



APPLE



# INTRODUCTION

- **Premier table fruit of the world.**
- **A typical temperate fruit tree.**
- **> 80% of the world's supply being produced in Europe.**
- **Major producers of apple in the world: USA, China, France, Italy, Turkey, Russia, Iran, Romania, Poland, Germany, U.K., New Zealand, Australia, Israel, Japan, Ezypt etc.**
- **Major apple producing belts in India:**
  - North West Hill Region: J&K, HP and Uttrakhand**
  - **North East Hill Region: Arunachal Pradesh**

# HISTORY

- **First apple orchard in H.P. : Bundrole ( Kullu Valley) by Captain A.A.Lee, an Englishman around 1870.**
- **Alexander Coutt's introduced many apple vars. in his orchard called " Hillock Head" at Mashobra in 1887.**
- **S.N. Stokes introduced famous Delicious vars. In 1918 at Kotgarh ( Shimla Distt.).**

# ORIGIN

- **Eastern Europe and Western Asia-  
regions which include Asia Minor,  
Caucasus, Central Asia and Himalayas**

# Climate

- Areas located at altitudes ranging between 1500-2700 m a.m.s.l. are suitable.
- Can be grown in areas which experience 800-1600 chilling hours
- Temperature during growing season should be around 21-24°C
- Sites located on North-Eastern aspect at lower elevation are suitable
- For optimum growth and fruiting, it requires 100-125cm of annual rainfall equally distributed over the growing season
- Excessive rains and fog near fruit maturity is undesirable
- Proper drainage should be made in heavy flat soils having high water table
- Areas exposed to high velocity winds are not desirable
- Dray winds during blooms desiccate flowers and hamper bee activity
- Areas should be free from hail storms and spring frost
- Temperature below 4.4°C at bloom inhibits bee activity and prevents pollen germination
- Fully opened blossoms may be killed at temperature below -2.2°C

# Topography and soil

- **Sites with gentle slopes are generally more suitable than flat or too steep areas**
- **Site at the middle of the slope is more desirable as compared to top and bottom of the ridge.**
- **Loam soils rich in organic matter with pH 5.8 to 6.2 and having proper drainage are more suitable.**
- **Soil should be free from hard substrata and water lodging .**

# Recommended cultivars

## Standard cultivars

- **Early** : Tydeman's early Worcester (P), Mollie's delicious, Summer queen (P)
- **Mid season**: Starking delicious (Royal delicious), Red delicious, Rich-a-red, Vance delicious, Top red, Lord lambourne (P), Skyline supreme delicious, Hardeman.
- **Late**: Golden delicious (P), Yellow Newton, Granny smith

- **Spur type cultivars** : Red spur, Gold spur, Red-Chief, Oregon spur-II, Well spur, Bright-N-early, Silver spur.
- **Low chilling cultivars:**
  - **Table purpose:** Michal and Schlomith
  - **Processing purpose:** Tropical beauty and Parlin's beauty.
- **Scab resistance** : Red free.



# Varieties in other states

**J&K:** Benoni, Irish Peach,  
Cox's Orange Pippin, Lal Cider,  
Razakwar, Ambri, Apirouge,  
Golden Delicious, Lal Ambri,  
Maharajki, Red Delicious,  
Sunehari

**Uttrakhand:** Early Shanburry, Fanny,  
Golden Delicious,  
Cortland, Red Delicious  
McIntosh, Buckingham,  
Rymer

# Varieties

**Triploid** : Baldwin, Winesap,  
Gravenstein, Rhode Island Green

## Hybrids:

1. **Lal Ambri**: Red Delicious X Ambri
2. **Sunehari**: Ambri X Golden Delicious
3. **Ambred**: Red Delicious X Ambri
4. **Ambrich**: Rich-a-Red X Ambri
5. **Ambroyal**: Starking Delicious X Ambri
6. **Chaubattia Anupam**: Early Shanburry X  
Red Delicious

# Proportion of cultivars for an ideal apple orchard

**Delicious group ( Main) : 67%**

- **Pollinizer (Golden Delicious, Granny smith, Red gold, Tydeman's early Worcester, Lord lambourne) : 33%.**
- **For hail prone areas, there should be 50% pollinizer.**

# Rootstocks

- **Seedling rootstock** : **Crab apple**  
(*Malus baccata*).
- **Clonal rootstock** :

