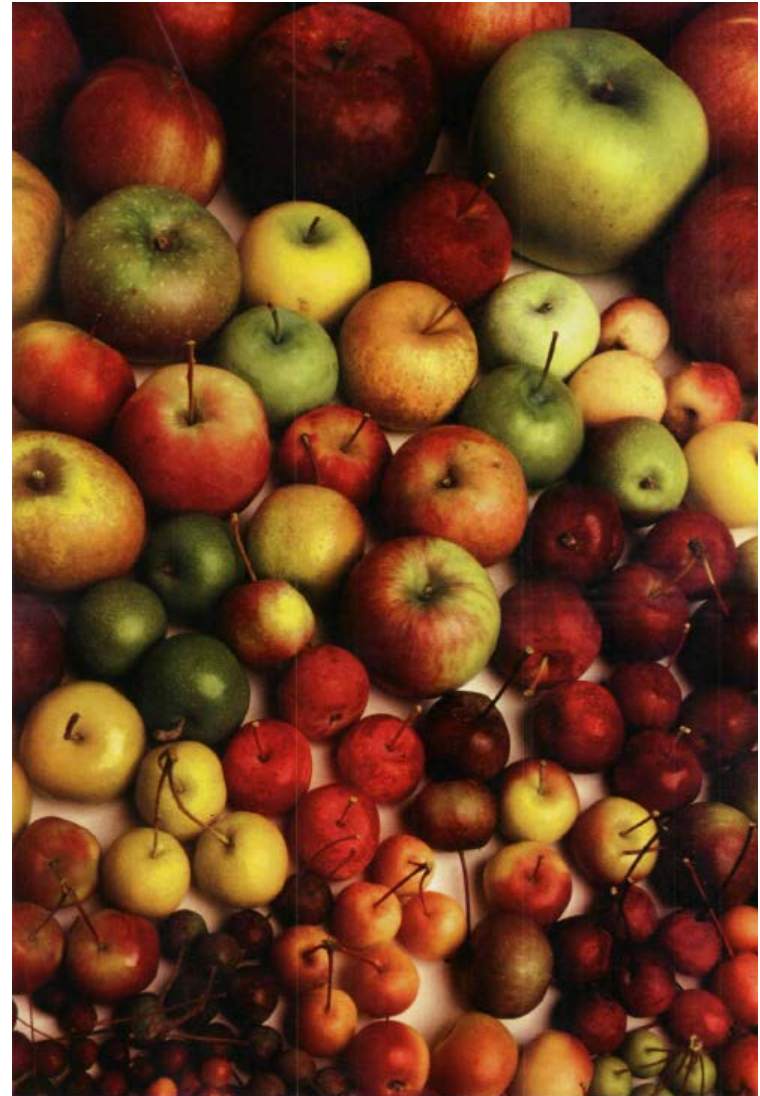
- In the Tien Shan (Heavenly) Mountain range (Kazakhstan, Tajikistan, Kyrgyzstan)







Neolithic apple



Genetic diversity in the wild



Botany and History

- Much folklore and myth
- Cultivated by primitive man
- Evidence of domestication by 10th century B.C.
- In 9th B.C., in *The Odyssey*, Homer wrote about apple trees

History

- **8,000 B.C.**—Nomadic hunter/gatherer societies invent agriculture and begin to "settle" in places throughout the "fertile crescent" from the Nile through the Tigris and Euphrates, the Indus, and Yellow River Valleys
- As both trade and military expeditions begin among these earliest civilizations, **apples quickly spread from the forests of their origin in the Tien Shan mountains of eastern Kazakhstan throughout the "*civilized*" world**

History

- **323 B.C.**—Theophrastos describes 6 varieties of apples and discusses why budding, grafting, and general tree care are required for optimum production and says seeds almost always produce trees of inferior quality fruit.

- **79 A.D.**—Pliny the Elder in his *Natural History* describes 20 varieties of apples.
- **200 A.D.**—Famous Greek physicians living in Rome, Galen and later Hippocrates, recommend **sweet apples** with meals as aids to digestion and sour apples only for fainting and constipation.

Legend

- In Greek mythology, Gaia, or Mother Earth, presented a tree with golden apples to Zeus and his bride Hera on their wedding day.
- Guarded by Ladon, a serpent who never slept, the apple tree was in the garden of the Hesperides, daughters of the Evening Star

Legend

- These golden apples became involved with many tales of love, bribery and temptation ranging from the abduction of Helen of Troy to the defeat and marriage of Atlanta.

