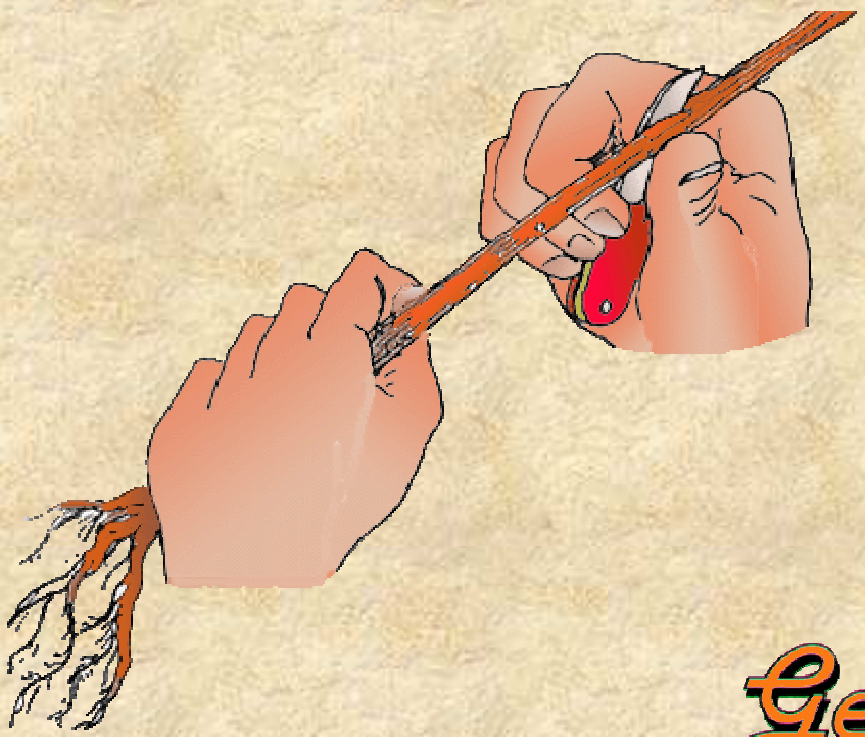
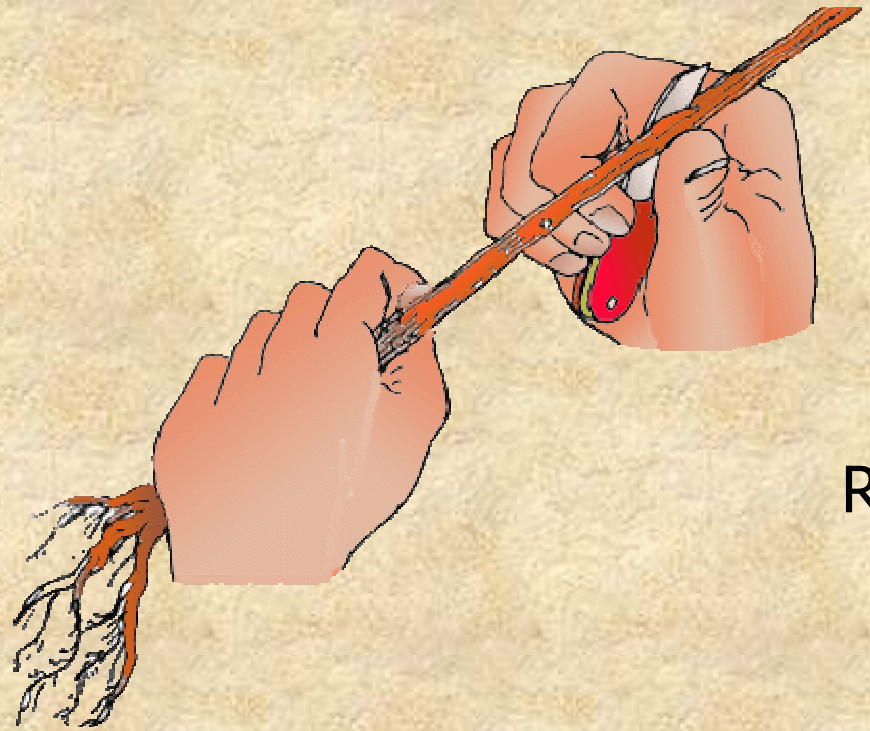
Grafting Fruit Trees



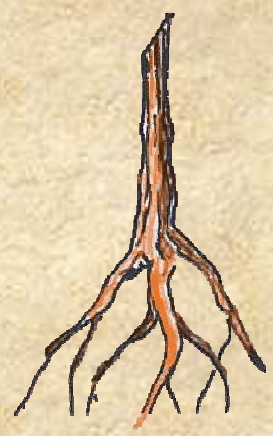
By George Tiger

Glossary of Grafting Terms



Rootstock

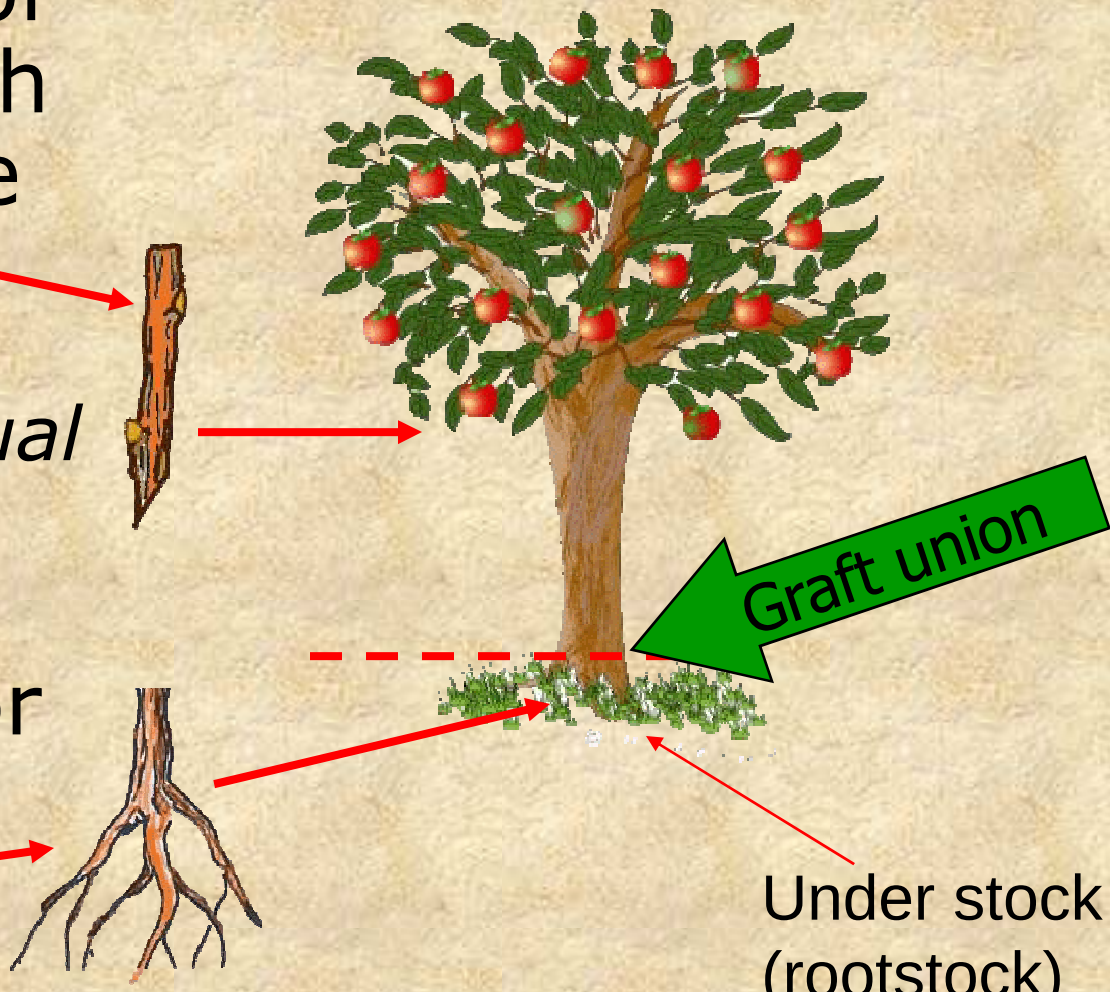
Scion



- **Grafting-**the process of inserting a part of one plant into or on another in a way that they will unite and continue growth as a single unit.

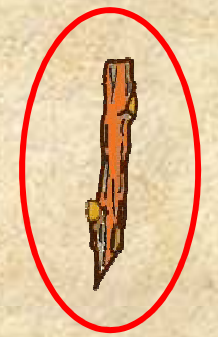
What the Scion Brings to the Union

- **Scion**—A piece of last year's growth with two or three buds *(genetic material for* ***vegetative****—asexual propagation***)**; the part inserted on the understock or what we will call rootstock.



Why is it necessary to <u>vegetatively</u> propagate most tree fruit and nut cultivars by grafting (or budding)?

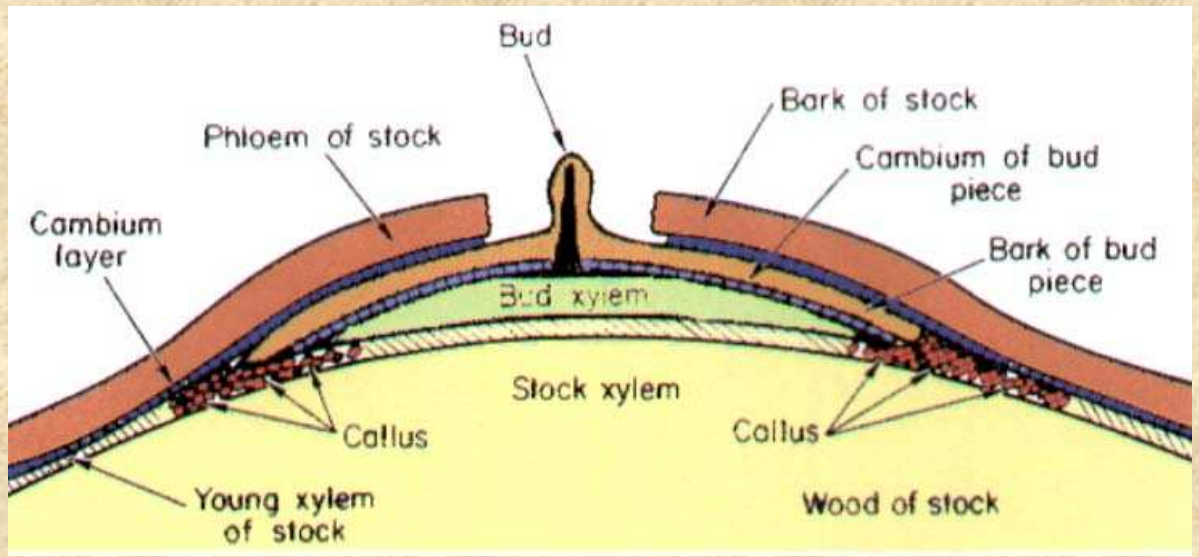
- **Vegetative (Asexual)** propagation maintains the genetic identity of the offspring



Scion: A detached shoot or twig containing buds from a woody plant, used in grafting. Alternate definition: A descendant; an heir; as, a scion of a royal stock.

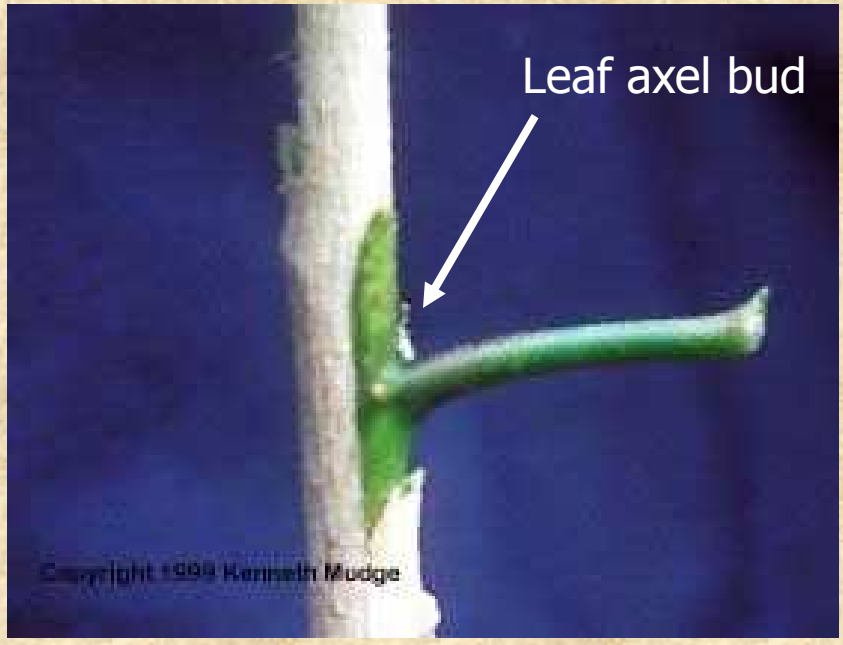
- Trees are grafted (or budded) because they are often **difficult to root** or
- they **benefit from characteristics** of the rootstock variety.

Bud ‘grafting’



- It could be described as the "transplanting" of a single bud of a desired variety into the stem of a hardy rootstock.
- Budding is done in late July or early August.

Bud Graft



- Many of the apple trees and all of the stone fruit trees (plum relatives) sold in the area's nursery trade are propagated by budding.

Plums

Plums are classified into six general categories-

1. Japanese,
2. American,
3. Damson,
4. Ornamental,
5. Wild and
6. European/Garden-
   - whose size, shape and colors vary.

Plums

- The European plum discovered around two thousand years ago, originating in the area near the Caspian Sea.
  - Even in ancient Roman times, there were already over 300 varieties of European plums.
  - European plums made their way across the Atlantic Ocean with the pilgrims, who introduced them into the United States in the 17th century.
- While Japanese plums actually originated in China.
  - Japanese plums were introduced to the U.S. in the late 19th century.
  - Today, the United States, Russia, China and Romania are among the main producers of commercially grown plums.

Less Common Plum Varieties

- The **American plum** has a round shaper and amber-colored skin and flesh.
  - **Cultivated Varieties:** *Prunus* x 'Alderman', 'Pipestone', 'Tecumseh', 'Toka', 'Underwood', and 'Waneta' are fruiting cultivars of plums.
- It's resistant to cold and grows well on the east and west coasts of the United States.
- Damson, ornamental and wild plums are rather acidic and have a tart flavor.
- These less common varieties are used to make jams and preserves.

More on American Plums

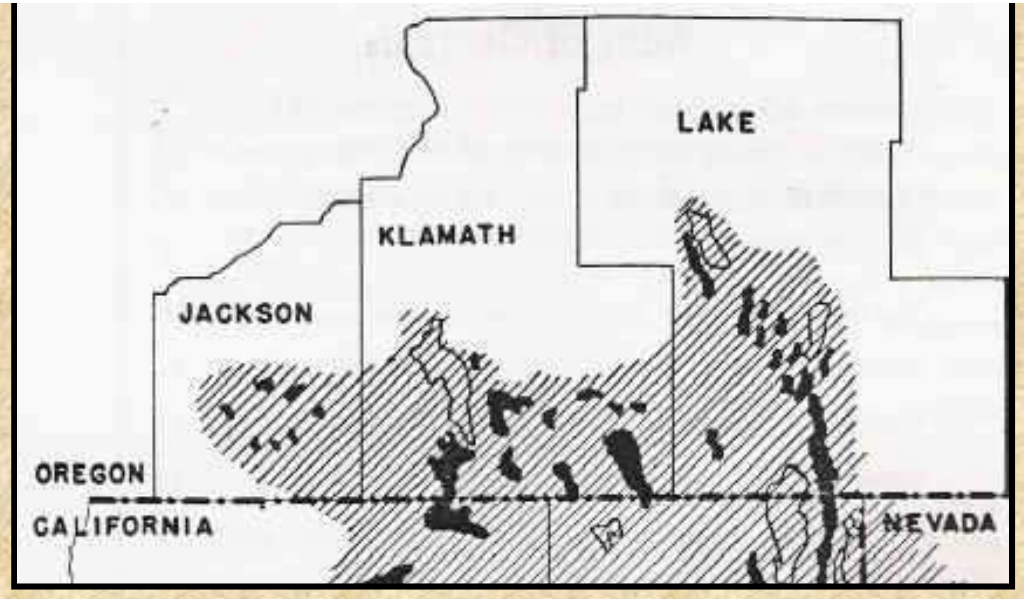
American Plum (*P. americana*)

Chickasaw Plum (*P. angustifolia*)

- *Prunus americana* (American Plum,
- but also called American Red Plum, American Yellow Plum, Native Plum, Wild Plum, River Plum, August Plum, Goose Plum, Canadian Plum) is a wide-ranging species found almost everywhere in the United States except from the Texas panhandle up through the great plains.

Pacific Plum

(Prunus Subcordata)

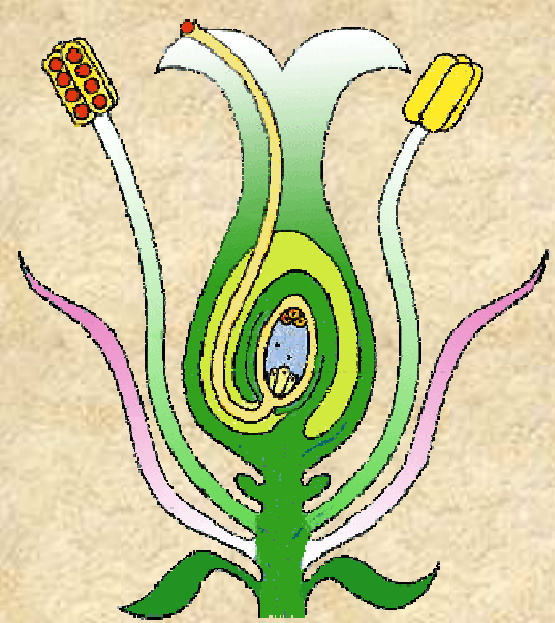


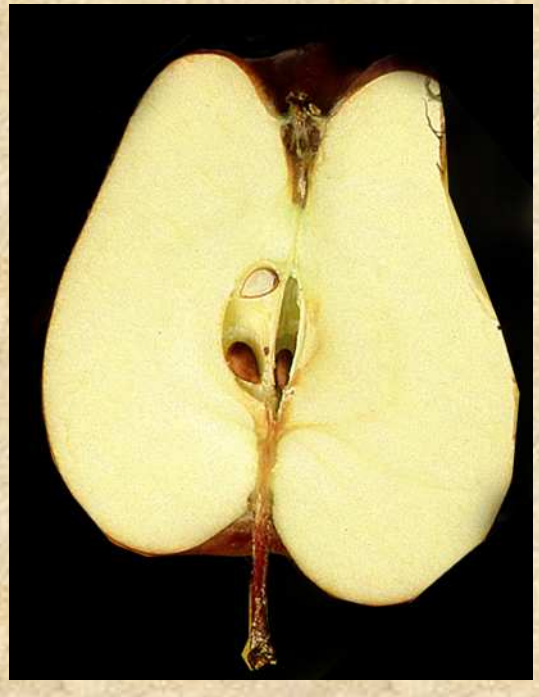
***Prunus subcordata* (Pacific Plum, but also known as Klamath Plum and Sierra Plum)**

The Pacific or Western plum (Prunus subcordata, Bentham) is a native species found growing wild in a relatively limited region east of the Coast Range from southern Oregon to central California. It occurs in greatest abundance in Lake and Klamath counties in Oregon.

Pome fruit

Pome: The fruit type derived from the fusion of the ovaries, calyx cup, and floral tube, produced by the apple, pear, quince, and other members of the subfamily Pomoideae.





Apple trees are monoecious--having male and female reproductive organs on the same plant.

History of Apples

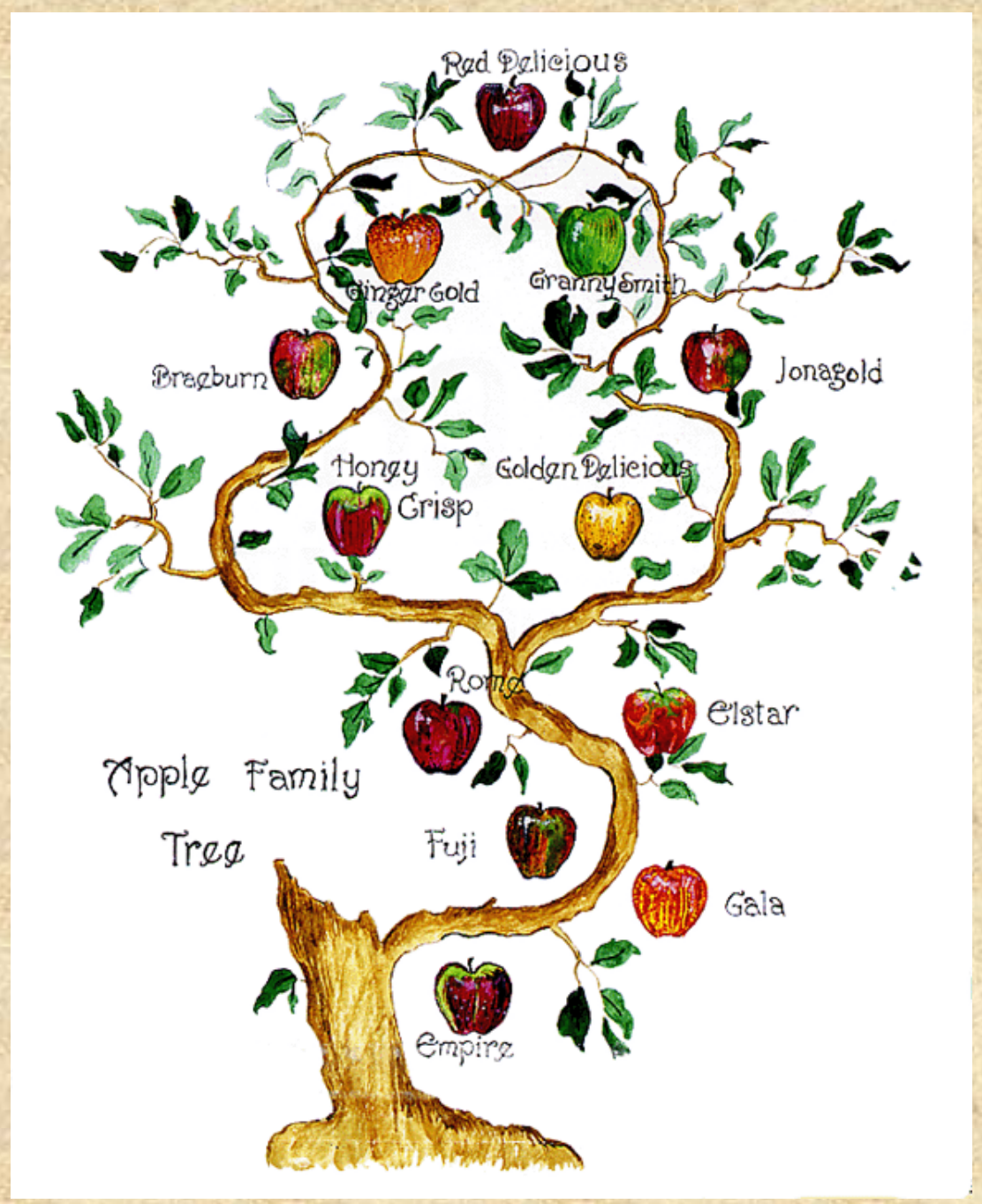
- It is generally believed that the edible apple originated somewhere in Central Asia.
- It is a member of the *Rosaceae* (rose) Family, and is designated by the scientific name *Malus domestica*.

- The apples we eat today is a small population of a single species still growing in on the northern slopes of the mountains at the border of northeast China and the former Soviet Republic of Kazakhstan.

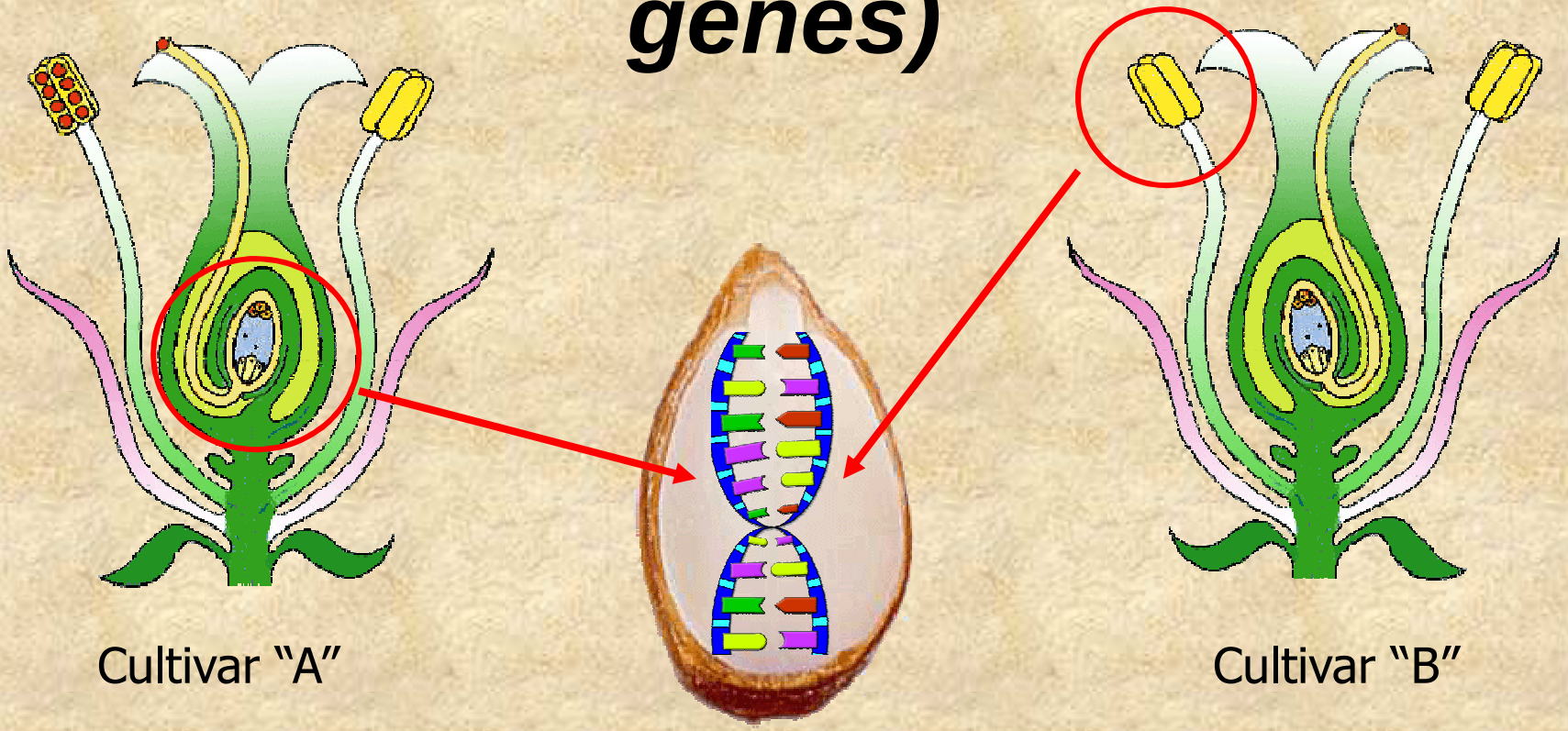
Cultivar—

- Denotes a cultivated type of plant. (Now used in place of the term variety.")

=



Sexual propagation…(its all in the genes)

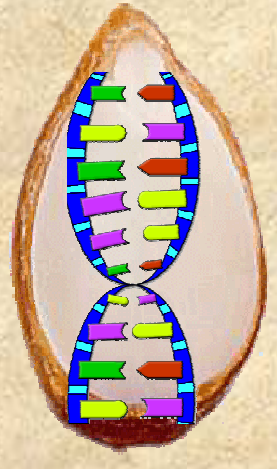


Cultivar "A"

Cultivar "B"

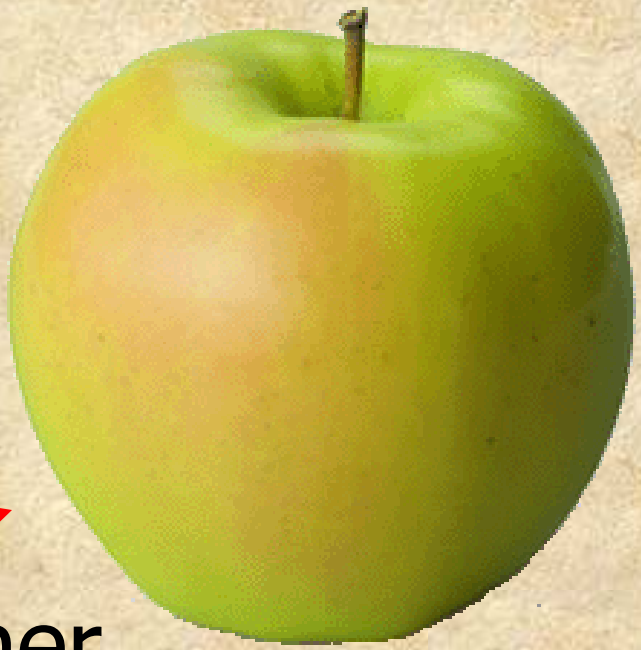
.. allows for genetic ***mixing*** and ***recombination*** that requires a number of steps for diploid parents. ..They must first form haploid gametocytes, and that means their diploid chromosomes must partition themselves into two sets. ..This partitioning can be called genetic segregation.