<u>Category</u>	<u>Rootstock</u>	<u>Remarks</u>
V. Dwarfing	M27	Weak anchorage
Dwarfing	M9, M26	-do-
Semi- Dwarfing	MM106, M7, M4	MM106 susceptible to collar rot
Semi-vigorous	M2, MM109, MM111	MM111 resistant to drought
Vigorous	M16, M25, MM104	M25 is precocious

# Propagation Method

- **Tongue grafting: February – March**
- **Cleft grafting : February – March**  
(Top working method)
- **Chip budding : Mid June and Mid September**
- **T-budding : May – June**

# Layout and planting

- **In steep areas planting should be done in the contour system**
- **If terraces already exist, trees can be planted in the middle of terrace at appropriate spacing.**
- **In valley areas, systems like square or hexagonal can be adopted.**
- **High density planting should be taken up in areas where soils are fertile, irrigation facilities are available, soils are flat and free from high velocity winds.**

# Planting Distance

Variety	Rootstock	Vigour of tree	Planting distance (m)	No. of plants/ha
Non spur	Seedling	Vigorous	7.5	178
Non spur	MM111; MM109	Semi-vigorous	6.0	278
Non spur	MM106; M7	Semi-dwarf	4.5	494
Non spur	M9	Dwarf	1.5	4444
Spur	Seedling	Semi-Vigorous	5.0	400
Spur	MM111; MM109	Semi-dwarf	3.5	816
Spur	MM106; M7	Dwarf	3.0	1111

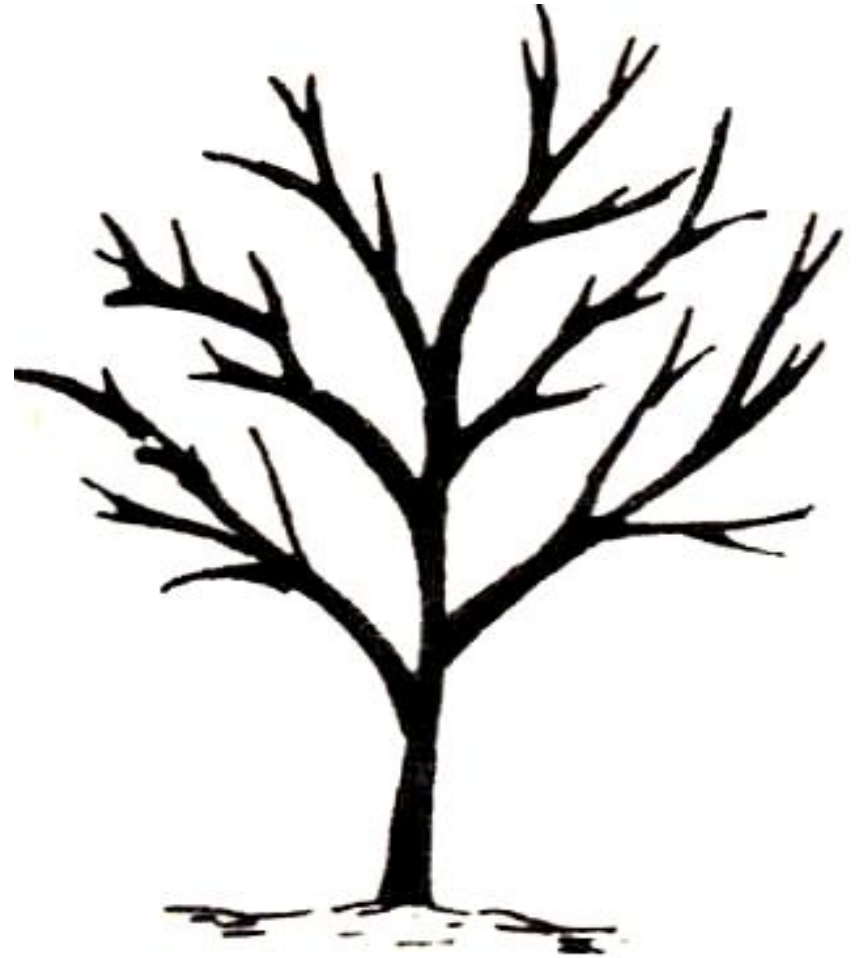
# Planting

- **Time** : December – March. Early planting is desirable
- Irrigate newly planted trees to get high survival rate
- While planting roots should be intact and spread in their natural position before covering with soil
- Tree should not be planted deeper than their natural position in the nursery
- Graft union should be 8-10” above ground level to avoid collar rot
- Before planting, nursery plants should be dipped in copper fungicide solution