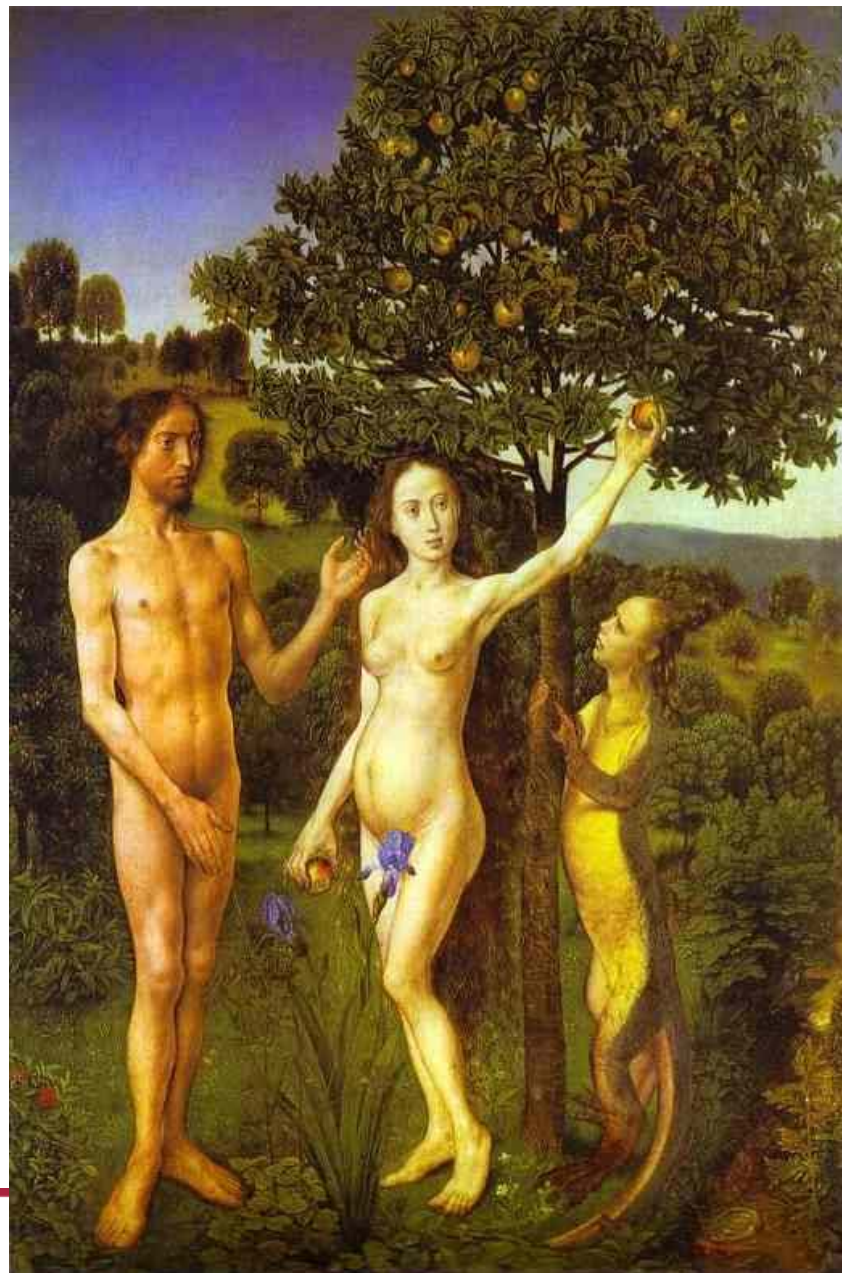


The Hesperides in the garden. Here the apples are on a tree, and the dragon Ladon looks more like a single-headed serpent.

London E 224, Attic red figure hydria, ca. 410-400 B.C.

Photograph courtesy of the Trustees of the British Museum, London

1470 A.D.—*The Fall of Man*, a painting by the popular and highly respected Hugo Van Der Goes, depicts an apple tree in the biblical Garden of Eden complete with Adam and Eve and the Devil. Thereafter artists everywhere choose apples for the Garden of Eden, even though the apples were no doubt borrowed from a similar creation story in Greek mythology, causing apple demand among illiterate Christians to plummet. Among learned Christians, e.g. in the monasteries and royal courts, apples continued to flourish.



Botany and History

- Brought into American continent by Canadian settlers
- First commercial orchard in the US~ 1600 in Maine
- Colonial: before 1800
 - called "pippins," prospered in New England, especially after the colonists imported honeybees to improve pollination.
- Cider-apple time - 1800-1875
 - In 1810:125 distillers/12,300 gal brandy in VT alone
- Farm orchards - 1875-1900
- Commercial - 1910-1940
- Specialized commercial - 1940-date

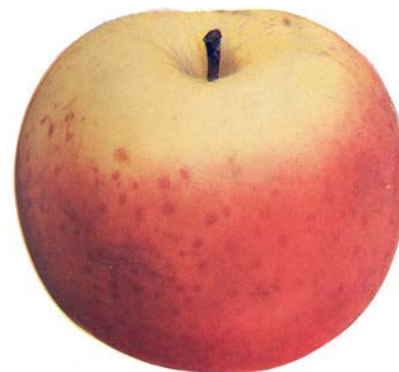
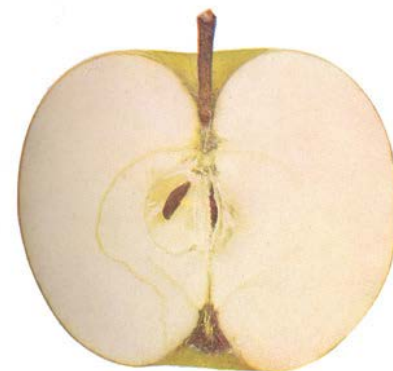
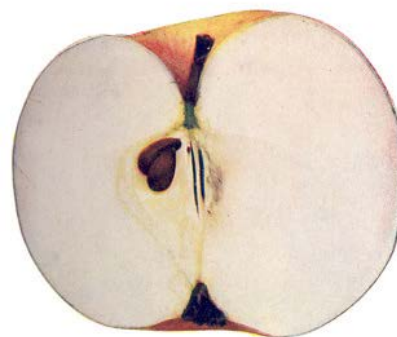