Only a few are selected



Either

or



Dog

Winner

It takes a tremendous amount of time, effort, and screening process to determine whether one of out of thousands or more resultant prodigies is discarded (a dog) or of commercial value (a winner).

Honeycrisp

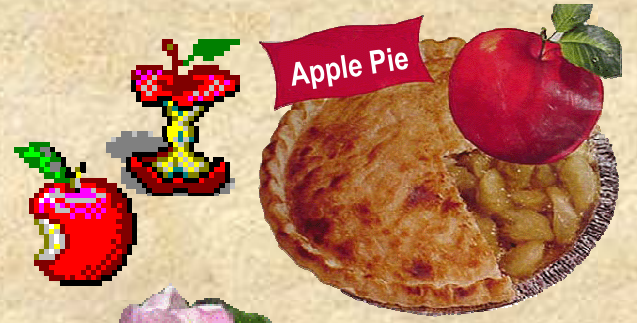
Dog or winner

- **Honeycrisp** (Malus domestica 'Honeycrisp') is an apple cultivar developed at the Minnesota Agricultural Experiment Station's Horticultural Research Center.
- Released in 1991, the Honeycrisp, once slated to be discarded, has rapidly become a prized commercial commodity.
- The Horticultural Research Center indicated that the Honeycrisp was a hybrid of the apple cultivars **Macoun** and **Honeygold**.
- However, genetic fingerprinting determined that neither of these cultivars is a parent of the Honeycrisp, but that **Keepsake** is one of the parents. The other parent has not been identified, but it might be a numbered selection that could have been discarded since.

Cultivar is a label that denotes…

expectation of:

- Use & Flavor- sweet, tart
- Flowering and pollination-
- Disease resistance
  - mildew,
  - apple scab
- Fruiting- Annual vs biennial
  - early,
  - mid season,
  - late



Pollination

Apple Scab

Season of harvest

- August
- September
- October

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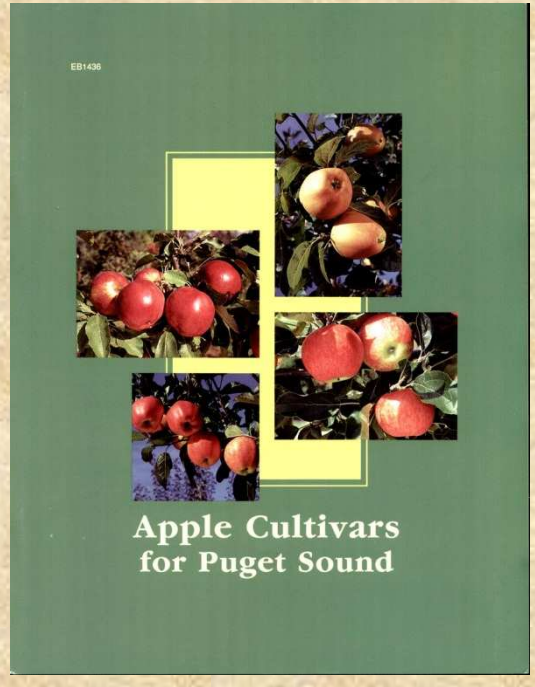
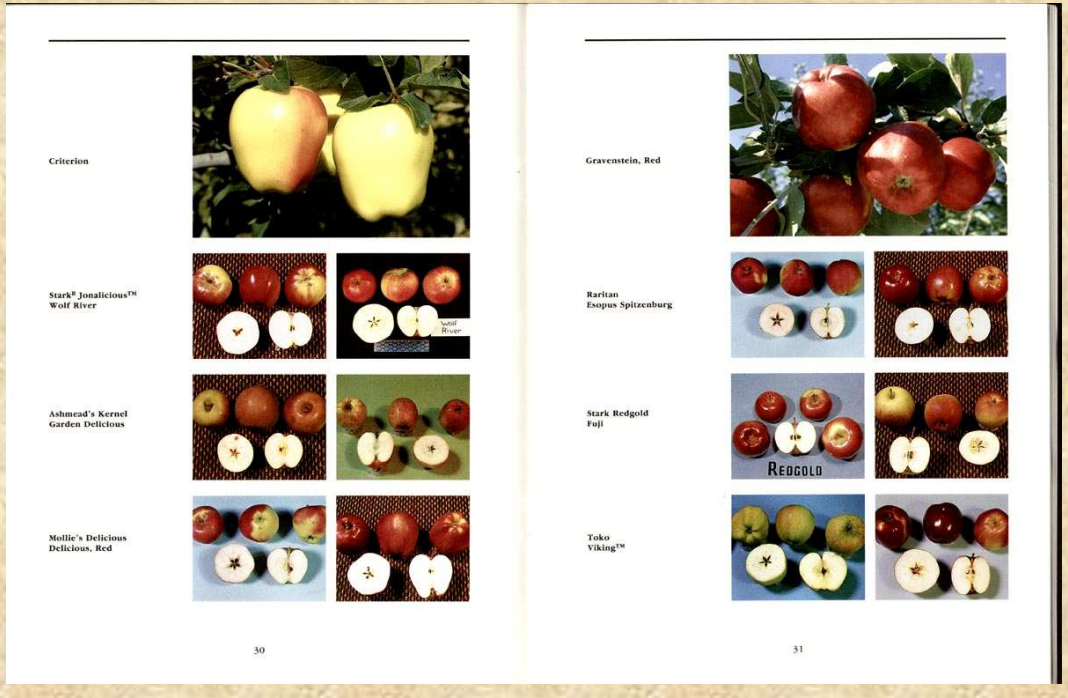
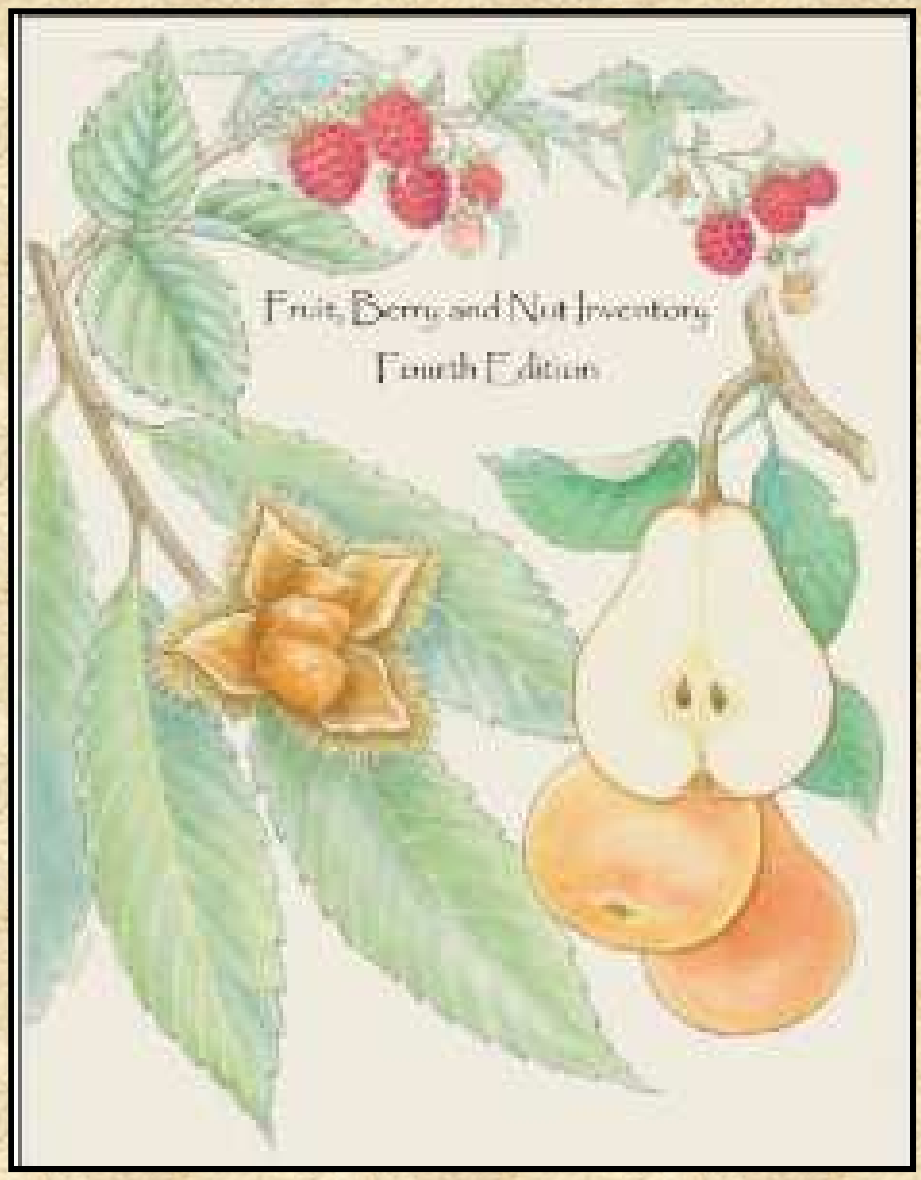




- **Apple Cultivars for Puget Sound (EB 1436)**
  Bloom and harvest dates, scab and mildew ratings, general descriptions and photographs.

http://cru84.cahe.wsu.edu/cgi-bin/pubs/EB1436.html



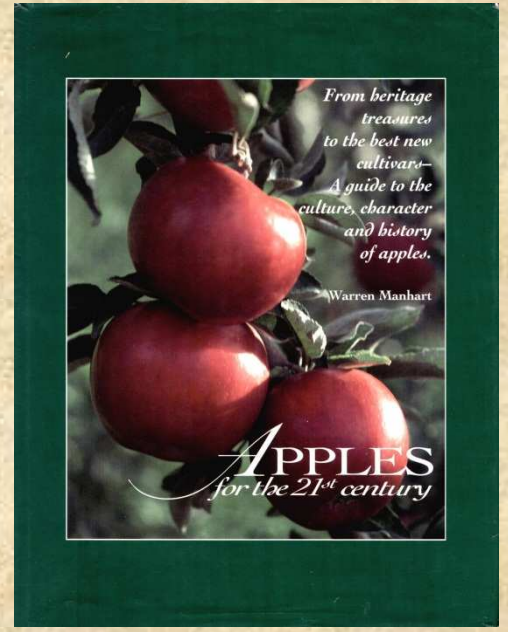
Kent Whealy (Author)

An Inventory of Nursery Catalogs and Websites Listing Fruit, Berry and Nut Varieties by Mail Order in the United States

Source of information on apples: Mail Order

Warren Manhart's Four Favorite Apples

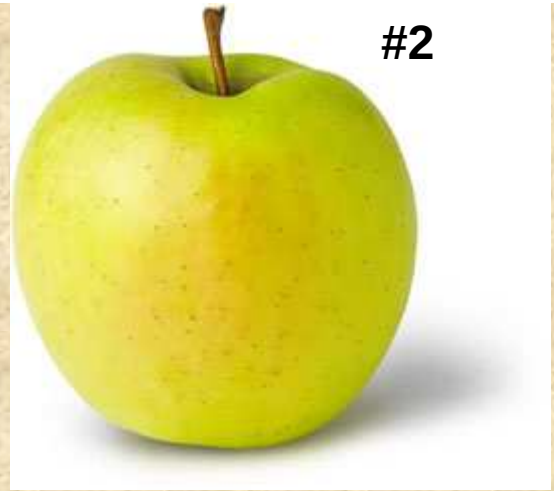
(from a list of 50 top cultivars)



- **Elstar:** All purpose apple
- **Spitzenberg:** "Very good to best."
- **Braeburn:** Best of newer late apples.
- **Newtown:** Rated the highest of all.

Source of information on apples: Online

Source of information on apples: local markets



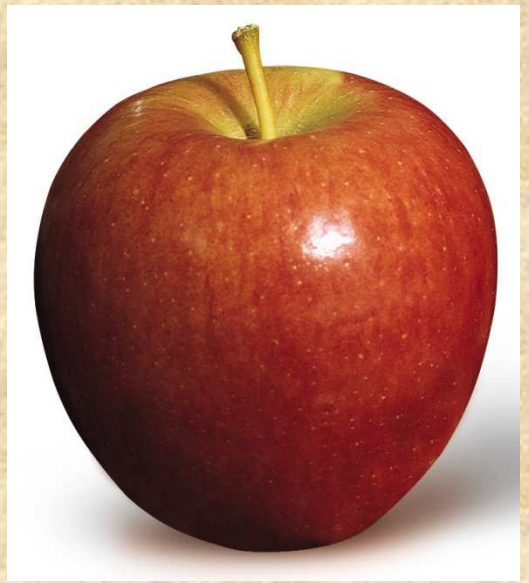
The five most popular apples in the United States are Red Delicious, Golden Delicious, Gala, Fuji and Granny Smith.

Apple Cultivars Moving Up

Jonagold

Honeycrisp

Braeburn



Pink Lady

Cameo

Heirloom Varieties

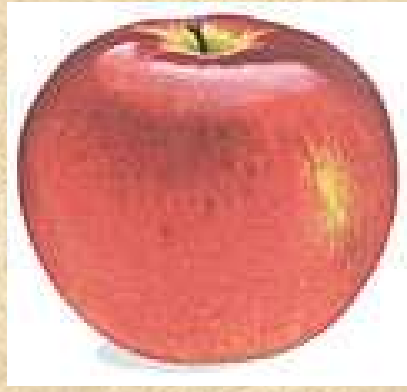
Arkansas Black

Newtown Pippen

Spitzenberg

Northern Spy

Jonathan



Cox Orange

Disease Resistance and Good Quality

- Cultivars that have shown good resistance and good quality are: 'Akane', 'Chehalis', 'Liberty', 'Dayton', and 'Redfree'.
- Intermediate resistance: 'Jonagold', 'Macoun', 'Melrose', 'Spartan', 'King'.

Cider Apples

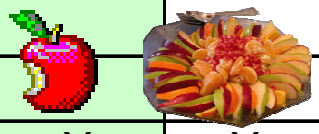
Cider quality inevitably depends on the type of apple used. Cider is traditionally made with one third each of sweet, bittersweet, and sharp apples.

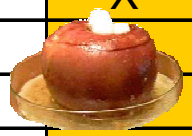
<u>Bittersweet</u>
Dabinette
Kingston Black
Michelin
Yarlington Mill

<u>Sharp</u>
Duchess
Melrose
Rhode I. Greening

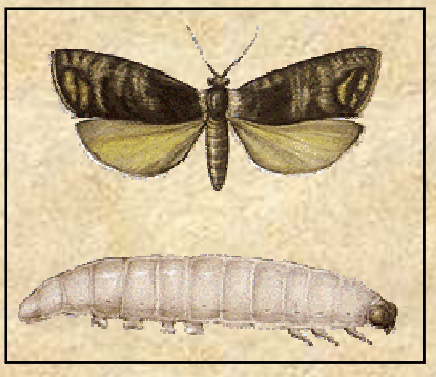
<u>Sweet</u>
Cox's Orange Pippin
Gravenstein
Pitmaston Pineapple
Newtown Pippin

Apples & Their Use	Fresh	Salad	Bake	Cook	Pie	Dried	Sauce	Bloom
Belle de Boskoop			X	X	X		X	Late-mid
Bramley's Seedling			X	X	X		X	Late
Cortland (Redcort)	X	X	X	X	X		X	Mid-season
Elstar	X	X	X		X		X	Mid-season
Empire	X	X	X	X	X		X	Early
Fuji (Beni Shogun)	X	X	X		X		X	Late-mid
Gala	X	X	X		X	X	X	Mid-season
Ginger Gold	X	X	X				X	Mid-season
Golden Delicious	X	X	X	X	X		X	Late-mid
Gravenstein	X		X	X	X		X	Early
Haralred	X		X	X	X	X	X	Early-mid
Honeycrisp	X	X	X	X	X	X	X	Late-mid
Jonagold, Jonagored	X	X	X	X	X		X	Mid-season
Jonamac	X		X	X				Early
McIntosh	X	X		X	X		X	Early
Melrose	X	X	X		X		X	Early
Paula Red	X	X	X	X	X		X	Early-mid
Pristine	X		X		X		X	Early-mid
Queen's Cox	X		X	X	X		X	Late-mid
Redfree	X				X	X		Mid-season
Spartan	X	X		X	X		X	Mid-season
Wealthy	X		X	X	X		X	Early-mid
Wolf River	X		X	X		X	X	Mid-season
Zestar	X		X				X	Early-mid



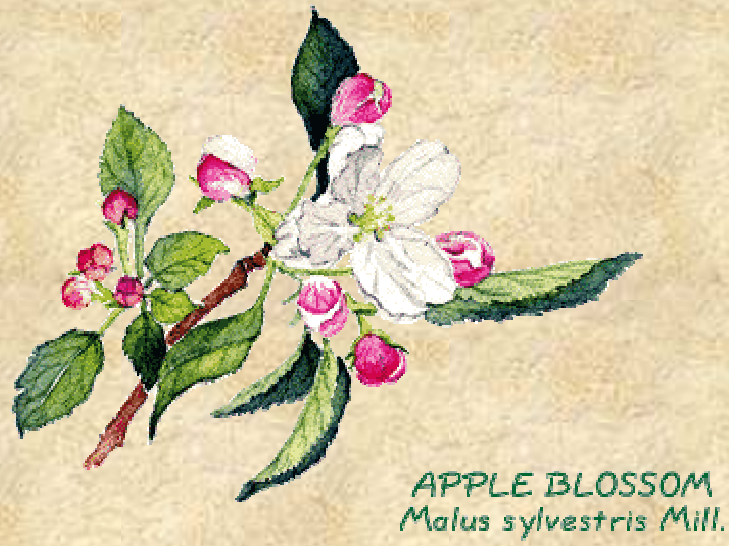

Seeds are important



June Drop: The more seeds in a particular apple, the more hormones produced on the tree. By the end of June, the tree reaches a tipping point, where in the period of about ten days, it drops the smallest and weakest remaining fruits, which are the ones with the least number of seeds.

Codling moth larvae burrows into the fruit, eats for around three weeks, then leaves the fruit to overwinter and pupate elsewhere. Most nourishment is obtained by feeding on the proteinacous seeds. When the seeds are destroyed the wormy apples drop early.

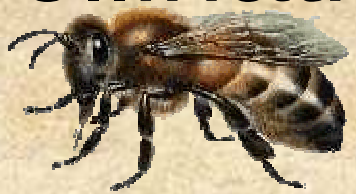
Pollination



- The apple, *Malus domestica*, is considered to be **self-unfruitful**.
- All apple cultivars (varieties) require the pollen of a different cultivar to set a crop of fruit.
- A **pollen source** and **transfer** must be provided for these cultivars.

Pollination

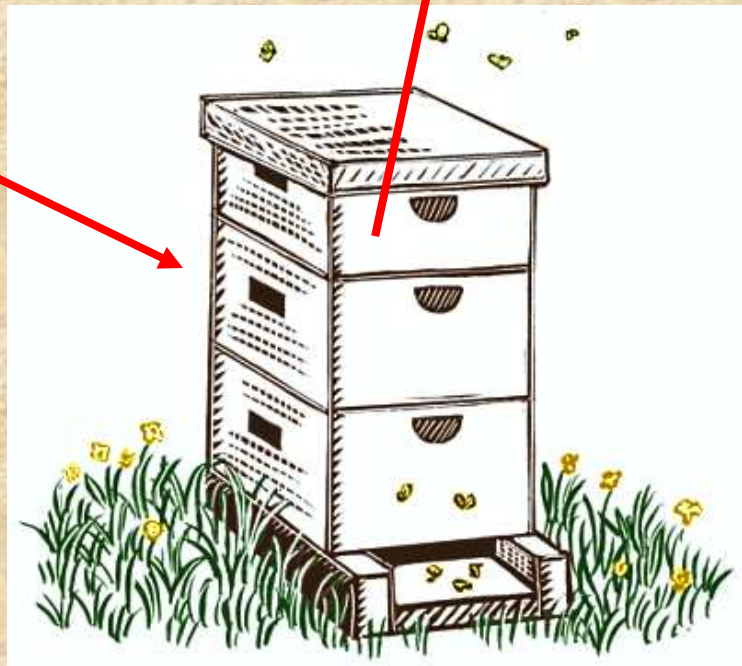
Cultivar A



Pollinator

Compatible pollen source

Cultivar B



Self incompatible verses self pollination

Diploid = two sets of chromosomes

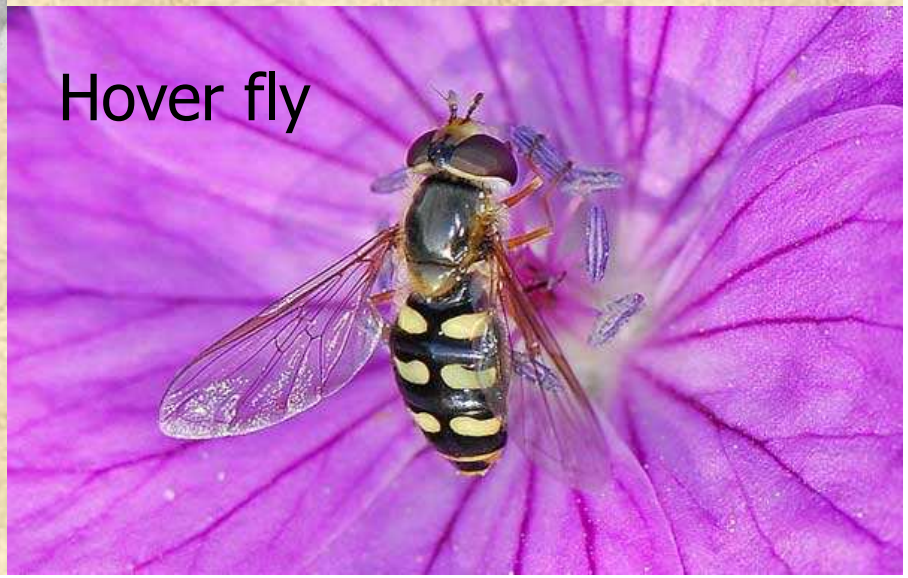
Triploid = three sets of chromosomes

Pollen sterile: Triploid will not fertilize diploid cultivars—Diploids (normal) will fertilize triploids.

Other Pollinators or Transfer Agents

Blue Orchard bee
(Mason bee)