# Training and Pruning

- **Modified central leader system:** Trees on seedling rootstocks are trained on this system.
- **Spindle bush system:** For trees on dwarf rootstocks, most popular and efficient system.
- **Pruning should be done during late winter or early spring.**



**Modified Central Leader**

# Orchard soil management

- Weeds in tree basins should be kept under check by hand-weeding or by using herbicides and mulching
- Application of grass mulch (10cm thick) plus Glyphosate @ 800ml / 800L water/ha is recommended
- Black alkanethene has also been found useful to control weeds in higher hills.
- Green manure crops like sunflowers and beans can be used to improve texture and nutrient status of soil
- Growing of grasses and legume in the orchard can improve soil fertility, prevent soil erosion apart from controlling the weeds and other shrubs.

# Manure and fertilizers

Age (Yrs)	FYM (kg)	N (g)	CAN (g)	P <sub>2</sub> O <sub>5</sub> (g)	SSP (g)	K <sub>2</sub> O (g)	MOP (g)
1	10	70	280	35	220	70	120
2	20	140	560	70	440	140	240
3	30	210	840	105	660	210	360
4	40	280	1120	140	880	280	480
5	50	350	1400	175	1100	350	600
6	60	420	1680	210	1320	420	720
7	70	490	1960	245	1540	490	840
8	80	560	2240	280	1760	560	960
9	90	630	2520	315	1980	630	1080
10 & above On year	100	700	2800	350	2200	700	1200
Off year	100	500	2000	250	1560	400	650

# Method of fertilizer application

- **NPK fertilizer should be broadcasted on the soil surface under the spread of tree and slightly mixed with soil**
- **Fertilizer should be applied 30cm away from the trunk in old trees and should not be applied in too wet or too dry soils**
- **In high rainfall areas with steep slope where the size of basins is small, band application of N fertilizers should be preferred.**
- **In rich soil fertilizer doses may be regulated on the basis of leaf and soil analysis report**
- **In orchards with well established cycle of 1 off year and 1 on year fertilizer doses should be reduced by 50% during off years**
- **Apply FYM during December – January along with P and K**

# Method of fertilizer application

- Apply half dose of nitrogen 2-3 weeks before flowering and remaining second half dose one month after 1st application.
- For areas experiencing continuous drought during early summer, second dose of N should be avoided. Apply N in a single dose along with P and K. In case full dose of N is not applied then second dose of N can also be given 1-2 foliar sprays of urea @ of 0.5% (500 g/100 L water) after fruit set.
- Since the response of P application is poor, therefore, its excessive application should be avoided. It would be better if P is applied after every 2 years or alternate years.
- Give 2 sprays of calcium chloride @ 0.5 %, 45 and 30 days before harvesting to improve storability of fruits.
- In heavy bearing orchard 1% urea should be sprayed immediately after harvest along with Blitox / Copper oxychloride (0.3%) @ 300g/100L water.
- Pre-leaf fall application of 5% urea (5 kg/100L water) should be given.

# Foliar application of nutrients

<b>Element</b>	<b>Chemical</b>	<b>Concentration (%)</b>	<b>Frequency</b>	<b>Time</b>
<b>Zinc</b>	<b>Zinc sulphate</b>	<b>0.5</b>	<b>1-2 spays at 15 days interval</b>	<b>May – June</b>
<b>Boron</b>	<b>Boric acid</b>	<b>0.1</b>	<b>-do-</b>	<b>June</b>
<b>Manganese</b>	<b>Manganese sulphate</b>	<b>0.4</b>	<b>-do-</b>	<b>June</b>
<b>Calcium</b>	<b>Calcium chloride</b>	<b>0.5</b>	<b>2 sprays at 15 days interval</b>	<b>June – July</b>
<b>Copper</b>	<b>Copper sulphate</b>	<b>0.3</b>	<b>1-2 sprays at 15 days interval</b>	<b>June – July</b>

# Fruit Thinning

- In apples, heavy bearing not only results in small-sized poor quality fruits but also sets in alternate bearing cycle.
- The judicious thinning suitably used at the proper stage of fruit development can regulate cropping and improve fruit size and quality.
- Application of NAA (10 ppm), 7-15 days after petal fall is effective for optimal fruit thinning.