Old American Varieties

- Roxbury Russet



- Pippin:
 - Newton, Fall,
 - Cox Orange

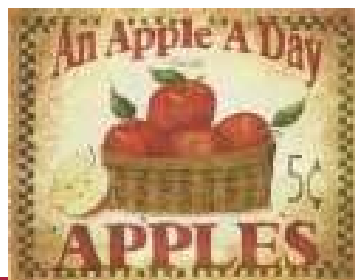


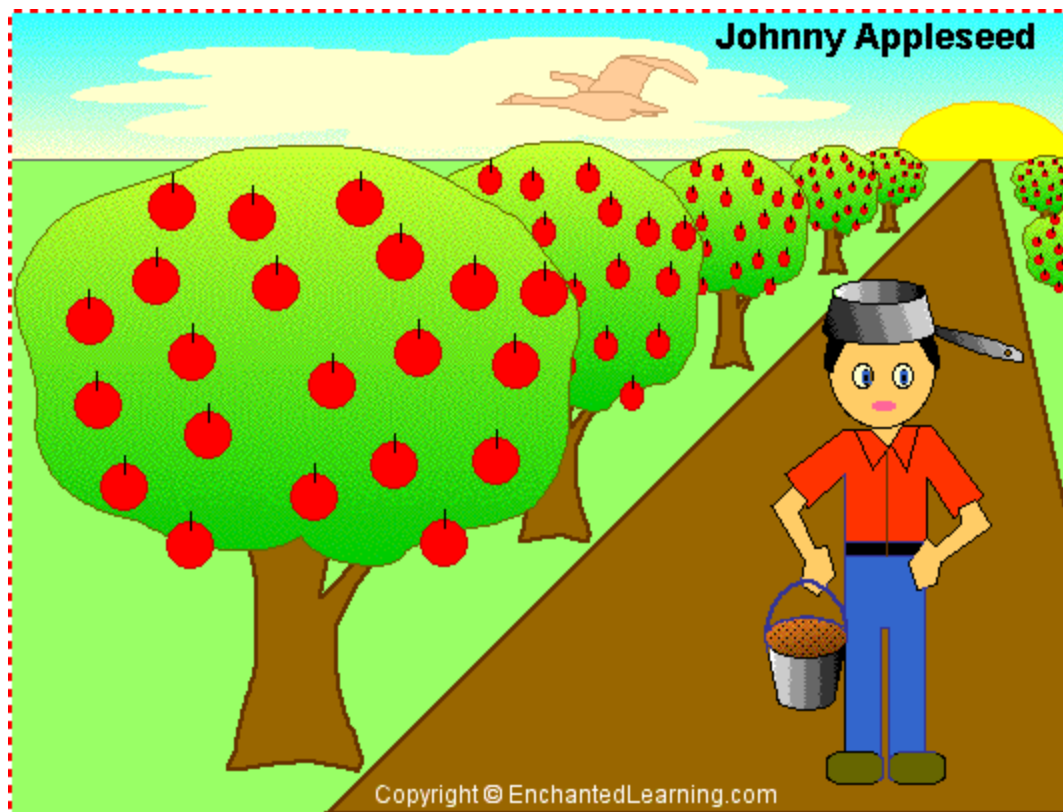
Cranberry Pippin



Fall Pippin

- "An apple a day keeps the doctor away" was an old adage, dating from the late 1904, that was updated into an advertising slogan, promoted by apple growers fearful that prohibition would cut sales.

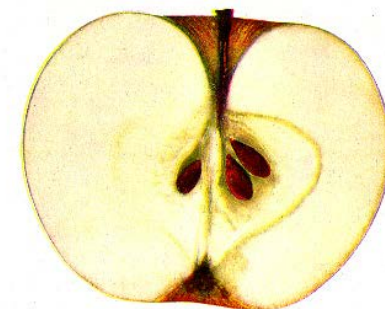




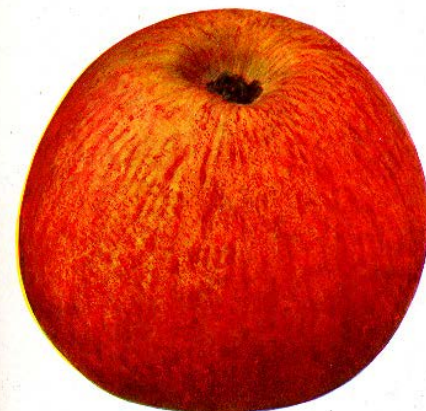
Horticulturist but also, a smart and shrewd real estate agent!

Arkansas Production

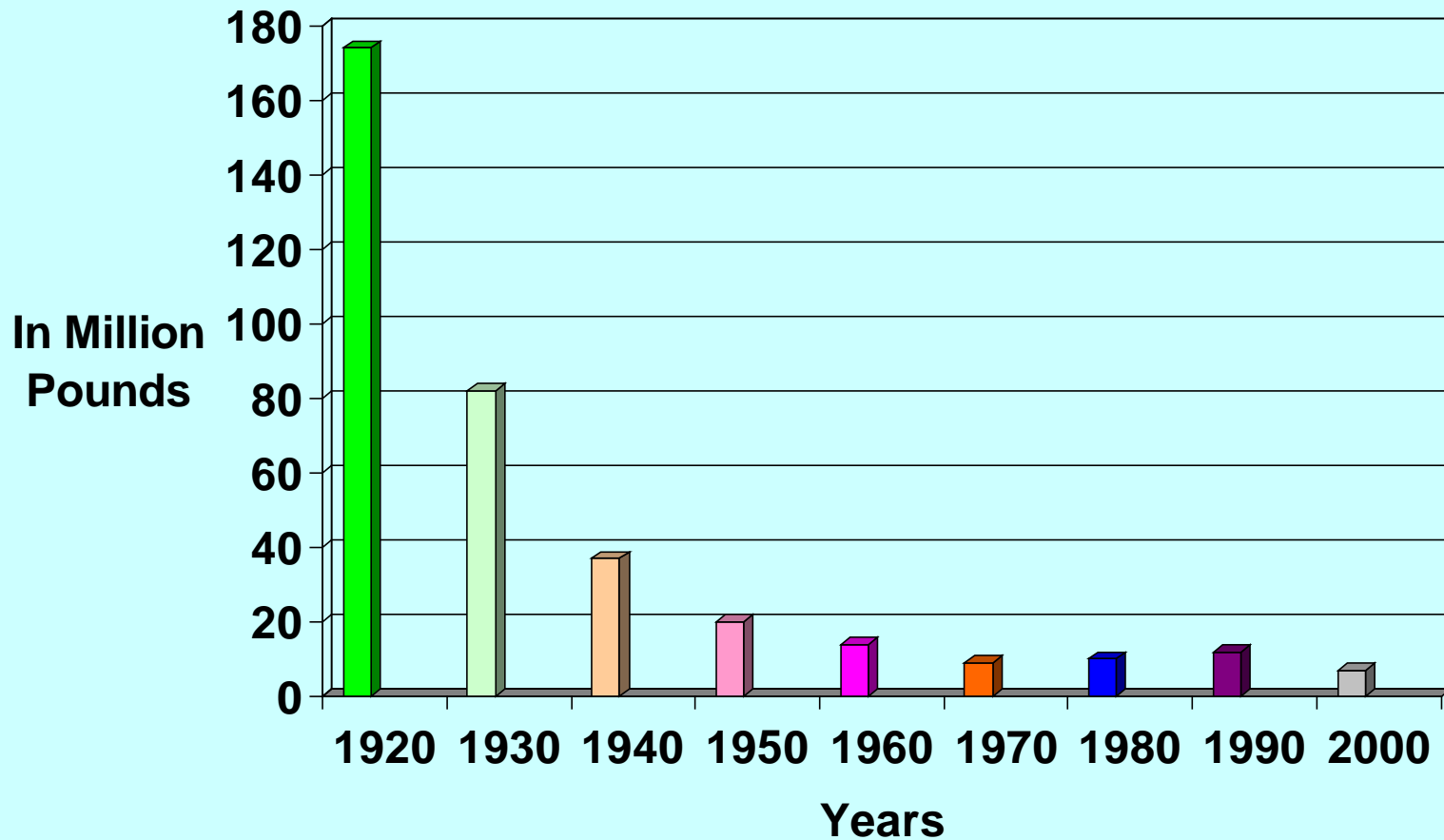
- In 1900, there were 1,613, 760 apple trees planted in Benton Co
- In 1907 , the largest crop on record: over 5 million bushels
- Industry based on Ben Davis
- Industry began to decline
 - Pest control
 - Prohibition
 - “Hawkeye” Red Delicious: Introduced in 1894



