

FRUITING

✓ Growth stages

Juvenile phase: The non-flowering period after seed germination.

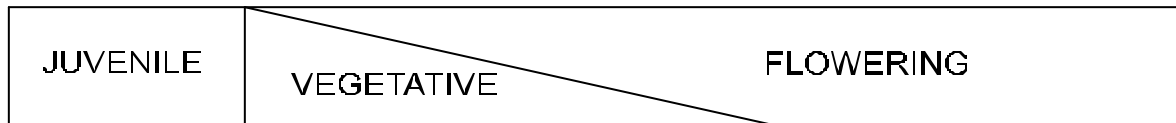
- Morphological differences
 - Leaf shape and thickness
 - Ability to form adventitious roots
- Seedling can not be induced to flower by any means

Transition to the adult phase occurs when the tissue reaches a certain stage

Grafting of mature tissues results in shoots that maintain their flowering

Increasing the growth rate by any means decreases the juvenile period

Factors affecting juvenility, vegetative growth and flowering



N →

High rate of growth

← **N**

Grafting

Extensive pruning

Vigorous rootstock

GA treatments

→

Horizontal branching

Ringing of branches

Dwarfing rootstocks

Ethaphone treatments

✓ Flowering

3 major developmental processes occurring during two successive growing seasons

- Initiation: The time when the meristem is committed to form a flower.
 - Usually occurs early during active vegetative growth.
 - There are no visual clues to this development
- Differentiation: Starts the time terminal growth on a tree stops.
 - Actual flowering structures appear
 - Before entering winter dormancy, flower buds have developed to

85% of their size

Anthesis: Flower opening and shedding of the pollen

Time of flower initiation and anthesis of some deciduous fruits			
Kind	Beginning of inductionOr initiation	Flowers borneon	Season of anthesis relative to season of initiation
Peach	Late June-late July	Lateral buds, 1 yr. shoots	Next spring
Apricot	Early Aug	Lateral buds, 1 yr. Shoots + 2 yr. spurs	Next spring
Cherry, sweet	Early July	Lateral buds, 2 yr. spurs	Next spring
Cherry, sour	Mid-July	Lateral buds, 2 yr. spurs	Next spring
Apple	Mid-June-mid-July	Terminal buds. 2yr.spurs	Next spring
Pear	Early July– early Aug.	Terminal buds. 2yr.spurs	Next spring

✓ **Factors influencing flower bud formation**

- The vegetative needs to be at a certain stage. A critical node number is required i.e., 20 nodes for Cox's Orange Pippin and 16 nodes for Golden Delicious
- Hormonal balance
- Change in the distribution of nutrients inside the apical meristem
- Development of flower buds does not start uniformly throughout the tree. In apple the terminal bud of a spur begin their transformation 4-6 weeks earlier than lateral buds

✓ **Light**

In apples, areas receiving < 30% of sunlight, no spurs form. This is due to the limited movement of CHO within the tree

✓ **Spur leaf area**

In pear, return bloom increased with increased spur leaf area to about 90 cm² (5-6 leaves)

✓ **Tree vigor**

Vigorous growth decreased flower bud initiation

Pruning increases vigor and decreases flower bud initiation

In peaches bud development in shoots with less than 200mm³ per internode

Trees with low vigor are unable to initiate flower buds due to lack of CHO

- Hormones
- * Gibberellins

type
seeds
apical meristem and young leaves
some compounds counteract GA such as ethephon

- * Auxin
- * Ethylene
- * Cytokinins
- * General conclusion: Floral initiation occurs in fruit trees when GA in the bud is below a critical inhibitory level, and the balance of other hormones-auxin, cytokinins, ethylene – is favorable for initiation during the normal time of initiation for that species

✓ **Crop load**

✓ **Practices affecting initiation (see factors affecting juvenility...)**

Flower development

Flowers are mostly developed by the time they enter winter dormancy

Very slow development occurs during winter

Rapid development occurs in the spring

Factors affecting flower development

- Age of wood
- Position on tree
- Temperature
- CHO availability
- Water availability
- Growth regulators
- Winter chilling
- N fertilization

Flower Phenology

✓ **Pollination and fruit set**

Parthenocarpic: Requiring no pollination for fruit development, seedless

Self-fruitful: Capable of setting a commercial crop following self-pollination

Self-unfruitful: Requiring cross-pollination

Polyploid: has more than the diploid number of chromosomes. Pollen is not viable. Can not be used as a pollinator, and needs to be cross-pollinated

Incompatible: Having viable pollen, but incapable of setting fruit when cross-pollinated with certain cultivars. i.e., Cortland X Early McIntosh

Is pollination required?

Factors affecting pollination

- Compatibility
- Pollen viability
- Effective pollination period (EPP)
- Pollinizer placement
- Pollinators

Pollination vs. fertilization (see fig. 1 in chpt 9 Fruit set. In Tree Fruit Physiology

Tree factors affecting fruit set other than pollination

- * Cultivars that are self-fruitful tend to set more heavily than those that are self-unfruitful.
- * As bloom density increases the percentage of fruit set decreases due to competition among flowers. The carbohydrate rations and growth regulator substances manufactured by the plant usually only satisfy less than 20% of the growing fruitlets. Therefore, most of the fruiting clusters are shortchanged and drop their fruitlets.
- * In an apple tree with heavy bloom, only 10% percent of the flowers will eventually develop into fruits. More set, 15 to 20%, may be needed in trees with sparse bloom.
- * Young trees, especially on vigorous rootstocks, often set poorly.
- * Trees on semi-dwarf and dwarfing rootstocks tend to set more fruit than seedling rootstock.
- * The quality of the fruit cluster buds. As a rule, the smaller and poorer quality cluster buds show a greater fruit drop or produce smaller apples. The following are common characteristics associated with good and poor quality fruit buds.