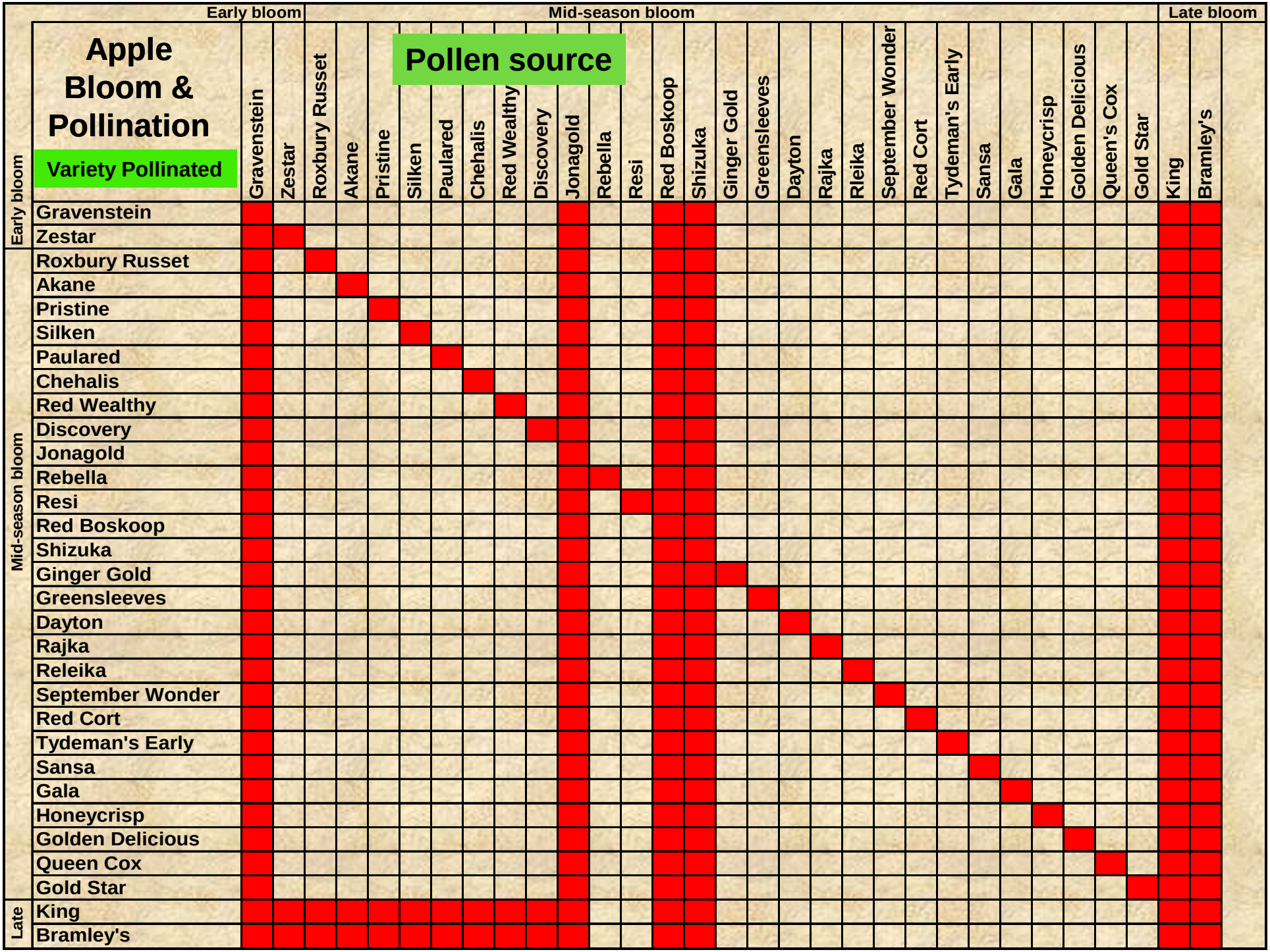
Bumble bee

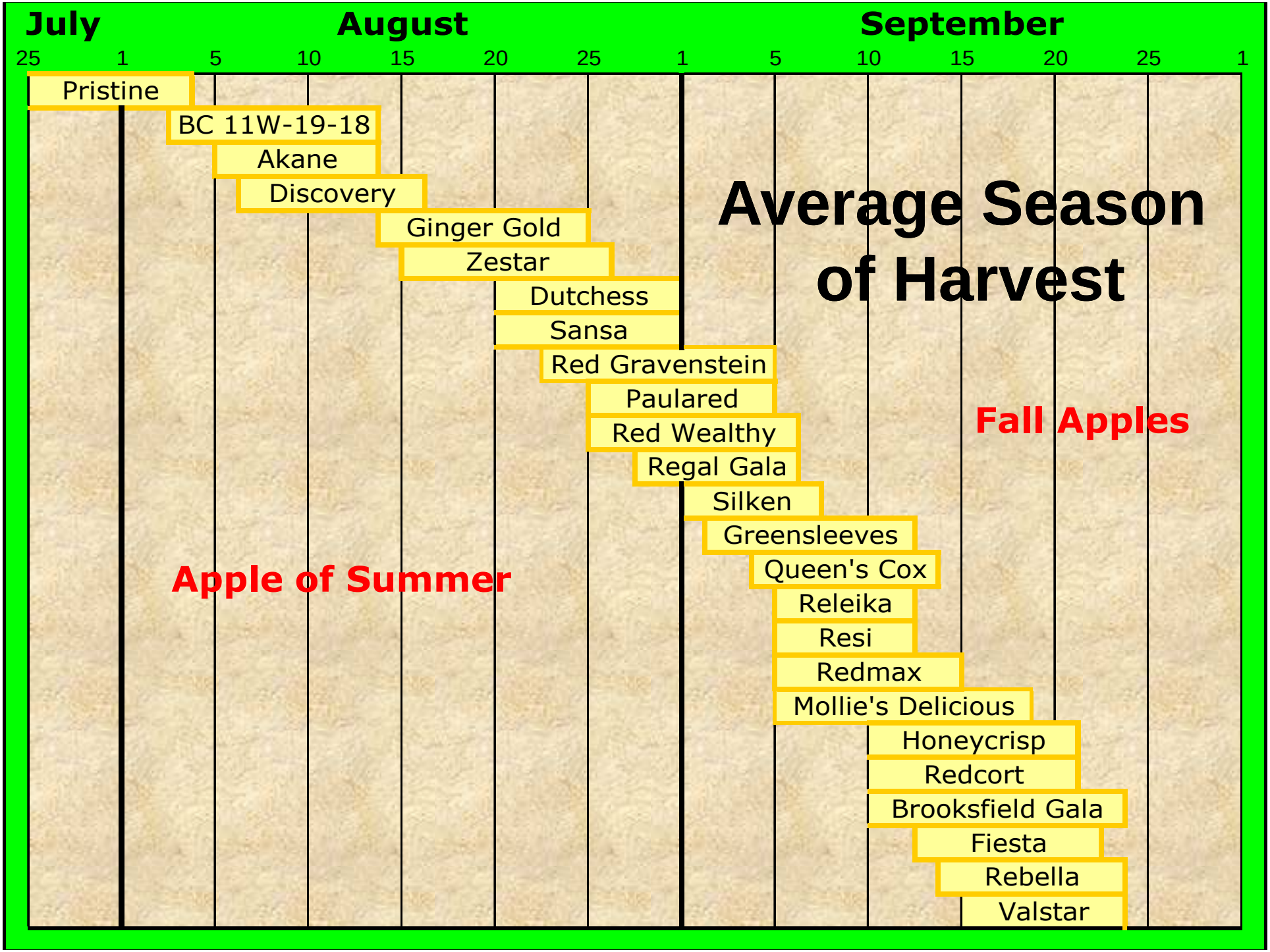


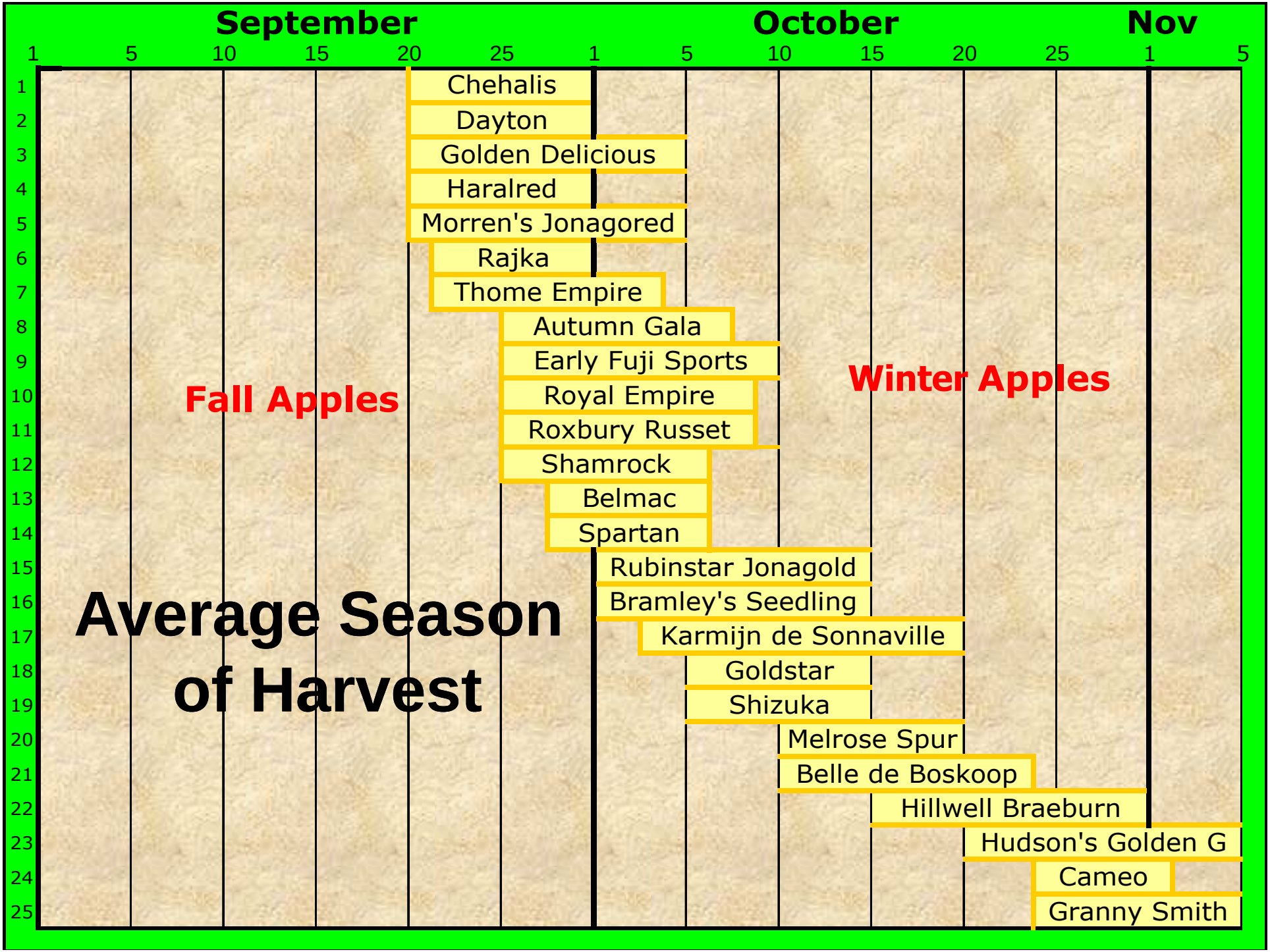
Hover fly

Understanding the Following Pollination Chart (next slide)

- For pollination you need to have two different apple varieties! A single red block (■) denotes where the same variety intersects indicates it will not self pollinate.
- All the apples shown with red blocks (across the chart) are triploids. These will not pollinate other varieties.
- The apple varieties are listed from the earliest bloomer to the latest bloomer.
- The early season bloomers and the late season bloomers will not cross pollinate because their bloom time is too far apart and the early varieties will be done blooming before the late ones start.
- The closer the two varieties you chose in bloom time, the more likely their bloom will overlap and the more likely you will get pollination and therefore fruit set.
- While the bloom order stays generally similar in different areas of Oregon and in different years, the actual bloom dates changes from year to year depending on the weather.


Early bloom
Mid-season bloom
Late bloom
Apple Bloom & Pollination
Pollen source
Variety Pollinated
Early bloom
Mid-season bloom
Late
Gravenstein
Zestar
Roxbury Russet
Akane
Pristine
Silken
Paulared
Chehalis
Red Wealthy
Discovery
Jonagold
Rebella
Resi
Red Boskoop
Shizuka
Ginger Gold
Greensleeves
Dayton
Rajka
Rleika
September Wonder
Red Cort
Tydeman's Early
Sansa
Gala
Honeycrisp
Golden Delicious
Queen's Cox
Gold Star
King
Bramley's


July
August
September
25
1
5
10
15
20
25
1
5
10
15
20
25
1
Pristine
BC 11W-19-18
Akane
Discovery
Ginger Gold
Zestar
Dutchess
Sansa
Red Gravenstein
Paulared
Red Wealthy
Regal Gala
Silken
Greensleeves
Queen's Cox
Releika
Resi
Redmax
Mollie's Delicious
Honeycrisp
Redcort
Brooksfield Gala
Fiesta
Rebella
Valstar
Average Season of Harvest
Fall Apples
Apple of Summer


September
October
Nov
1 5 10 15 20 25 1 5 10 15 20 25 1 5
1 Chehalis
2 Dayton
3 Golden Delicious
4 Haralred
5 Morren's Jonagored
6 Rajka
7 Thome Empire
8 Autumn Gala
9 Early Fuji Sports
10 Royal Empire
11 Roxbury Russet
12 Shamrock
13 Belmac
14 Spartan
15 Rubinstar Jonagold
16 Bramley's Seedling
17 Karmijn de Sonnaville
18 Goldstar
19 Shizuka
20 Melrose Spur
21 Belle de Boskoop
22 Hillwell Braeburn
23 Hudson's Golden G
24 Cameo
25 Granny Smith
Fall Apples
Winter Apples
Average Season of Harvest

Picking and Storing Apples

FS 147

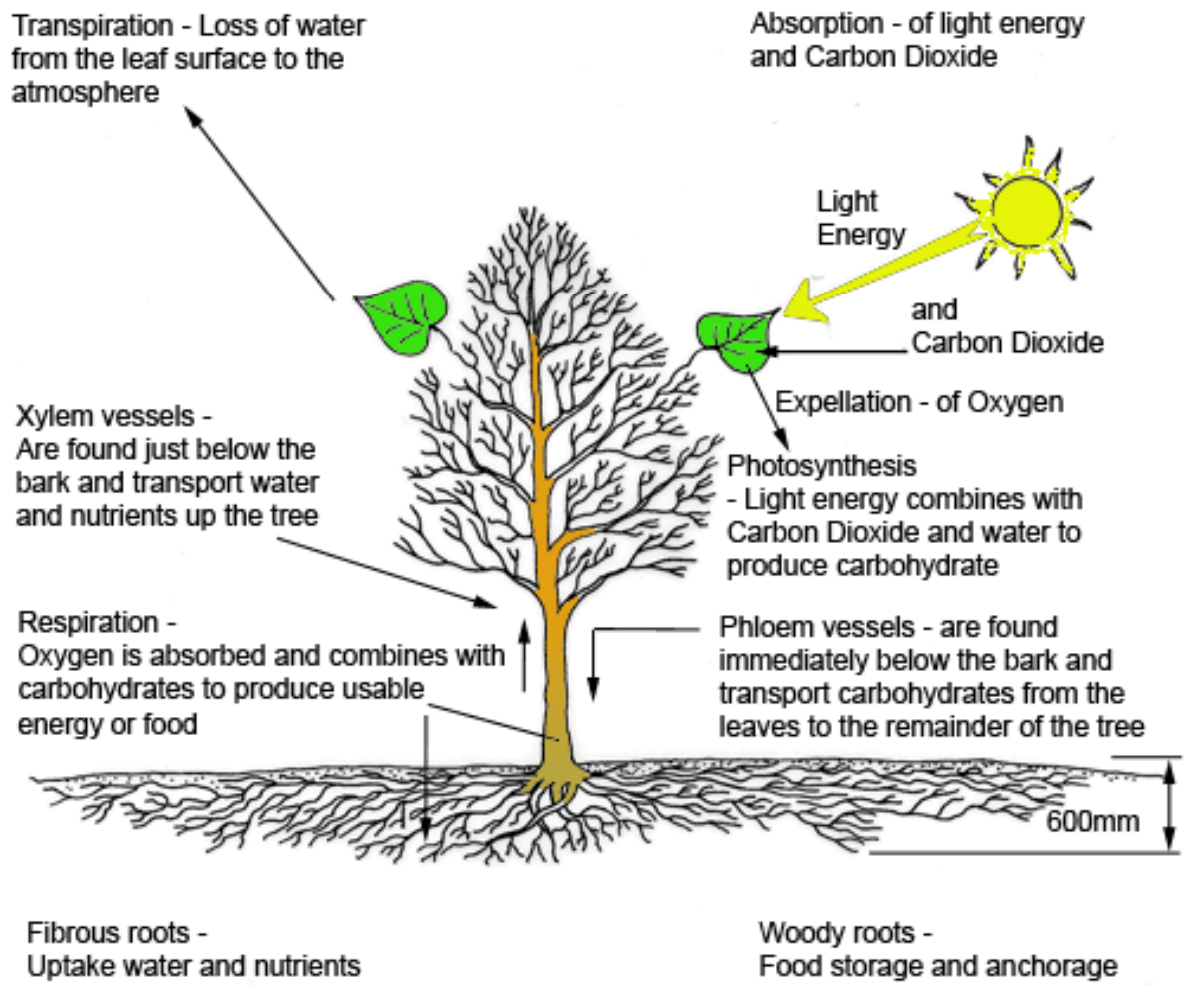
***Early*--Jackson County, Milton-Freewater, and Wasco**
***Midseason*--Lower Hood River, Malheur, Douglas County, and Josephine County**
***Mid- to late*--Willamette Valley**
***Late*--high mountains and plateaus and the coast.**
Early districts often begin harvest about 10 days earlier than midseason districts, and late-season districts about 10 days later.

Table 1.—Maturity dates for apples in the midseason districts.

Variety	Dates	Skin color when mature
Yellow Transparent	July 10–25	Creamy yellow
Lodi	July 15–30	Creamy yellow
Chehalis	Aug. 20–30	Yellow
Gravenstein	Aug. 20–25	Yellow with red
Tydeman's Red	Aug. 25–30	Red
Prime Red	Aug. 20–30	Red
Gala	Sept. 1–15	Yellow with red stripes
Red Wealthy	Sept. 10–20	Yellow with red
Jonagold	Sept. 15–Oct. 7	Yellow with red stripes
Elstar	Sept. 17–24	Yellow with red stripes
Arlet	Sept. 17–30	Red
McIntosh	Sept. 20–30	Yellow with red blush
King	Sept. 15–25	Yellow with red blush
Jonathan	Sept. 20–25	Yellow with red blush
Liberty	Sept. 20–Oct. 8	Mostly red
Grimes Golden	Sept. 25–Oct. 5	Yellow
Empire	Sept. 27–Oct 7	Red stripes
Golden Delicious	Oct. 1–15	Yellow
Spartan	Oct. 1–10	Red
Delicious—red strains	Oct. 1–15	Red
Spitzenburg	Oct. 5–20	Yellow with red stripes
Winter Banana	Oct. 5–20	Yellow
Braeburn	Oct. 10–25	Red stripes
Melrose	Oct. 15–30	Red stripes
Fuji	Oct. 15–Nov. 1	Red
Winesap	Oct. 20–25	Red
Rome Beauty—red strains	Oct. 25–Nov. 10	Red
Northern Spy	Nov. 5–15	Yellow with red stripes
Yellow Newtown	Nov. 10–20	Green
Granny Smith	Nov. 10–20	Green

Environmental factors that affect plant growth include:

- temperature,
- water,
- humidity,
- light, and
- nutrition.



Bitter Pit

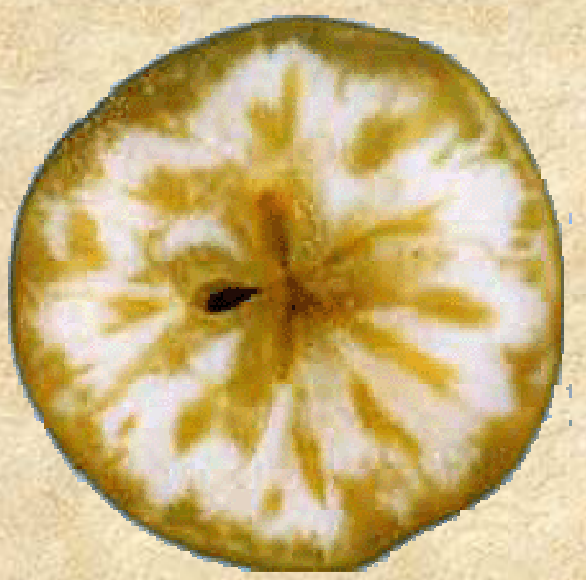
Low levels of calcium in the fruit are due to competition with shoots for calcium, which may be aggravated by weather conditions.

Hot, dry weather in July or August tends to increase the incidence of bitter pit. **Irregular irrigation** may also increase bitter pit.

Heavy dormant-season pruning, overthinning, and excessive nitrogen fertilizer promote bitter pit. Injury to trunks, such as winter freezes, interferes with calcium movement. Bitter pit occurs most severely in years of light crops.

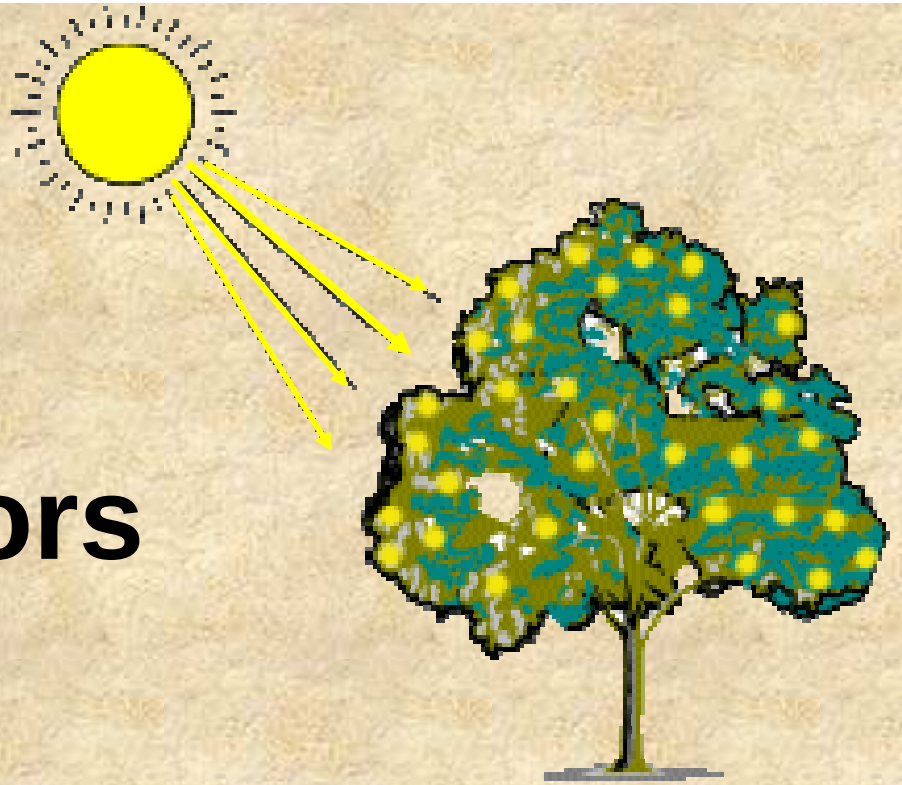
Water Core

External Symptoms



Internal symptoms

- Water core is a physiological disorder that causes apple tissues to appear translucent and fill with a sugar-water solution.
- Water core often increases rapidly as apples become over-mature.



Causal factors

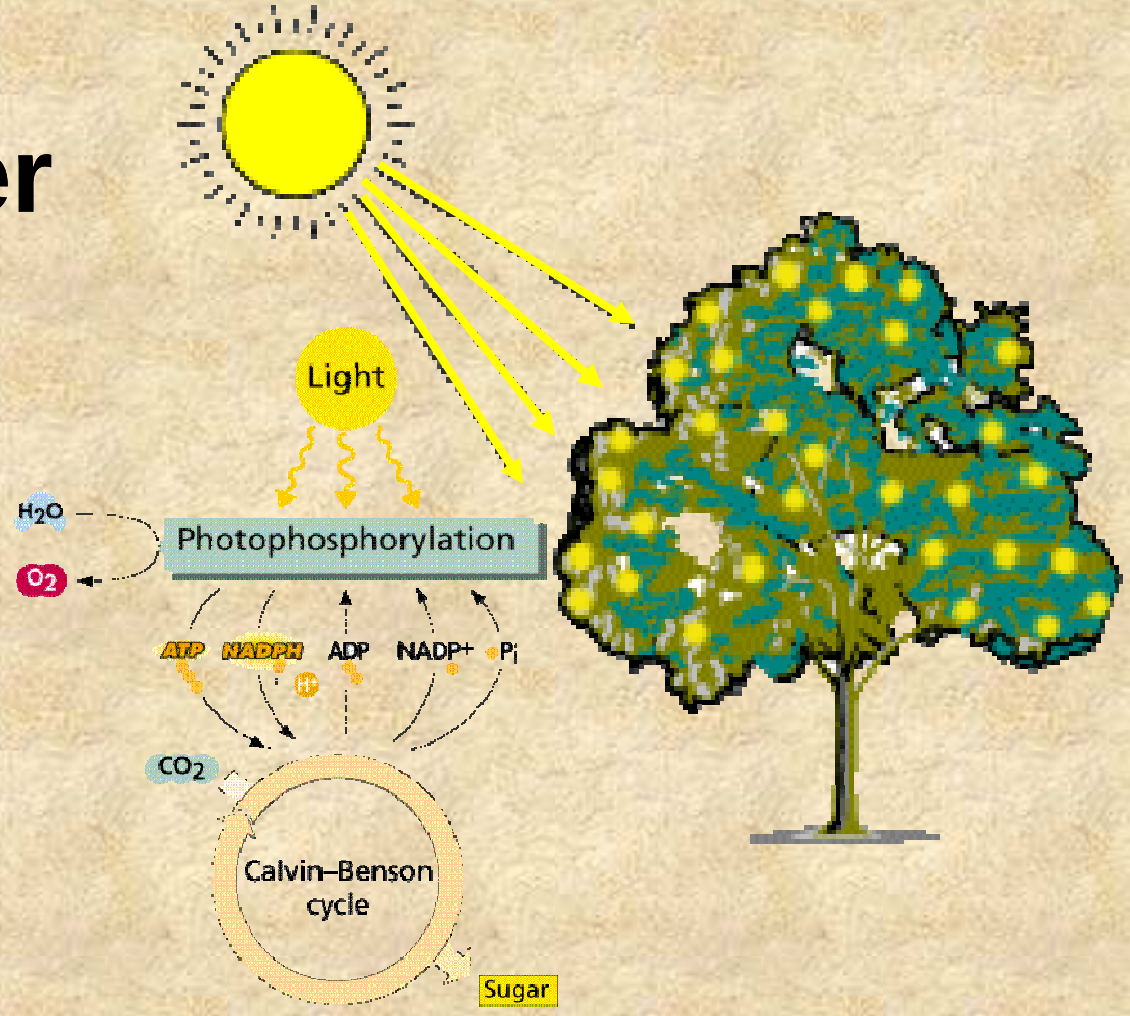
Water core is particularly

bad in sections where heat and sun-light are intense.

High temperatures at the time the apples are approaching maturity favor its development.

More on Water Core

Sorbitol accumulates in the intercellular spaces of tissue with water core because **the enzyme that converts sorbitol to fructose is absent** or is present in very low quantities.

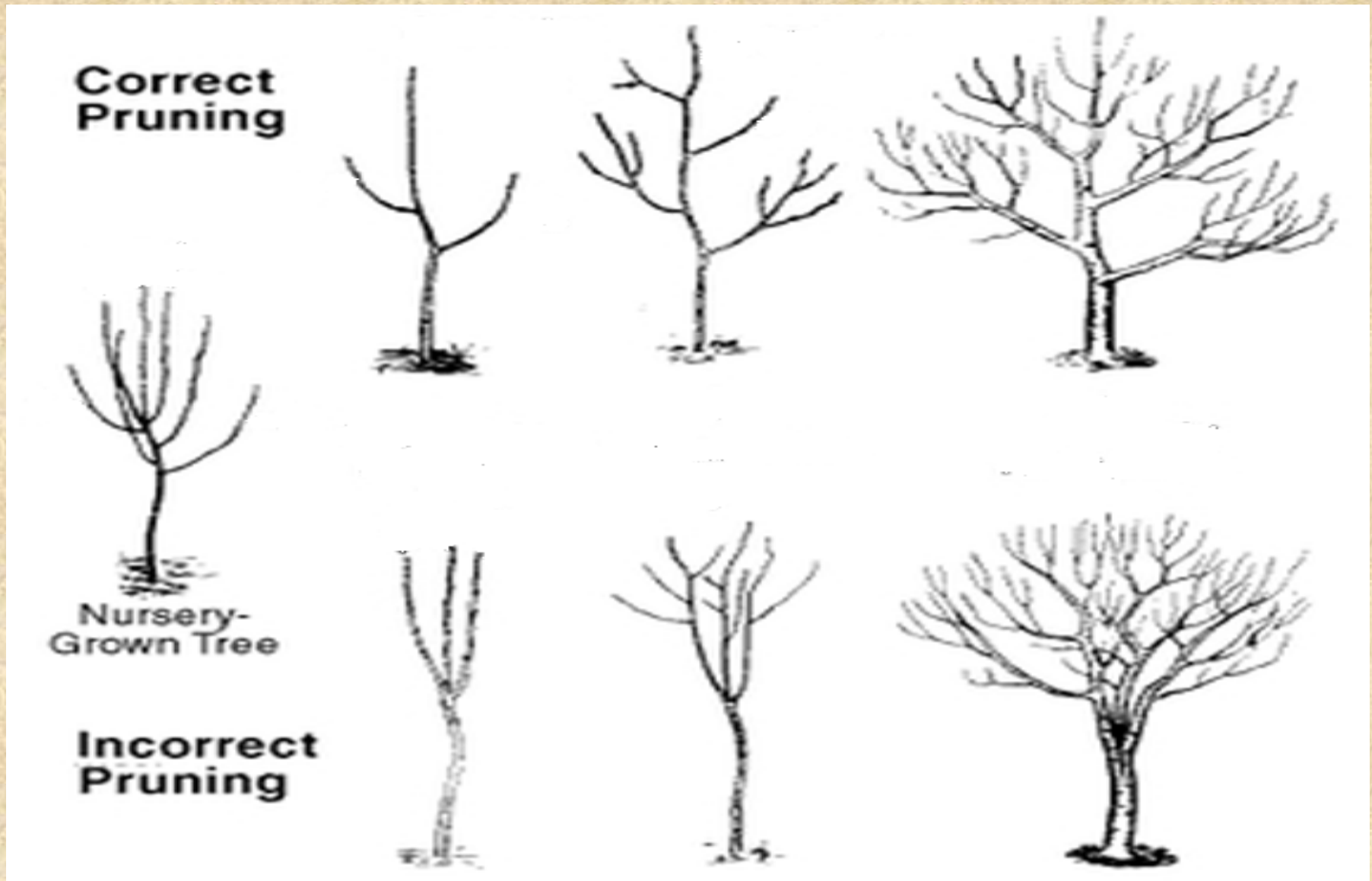


6H2O + 6CO2 ----------> C6H12O6+ 6O2

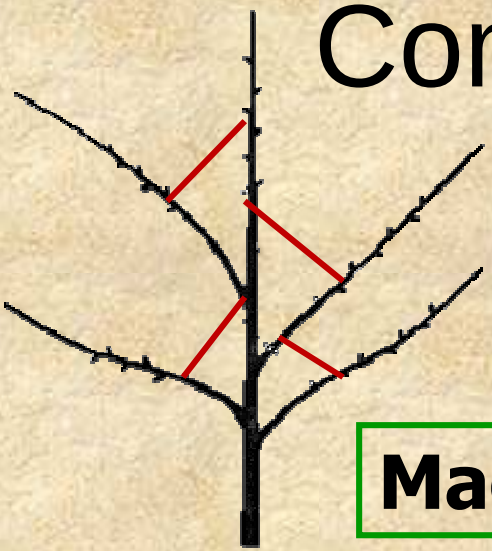
Control measures

Control of the disease is attained mainly by picking fruits before extensive water core develops.

Cultivars Selected on Tree Growth & Structure



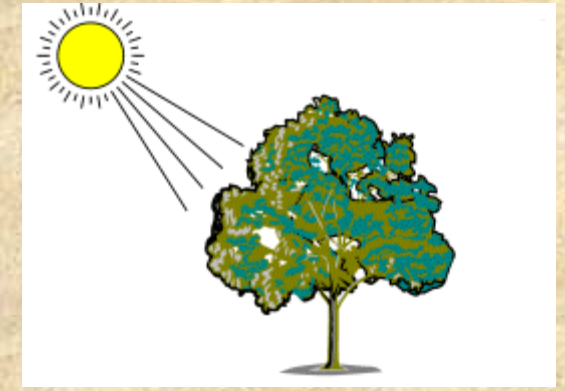
Comments on Structure of Specific Cultivars



Macoun: Upright habit needing spreading

SPITZENBURG: Tree moderately vigorous, **growth habit willowy**, cropping heavy.

Fiesta grows in a bizarre straggly fashion, rather more sideways than vertically. This is definitely not a variety to plant as a specimen tree - it has the growth habit of a clematis!



Influence of Tree Structure

- Sunlight is critical to tree growth and cropping.
- Photosynthetic products are required for vegetative growth, fruit set, fruit growth, fruit color, and flower bud initiation and development.
- Tree size, shape, and density greatly influence the distribution of light through the tree canopy.