Ben Davis



Arkansas Apple Production







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ORCHARDING
IN THE OZARKS



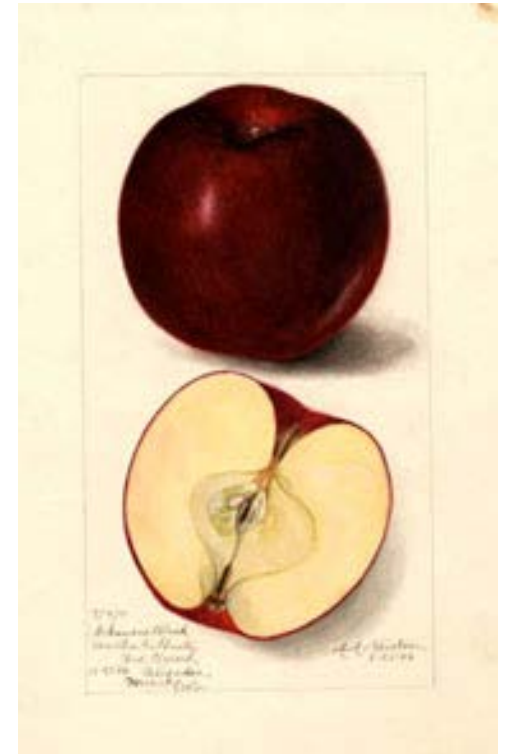




Crop from unsprayed tree. Fourteen sound apples on left,
1,275 scabby apples on right. 1.9% sound

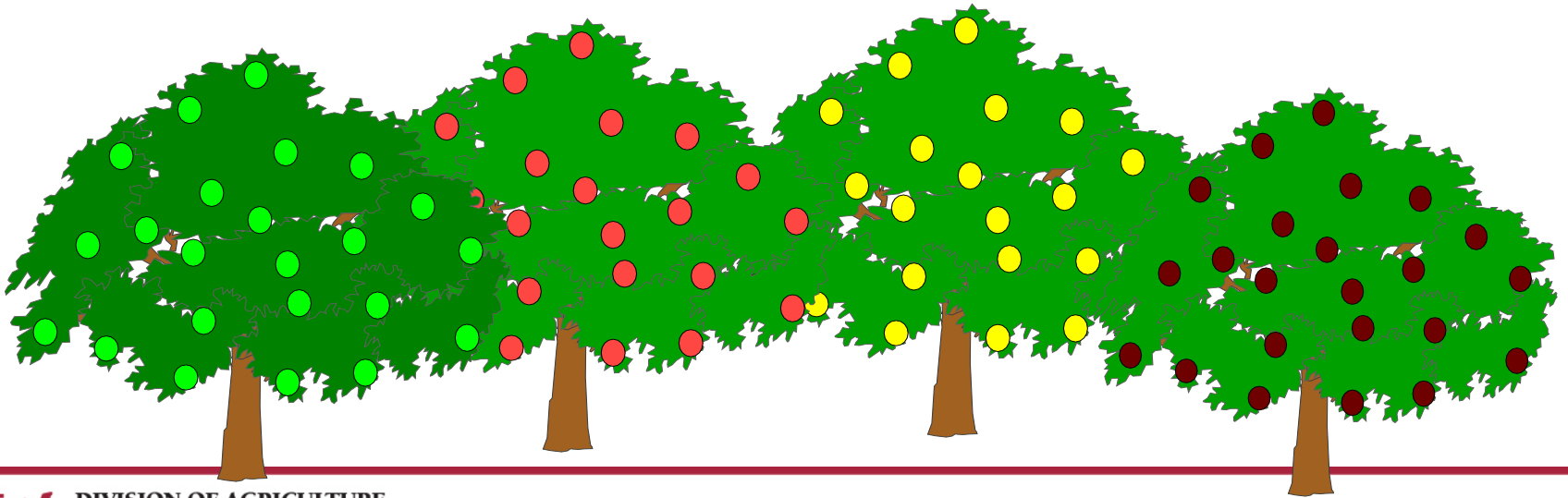
Arkansas Black

- Originated in Benton Co
- Bore its first fruit in 1870
- “It is one of the most beautiful apples. It is a good keeper and commands a good price....”
(The Apples of New York, 1905)



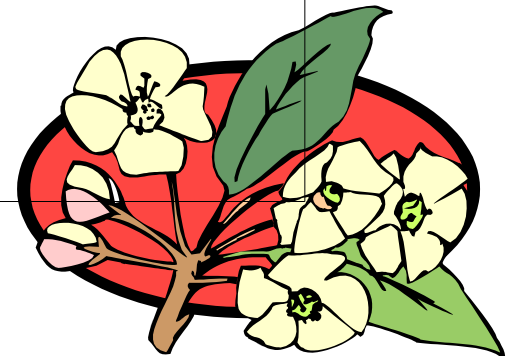
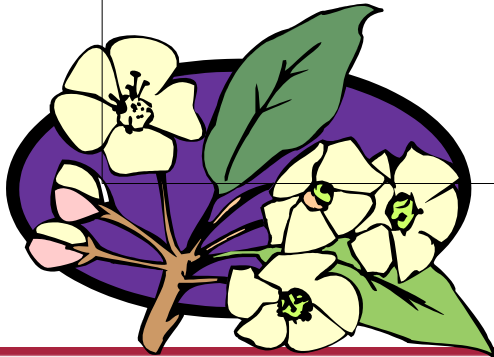
Botany and History

- The domesticated apple is genetically very diverse.
- It does not 'come true to seed'



Botany and History

- Most apple trees require cross pollination
 - You must have two different cultivars of apples in order to have fruit