# Fruit drop

- Most of the commercial varieties of apple have been noticed to have the following three waves of fruit drop:
  - Early drop
  - June drop, and
  - Pre-harvest drop.

## Control

- The application of 10 ppm NAA before the expected fruit drop or 20-25 days before harvest can check the fruit drop effectively



# Improvement Of Surface Colour And Enhancement Of Maturity

- Application of ethrel @ 1000 ppm(a.i.) or 2.5-3.0 ml per liter of water improves the colour in mid hills and enhances maturity in high hills.
- Spray of freshly prepared solution should be done about a week before the desired harvest time.
- The application of ethrel should be done only at the stage when maximum fruit size has been attained and about 30% red colouration has developed.
- NAA @ 10 ppm should be added to ethrel to arrest the excessive fruit drop caused by ethrel.
- Since the ethrel impairs the storage life of fruits, the growers should avoid cold storage of treated fruits.

# Harvesting

- **The stage of maturity at which apples should be picked depends upon the intended use.**
- **For cooking, apples may be usable before they mature, although the flavour and texture is inferior to that which develops later with proper maturation and ripening.**

# Maturity Indices

•For market purposes, the maturity indices of some important commercial apple cultivars grown in the high hill regions (1800-2000 m above msl) of the State based on firmness ratings as related to DFFB (days from full bloom) and TSS (Total Soluble Solids) are:

<b>Cultivar</b>	<b>DFFB (Days)</b>	<b>Firmness (kg) .</b>	<b>TSS (%)</b>
<b>Tydeman's Worcester</b>	<b>90 4</b>	<b>7.8 0.15</b>	<b>12.0-13.0</b>
<b>Starkrimson Delicious</b>	<b>103 3</b>	<b>8.2 0.20</b>	<b>12.5-13.5</b>
<b>Lord Lambourne</b>	<b>103 3</b>	<b>8.2 0.20</b>	<b>11.0-12.5</b>
<b>Royal Delicious</b>	<b>120 5</b>	<b>8.2 0.40</b>	<b>13.0-15.0</b>
<b>Red Gold</b>	<b>122 3</b>	<b>8.3 0.20</b>	<b>12.0-13.5</b>
<b>Richared</b>	<b>128 3</b>	<b>8.6 0.25</b>	<b>12.0-13.0</b>
<b>Red Delicious</b>	<b>134 5</b>	<b>8.4 0.40</b>	<b>11.0-14.0</b>
<b>McIntosh</b>	<b>135 4</b>	<b>6.8 0.25</b>	<b>11.5-13.5</b>
<b>Golden Delicious</b>	<b>148 5</b>	<b>8.4 0.40</b>	<b>12.0-14.5</b>
<b>Granny Smith</b>	<b>180 5</b>	<b>8.7 0.30</b>	<b>11.5-13.0</b>

# Yield

- Although average productivity of apple in H.P. has been shown as 9.4 t/ha, some well managed orchards of Delicious apple in Kotgarh area yield about 50 t/ha.
- Similarly, yield record of 35 t/ha has been achieved in 12 year old plantations of colored mutant apple cultivars on MM 106 rootstocks under high density planting system (2222 plants/ha) in a research station in Shimla hills of H.P.

# Grading

- **Grading should be based on characters like size, weight, shape, colour, maturity, etc.. size grading is essential for uniformity and packing in standard cartons or boxes.**
- **There are 7 size grades of apple**

# Size Grades of Apple

Grade	Equatorial fruit Dia.(+2.5)	Box size (cm) inner dimensions			Size of wrapping paper (cm)	No. of layers
		L	B	H		
Super large	85	45.7x30.5x27.9			27.9x27.9	3
Extra large	80	45.7x30.5x25.4			26.7x26.7	3
Large	75	45.7x30.5x30.5			25.4x25.4x24.1x2 4.1	4
Medium	70	45.7x30.5x27.9			24.1x24.1	4
Small	65	45.7x30.5x25.4			22.8x22.8	4
Extra small	60	45.7x30.5x25.4			21.5x21.5	5
Pittoo	55	45.7x30.5x25.4			Not wrapped	loose

# Packing

## 1. Wooden Boxes:

- Each wooden box is lined inside with old newspaper sheets keeping the margins for over hanging the flaps.
- Fruits are initially padded with wood wool/ pine needles at the bottom.
- Paper wrapped fruits are arranged in each layer and top layer is covered with paper by bringing together the over hanging flaps.
- Then nail the top and the box is further reinforced externally by clasping with a tight 14-16 gauge steel wire.