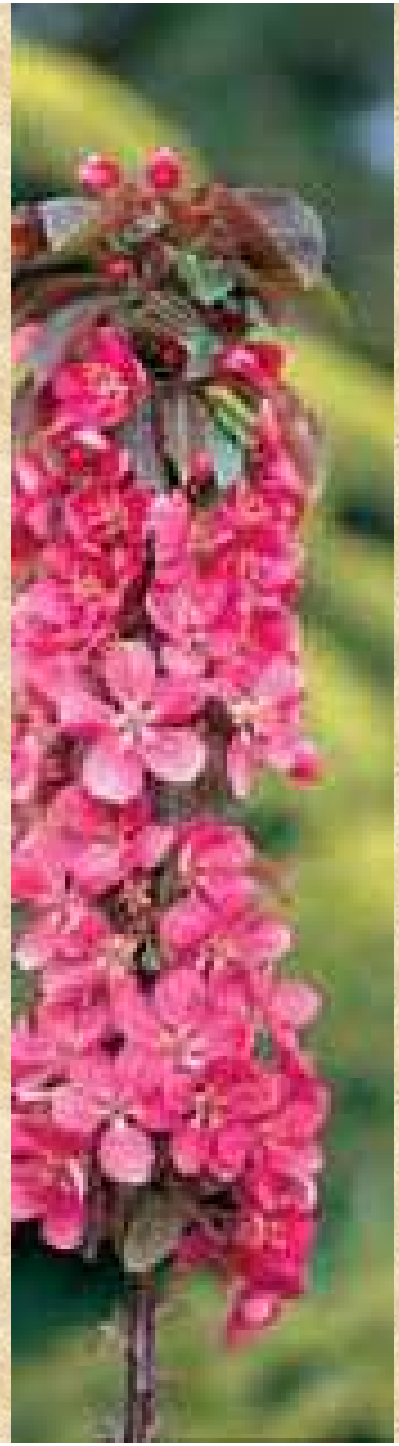
Spur-type strains

- Spur-type strains of certain varieties such as Delicious, Golden Delicious, and others are available.
- Spur types are smaller, especially on dwarfing root stocks, and they're often more productive than nonspur types.

Semi-dwarf and Dwarf Trees

- Dwarf trees have the additional advantage of being easier to prune, spray, thin, and harvest.

Columnar Apple Trees



COLUMNAR APPLE TREES

- Columnar apple trees are well suited to growing in a container.
- Columnar apple trees set their fruit along the main trunk.
- On columnar trees, cut any side branches short or off.
- Allow the leader to grow to the desired height. Some can eventually reach 10’ tall or more.

CONTAINER FRUIT TREES

Another way to dwarf a fruit tree is by growing it in a container. The growth of the tree is stunted as the roots become bound. By using this method in combination with a dwarf rootstock, very small dwarf fruit trees can be grown.

Mini-dwarf apple trees

Fourth Year's Spring

The scaffolding branches are in place, and it's time for this mini-dwarf to start bearing apples.

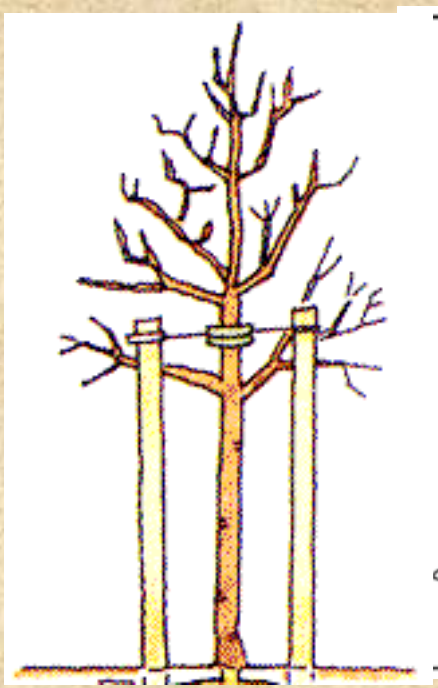
Red Chief

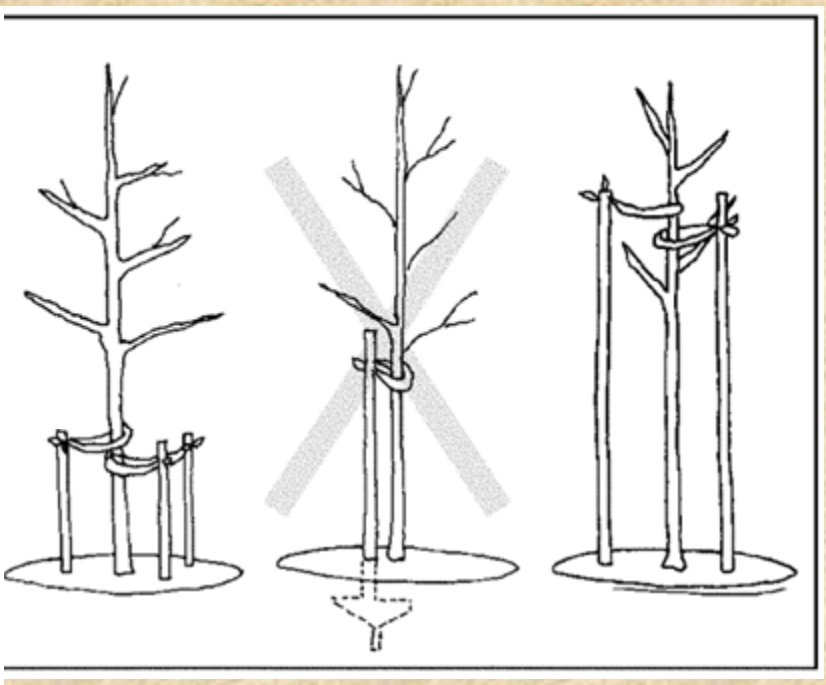
- Mini-dwarf apple trees are grown on very dwarfing EMLA 27 rootstock.
- They are easily maintained at only four to six feet tall.
- These highly productive, compact trees, grown in large pots on patios or….
- …are perfect to grow in a small backyard.

MINI-DWARF APPLE TREES

- Apples and other mini-dwarf trees are often maintained at only four to six feet tall at maturity.
- Since they will be kept short, it is desirable to have branching begin low to the ground, at one or two feet.
- If the tree doesn’t already have branches at such low heights, pruning back the center will encourage low branching.

STAKING THE DWARF TREE





Mini-dwarf apple trees benefit from permanent staking, especially in a windy area or in a loose, sandy soil.

FRUITING

- The ripening fruits can consume all the resources of the tree and its growth can be stunted So, delay fruiting 1-2 years.
- Pick off the immature fruits as soon as you can in late spring for the first year or two, so that the tree can continue to grow.
- After a few years you will have a nice dwarf tree and abundance of fruit.

POTTING AND REPOTTING

- A plant can stay in the same pot for several months or years.
- If you are going to grow the plant in a pot instead of in the ground,
  - it will usually be necessary at some point to move the plant to a larger pot.
  - Do not plant a small plant in a huge pot!
- Instead, increase the pot size incrementally, leaving no more than a few inches of new soil around the outer roots..

POTTING AND REPOTTING

(continued)

- It is possible to keep a plant in the same size pot by:
  - each year, take the plant out of the pot, shave off an inch or two all around the rootball,
  - cut any encircling roots
  - cutting back the top and
  - add fresh soil into the same size pot.
- It is important when repotting plants to use a good quality potting mix.

Plant Caddy

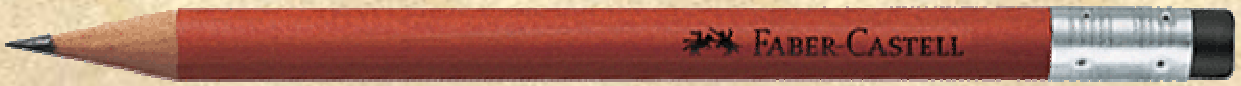
- Plants that have been potted for several years can become quite heavy.
- A wheeled plant caddy can aid in the task of moving it.

Mini-dwarf Raintree choices

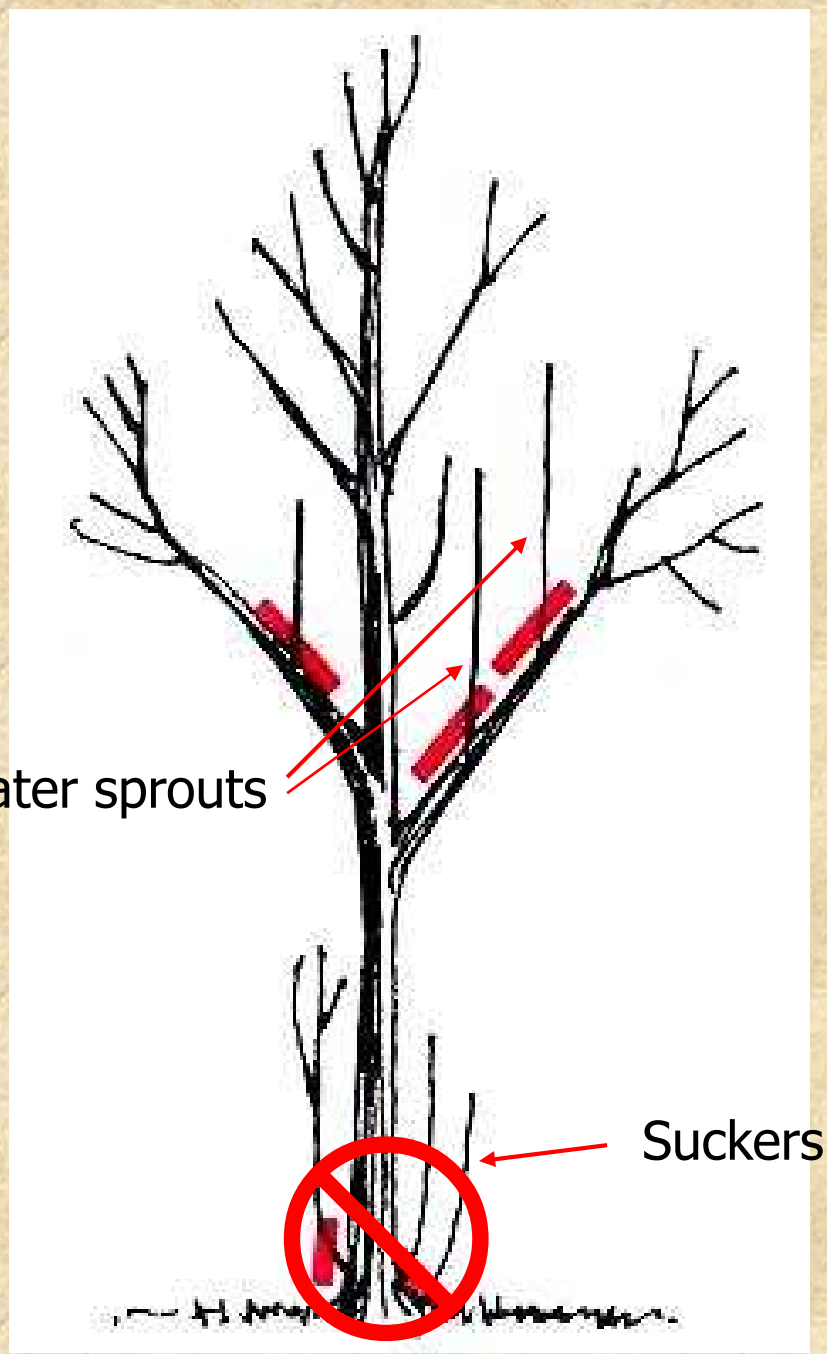
Akane
Ashmead's
Beni Shogun
Belmac
Red B. de Boskkoop
Chehalis
Greensleeves
Enterprise
Evereste
Gravenstein
Honeycrisp
Karmijn
Liberty
Melrose
Pristine
Jonagold
Queen Cox
Rubinette
Pink Lady
Spartan
William's Pride

Or by learning to graft, you can create your own mini-dwarf with available scion wood and M 27 rootstock.

Scion Wood Selection & Storage



- Collect scions of one-year-old wood in the fall, winter or early spring.
- They may come from trees whose fruit you desire -- perhaps those of neighbors or friends. Scion wood is also available from nurseries or experiment stations.
- Scion wood should be placed in closed plastic bags and stored under refrigeration (32 to 40°F) until used.
- The grafting is done in early spring, usually before growth starts.



Scion wood collected from one year old wood or last year's growth

Scion Wood Source

Nick Botner
4015 Eagle Valley Rd.
Yoncalla, OR 97499
(541) 849-2781

Neighbor
Local Nursery
Home Orchardist

Maple Valley Orchards & Nursery
11541 Claywood Road
Gillett, WI 54124
Phone 920-842-2904
Fax 920-842-3204@

http://www.maplevalleyorchards.com/Pages/ScionWood.aspx

http://mountvernon.wsu.edu/FruitHorticulture/ScionwoodVarieties.html

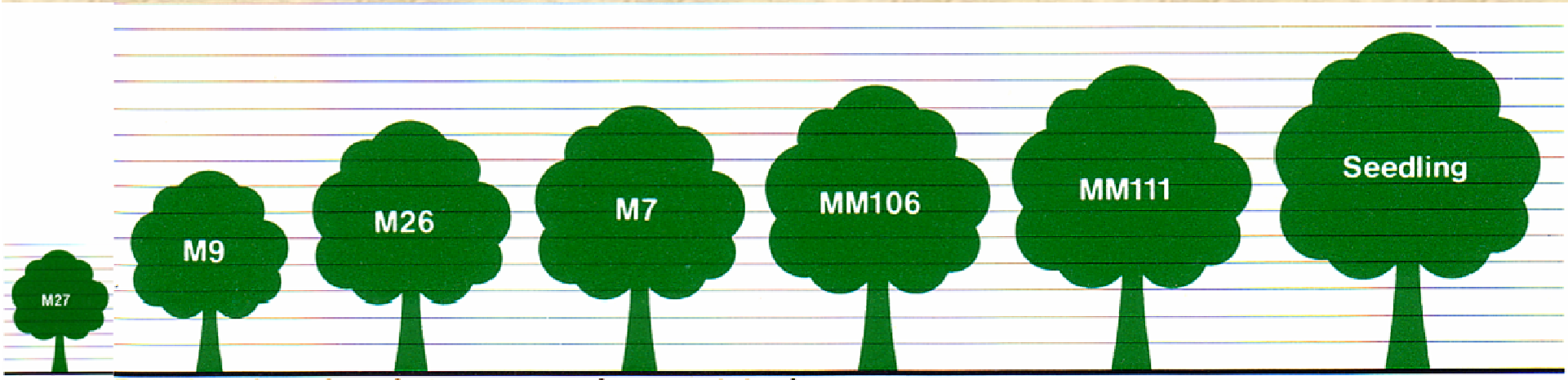
Graft Compatibility

Sufficiently close genetic relationship for the formation of a successful graft union

- Limits of Compatibility
  -

Clone	Species	Genus	Family	Difficulty
S	S	S	S	No sweat
D	S	S	S	Easy
D	D	S	S	Moderate
D	D	D	S	Unlikely
D	D	D	D	Nill

Apple Rootstock listed by size class Size



Relative size of apple trees on various rootstocks.

Class 1 P.22 **M 27** G.65	Size Class 3 **M.9** **Bud.9** P. 2 G.16	Size Class 5 G. 30	Size Class 7 **MM. 106** Bud. 490	Size Class 9 Bud. 118 P. 18
Size Class 2 Bud 146 Bud 491 P.16 Mark	Size Class 4 G. 11 **M. 26**	Size Class 6 **M. 7**	Size Class 8 **MM. 111**	Size Class 10 **Seedling**

Tree and Rootstock vigor

Rootstock

Scion wood

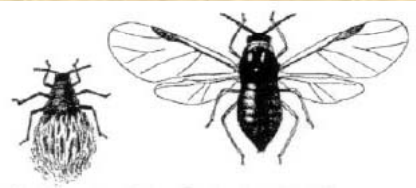
Rootstock		Very Low Vigor	Low Vigor	Moderately Vigorous	Vigorous	Very Vigorous
		Spur Rome Super Spur Delicious Spur Winesap	Spur Delicious Spur Golden Spur Granny Smith	Delicious Golden Jonathan Akane Criterion Empire Spur Winter Banana	Jonagold Cortland Granny Smith	Gravenstein Mutsu Jonadel Spencer Winter Banana
Very Dwarf	**M 27**	**N.R.***	**N.R.***	**N.R.***	**N.R.***	**1(?)**
Dwarf	**EM 9**	**N.R.***	**N.R.***	**1**	**1,2**	**2**
	M 26	**1,2**	**1,2**	**2,3**	**3,4**	**4,5**
	MAC 9	**1,2**	**1,2**	**2,3**	**3,4**	**4,5**
Semi-Dwarf	**EM 7**	**2**	**2,3**	**4**	**4,5**	**5**
	M 7a	**2**	**2,3**	**4**	**4,5**	**5**
	EMLA 7	**2**	**2,3**	**4**	**4,5**	**5**
Moderately Vigorous	**MM 106**	**2**	**3**	**4,5**	**5**	**5,6**
	EM 4	**2**	**3**	**4,5**	**5**	**5,6**
	EM 2	**2**	**3**	**4,5**	**5**	**5,6**
	MM 111	**2**	**3**	**4,5**	**5**	**5,6**
	Interstem 9 on very vigorous root	**2,3**	**3**	**4,5**	**5**	**5**
Vigorous	**EM 1**	**3**	**3,4**	**5**	**5,6**	**6**
	MM 104	**3**	**3,4**	**5**	**5,6**	**6**
Very Vigorous	**Seedling**	**4**	**4,5**	**5**	**6**	**6+**
	EM 16	**4**	**4,5**	**5**	**6**	**6+**
	Alnarp 2	**4**	**4,5**	**5**	**6**	**6+**

Rootstock Selection

Selection on basis of :

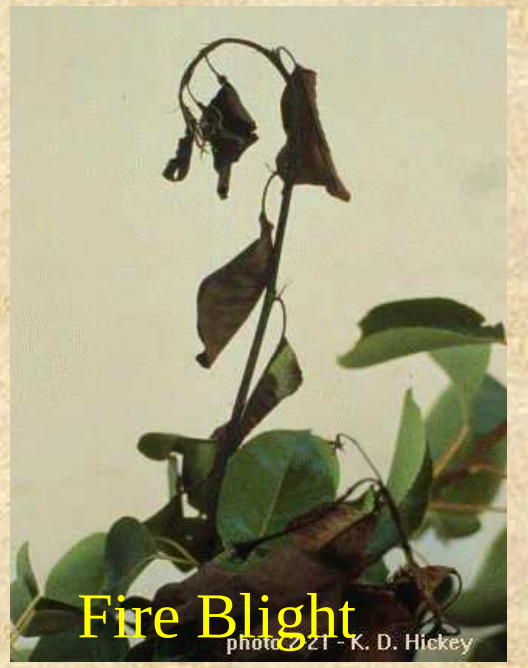
- Dwarfing
- Precocious
- Disease &
- Insect resistance
- Soil type

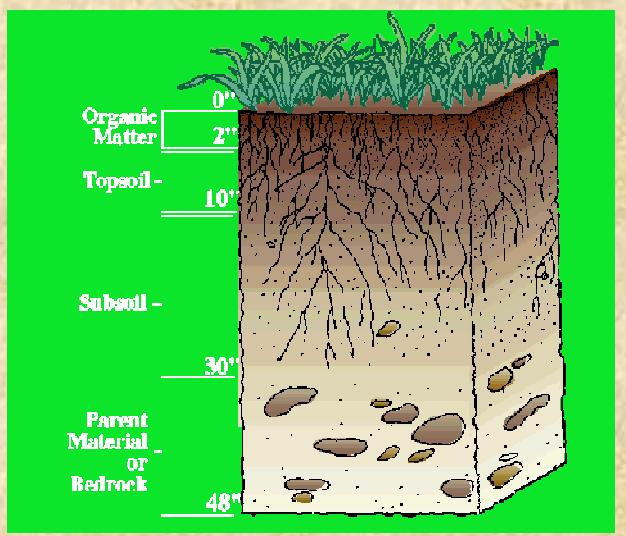
Early fruiting



Woolly apple aphid

Scab fungi





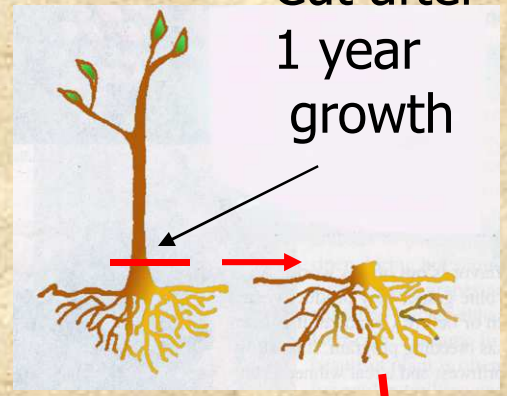
Soil site conditions

Propagating Rootstock

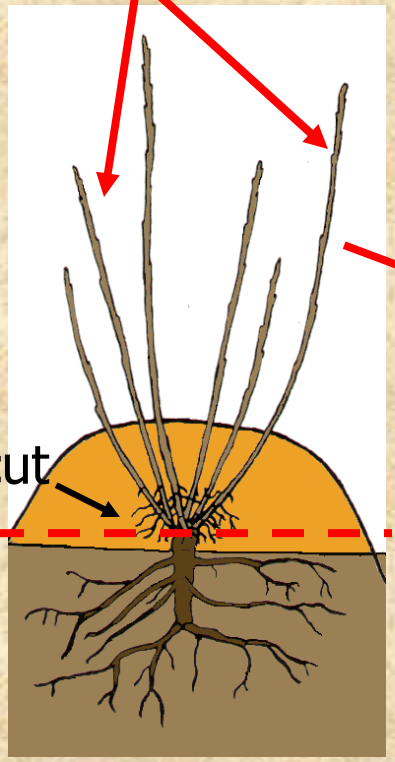
Rootstock also selected for: Ease of propagation

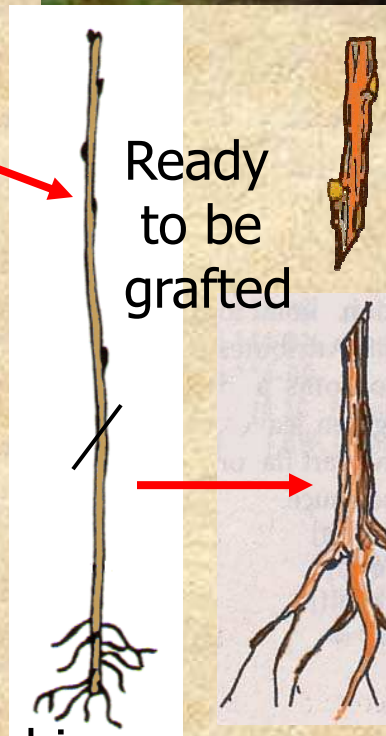
Harvest rooted whips

Cut after 1 year growth



Stoolbed

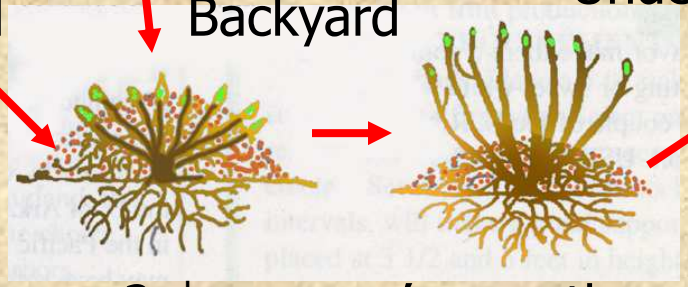




Ready to be grafted

Mounded sawdust

Backyard



2nd summer's growth

Under cut

Dormant season harvest of rooted whip

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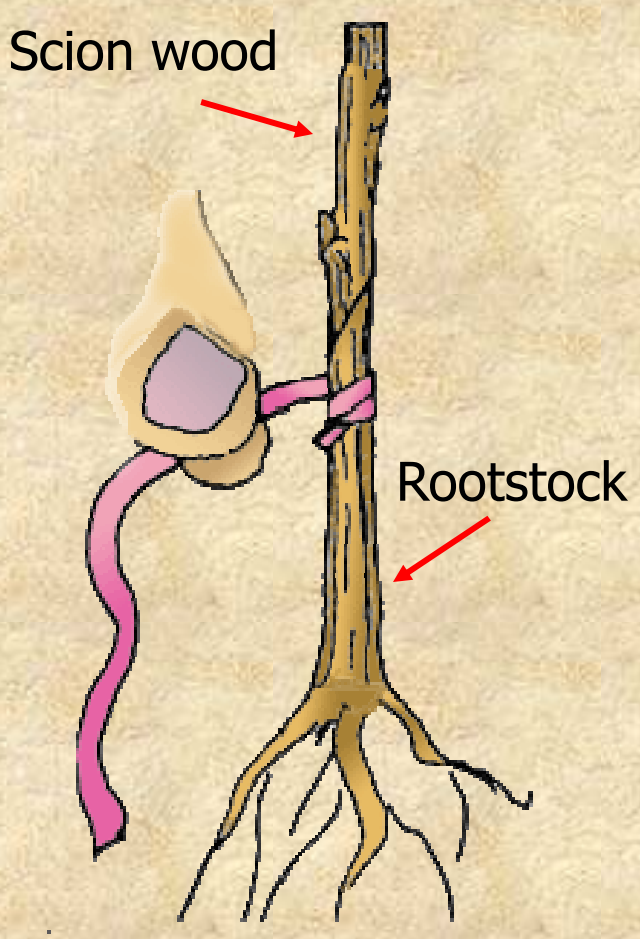
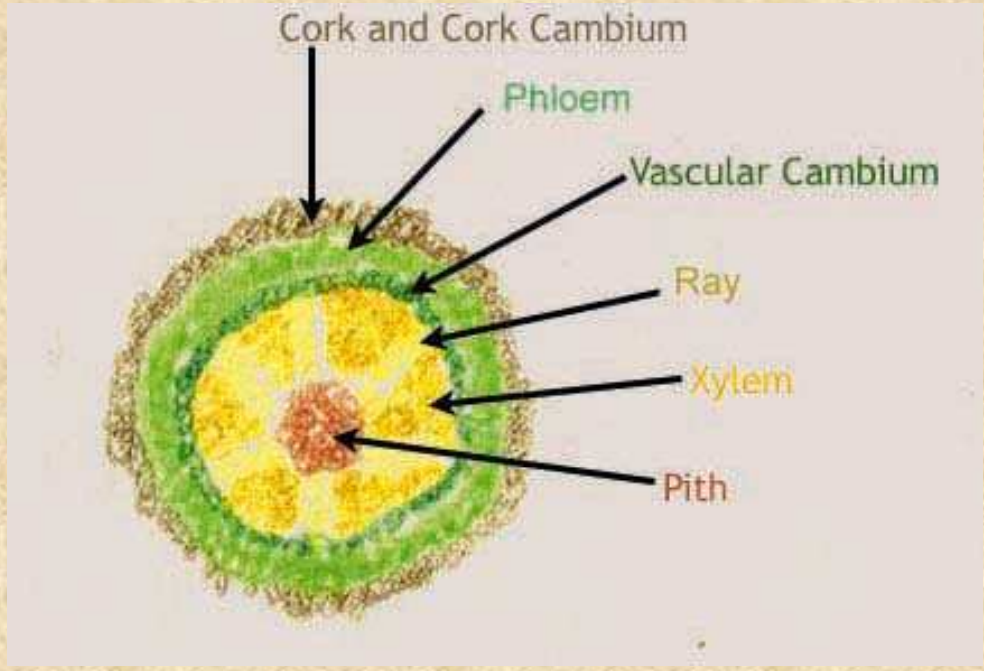
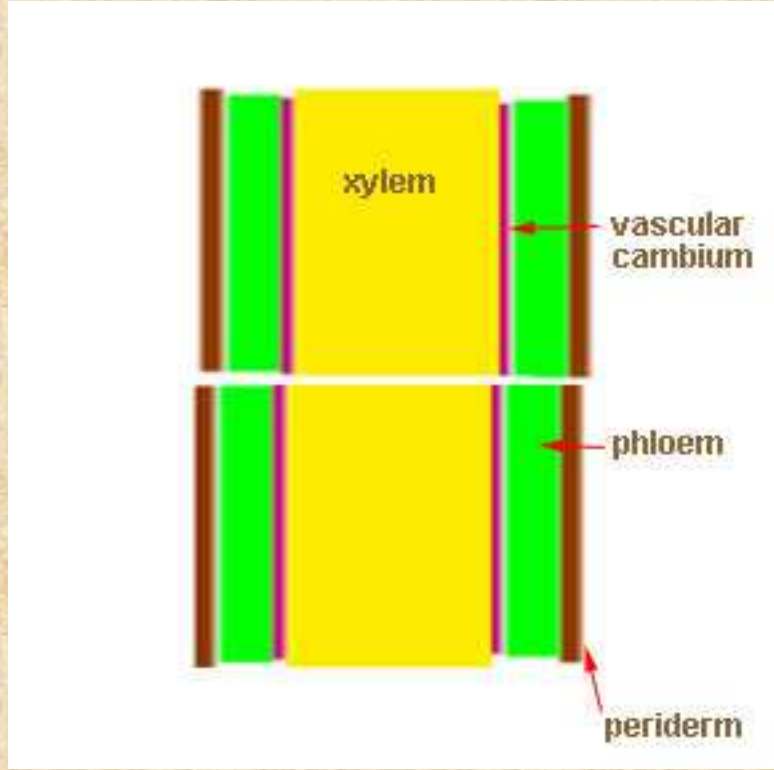
Review: Four Criterion for Successful Graft Union Formation



1. Cambial contact
2. Avoidance of desiccation
3. Compatibility
4. Pressure

Cambium—

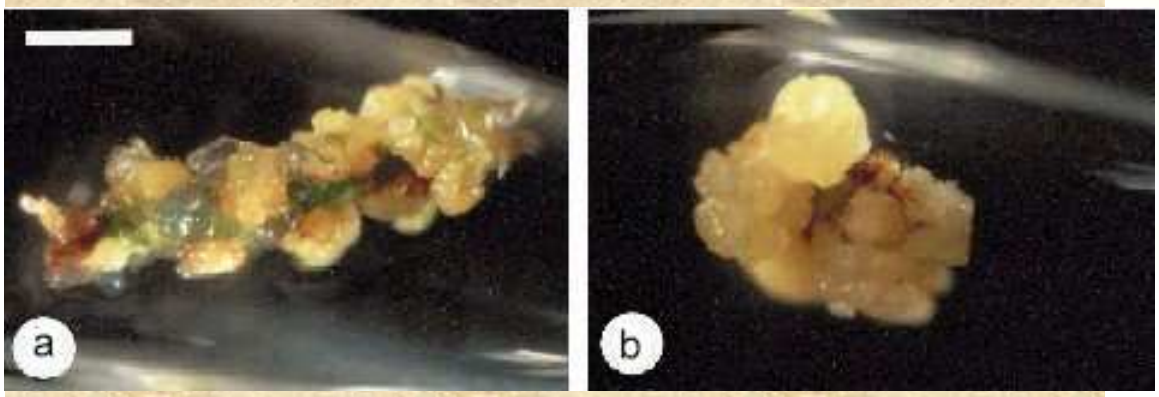


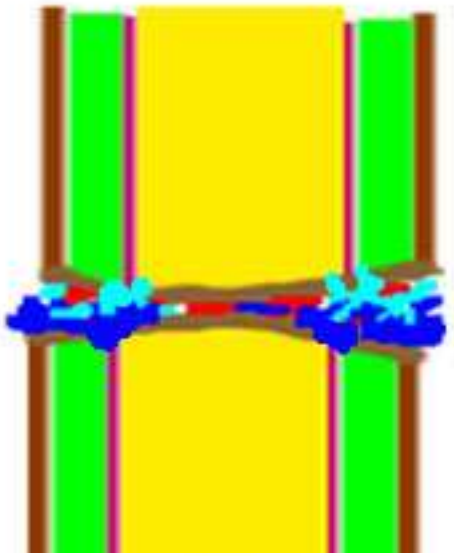


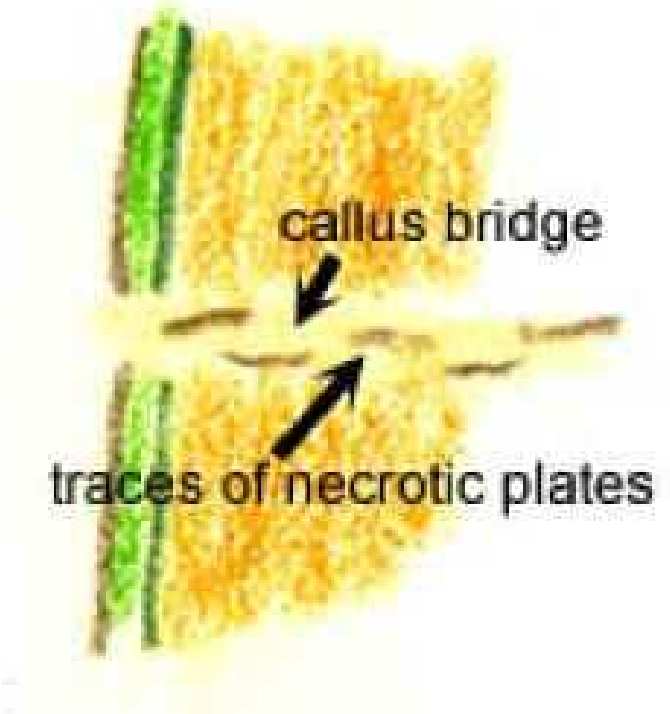
- The growing part of the tree; located between the wood and bark. At the season when bark separates freely, cambium will be both on the wood surface and on the inner bark.