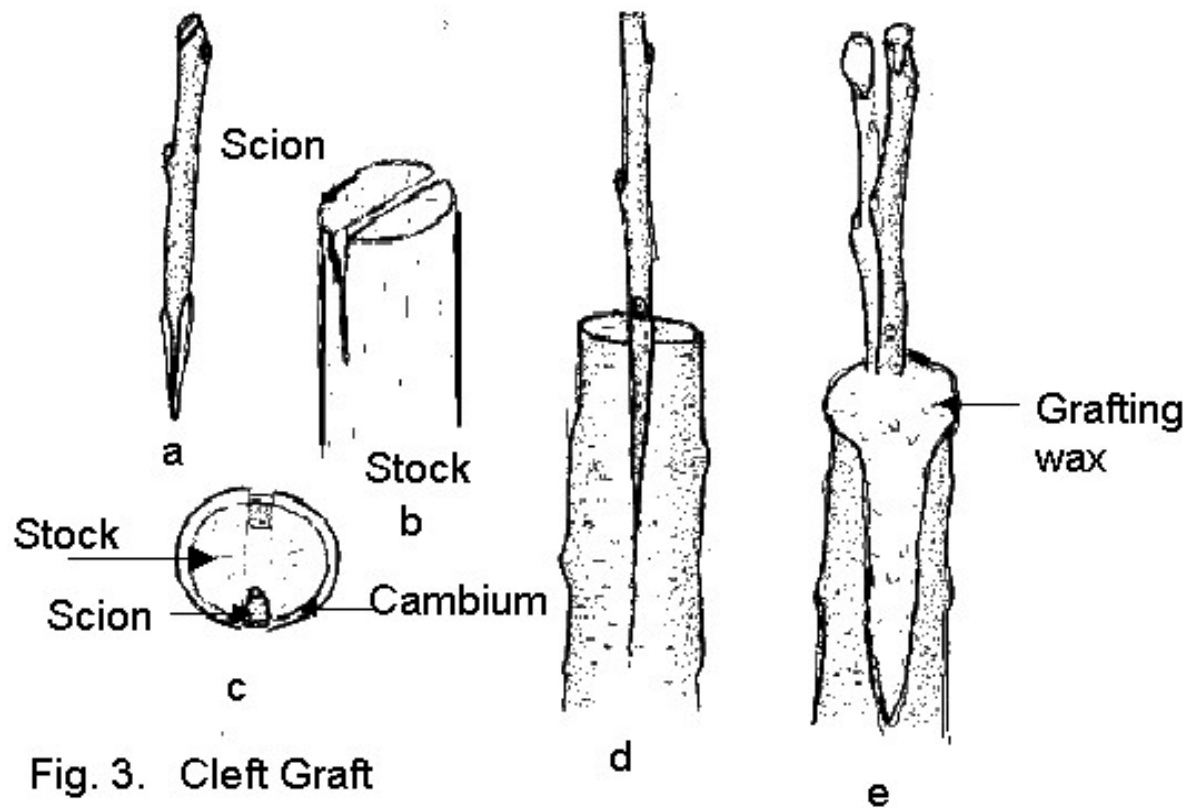


Apple propagation

- Asexual propagation or cloning
 - When you take part of one plant, place it into another plant, and let them grow together as a new organism

