

Cultivation of Apple

**Production Technology of Fruit and Plantation crops
B.Sc. (Ag) 2nd year 3(2+1)**

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Introduction of apple

- ▶ King of temperate fruit, symbol of health, premier fruit of the world.
- ▶ Deciduous fruit tree.
- ▶ Most widely grown temperate fruit of the world.
- ▶ Apple bowl of India-Himachal Pradesh
- ▶ Among the fruit apple have long storage life



Nutritional value of apple

Nutritive Values



It has great nutritional values, containing essential food elements

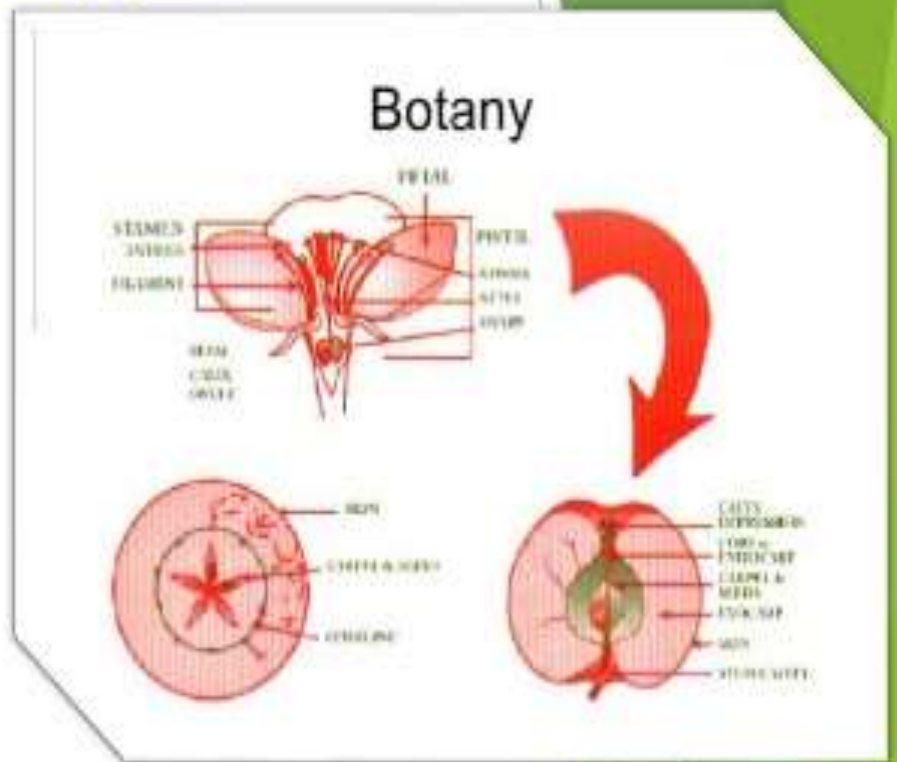
- Sugar 11%
- Protein 0.3%
- Carbohydrates 14.9%
- Vitamins C, A & B in a balanced form

Health Benefits



Taxonomy in apple

- ▶ B.N:-*Malus domestica*
- ▶ Family:-Rosaceae
- ▶ Sub-family:-maloideae
- ▶ $2n=34(x=17)$
- ▶ O.P:-south western asia
- ▶ Major sugar found sorbitol
- ▶ Flower colour:-white to pink
- ▶ Type of fruit-pome
- ▶ Edible portion-fleshy thalamus(mesocarp)
- ▶ Stone cells are absent in the flesh.



Area and production:-

- ▶ Apple account 55% area and 75% production of temperate fruits in India.
- ▶ China is the largest apple producing country in the world.
- ▶ Over 700 accessions of apple, introduced from USA, Russia, U.K., Canada, Germany, Israel, Netherlands, Australia, Switzerland, Italy and Denmark have been tried.
- ▶ Area in India: 83% of the area under apple in H.P., 45% in J&K and 30% in U.P. hills.
- ▶ Other:-also been extended to Arunachal Pradesh, Sikkim, Nagaland, and Meghalaya in north-eastern region and Nilgiri hills in Tamil Nadu.



Climate and soil

- ▶ MSL-1500-2700m
- ▶ Temp-21-24⁰ C, fruit setting is 21.1-26.7⁰ C.
- ▶ Rainfall-100-125 cm
- ▶ Chilling hour-1,000-1,500 hours of chilling (the no. of hours during which temperature remains at or below 7⁰ C during the winter season)
- ▶ Soil pH-5.5-6.5
- ▶ Soil type-Loamy soils, rich inorganic matter.