Cambial Contact

•In the first days or weeks after the two parts to be grafted are cut, cells proliferate at the site of the cut. This tissue is called "callus".

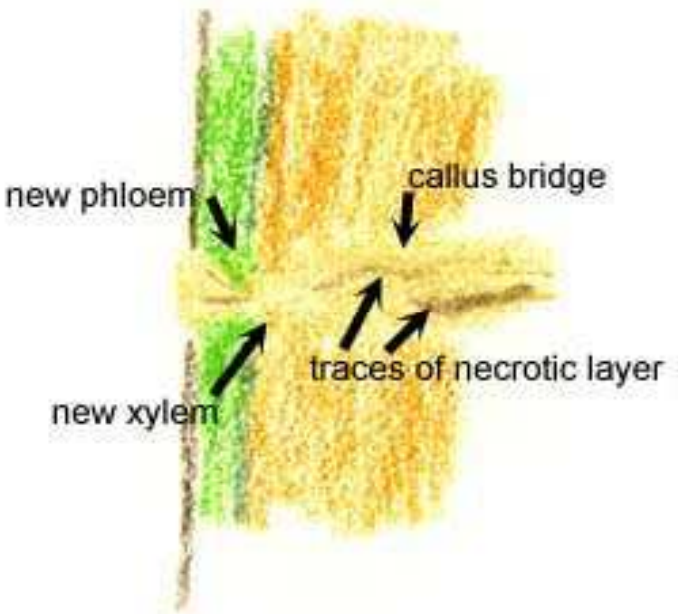


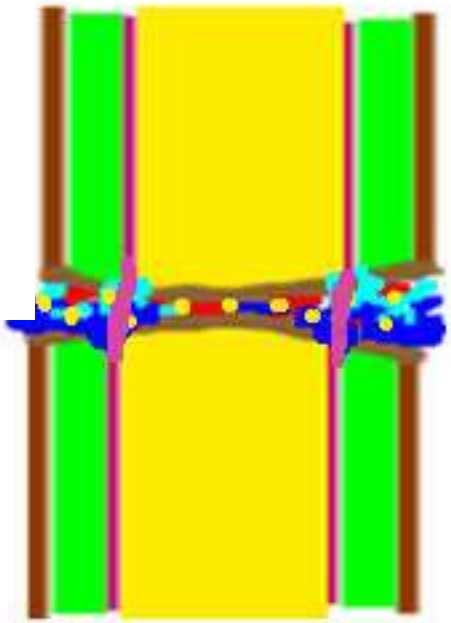


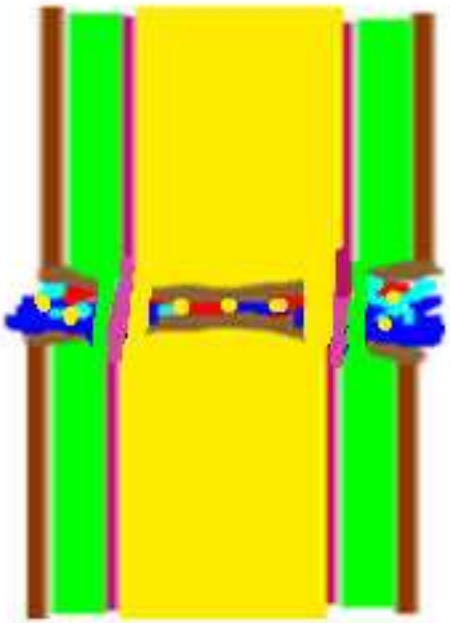


Callus Bridge

If the two parts are in contact with pressure between the parts these two callus layers will begin to grow together, creating a "callus bridge."

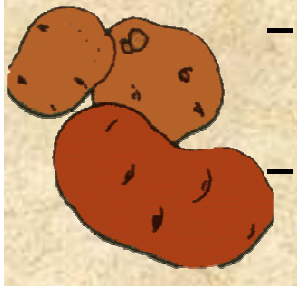




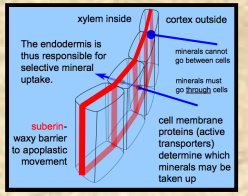


Avoidance of Suberization

- The potato industry refers suberization, almost synonymously with wound-healing.
- Suberization is the process of sealing off wounds, cuts, and general skin damage that occurs during harvest.
  - The deposit of suberin, a waxy, fatty substance into cells, adjacent to wounds, and.
  - Transforming the surface of the damaged area and skin into corklike tissue.

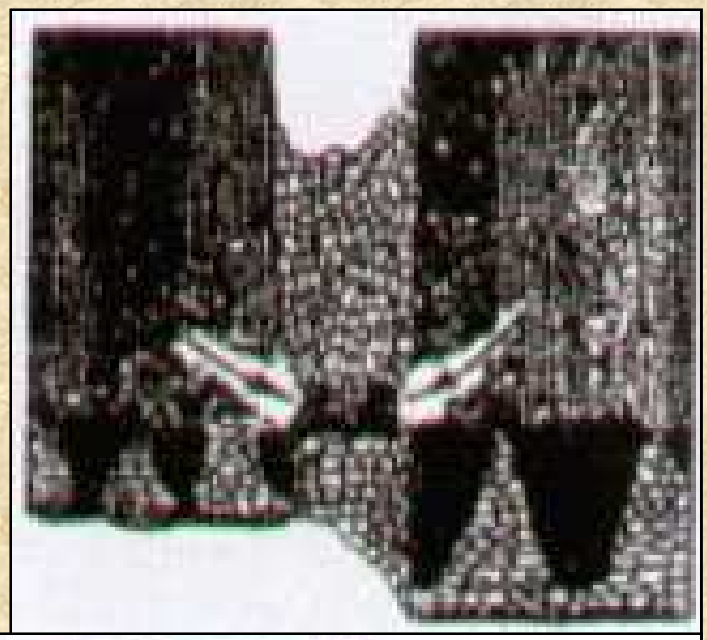


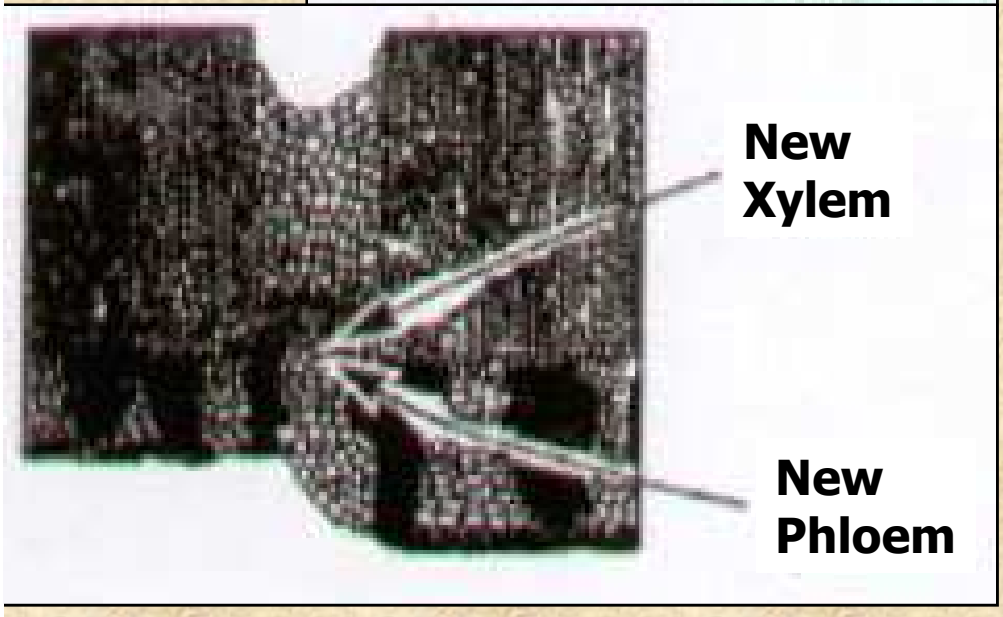
- Prior to the formation of suberin, the exposed cell are permeable to water, which allows moisture to escape from the potato.



- So the deposit of the waxy suberin, which are also found in apple wood, helps to prevent moisture loss, along with other important benefits but are not functional for grafting.

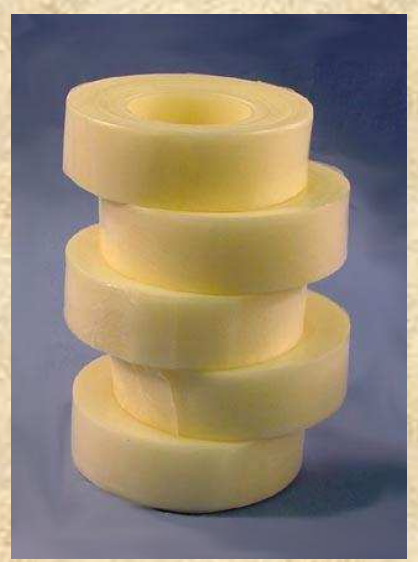
Differentiation of new cambium.





- Parenchyma cells **differentiate** into cambium cells, thus uniting the cambium of the stock with the cambium of the scion.
- Formation of secondary xylem and phloem from new cambium allows translocation between the stock and scion.

Avoidance of desiccation



1.) Management during cuts. Keep cut edges moist.

2.) Use budding & grafting tape---or

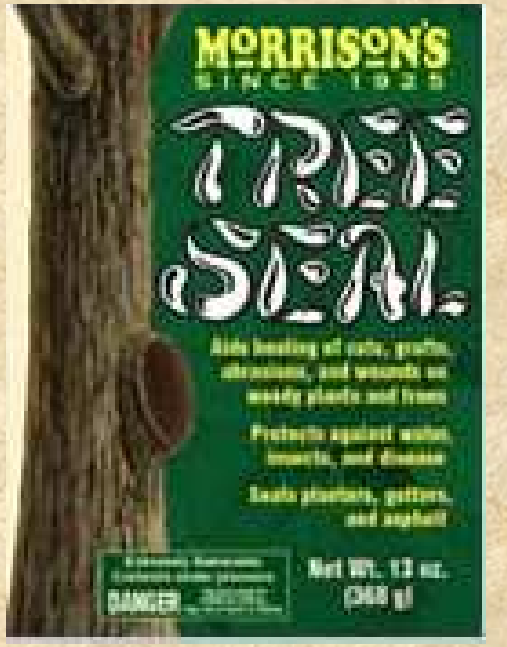
3.) Use budding & grafting bands.

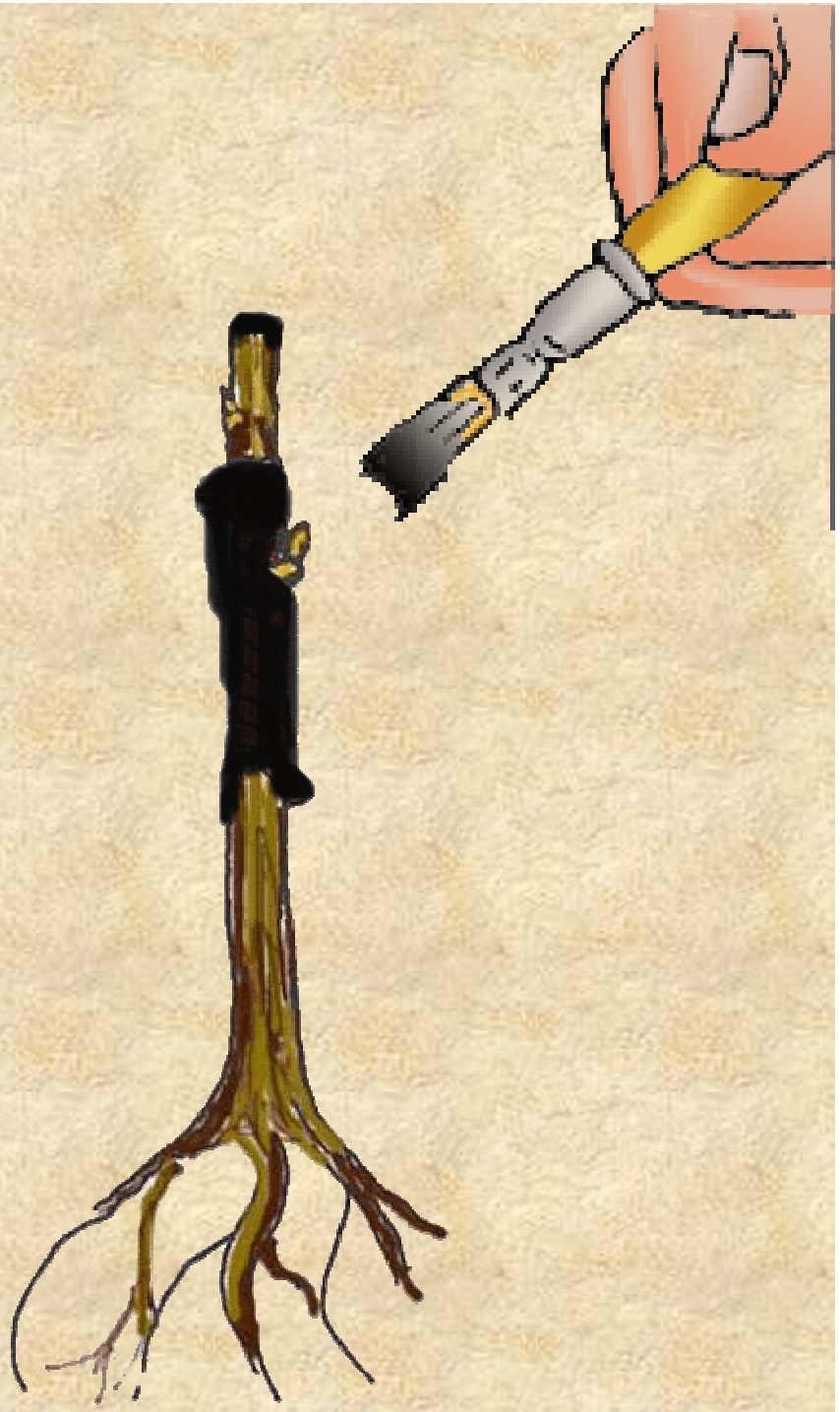
4.) Use tree seal

Wrap the splice cuts…

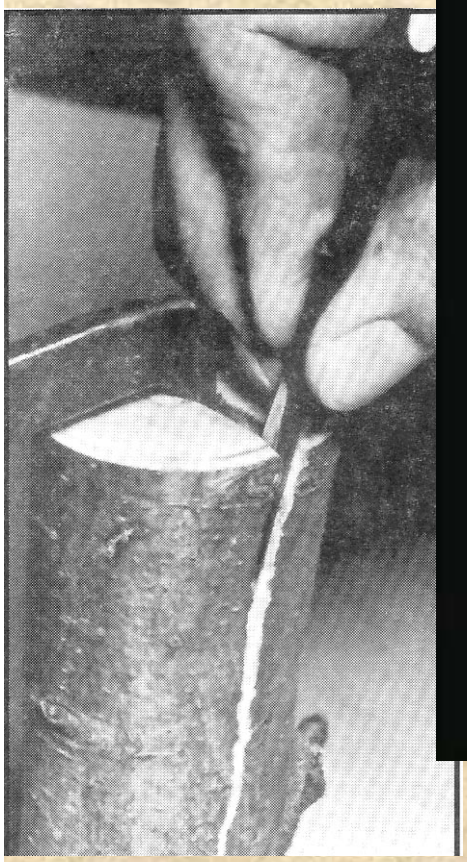
…firmly to create pressure and stability

Apply tree seal





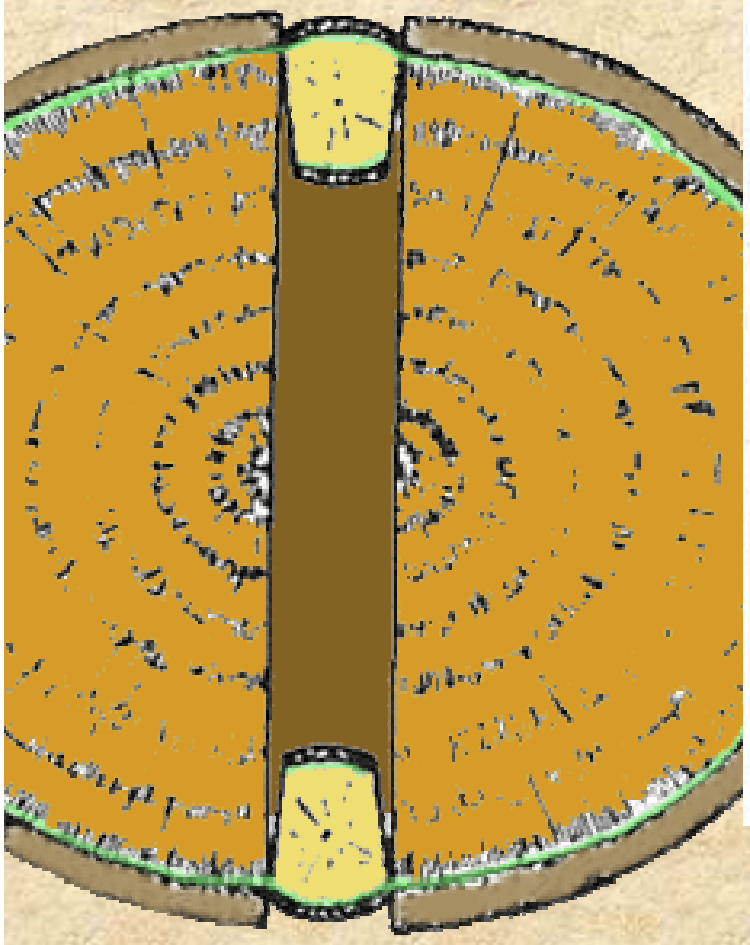
Cleft Graft

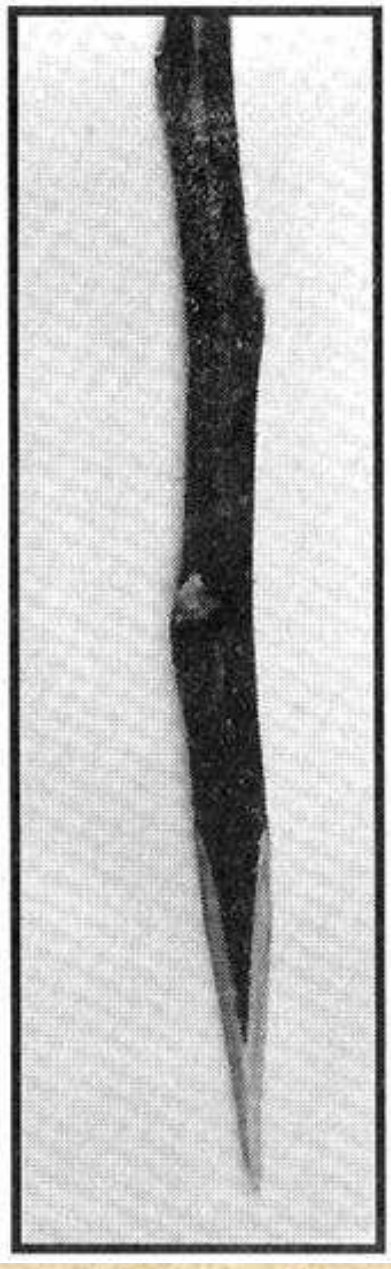


Cleft Graft

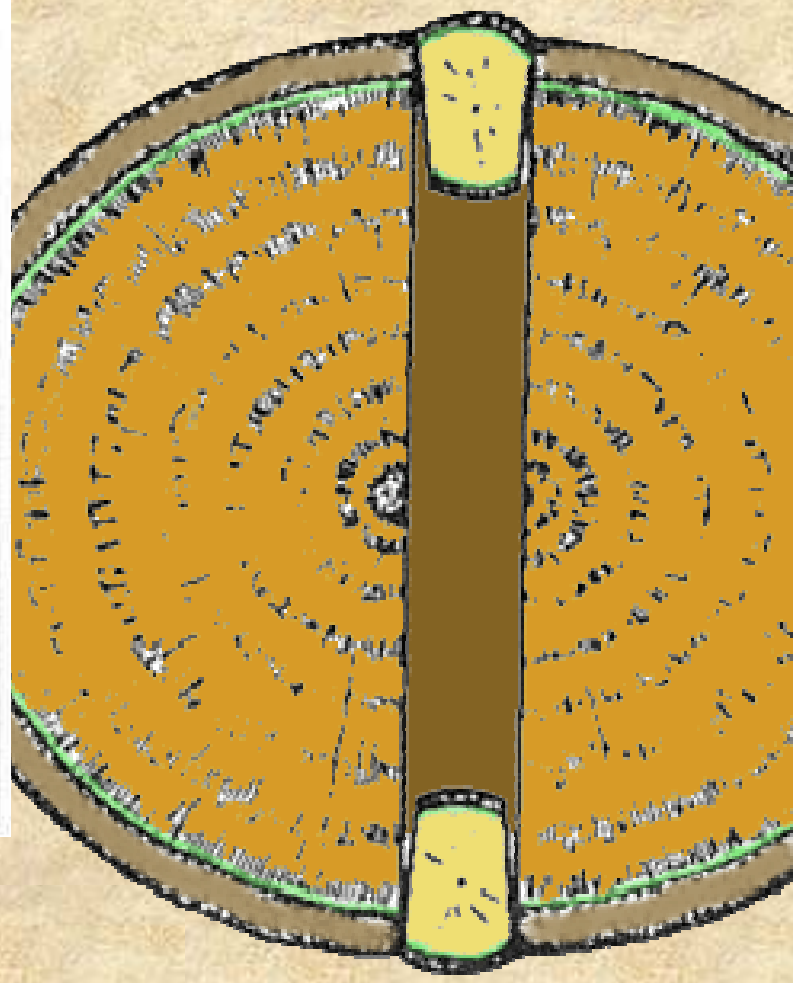
Be sure to align cambium

Right





Wrong



Topworking

- When a desired variety is grafted onto the limbs of a hardy tree it is called "topworking."
- The operation of cutting back the branches and top of an established tree and budding or grafting part of another tree on it.

Growing Multi-grafted Trees


Multi-graft apple tree

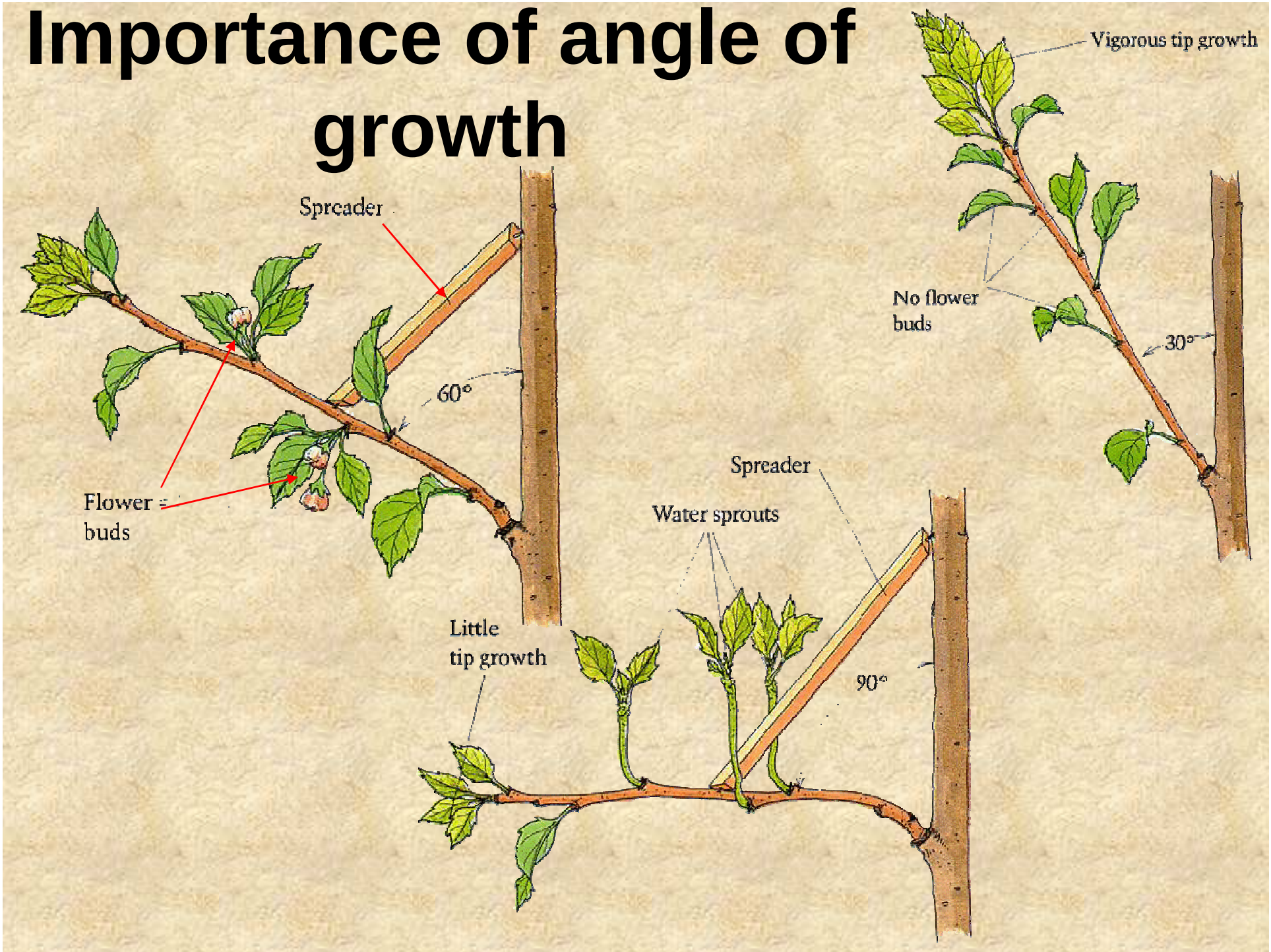

Open Center Leader

- Sometimes, more than one apple variety is grafted on the same tree.
  - This is reasonably satisfactory, but varieties have different growth rates and maturity dates,
  - so it's more difficult to prune and spray such trees.
- You can avoid these problems by planting several dwarf trees of different varieties.