Asexual propagation used in apples

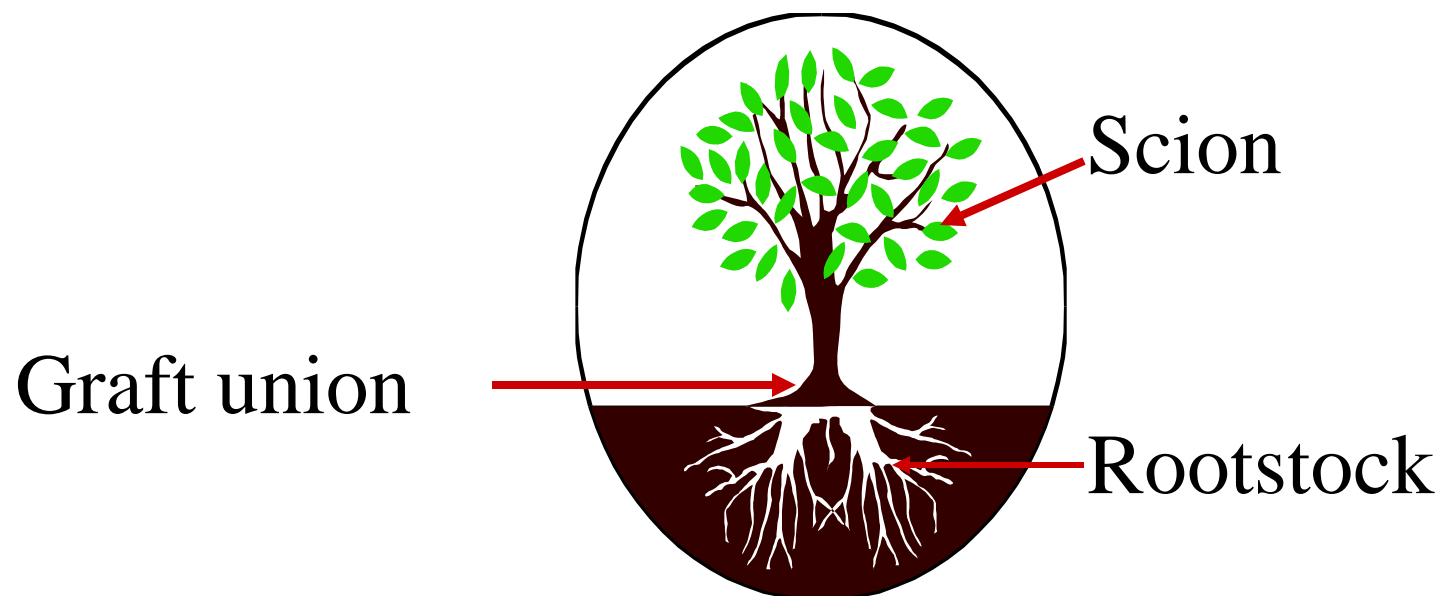
- Grafting
- Budding





Cultivars and Rootstocks

- All commercially sold apple trees consist of two parts



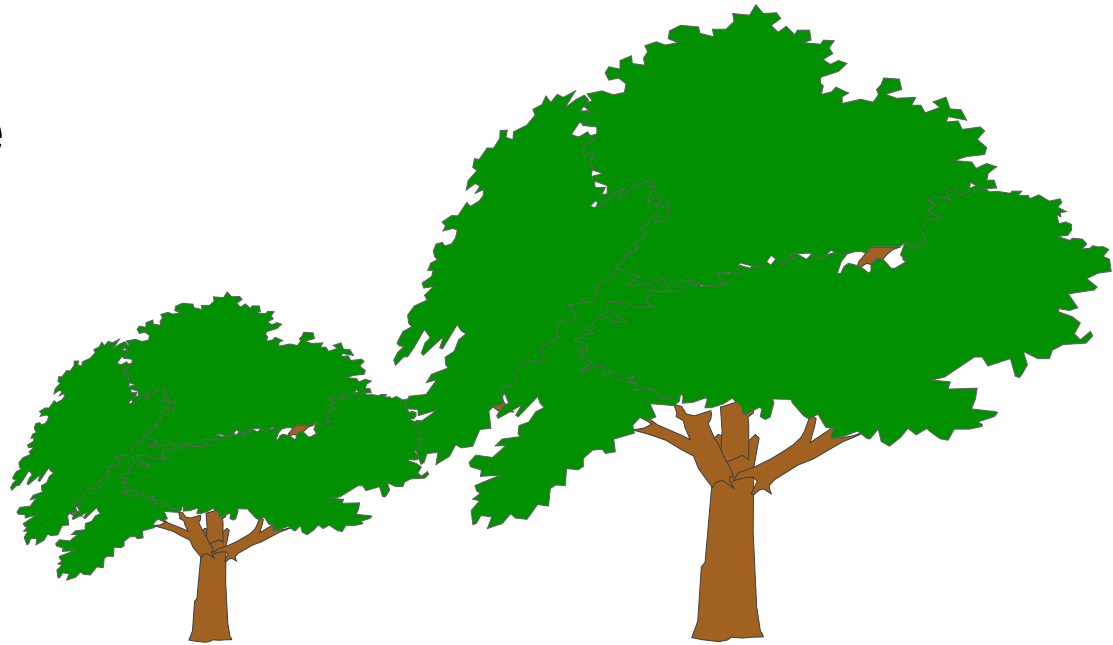
Cultivar and Rootstock

- What to look for in a cultivar
 - Appearance
 - Taste
 - Disease resistance
 - Insect resistance
 - Climatic adaptability



Cultivars and rootstocks

- What to look for in a rootstock
 - Climatic adaptability
 - Soil type adaptability
 - Pest resistance
 - Overall tree size
 - standard
 - semidwarf
 - dwarf



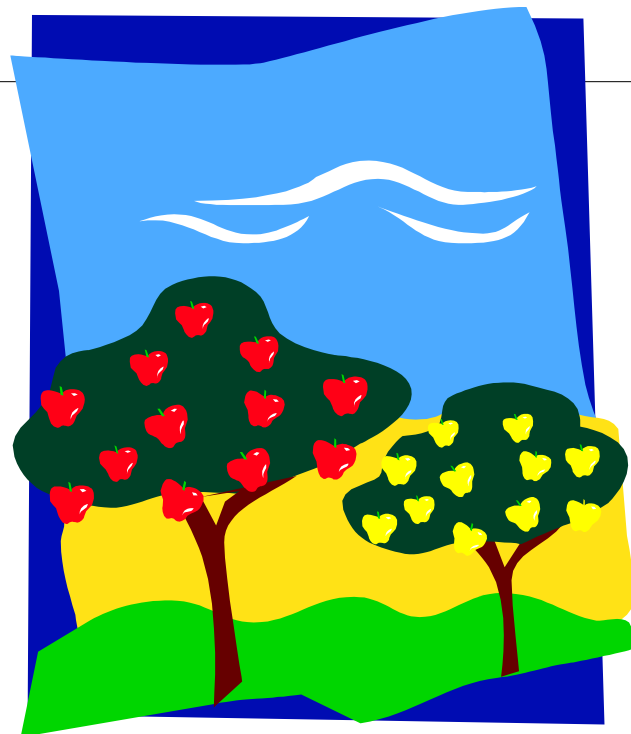
Apple cultivars or varieties

- Cato the Elder: 1st B.C.
 - 7 varieties
- 1st century A.D.
 - 36 varieties
- Today, there are approximately 20,000 different kinds of apple
- Where do these cultivars come from?

Origin of cultivars and varieties



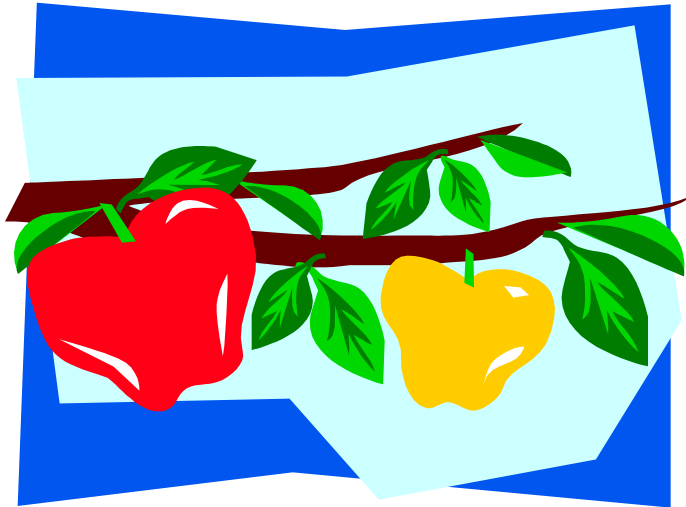
Wild seedlings



Hawkeye- Red Delicious

Origin of cultivars and varieties

Mutations



Bud sport

Yellow Delicious

Origin of cultivars and varieties

Breeding programs where crosses are made

‘Liberty’



Disease Resistant Cultivars

- ‘Field immune’ to apple scab and have varying degrees of resistance to other diseases
 - Liberty
 - Williams Pride
 - Redfree
 - Jonafree
 - Pristine
 - CrimsonRed
 - GoldRush

Genetically engineered apples

- None to date commercially
- **1989** Researchers at Cornell University used a "**gene gun**" to successfully transfer an anti-bacterial gene from a *Cecropia* moth to a fire blight susceptible apple tree.
- This gene transfer from an animal to a plant enabled the tree to develop its own fire blight resistance and trees made from buds or graft wood from this tree also had blight resistance.
- Bio-tech as demonstrated could save the apple industry and consumers millions of dollars.