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# Packing

## 2.CFB telescopic tray pack cartons:

- Lighter in weight and consumes about 1/3 wood,
- Easy to handle,
- Ease in packing,
- Involves no extra labour in wrapping material, nails, padding material etc.
- The fruit fetch better price because of lesser (3.5%) bruising damage.
- But they are slightly more expensive than wooden boxes and need protection from direct rains.

- **Unlike wooden boxes, tray pack CFB cartons of single size are recommended. Inner dimensions of CFB cartons with trays are 50.4x30.3x28.2 cm (outer piece ) and 50.0x30.0x28.2 cm (inner piece).**
- **Plastic crates have been found useful as field boxes, for cold storage and for processing units.**

# Methods of packing of apple in CFB cartons

<b>Grade</b>	<b>No. of fruit layers</b>	<b>No. of fruits per layer</b>	<b>No. of fruits per box</b>	<b>No. of trays including capper</b>
<b>Super large</b>	<b>4</b>	<b>18</b>	<b>72</b>	<b>5</b>
<b>Extra large</b>	<b>4</b>	<b>20</b>	<b>80</b>	<b>5</b>
<b>Large</b>	<b>5</b>	<b>20</b>	<b>100</b>	<b>6</b>
<b>Medium</b>	<b>5</b>	<b>25</b>	<b>125</b>	<b>6</b>
<b>Small</b>	<b>5</b>	<b>30</b>	<b>150</b>	<b>6</b>
<b>Extra small</b>	<b>5</b>	<b>35</b>	<b>175</b>	<b>6</b>
<b>Pittoo</b>	<b>Loose</b>	<b>-</b>	<b>Loose</b>	<b>-</b>

# Storage

- **Apple fruit can be stored for 4-8 months at a temperature of  $-1.1^{\circ}\text{C}$  with relative humidity of 85-90%.**

# Physiological Disorders

# Bitter Pit

- Bitter pit reduces the fresh market quality of fruit.
- Recognized as an abiotic disorder found in all areas of the world where apples are grown.
- influenced by climate and orchard cultural practices.



# Bitter Pit- Symptoms

- Symptoms occasionally appear on the tree before harvest, but symptoms most often appear after harvest, during the first 4 to 8 weeks after harvest.
- Small brown lesions of 2-10 mm in diameter (depending on the cultivar) develop in the flesh of the fruit. The tissue below the skin becomes dark and corky.
- At harvest or after a period of cold storage, the skin develops depressed spots on the surface. These most often start to appear as water soaked spots on the skin near the calyx. These spots generally turn darker and become more sunken than the surrounding skin and are fully developed after one to two months in storage.

- Fruit located on vigorous, leafy, upright growing branches have a greater potential to develop bitter pit than does fruit that develops from spurs or on horizontal wood near the tree's main frame.
- Young trees that are just coming into bearing are the most susceptible.
- Immature fruit are more susceptible to bitter pit than fruit harvested at the proper harvest maturity.
- Older trees, which are less vigorous and produce larger crop loads, reduce their susceptibility to bitter pit except in the very sensitive cultivars.
- Bitter pit is usually associated with low calcium concentrations in the fruit flesh, but it is actually caused by an imbalance of calcium, potassium and magnesium. Thus, fruit with adequate amounts of calcium may develop bitter pit if the levels of potassium and/or magnesium are too high.



# Control

- Cultural practices that reduce the incidence of bitter pit are annual bearing, moderate tree vigor, smaller fruit size, calcium sprays, summer pruning and harvesting mature fruit.
- Avoid nitrogen and magnesium summer sprays, fertilizer treatments that result in lowering the soil pH or induce excess vigor, and fluctuating soil moisture.
- Early thinning and over thinning can increase bitter pit.
- Do not over dormant prune, which would result in a light crop and large fruit.
- Sprays of calcium chloride( $\text{CaCl}_2$ ), calcium nitrate( $\text{Ca}(\text{NO}_3)_2$ ) and/or a post harvest dip in a calcium solution are recommended