Cluster fruit bud characteristics:

Weak cluster bud	Vigorous cluster bud
Fewer, smaller leaves	More, larger leaves
5-8 ovules	10 ovules
10-18 stamens	20 stamens
2-4 pistils	5 pistils
2-4 flowers	6-7 flowers
Found in older (>5 yr.) wood	Found in younger (<5 yr.) wood
Weaker trees	Well-nourished trees
Located in interior canopy	Located in exterior of canopy
Too much vegetative vigor	Average vigor

Cultural factors affecting fruit set

- * Shading has a marked effect on fruit set, especially as the light levels drop to less than 40% of full sun. Shaded fruitlets have less cell division than exposed fruitlets.
- * The 35 days post-bloom period is important to production from two respects:
 - * First, fruit cell division, which occurs during this period, affects ultimate fruit size and condition, and
 - * Secondly, spurs not producing apples in '98 are establishing fruit buds for '99. Ideally, the more spurs that come in contact with light, the better off each crop will become in terms of potential profitability. Therefore, summer pruning (thinning out or cutting back) of current shoots or younger branches to provide better light distribution is a benefit where crop loads are justified.
- * Nutrition is a crucial factor in fruit set. Deficiencies in nitrogen, boron, zinc, and manganese will reduce fruit set.
- * Ringing (removal of a section of bark around the trunk or scoring (cutting the bark) can improve fruit set. Ringing is done 7 days after full bloom.
- * Branch bending can increase flower bud formation and fruit set. Bending can be done in the spring, prior to bloom or in August when the majority of the shoots have formed terminal buds, and the cambium is still active.

✓ **Apple Thinning**

- It has been estimated that 90% of apple growers in the United States use some form of chemical thinning to improve fruit size and to promote annual cropping.
- No single thinning program applies to all cultivars.
- The thinning response varies depending on climate and cultural conditions. The past history of the orchard, the grower's experiences with particular blocks, the cultivar, and the weather conditions should be used to determine the best time of application and the rates of the individual or combinations of thinners.

**Table 3. Tree and weather conditions affecting thinning with chemicals
(Good Fruit Grower, April 1, 1998)**

<i>Easy to thin when:</i>	<i>Difficult to thin when:</i>
1. Heavy or "snowball "bloom or a previous heavy crop	1. Insects are active in orchards of cross-pollinated cultivars
2. Nitrogen is low	2. Trees are in good vigor with 12 -18 inches terminal growth and there are no mineral deficiencies
3. Moisture is inadequate	3. Precocious trees come into fruiting with good vigor and mature bearing habit
4. Root system is weak due to injury or disease	4. Fruits are developing on spurs in well-lighted areas of trees (tops and outer canopy)
5. Fruit spurs are low in vigor on the shaded inside branches	5. Biennial bearing trees are in "on year"
6. Trees are self-pollinated or poorly-pollinated	6. Trees have horizontal or spreading fruiting branches
7. Fruit-set appears heavy on easily-thinned cultivars such as Delicious	7. Fruit set is in singles rather than clusters
8. Fruit sets in clusters rather than singles	8. Cultivars are heavy-setting spur types or Golden Delicious or Fuji
9. The cultivars tend to have a heavy "June drop"	9. Ideal fruit growth conditions occur before and after thinning period
10. Bloom period is short and pollination is inadequate	10. Low humidity causes rapid drying of the trees and decrease absorption
11. High temperature is accompanied by high humidity before or after spraying	11. Mild temperatures occur after bloom without any tree stress
12. Blossoms and young leaves are injured by frost before the spray application	12. Bloom is light, and high leaf-to-fruit ratio occurs
13. Foliage is condition for increased chemical absorption by prolonged cloudy periods before spraying	13. Limbs and/or spurs are slightly girdled from winter injury
14. Prolong cloudy periods reduce photosynthesis before of after the absorption of chemicals	14. Stress and endogenous ethylene production are low
15. When stress and endogenous ethylene production are high	15. Small fruited varieties

Table 4. Thinning Windows (Apple Thinning Guide)

Thinning Window	Bloom	Petal Fall	Early Fruit Set	Late Fruit Set	Closing
DAFB		5 to 10	11 to 15	16 to 20	20+
Fruit Size(mm)		PF to 8	8 to 12	16 to 20	20+
Stage (mm)	Full Bloom	Petal Fall	6 8 10 15	20 25	
General Thinning Success	Fair	Best	Good	Good	OK
Past Thinning			<i>Traditional Window</i>		Rescue thinning

Table 5. SPECIFIC THINNING RECOMMENDATIONS.

Cultivar	Stage of fruit development		
	Petal fall to 3 mm	7 to 12 mm	15+ mm
McIntosh	Sevin	Sevin+2.5-7.5NAA or Sevin+50-75Accel	Sevin
Cortland	Sevin	Sevin	Sevin
Delicious (Promalin at bloom)	Sevin	Sevin (+75Accel if needed)	Sevin
Empire	Sevin	Sevin+7.5-10NAA or Sevin+50-75Accel	Sevin
Macoun	Sevin+5-7.5NAA	Sevin+5-7.5NAA	Sevin
Macoun (alternative)	Sevin	Sevin+75-100Accel	Sevin
Golden Delicous	Sevin	Sevin+10-15NAA or Sevin+75-100 Accel	Sevin