MULTI-GRAFTED FRUIT TREES

- Multi-grafted fruit trees with several varieties on the same plant can be a fun way to grow lots of varieties in a limited area.
- Be aware, they are more challenging because one or more varieties will sometimes overgrow the others.
  - To bring the tree into balance, the over vigorous variety(s) need to be slowed down; by either by pruning or changing the angle of growth or both.
  - To encourage less vigorous varieties pull the tip up so it is nearly vertical.
- The vertical angle creates strong growth and horizontal weak growth. Continue this for the first few years until the tree is in balance.

Importance of angle of growth

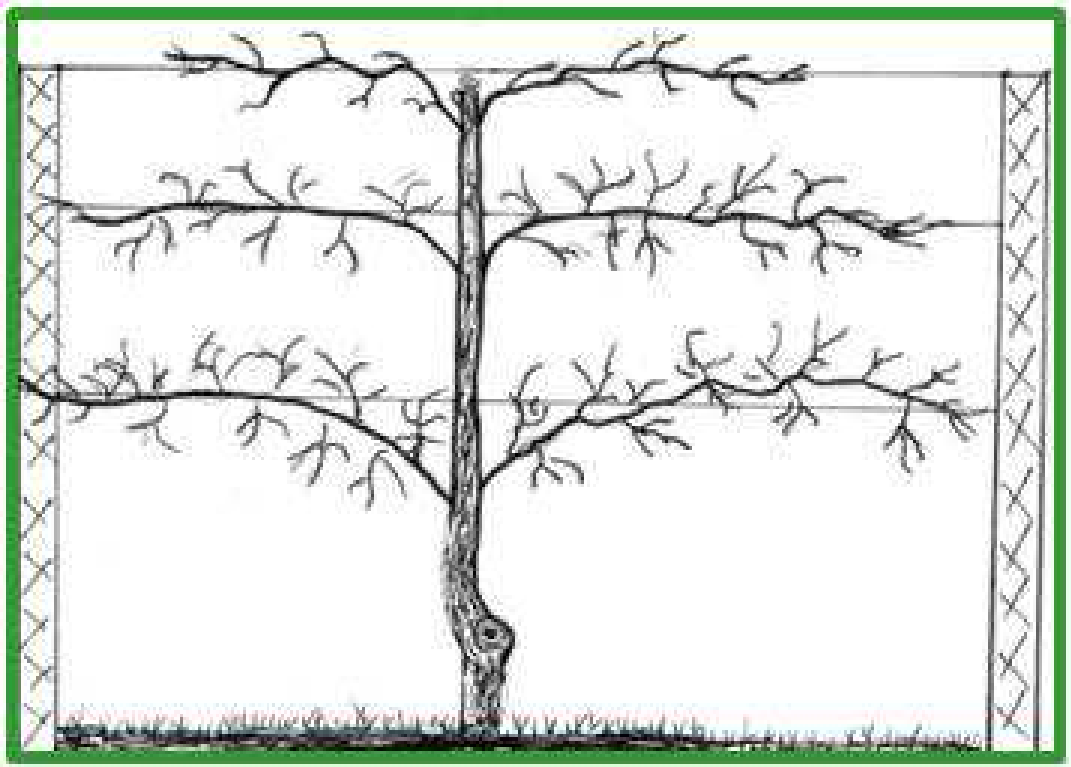


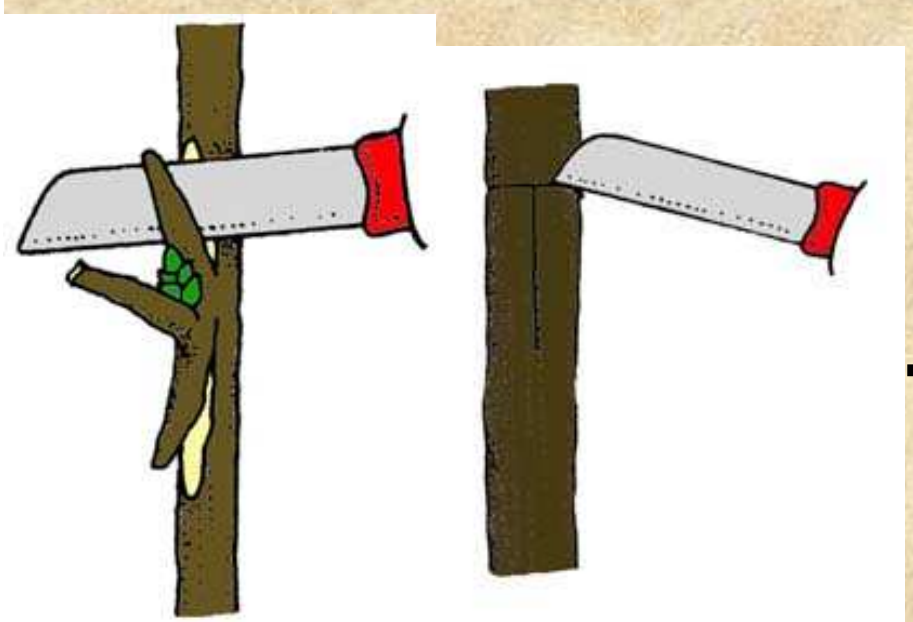
Multiple Graft Fruit Trees

M-7 rootstock with 3 tiers of branches with 5 of the following 6 varieties:

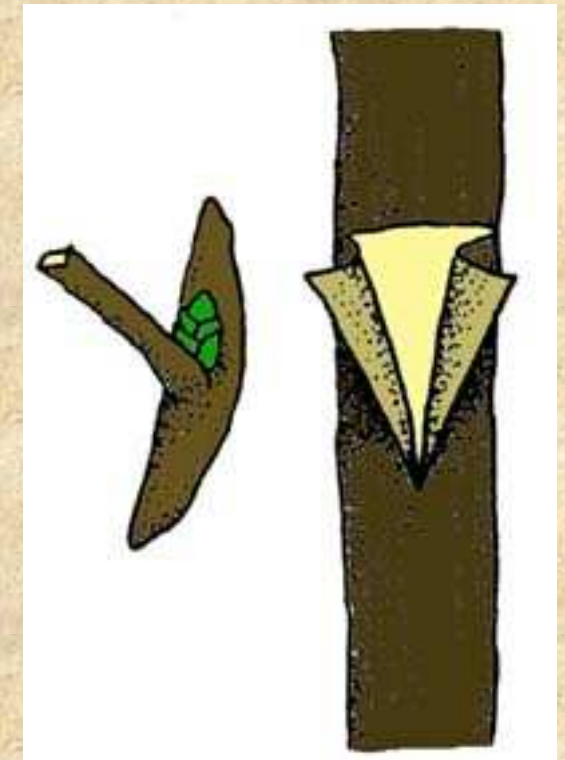
- Golden Delicious,
- Fuji,(Red Gravenstein)
- Gala,
- Red Delicious
- and Braeburn.

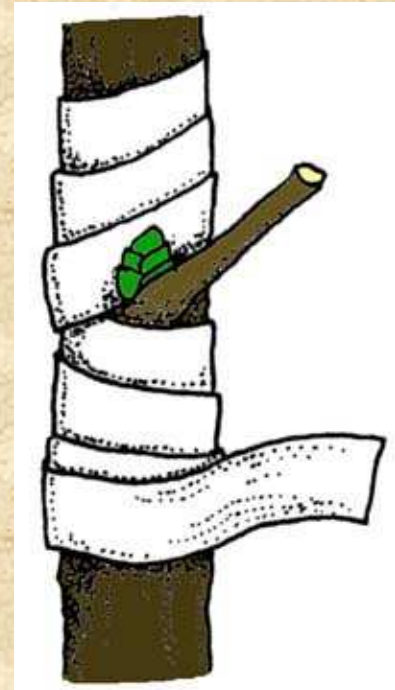
Select a spur-bearing variety



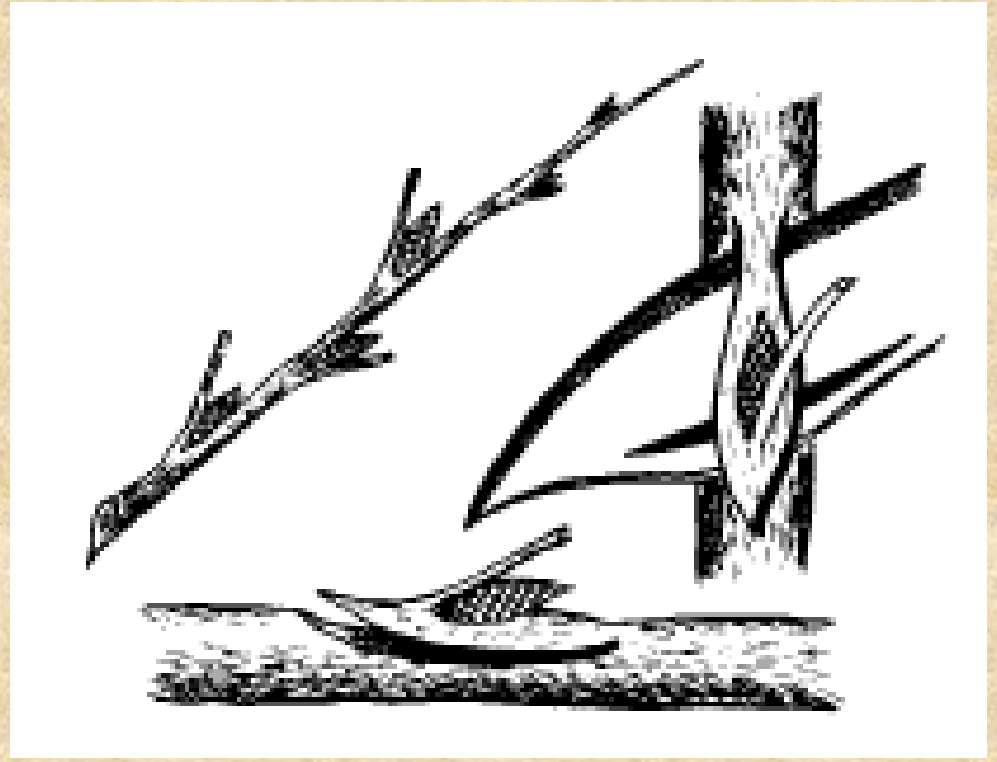


Propagation Using:
T or Shield Budding



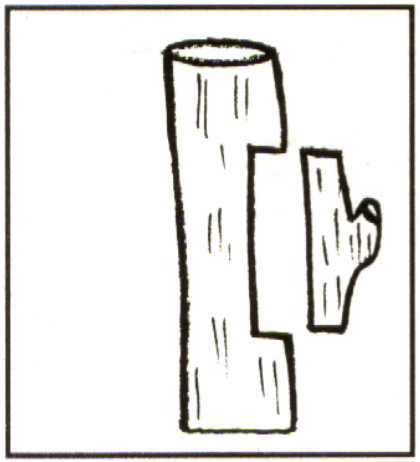


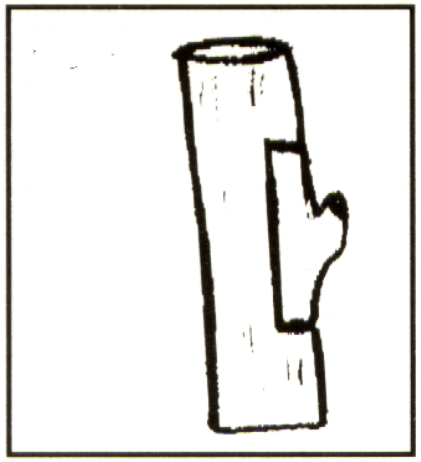
Glossary of Terms

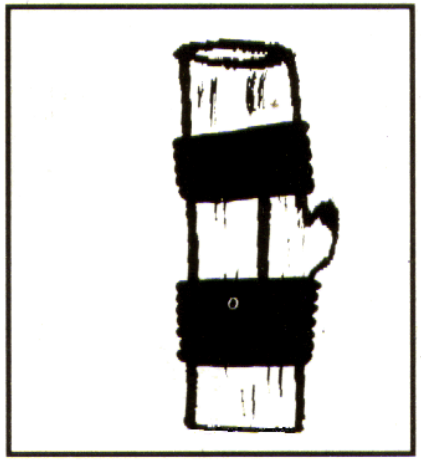


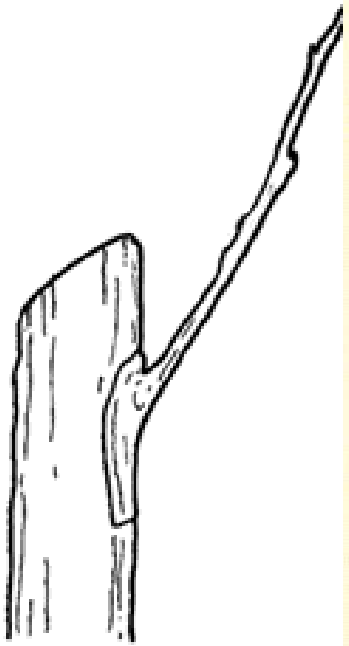
- **Budstick**—A shoot of the current season's growth used for budding. Leaves are removed, leaving ½ inch of leaf stem for a handle.

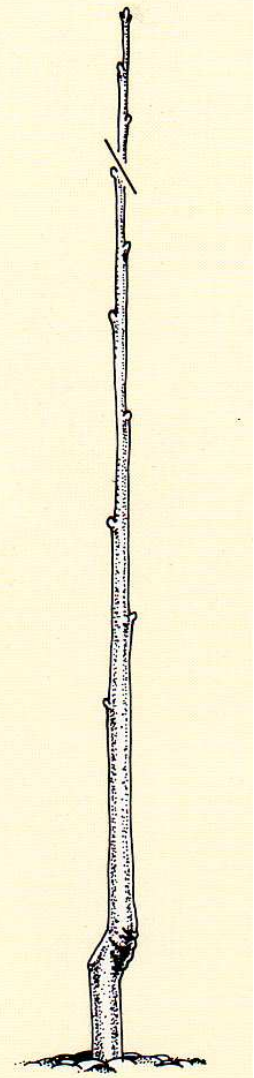
Chip Budding





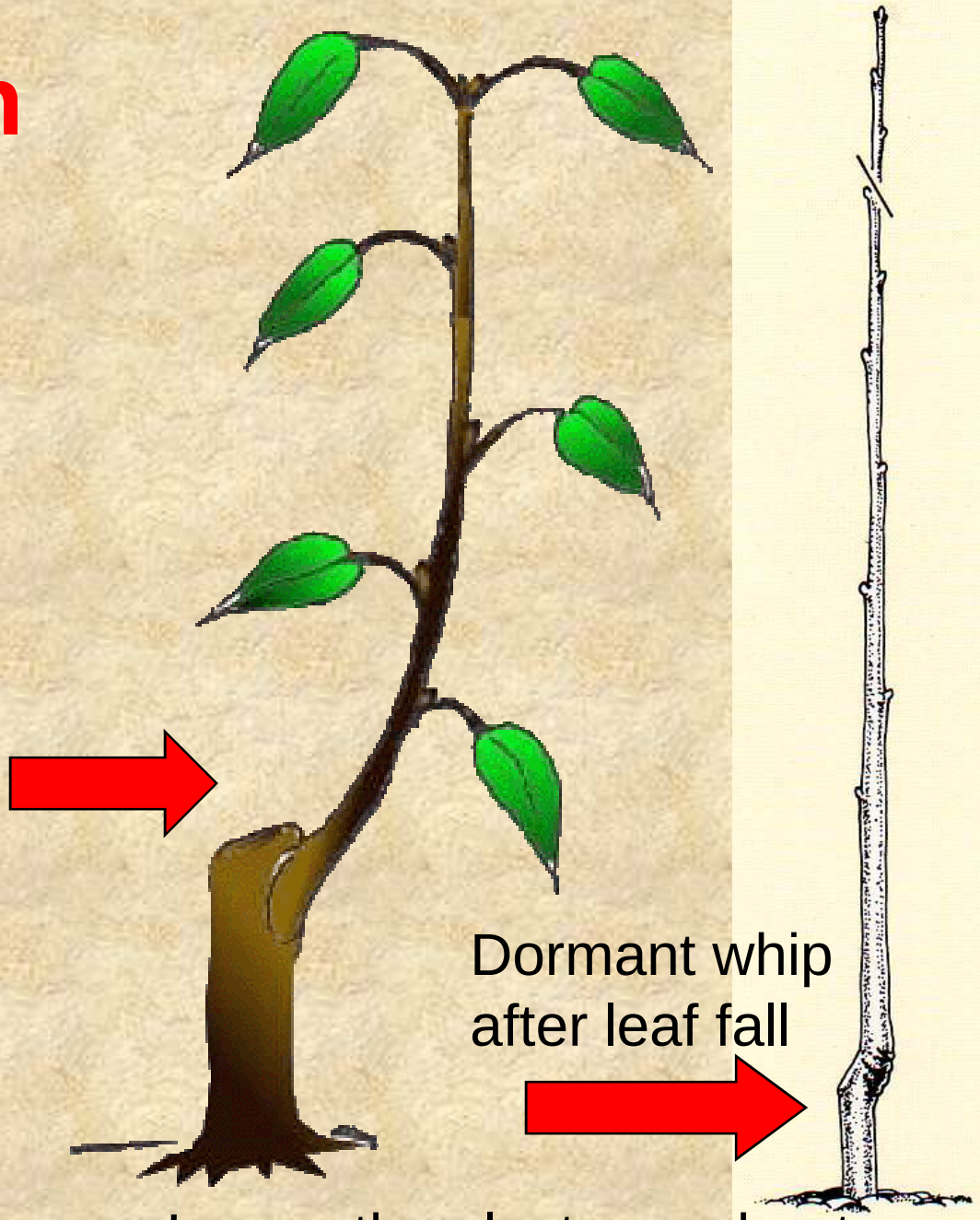






Chip budding is a technique that may be used whenever mature buds are available. Because the bark does not have to "slip," the chip-budding season is longer than the T-budding season.

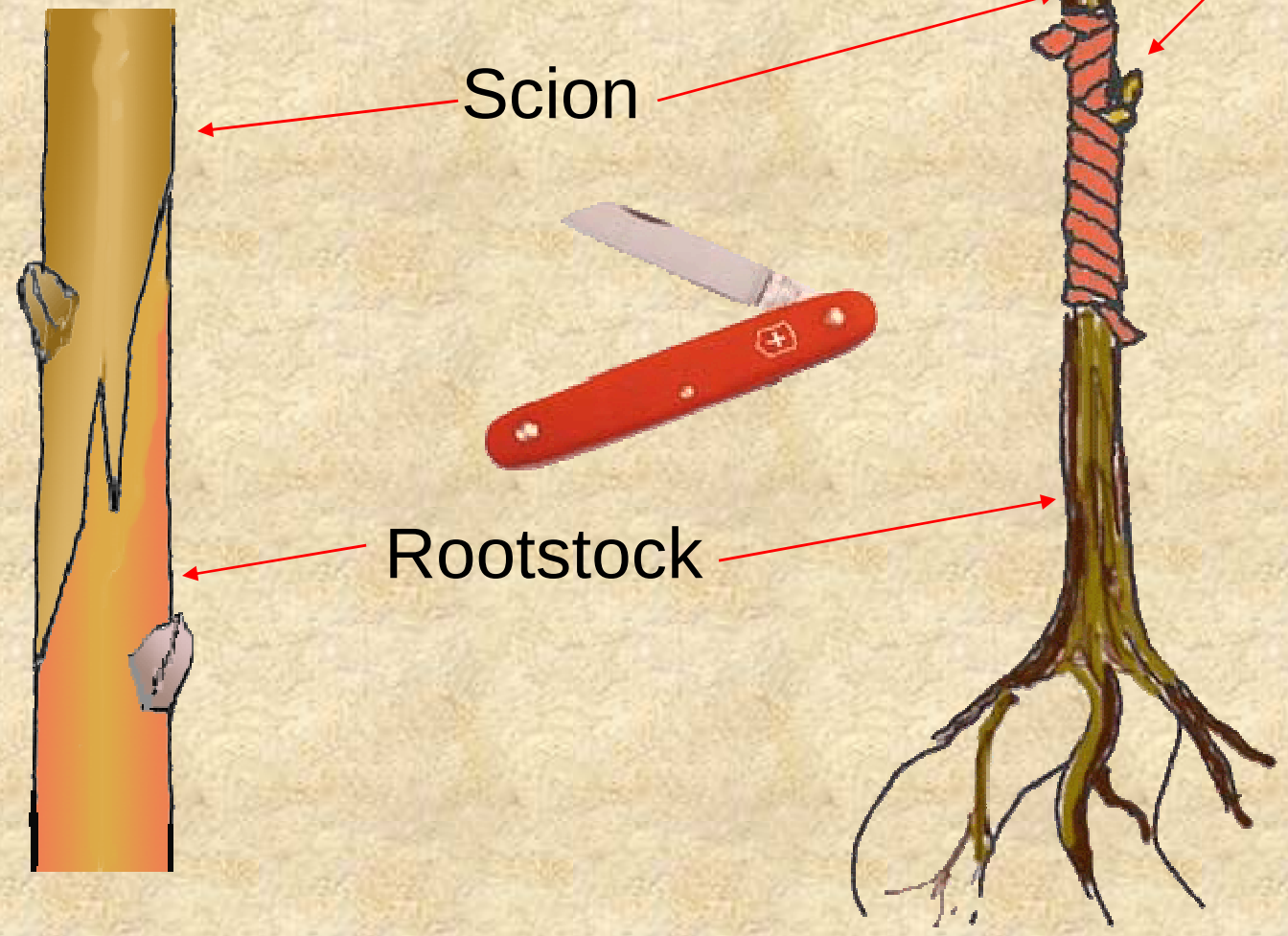
Propagation



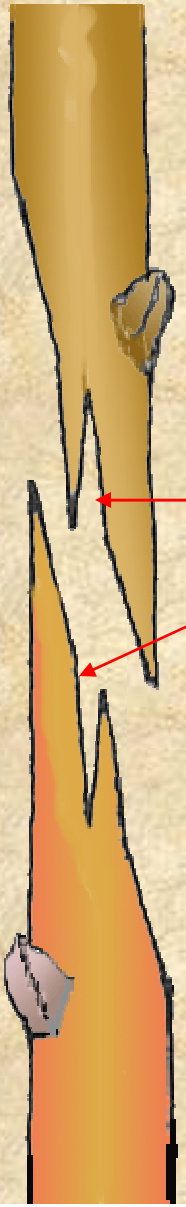
Dormant whip
after leaf fall

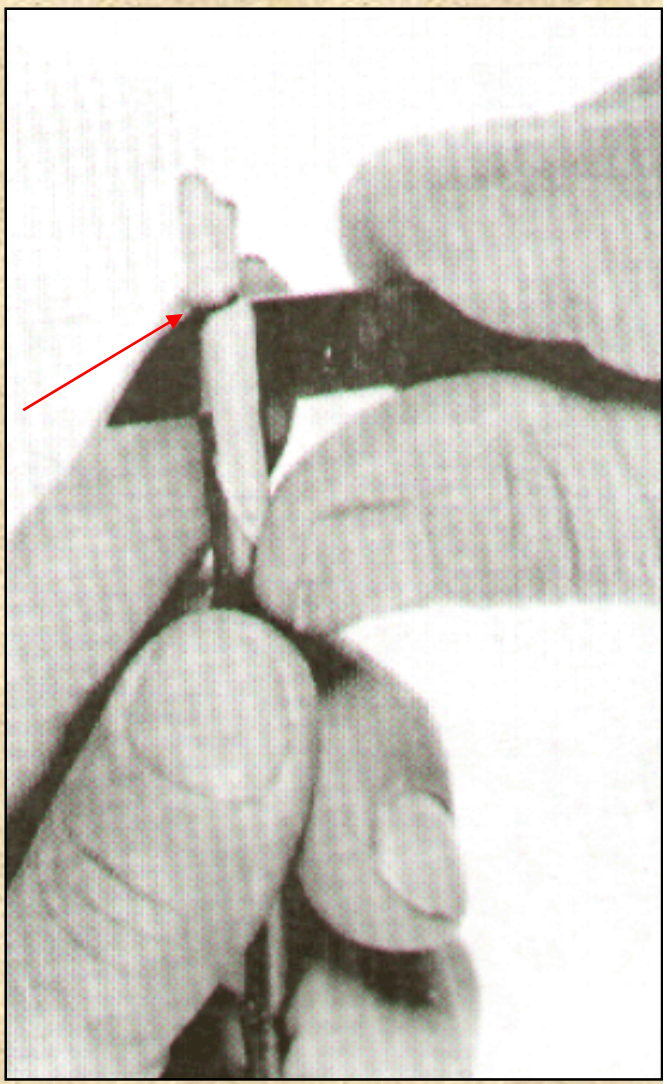
First summer’s growth-select one shoot.