Genetically engineered apples

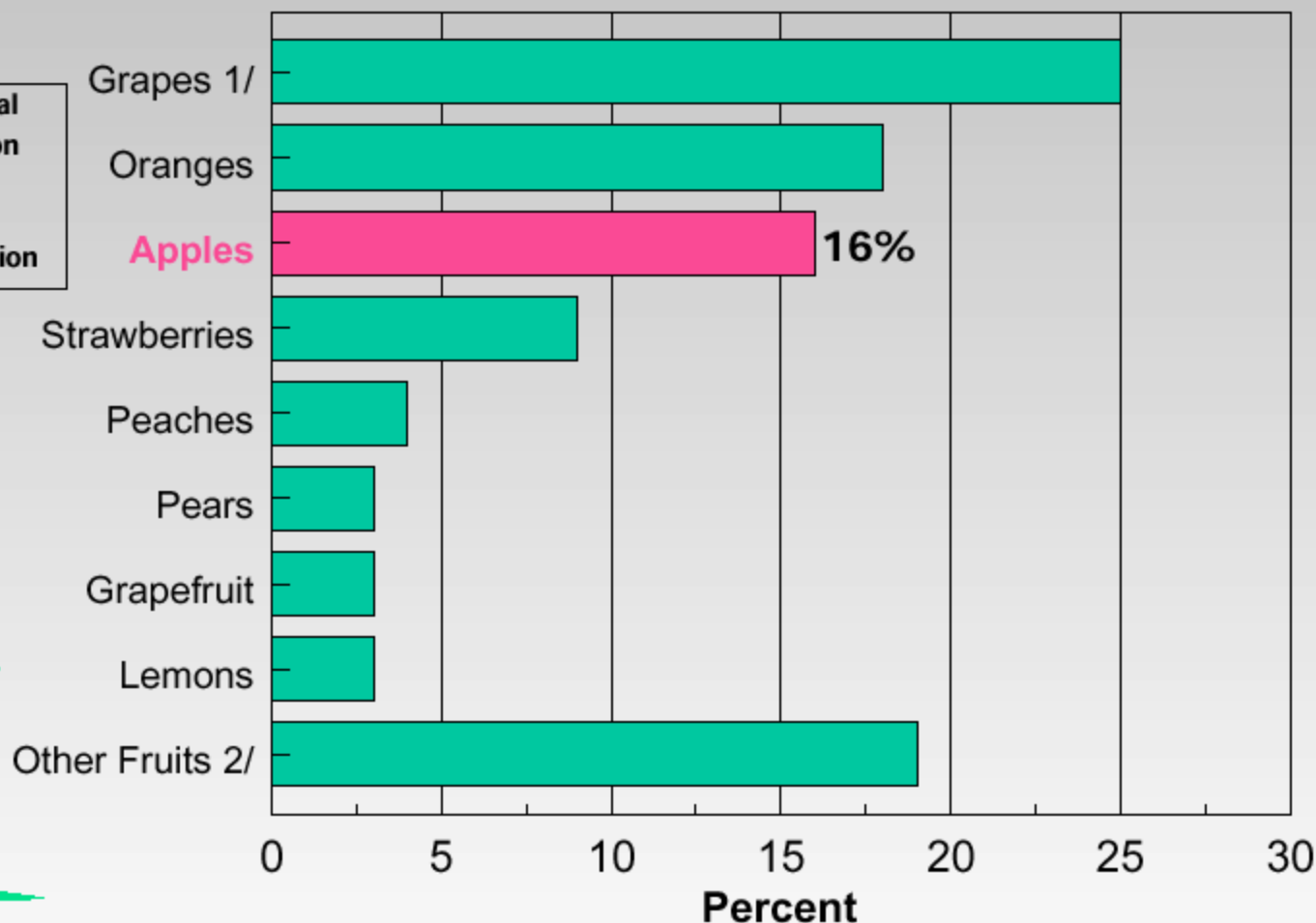
- Disease resistance
 - Fire blight resistant Gala
- Insect resistance



Apple Production Is Extremely Important To The Income Of U.S. Fruit Farmers

Source: USDA National Agricultural Statistics Service

Percentage share of the total value of U.S. fruit production during the period 1995/96-1998/99, which is estimated at \$10 billion



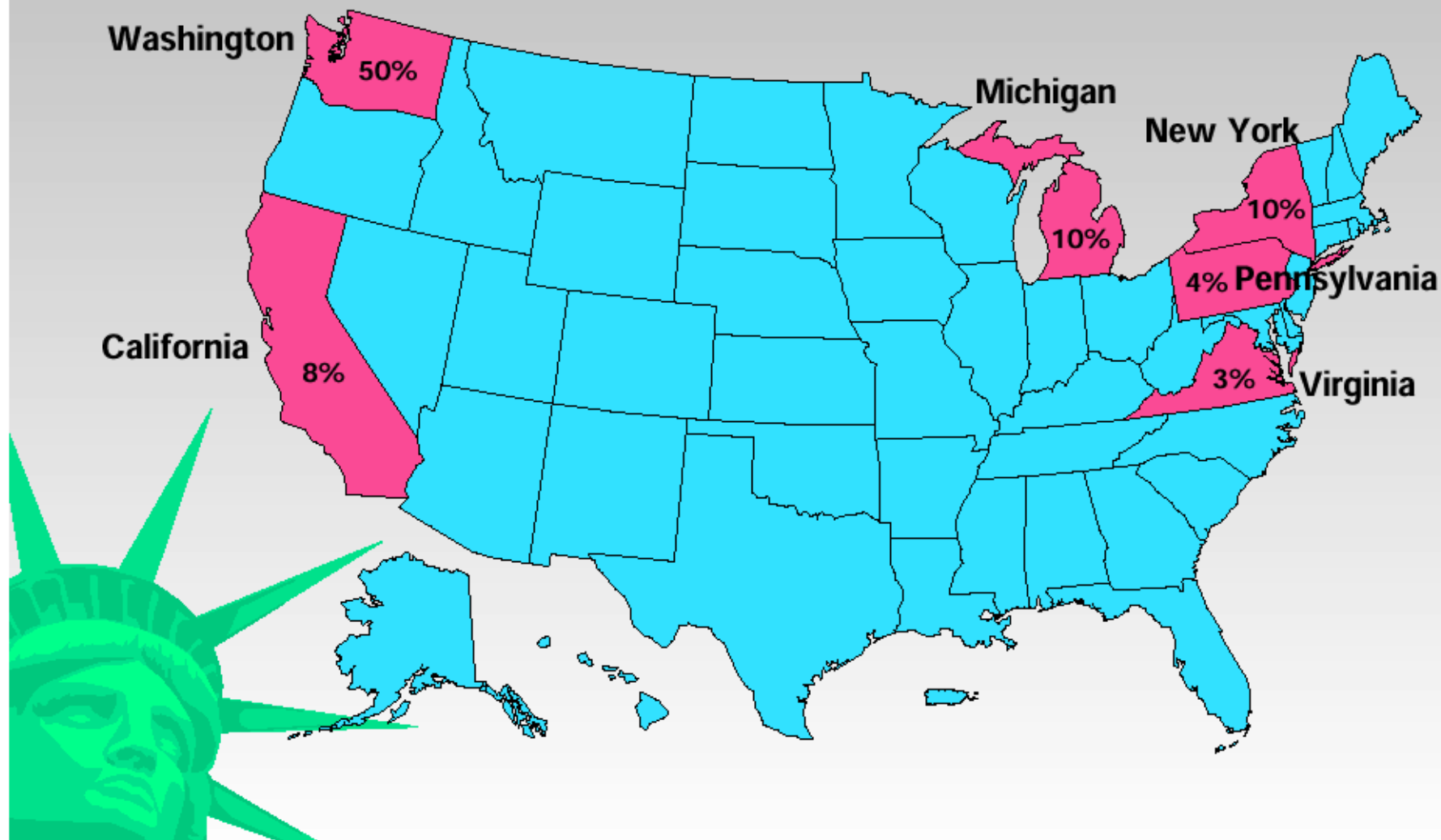
1/ Includes grapes for fresh table, dried, and wine use.