Variety:-

s.r no	season	Himachal Pradesh	Jammu & Kashmir	Uttarakhand
1	Early season	Tydemian's Early (P) Michael Molies Delicious Schlomit Starkrimson	Irish Peach Benoni	Early Shanburry (P) Fenny Benoni Chaubattia Princess
2	Mid-season	Starking Delicious Red Delicious, Richared Vance Delicious Top Red Golden Lord Lambourne (P) Red Chief ,Oregon Spur Redspur ,Red Gold (P)	American Mother, Razakwar Jpnathan (P) Cox's Orange Pippin (P) Red Gold (P) , Queen's Apple Rome Beauty ,Scarlet Siberian	Rea Delicious Starking Delicious McIntosh (P) Cortland Delicious (P)
3	Late season	Golden Delicious (P) Yellow Newton (P) Winter Banana Granny Smith (P)	King Pippin, American Apirouge Kerry Pippin, Lal Ambri, Sunhari Chamure, Golden Delicious (P) Red Delicious , Ambri Baldwin Yellow Newton (P), White Dotted Red	Rymer Buckingham (P)

Other features variety

- ▶ Spur types - Red spur, Starkrimson, Golden spur, Red Chief and Oregon spur.
- ▶ Color mutants - Vance Delicious, Top Red, Skyline Supreme.
- ▶ Low chilling cultivars - Michal, Schlomit.
- ▶ Early cultivars - Benoni, Irish Peach, Early Shanburry, Fanny
- ▶ Juice making cultivars - Lord Lambourne, Granny Smith, Allington Pippin.
- ▶ Scab resistant cultivars - Co-Op-12, Florina, Firdous, Shirean.
- ▶ Triploid variety:-Baldwin, mutsu, bramlays, winesap.
- ▶ Natural mutant variety:-red elstar
- ▶ New Hybrids - Lal Ambri (Red Delicious X Ambri), Sunehari (Ambri X Golden Delicious), Amred (Red Delicious X Ambri), Chaubatia Anupam & Chaubatia Princess (Early Shanberry X Red Delicious) developed in India.
- ▶ Note:-pamapples=pearxapple(intergeneric hybrids)

Developed by Ellis Marks in 1952 in John Innes Centre.



ambri



Red delicious



Golden delicious



Granny smith



mcIntosh



Pink lady



Starking delicious



cortland

Fig:-different apple cultivar



baldwin



jonathan



liberty



Yellow newton



Winter banana



Northern spy



maharaji

Fig:-different apple cultivar

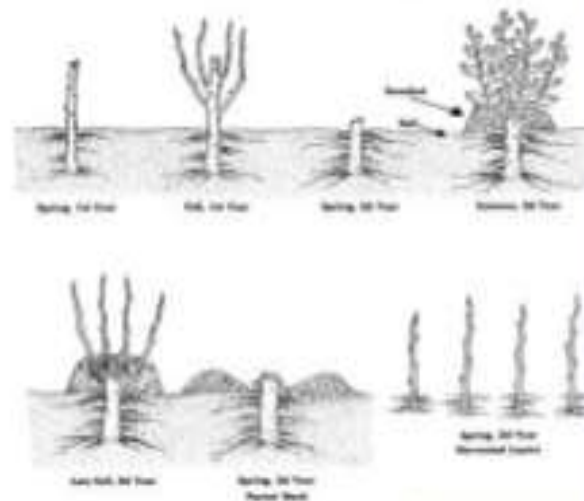
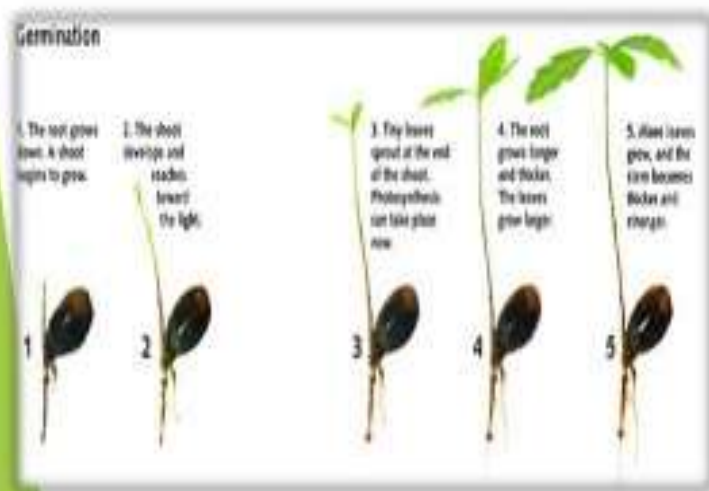
Rootstock

Seedling rootstock

- ▶ For raising rootstock seedlings, seeds of crab apple (*Malus baccata*) or commercial cultivars are stratified during December for 2-3 months at 2-5° C.
- ▶ One year old seedlings are used for budding/grafting.

Clonal rootstock

- ▶ Clonal rootstocks are raised through mound or stool layering.
- ▶ Rooted layers are cut off close to the ground level and planted in nursery beds for grafting/budding.