Whip-and-tongue graft (Whip graft)

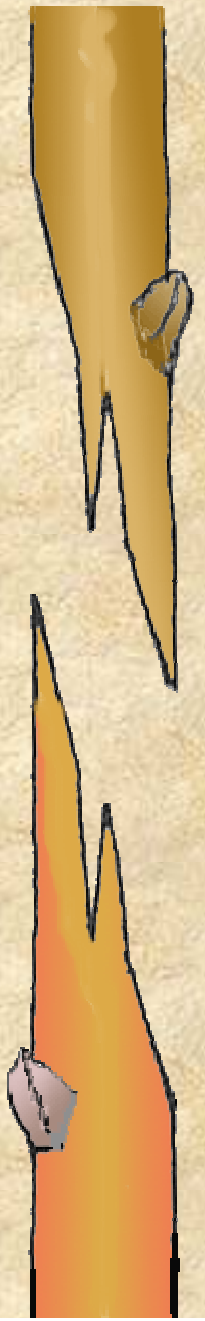


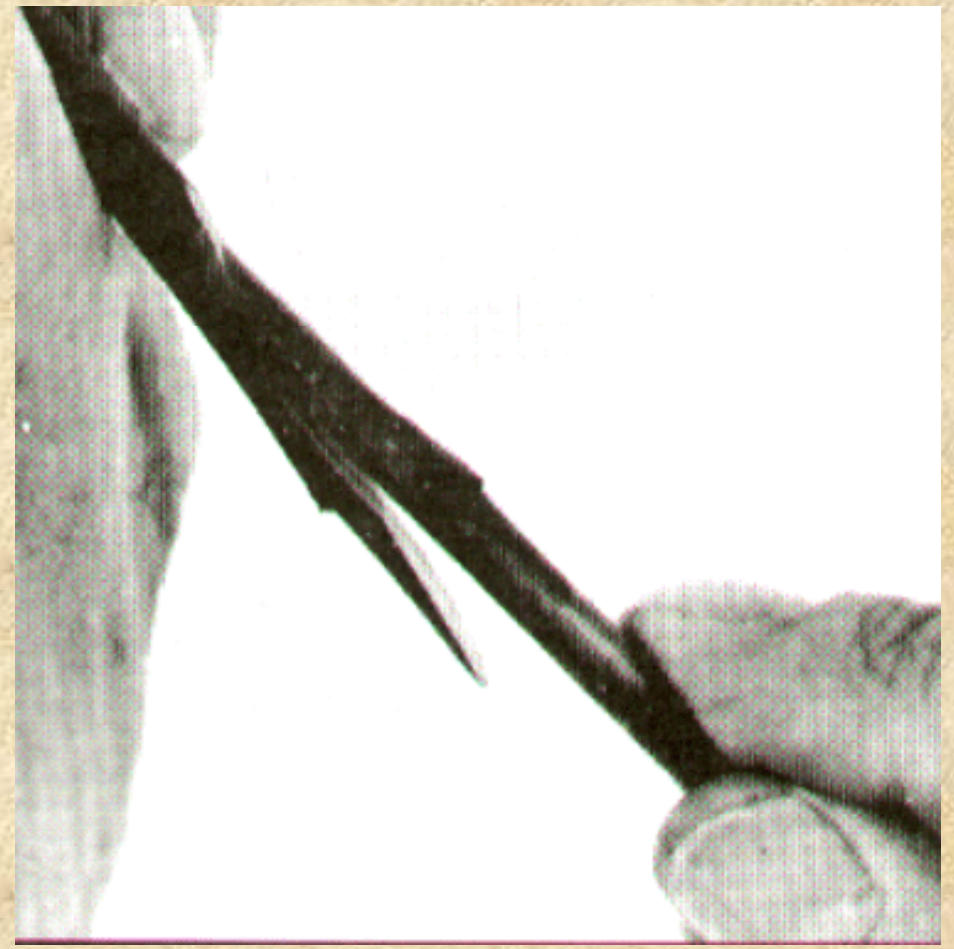
Second Cut


Scion
Buds point up
Second Cut on scion and rootstock.
Rootstock



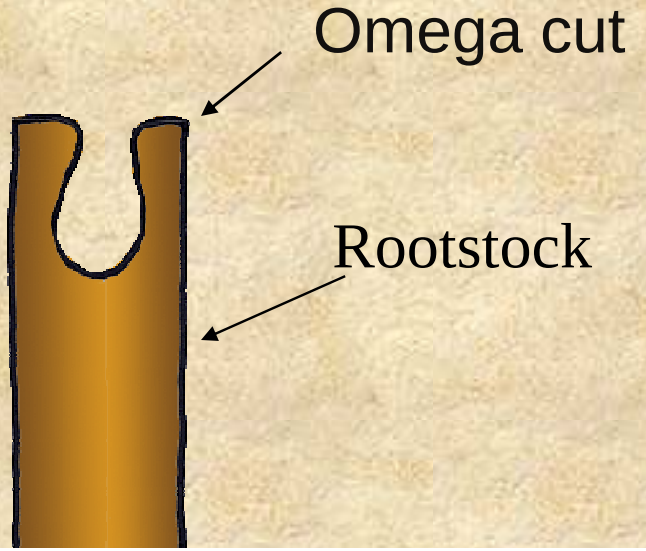
Putting it together





Using a Grafting Tool

Omega

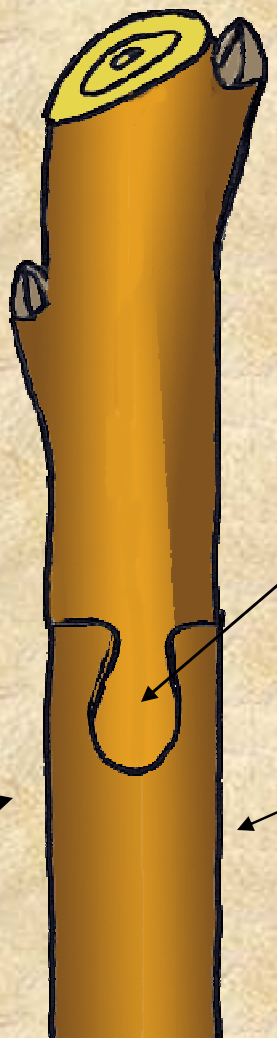


Using a Grafting Tool

Scion

Grafting Tool

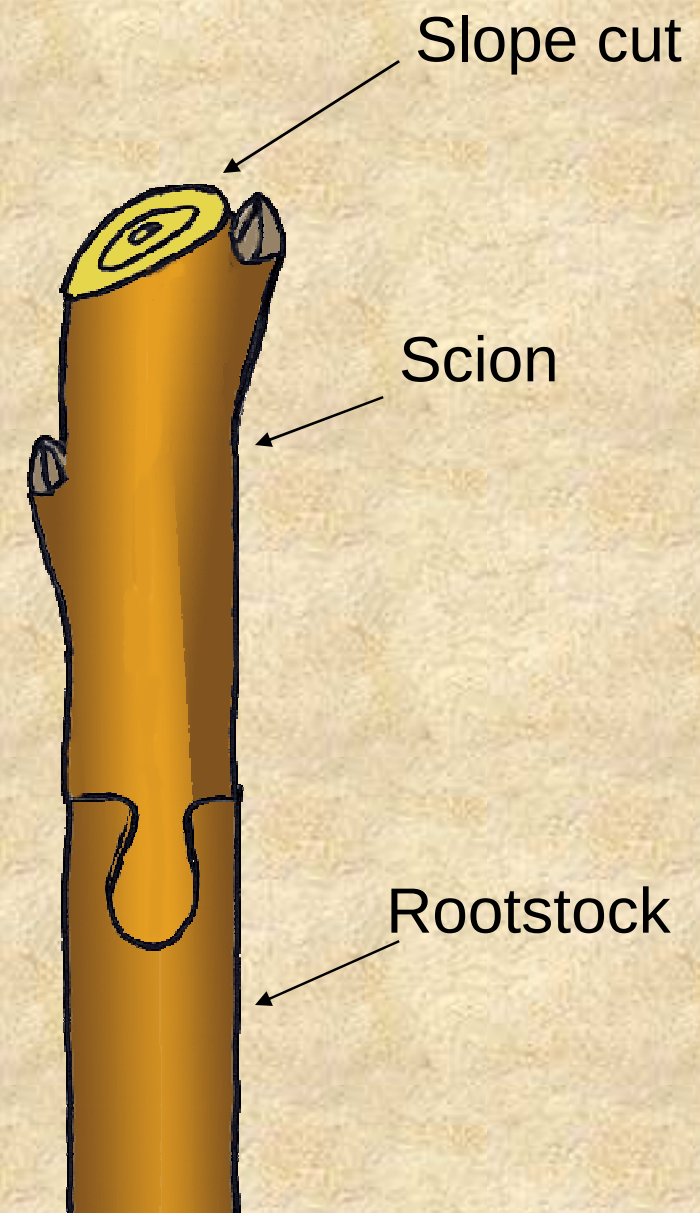
Slip the scion on to the rootstock from the side.

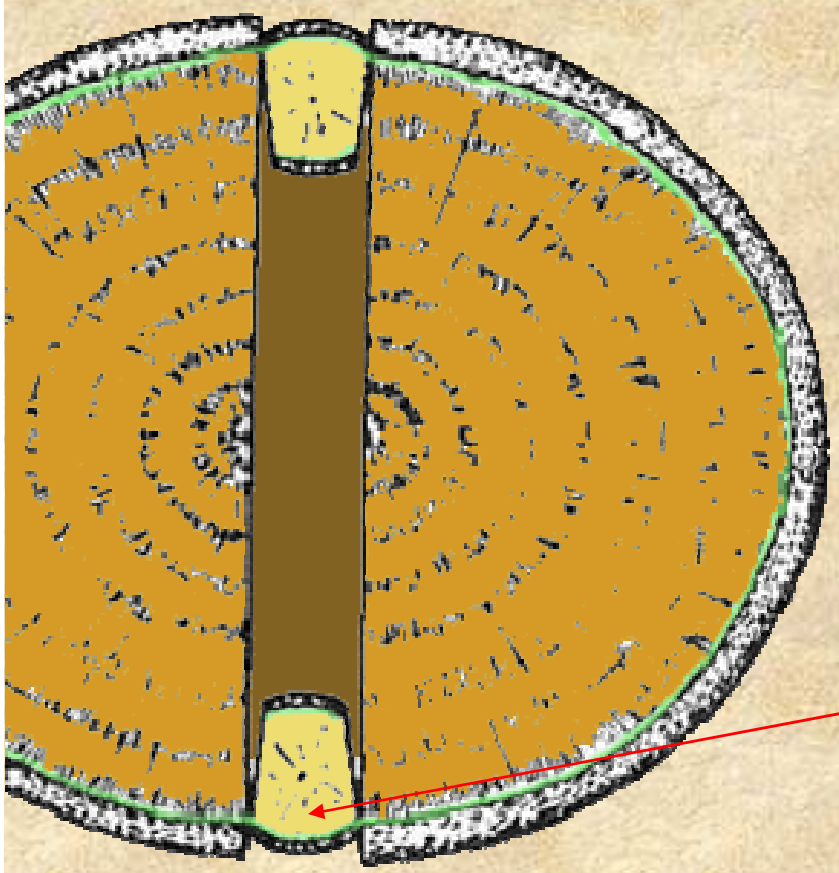


Rootstock

Cut both scion and rootstock with same tool.

Root stock should be (preferably) equal or greater in size than the scion.





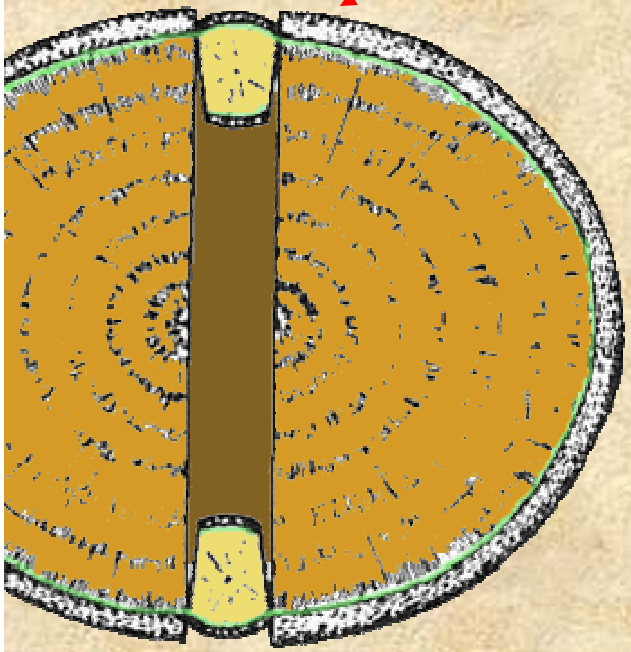
Scion

Rootstock

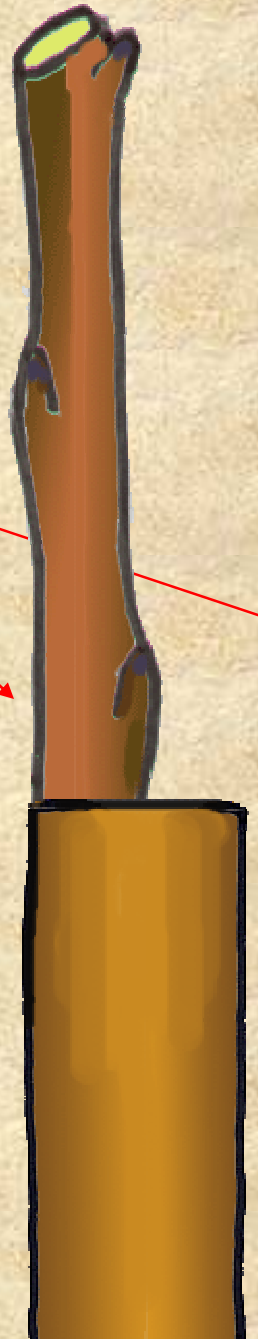
However, the scion is often smaller

When this is the case, align the cambial layers on one side

Cleft graft

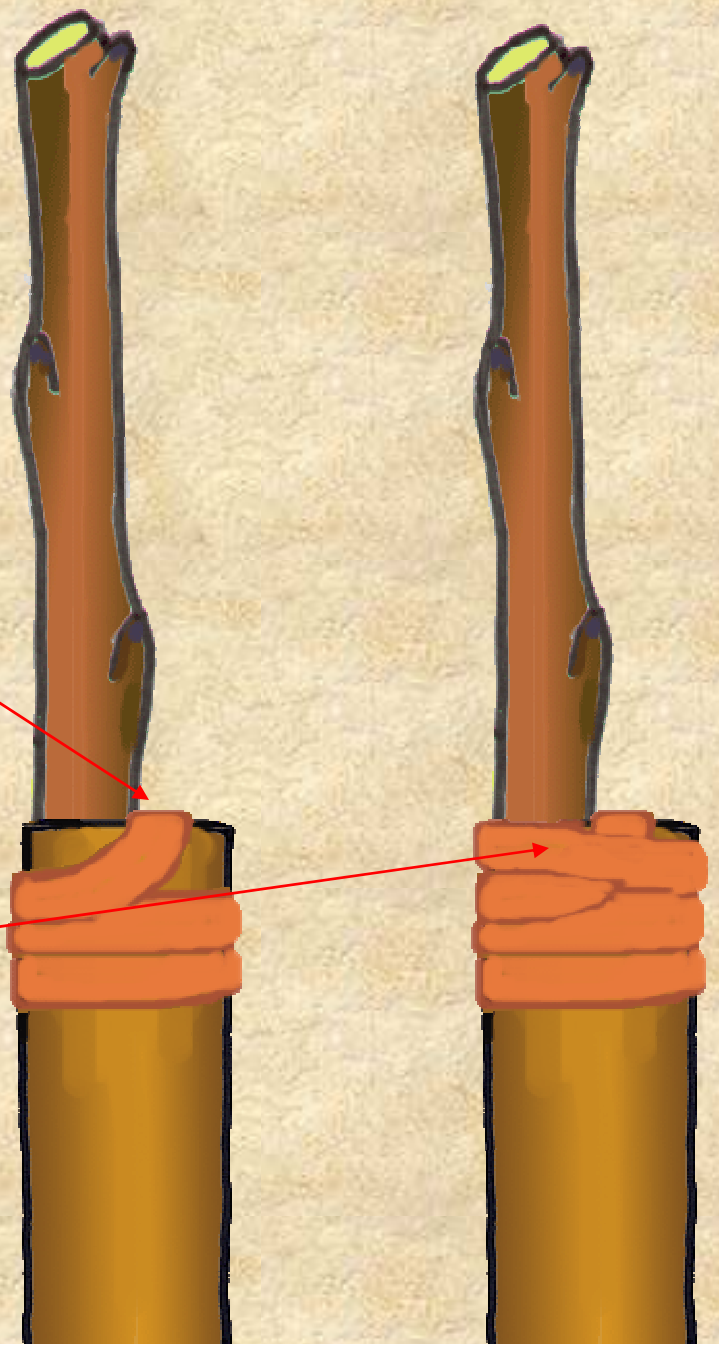


Omega grafting tool

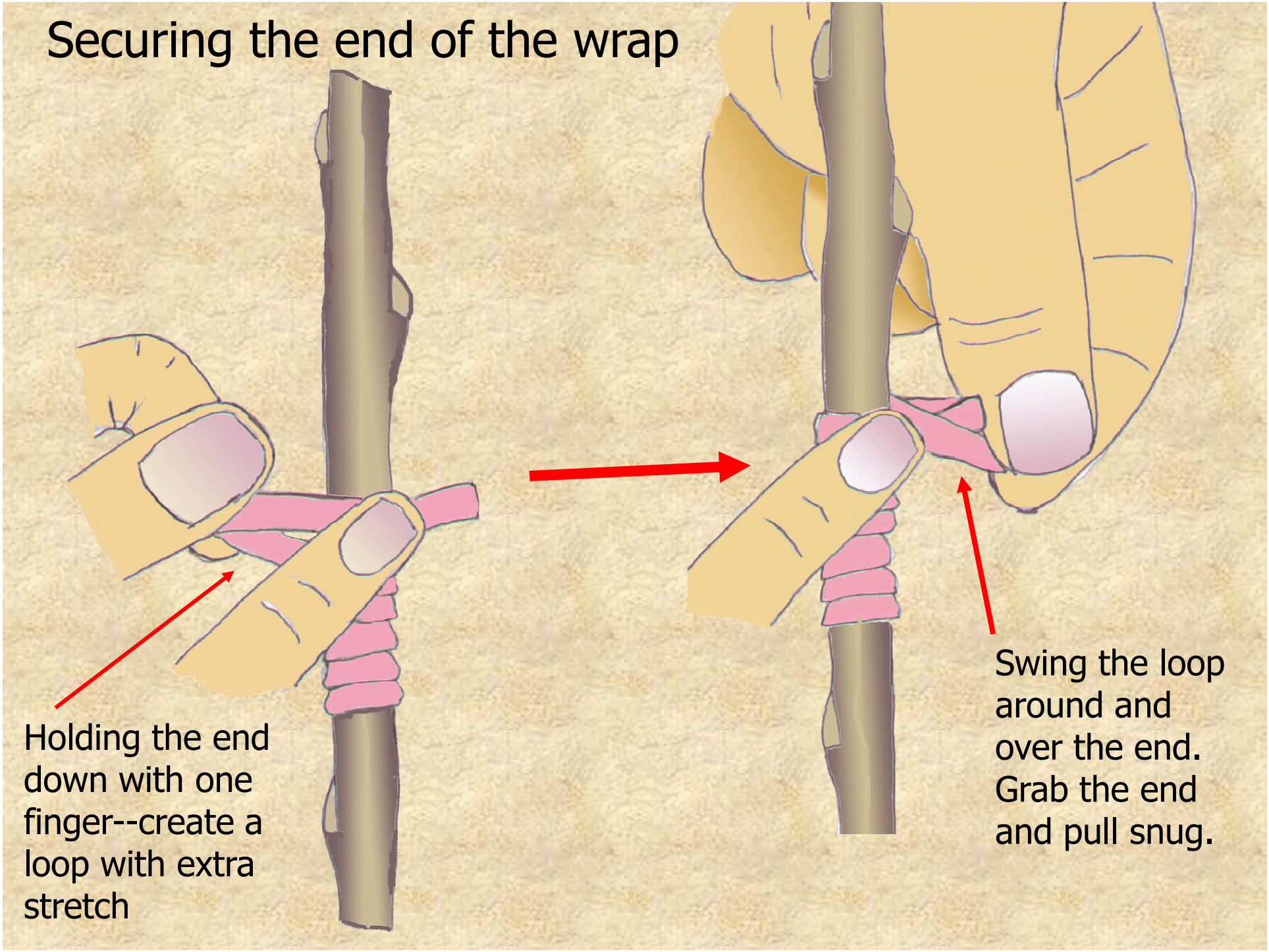


Whip & Tongue graft

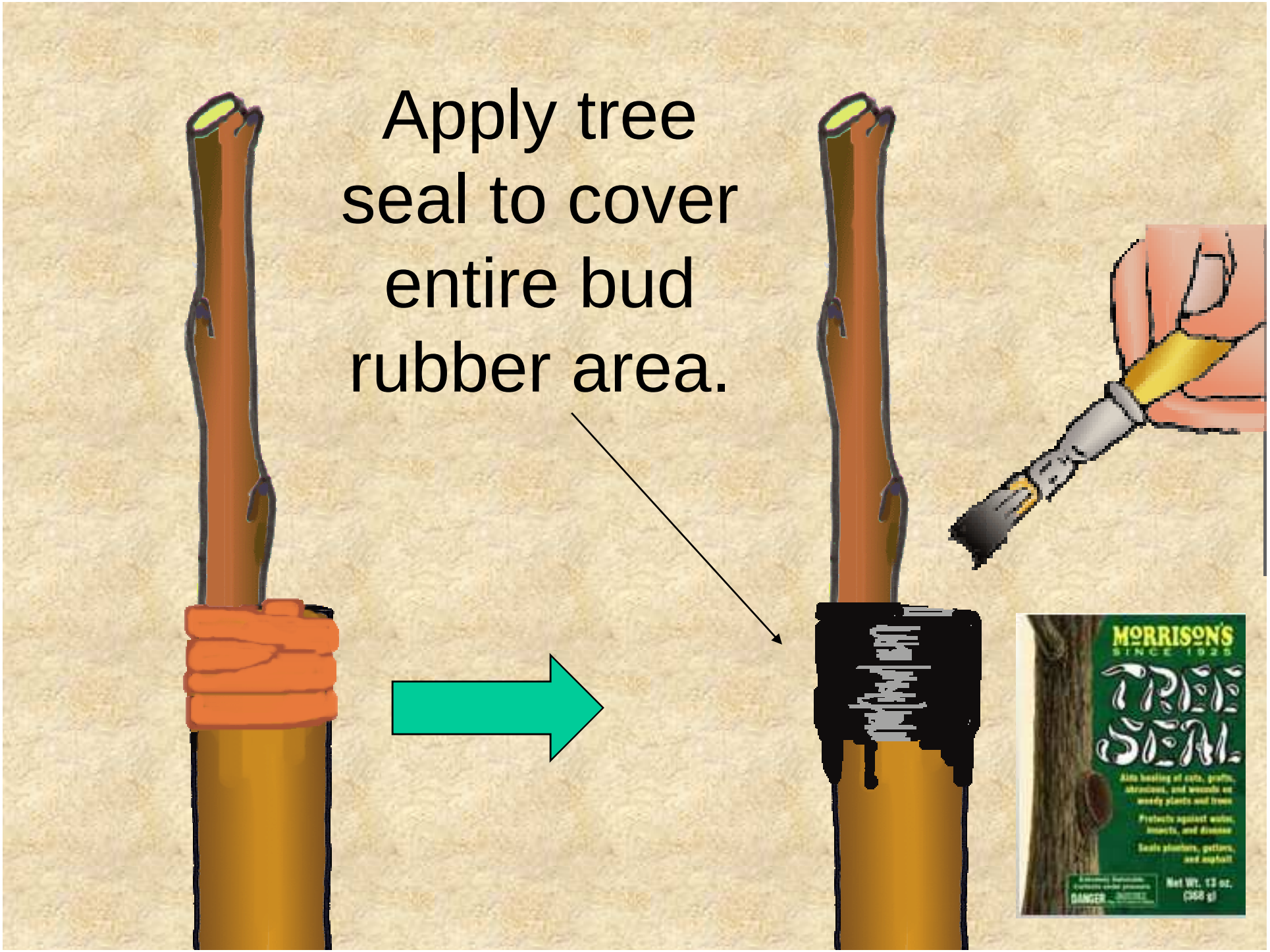
Anchor the aligned pieces by wrapping the elastic rubber over the ‘shoulder’ of the rootstock. Continue wrapping around rootstock until covered.



Securing the end of the wrap

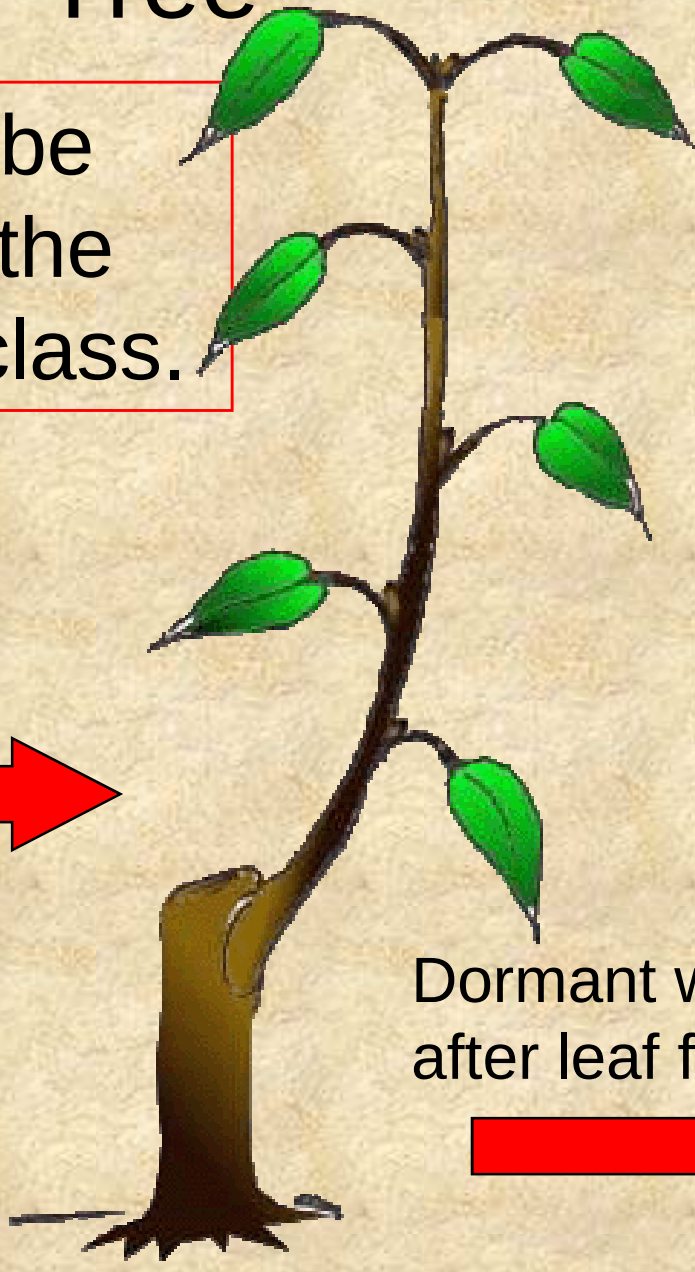


Apply tree seal to cover entire bud rubber area.

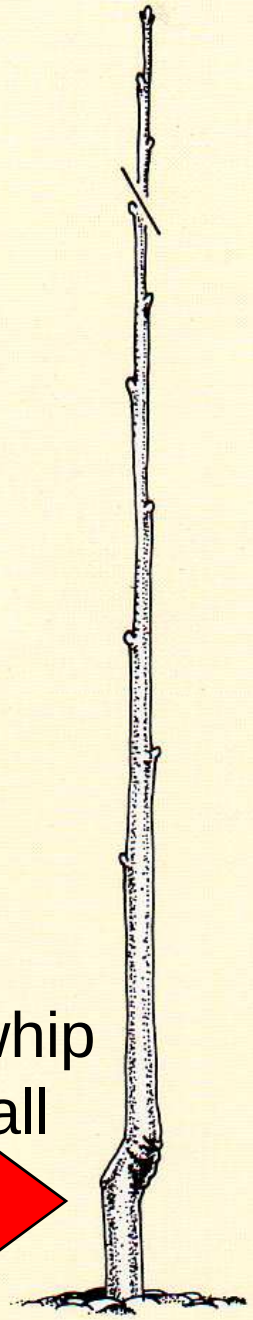


Care of Your New Tree

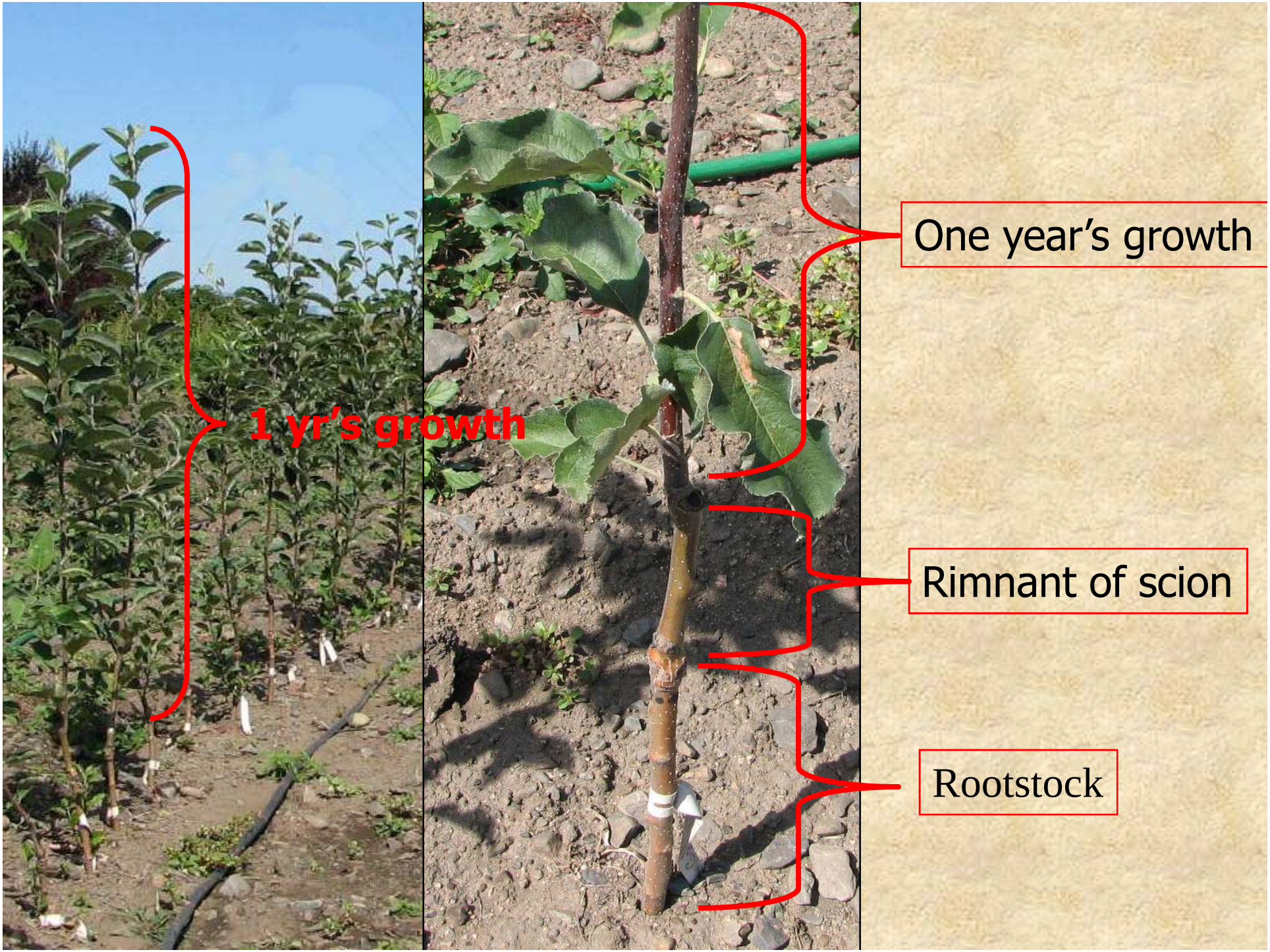
We will be here at the end of class.