2/ Major components in this category include cherries, blueberries, nectarines, and plums.



Six States Account For 85 Percent Of The U.S. Apple Crop

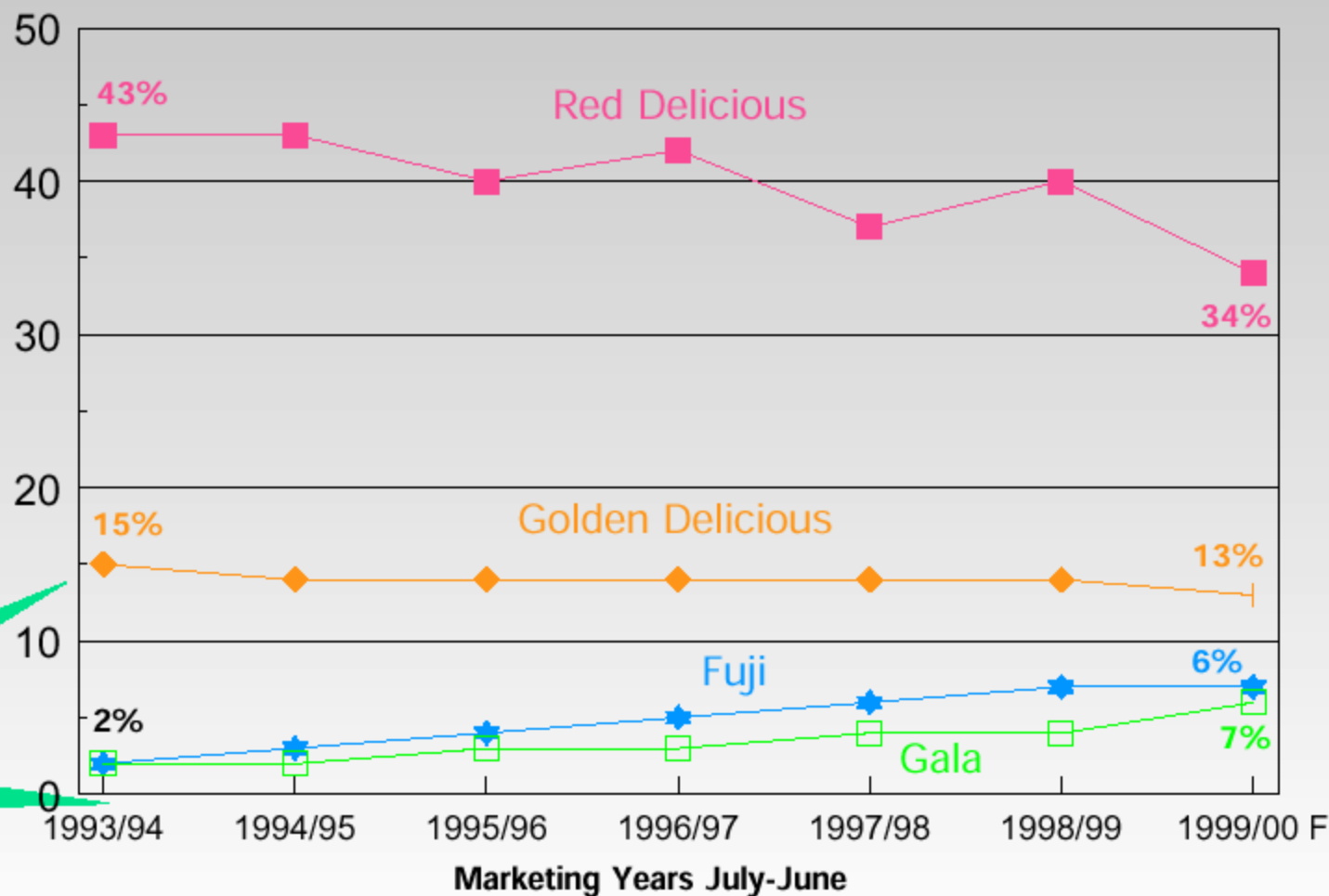
Source: USDA National Agricultural Statistics Service



U.S. Apple Production Is Slowly Shifting Away From The Traditional Delicious Varieties

Source: US Apple Association

Percent of Total Production



Nutrition Facts

Fresh Apples:

Nutrition Facts	
Serving Size	1 medium apple (154g/5.5 oz.)
Amount per Serving	
Calories 80	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 0mg	0%
Potassium 170mg	5%
Total Carbohydrate 22g	7%
Dietary Fiber 5g	20%
Sugars 16g	
Protein 0g	
Vitamin A 2%	Vitamin C 8%
Calcium 0%	Iron 2%
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:	
	Calories: 2,000 2,500
Total Fat	Less than 65g 80g
Sat Fat	Less than 20g 25g
Cholesterol	Less than 300mg 300mg
Sodium	Less than 2,400mg 2,400mg
Potassium	3,500mg 3,500mg
Total Carbohydrate	300g 375g
Dietary fiber	25g 30g
Calories per gram:	
Fat 9	Carbohydrate 4 Protein 4

What the Label does not Tell You

- Apples are a rich source of phytonutrient (plant-based) antioxidants.
- Apples and apple juice are two of the best sources of the mineral boron, which may promote bone health.
- Apples contain natural fruit sugars, mostly in the form of fructose.
- Because of apples' high fiber content, the fruit's natural sugars are slowly released into the blood stream, helping maintain steady blood sugar levels.

Health Benefits

- Breast cancer
- Colon cancer
- Type II Diabetes
- Alzheimer's
- Heart disease
- Asthma

U.S. Apple Association

<http://www.usapple.org/index-c.shtml>

Thank You !

