Dormancy:

Definition: condition of bud or (seed) characterized by inability to grow, usually associated with winter. There are some types of dormancy, such as:

Para dormancy (correlative inhibition): dormancy due to physiological factors in another part of plant.

Endo-dormancy (rest): dormancy due to internal conditions within bud.

1 – Temperate-zone woody perennial plants have long periods of endo-dormancy (rest) to prevent growth during periods of warm weather in winter.

2 – Period of low temperatures (chilling requirement) are accumulated to satisfy.

Endo-dormancy (break rest). When endo-dormancy is satisfied (rest completed), only low temperatures (eco-dormancy) keeps buds in a quiescent state and prevents them from grown.

Eco-dormancy (quiescence): dormancy due to unfavorable environmental conditions for growth, usually cold temperatures.

The fruit trees such as (apple, pear and quince) develop their vegetative and fruiting buds in the summer. As winter approaches, the already developed buds go dormant in response to both shorter day lengths and cooler temperatures. This dormancy or sleeping stage protects buds from the effects of cold weather. Once buds have started dormancy, they will be tolerant to temperatures much below freezing and will not grow in response to mid-winter warm spells.

Fruit Tree Chilling Requirements:

Before choosing a fruit tree variety, you should know something about chilling requirements, how they are used to select appropriate fruit tree varieties. Deciduous fruit trees need a certain amount of winter chilling to break down growth inhibitors in flower and vegetative buds.

Many nurseries provide an estimate of the chilling requirement (also called chill hours) needed for the tree to be success in a given climate regime. Varieties vary by chilling requirement and varieties are recommended based on the average number of winter chill hours a given area receives over the years.

The definition of chilling requirement is: (The number of hours the temperature is between 0-7 degrees C. more recently).

There are some observable symptoms to look for in fruit trees that have chilling hours incompatible with the local climate. Fruit trees with a lower chilling requirement than necessary frequently experience crop loss due to early bloom and a late spring frost damages the crop. In this situation, the chilling requirement was exceeded. Conversely, planting varieties with higher chilling requirements than required can result in uneven bloom and or delayed foliation. In these cases, the chilling requirement was not met.

There are some ranges of chilling requirements for most areas county by elevation range. For elevations above 6000 ft. look for varieties with chilling requirements above 1000 hours. For elevations between 4000 and 6000 ft. look for varieties with chilling requirements between 750 and 1000 hours. For elevation between 2500 and 4000 ft. look for varieties with chilling requirements between 500 and 750 hours.

Most deciduous fruit and nut trees from temperate climates require a genetically determined amount of cold weather (chill hours) to set fruit.

Chill units: these buds remain dormant until they have accumulated sufficient chilling units of cold weather. A chill unit is allocated when temperatures spend time within certain parameters (refer to chill accumulation models). When enough chilling accumulates, the buds are ready to grow in response to warm temperatures. As long as there have been enough chilling units the flower and leaf buds develop normally.

If the buds do not receive sufficient chilling temperatures during winter to completely release dormancy, trees will develop one or more of the physiological symptoms associated with insufficient chilling.

Windbreaks:

In exposed areas, a well established windbreak affords protection and lessens the velocity of the wind over a considerable area. This protection reduces moisture loss from evaporation, reduces damage to the fruit and to the trees during wind storms and may lessen the danger of winter injury. These effects of the windbreak vary from 11 to 22 ft for every foot in height of the windbreak. As the apple trees grow in size, they develop their own protection in a great measure, except at the edge of the planting.

Fruit development:

Fruit development in apple is characterized by continued enlargement of the receptacle. The link between the receptacle and carpel tissues becomes so close that the receptacle itself makes up the greater portion of the flesh of the apple. A rapid phase of cell division occurs in the first few weeks after pollination, which ceases abruptly within 30-40 days after full bloom in cox's orange pippin and after 4 weeks in Granny Smith. The subsequent fruit growth occurs mainly due to cell expansion. The fruit growth pattern flowers a smooth sigmoidal curve. In studied, of the fruit growth pattern of Delicious apples from bloom to October harvest. Fruit length was found to increase at the rate of 82% of fruit expansion, and after 2 months, diameter surpassed length. The rate of fruit volume increase was 110% of the rate of fruit weight over the season as carpellary space increase and cell packing loosened. Intercellular space increase at the rate of 18% of cell enlargement in pith and cortex, but at 14% in the two lobe regions.