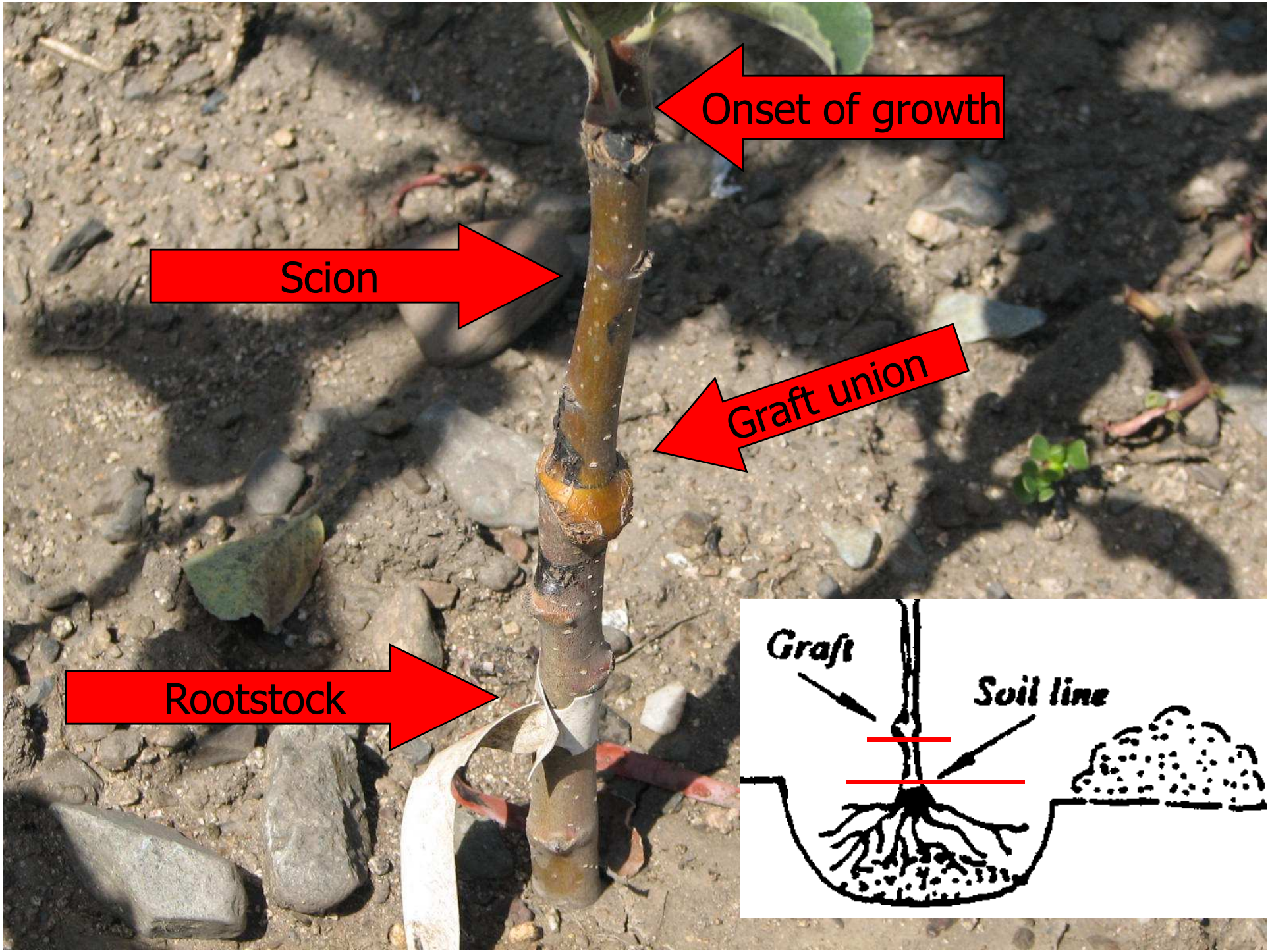


Dormant whip after leaf fall



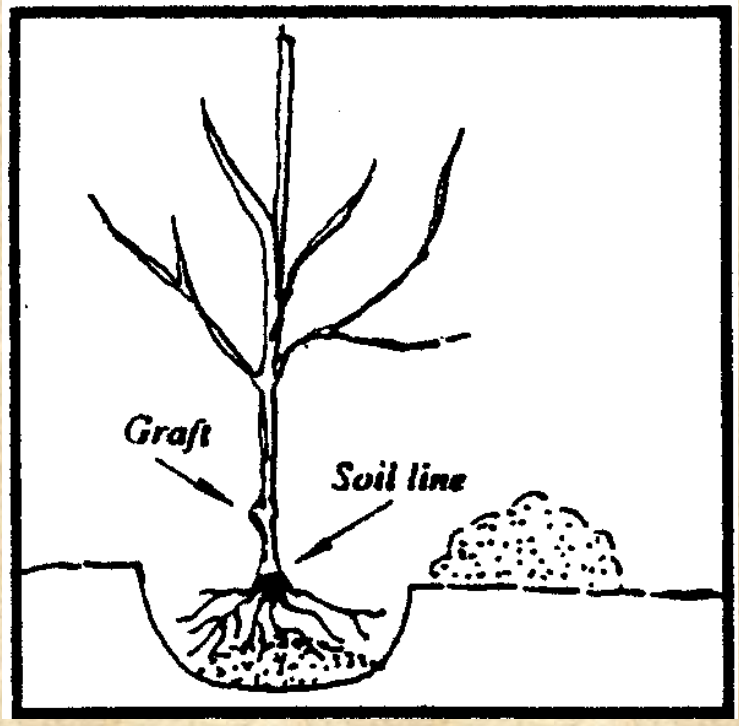
First summer's growth-select one shoot.

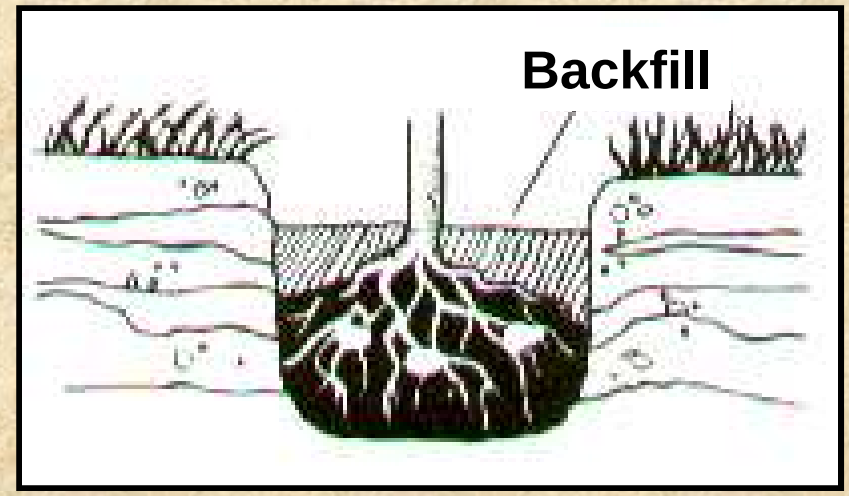

1 yr's growth
One year's growth
Rimnant of scion
Rootstock


Onset of growth
Scion
Graft union
Rootstock
Graft
Soil line

How to Plant

Make a mound in the bottom of the hole and spread the roots outward and slightly downward.





If you have heavy clay soil, backfill with the native soil.

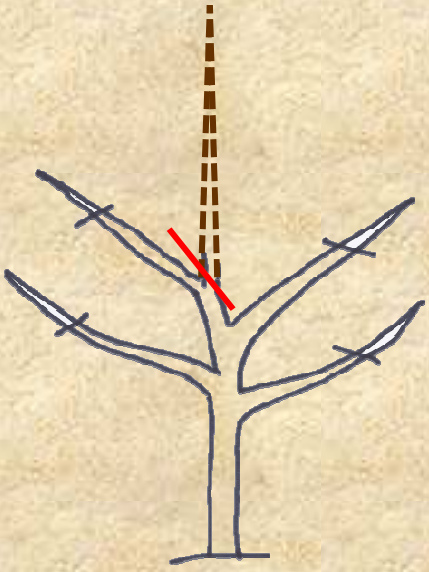
WATERING

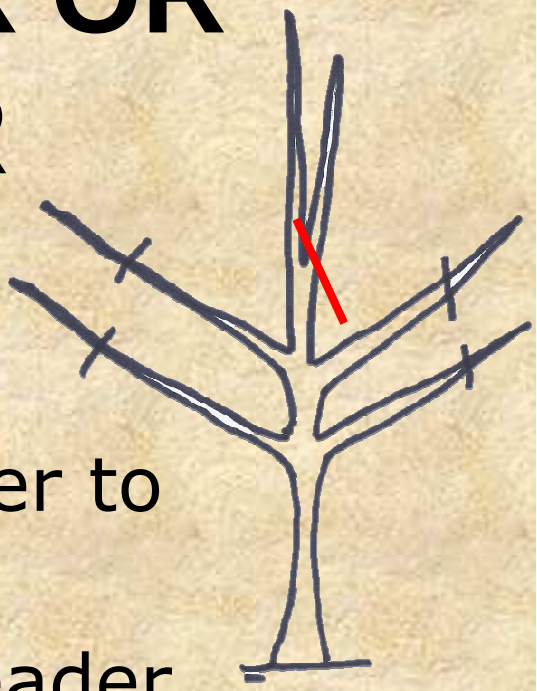
- This is the most important and often the most difficult part of successfully growing plants.
- There are many factors, including the humidity, temperature, soil type, wind, and amount of direct sun.
- A general rule of thumb is to apply an inch of water per week over the root zone.
- This will of course depend on your own conditions and the plants you are growing!

WHIP PRUNING

- “Whips” of dwarf’ apples should be headed back 1-2 feet from the ground to encourage branching low to the ground.
- Whips of most other trees should be headed back to 3-4 ft.
- The top bud usually sprouts and grows strongly upright to form a new leader, while lower buds will usually grow more horizontally and make side branches.

CENTRAL LEADER OR OPEN CENTER



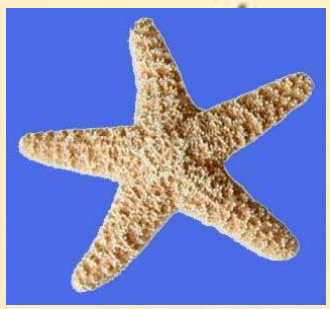


Start by deciding whether to prune to an

open center or central leader.

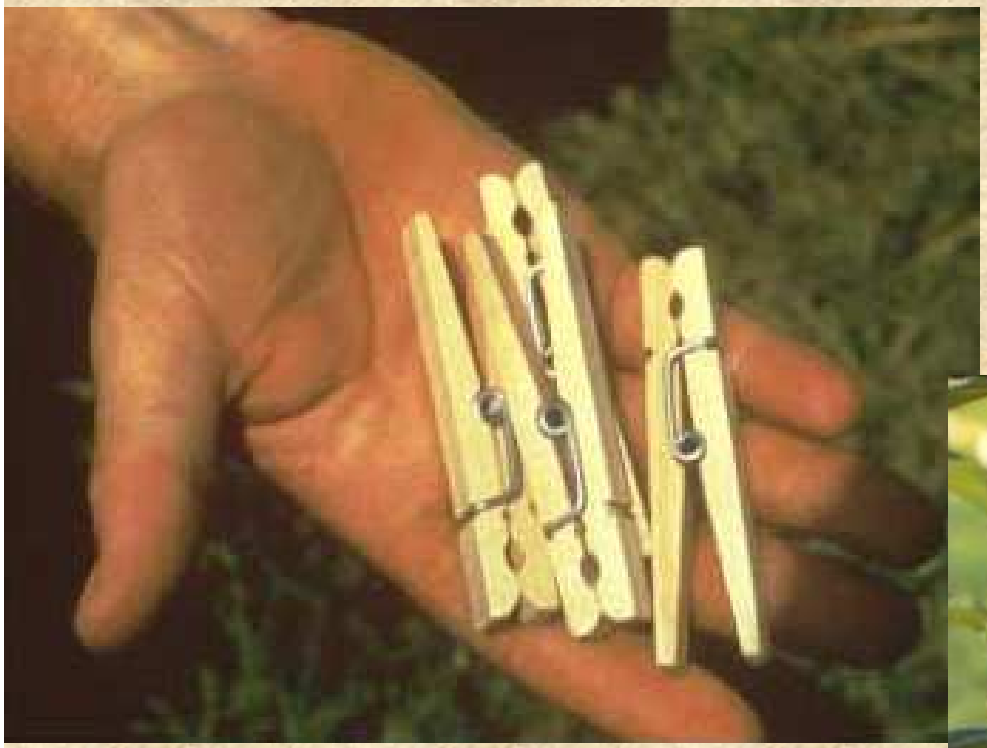
- Open center which was used with multi-grafted trees requires more space.
- Central leader training and pruning is used now days on dwarf and semi-dwarf trees.

Training and Pruning

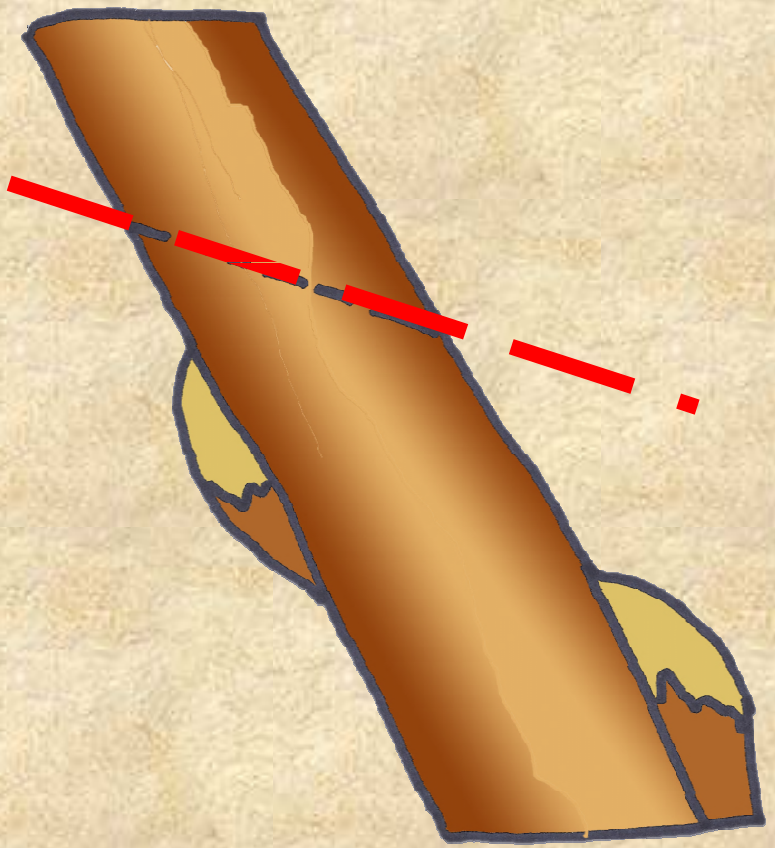


Choose 4 to 5 branches evenly distributed around the tree, hopefully about 90 degrees apart. When there are five, look for a starfish configuration.

Using spreaders

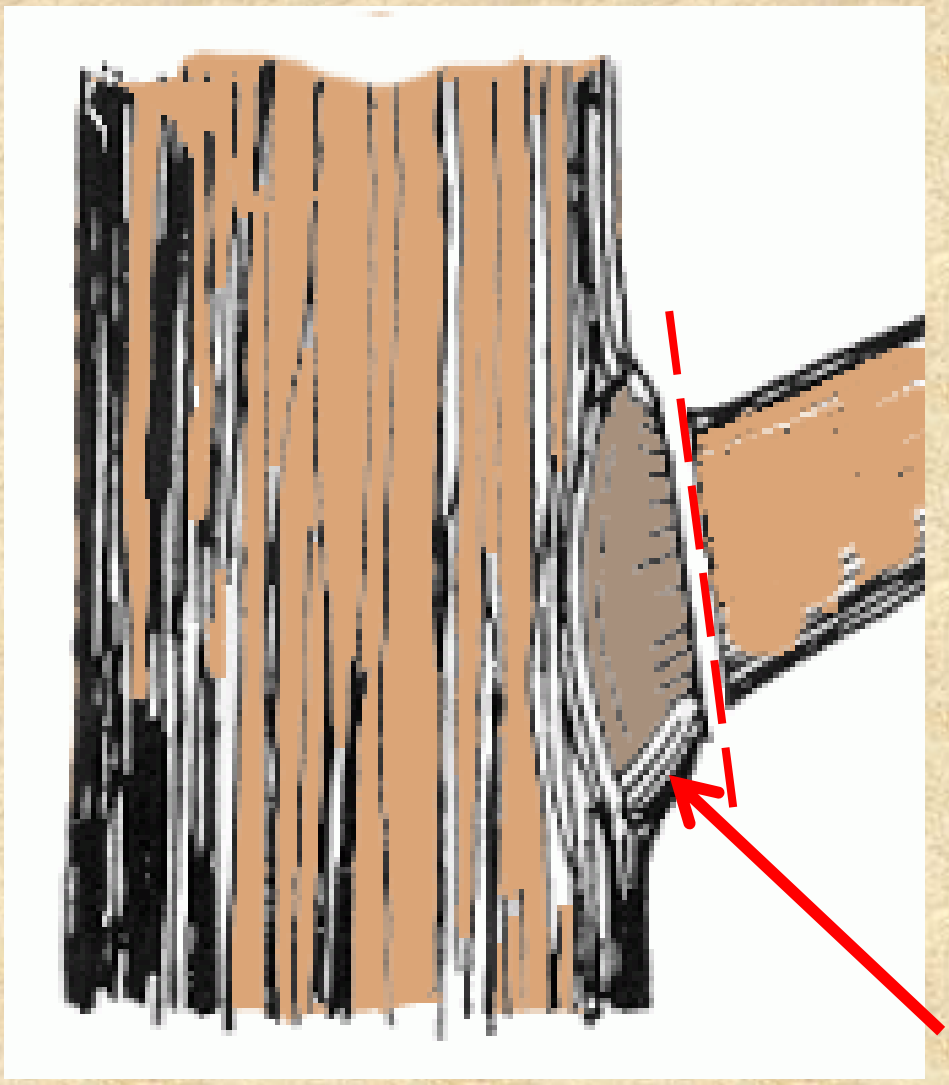


PRUNE TO AN OUTSIDE BUD



- On all plants, try to make sure the last bud you leave on a side branch is headed away from the center of the plant.
- This last bud determines the direction the branch will grow.

A FEW BASICS ABOUT PRUNING

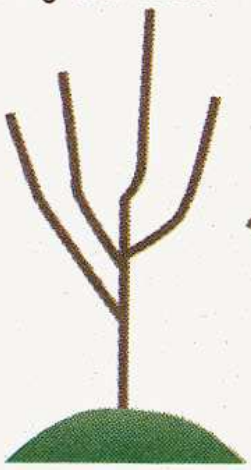


- When removing a branch, prune almost flush but not quite.
- Leaving the collar is important for the wound to heal.

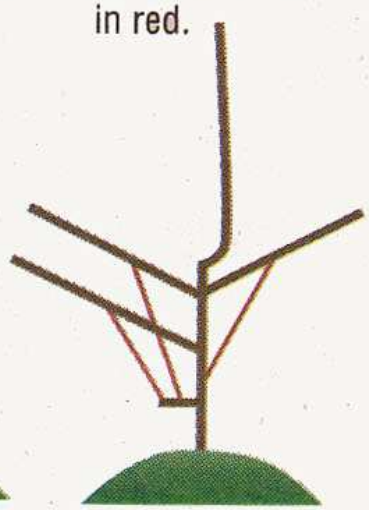
Training and Pruning

SHAPING THE TREE WITH TWINE

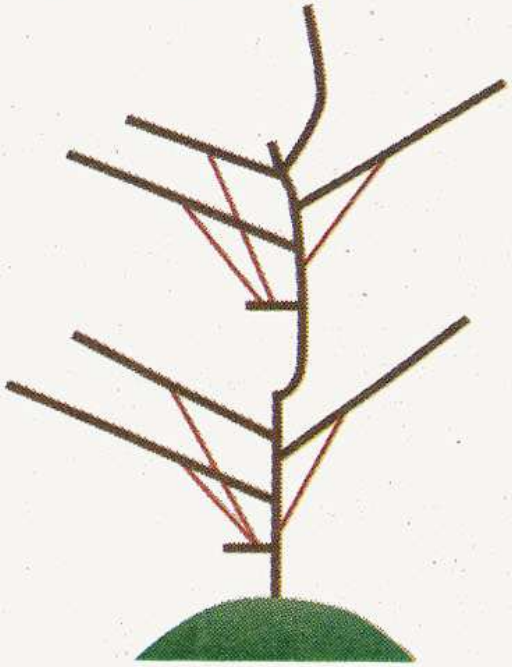
1. The branches on a brand-new fruit tree tend to grow vertically. Prune away all but three or four. These will be the main fruit-bearing branches.



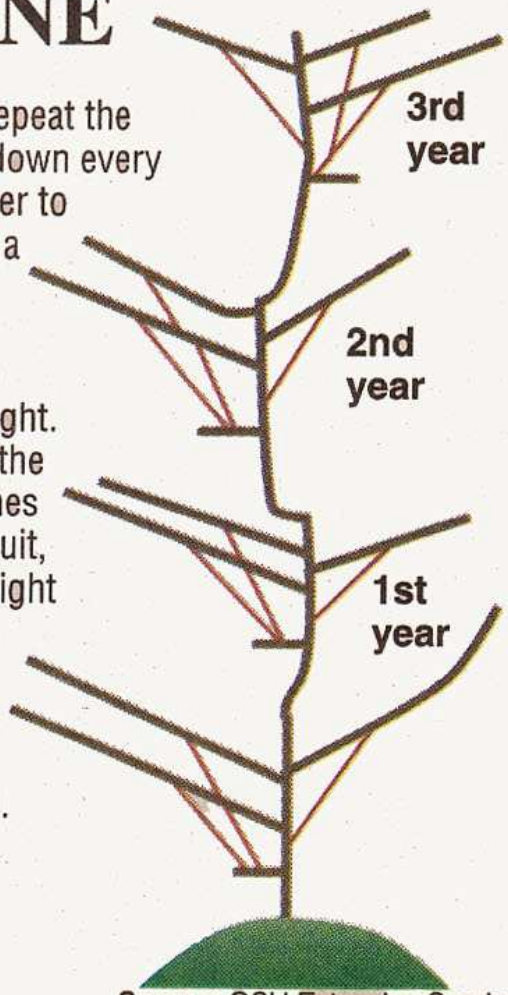
2. Tying down the branches encourages them to grow out and bear fruit, rather than grow up. This helps shape the tree. The tie-downs are shown in red.



3. When the tree makes new branches in its second summer, prune away all but three or four and tie them down, like the others, below.

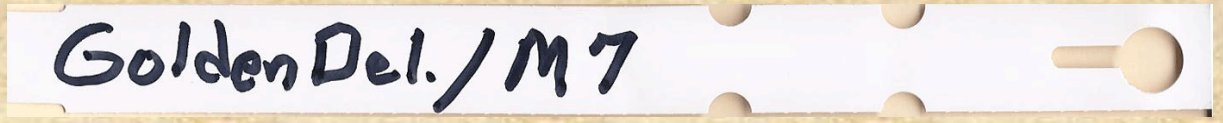


4. Repeat the tying down every summer to create a basic shape for the tree, right. When the branches bear fruit, the weight of the fruit keeps them spread.

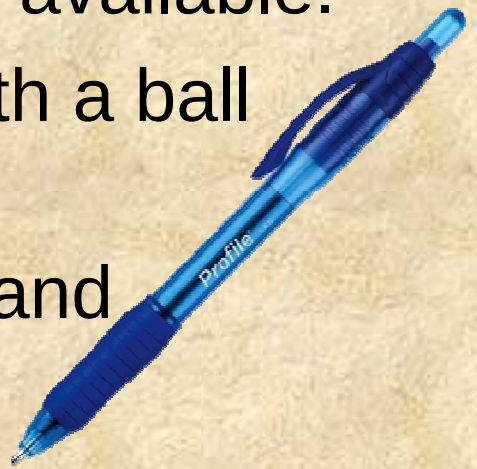


Source: OSU Extension Service

USE PERMANENT LABELS

- A plastic label will fade and become unreadable within a year. 

- More permanent aluminum markers are available.
- Simply write on each aluminum label with a ball point pen.
- Its best to write the name of the variety and rootstock.
- Put it around a small branch. Every few years loosen the wire around the branch.



Crimson Crisp

An exciting new disease resistant variety being offered for the first time in the spring of 2006. The fruit is medium in size with a very attractive crimson red color over 95% of the surface. Crimson Crisp has a very firm, crisp texture with a tart, complex flavor. The tree is very grower friendly with a spreading habit, fruiting throughout the tree on two and three year old branches. The fruit matures mid-season and will keep in cold storage for six months.

Fuji

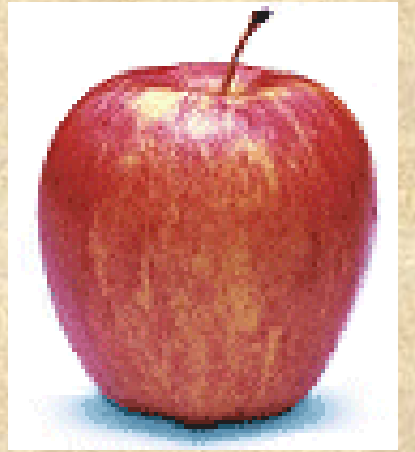
Ralls Janet X Delicious. High quality apple with fairly poor appearance. Tall, rectangular, medium size fruit. Yellowish green skin with an orangish red flush and darker stripes. Darker blush on sun side. Crisp, juicy slightly subacid white flesh with outstanding texture. Good keeper. Vigorous, productive, somewhat bushy tree. Needs annual detailed pruning. Developed in Japan and introduced in 1962. ~~Ripens very late~~. Very long storage life. Early maturing Fuji sports: **Auvil Early Fuji, Daybreak, Beni Shogun, and September Wonder.**

Golden Delicious

Originated in West Virginia. Thin skinned that ranges from pale green to medium yellow. The yellowier the skin, the sweeter and softer the flesh. Good baking apple if you choose the greenish ones. Particularly suited to open tarts (since it retains its shape through cooking). Resists browning after being cut. Needs very little sugar in cooking. Sweet eating and baking apple. Thin delicate peel. Bakes firm and makes a chunky sauce. Holds it's shape. Excellent pie apple. Sports of Golden Delicious listed below.

Golden Delicious (Mullins cv.)
Golden Supreme Golden Delicious (Carnefix cv.)
Goldspur Golden Delicious (Sundale cv.), spur
Nugget Spur Golden Delicious, spur
Smoothee Improved Golden Delicious (Gibson cv.)
Starkspur Golden Delicious, spur
Yelo Spur Golden Delicious, spur

Gala



The first Gala apple tree was one of many seedlings resulting from a cross between a Golden Delicious and a Kidd's Orange Red planted in New Zealand in the 1930s by orchardist J.H. Kidd. Donald W. McKenzie, an employee of Stark Bros Nursery, obtained a US plant patent for the cultivar on October 15, 1974. Terrific for eating out-of-hand, Gala is at its very best when purchased locally, in season. Brookfield Gala, Royal Gala, Pacific Gala, Crimson Gala.

Honeycrisp is an apple cultivar developed at the Minnesota Agricultural Experiment Station's Horticultural Research Center at the University of Minnesota, Twin Cities. Designated in 1974 as the MN 1711, and released in 1991, the Honeycrisp, once slated to be discarded, has rapidly become a prized commercial commodity, as its sweetness, firmness, and tartness make it an ideal apple for eating raw. The Honeycrisp also retains its pigment well and boasts a relatively long shelf life when stored in cool, dry conditions

Review: Four Criterion for Successful Graft Union Formation

1. Cambial contact
2. Avoidance of desiccation
3. Compatibility
4. Pressure


Okay! Let's graft some apple trees.