Clonal rootstock of apple

Category	Rootstock	Characteristics
Dwarfing	M 9	Short juvenile phase, weak anchorage, suitable for high-density planting in flat and irrigated areas only
Semi-dwarf	M 4, M7 and MM 106, M24	Suitable for high-density planting and well-drained soils; resistant to wooly apple aphid but susceptible to collar rot
Semi-vigorous	MM 111 & MM-104	Tree size is 70% of standard, drought tolerant and resistant to wooly apple aphid
Vigorous	Merton 793	Wooly apple aphid and collar-rot resistant, early-fruiting, recommended for Kumaon hills of Uttar Pradesh
Ultra dwarf	M-27(M-13xM-9)	Suitable for HDP

Spacing and planting density for different scion & rootstock combination

Scion & variety	rootstock	Tree size	Spacing in mm	Density(tree/ha)
standard	MM109	Semi vigorous	6x6	278
	MM111			
	M7	Semi dwarf	4.5x4.5	494
	MM106			
	M9	dwarf	1.5x1.5	4444
Spur type	Seedling	Semi vigorous	5x5	400
	MM109	Semi dwarf	3.5x3.5	816
	MM111			
	M7	dwarf	3x3	1111
	M106			

Propagation

- ▶ propagation method:- whip and tongue method of grafting.
- ▶ root-stocks :- *Malus sylvestris* (crap apple), *M. prunifolia*, *M. sikkimensis* or their hybrid derivatives or seedling progenies of cultivated varieties