In the developed fruit, 25% of apple is air space. The white refractive quality of apple flesh is related to the resulting cell-air interfaces. The water content in apple fruits varies from 75 to 90%, depending on the **(cultivar, stage of development, maturity and several climatic factors).** However, cumulative sunshine hours and number of days between full bloom and harvest did not show any significant correlation with fruit size.

Fructose, glucose and sucrose are the three principal sugars found in apple flesh and vary with stage of fruit development, cultivar, climate and cultural practices. The type and amount of nutrients, chemicals, herbicides and pesticides also have a direct influence on the sugar content of the fruit. In apple, starch accumulates at a very early stage of its development and is hydrolyzed into sugars with the advancement of maturity. The starch disappearance is higher at the later stages of fruit development. The hemicellulose and dextrin contents are higher at the early stages of development and decline gradually with the advancement of maturity. The titratble acidity of fruit steadily decreases as the fruit matures, but the absolute amount of acid present in the fruit increases until just before harvest, when it decreases slightly. The levels of free polyamines are high only during the first few weeks after full bloom and then decrease gradually. The development of apple can be modified with desirable properties by using certain growth regulators such as (NAA, 2,4-D, Alar and Cycocel).

The duration of growth period in apple (from petal fall to commercial harvest) varies considerably with different varieties. For some varieties the growth period is between 105 and 140 days, but for other varieties it between 170 – 190 days and for some others it well is reach for 200 days.

Ripening:

Fruit ripening is a complex process which involves change in texture, firmness, skin color, volatiles and chemical composition. The changes are usually preceded or accompanied by a surge of CO_2 evolution and ethylene production, indicating that respiration is not the cause of ripening but a by-product of these changes. For a climacteric fruit such as apple, the respiration rate is minimum at maturity, and it remains constant prior to onset of fruit ripening. However, once ripening is initiated, the rate of respiration rises up to a climacteric maximum, followed by a gradual decline in rate once again. The climacteric maximum of respiration rate of mature fruit is only one-fourth of that of an actively growing fruit.

Apples attached to the tree often contain high levels of ethylene in the pre climacteric phase, and the rise in concentration is more gradual than for detached fruit. This leads to inaccuracy in estimating the date when a particular concentration is reached. The sensitivity of apples to ethylene (C_2H_4) increases during development. The amount of (C_2H_4) produced by fruit is small in comparison with the amount of CO_2. In apple, the ratio of carbon dioxide production to ethylene production at room temperature is around 300:1. The effect of ethylene as a ripening stimulant can be inhibited by increasing carbon dioxide concentration and reducing oxygen in the fruit. Carbon dioxide may compete with ethylene for attachment to a receptor at the site of a reaction, thus preventing biological response to ethylene.

The general change associated with ripening, including softening of fruit flesh, hydrolytic conversions of storage materials in the fruit, and changes in pigments and flavors, can be attributed to the energy provided by respiratory activity. Chlorophyll content of peel and pulp break down with the advancement of ripening. Ripening also results in an increase in aroma released by the fruit. Major organic acids in apple fruit are malic and citric acid. The process of ripening in apples can be regulated by the use of growth hormones to accelerated ripening in early apple cultivars by use of a mixture of ethephon and NAA applied 14 days prior to harvest.

Harvesting:

1 – Maturity indices:

Indices of harvest maturity of apples are based largely on color (external and internal), flesh firmness, composition (starch, sugar and acid), mechanical properties (rupture force, modules of elasticity), ease of separation from spurs, and days from full bloom to harvest. The days from full bloom to harvest is considered a fairly good index of maturity, but climatic factors immediately after petal fall also play an important role. The current methods for monitoring changes in fruit maturity include measurement of fruit firmness, respiration rate, ethylene production, starch hydrolysis, soluble solids, titratable acidity, and also the color of the skin and cortical tissue. Late picking of apples can lead to storage disorders such as breakdown and browning of flesh and increased softening and yellowing. Various maturity indices have been used to predict the last safe harvest date for long-term storage.

2 – Harvesting methods:

The ultimate use of the apple fruits decides the method to be used in harvesting. There are two ways for harvesting of apple fruits:

A – Hand harvesting: The most commonly used harvest method for fresh-market and processing apples is by hand. The proper picking generally requires careful handling at every step to prevent bruising.

B – Mechanical harvest: This way of fruit harvest, particularly of relatively low-quality fruit for immediate processing, has now begun to make inroads. These methods of harvest are not recommended commercially, as considerably physical damage occurs to fruits. However, for immediate consumption and processing, these quick methods may be applied.