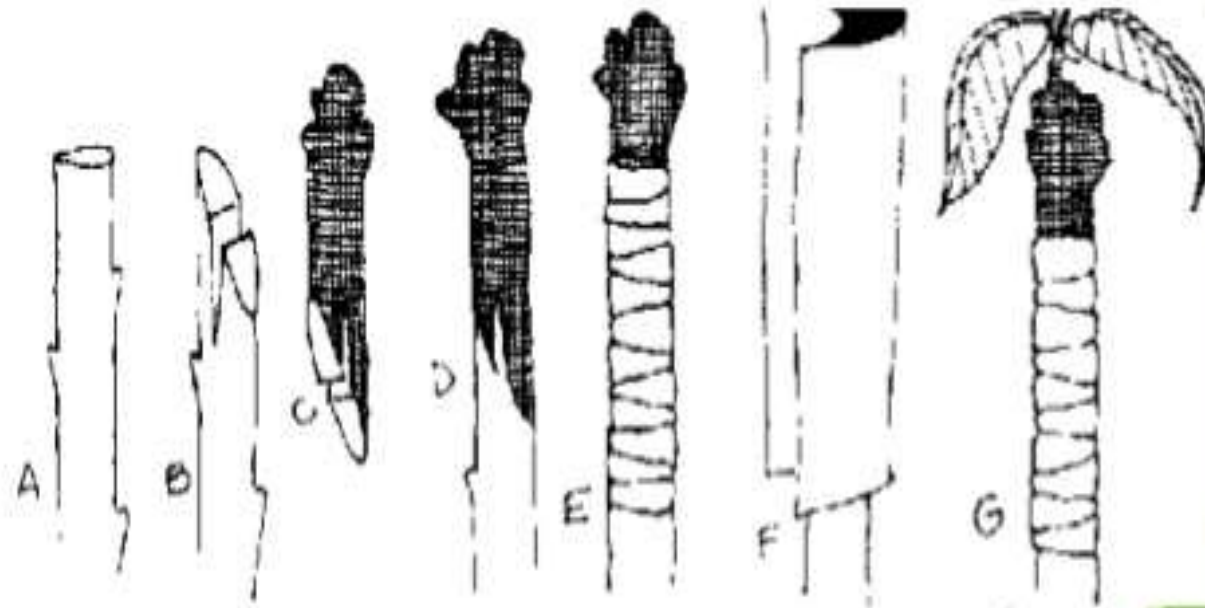


Fig:-process of tongue grafting in apple

planting

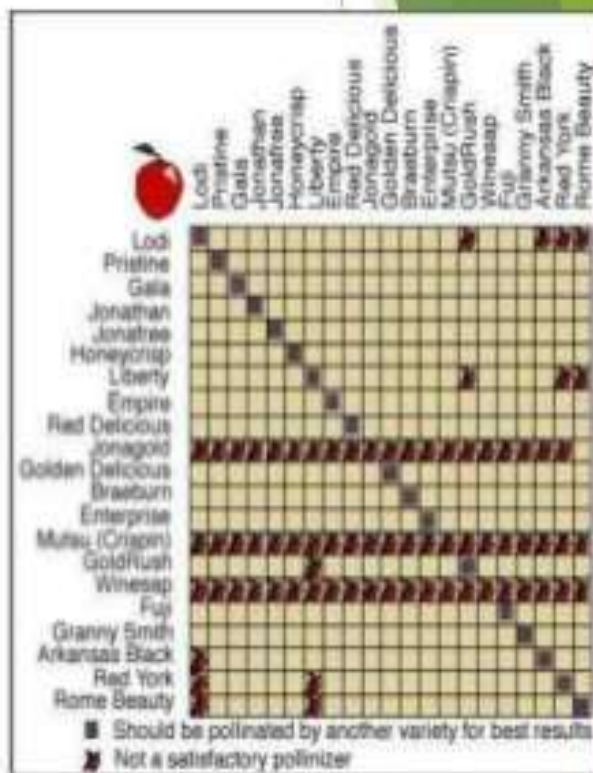
- ▶ Pit size-1mx1mx1m
- ▶ Planting system:-square or hexagonal planting system.
- ▶ Planting time:-January and February.
- ▶ The average number of plants in an area of one ha. can range between 200 to 1250.
- ▶ Four different categories of planting density are followed viz.
 - a) low (less than 250 plants/ha.),
 - b) moderate (250-500 plants/ha.),
 - c) high (500-1250 plants/ha.) and
 - d) ultra high density (more than 1250 plants /ha.).

Note:- during planting 30-40 kg. of FYM, 500 g. of Single super phosphate and 50 g. of Malathion dust are added after mixing properly in each pit.



Pollinizer plant

- ▶ Apple is self un fruitful due to self in compatibility.
- ▶ Pollinizer plant is recommended in india is 11-30%.
- ▶ Pollinator plant:-Royal Delicious variety, plantation of Red Delicious and Golden Delicious as pollinators is recommended



Fertilizer application

- ▶ FYM:- 10 kg. / year age of tree is applied .
- ▶ N:P:K-70:35:70 g./year (age of the tree)
700:350:700 g(10th years age of tree)
500:250:400g/yearan “off” year (when the crop load is low)

Table 4. Corrective Measures for Nutrient Deficiencies in Apple

Elements	Chemical & Dose	Time of Spray
N	Urea, 5.0%	Pre-petal fall
Ca	Ca Cl ₂ , 0.5%	30-45 days before harvest
Zn	ZnSO ₄ , 0.5%	After petal fall
Mn	Mn SO ₄ , 0.4%	After petal fall
B	H ₃ BO ₃ , 0.1%	Before bloom and after bloom

Irrigation



- ▶ Critical stage of apple: -fruit set.

- ▶ The water requirement of apple is 114 cm. per annum (15-20 irrigations).

In summer, irrigation is provided at an interval of 7-10 days .
while in winter it is given at an interval of 3-4 weeks.

note: -At least 8 irrigations are to be provided during critical period(April-August)

weeding

- ▶ application of glyphosate @ 800 ml./ha. or Gammoxone /Paraquat (0.5%) as post emergence herbicide suppresses weed growth for 4-5 months.

Mulching

- ▶ Mulching with hay or black alkathene is found to be effective in controlling the weeds in cool climates and also in conserving moisture.
- ▶ Use of dry grass or oak leaves has also been found to be effective in conserving soil moisture



intercropping

- ▶ Green manuring crops viz. sunflower and bean may be cultivated in the early years of plantation in order to improve soil texture and nutrient status of soil.



fruit drop

- ▶ In apple, there are three distinct fruit drops,
 - i) early drop (improper pollination or unfertilized blossoms)
 - ii) June drop (due to moisture stress and fruit competition) and
 - iii) Pre-harvest drop. (most serious economical loss)

Management:-

Pre-harvest drop can be controlled by spraying NAA @ 10 ppm. (1 ml. of Planofix dissolved in 4.5 l. of water) about a week before the expected drop.



Fruit drop in apple



Early fruit drop

Plant growth regulator

- ▶ Use of growth hormones is essential for good flowering and proper colouration in fruits.
- ▶ Chemicals like carbaryl or Sevin @ 750-1000 ppm. or NAA @ 10-20 ppm. at petal fall may be applied for the purpose.

Training

- ▶ Timely pruning and training operation is essential for proper growth and good productivity.
- ▶ The plants are trained according to growth habit and vigour of the rootstocks.
- ▶ The standard trees are trained on modified central leader system so that plants receive proper light.
- ▶ This improves fruit colour and also minimises the effect of heavy snowfall and hail.
- ▶ Spindle bush system is suitable for high density planting under mid hill conditions.

Common Fruit Tree Training Systems



Fig:-Modified leader system training in apple



Prunning

- ▶ Pruning is essential to maintain a proper balance between vegetative growth and spur development.
- ▶ Proper pruning of weak and undesirable branches/twigs is necessary after six years of plantation.

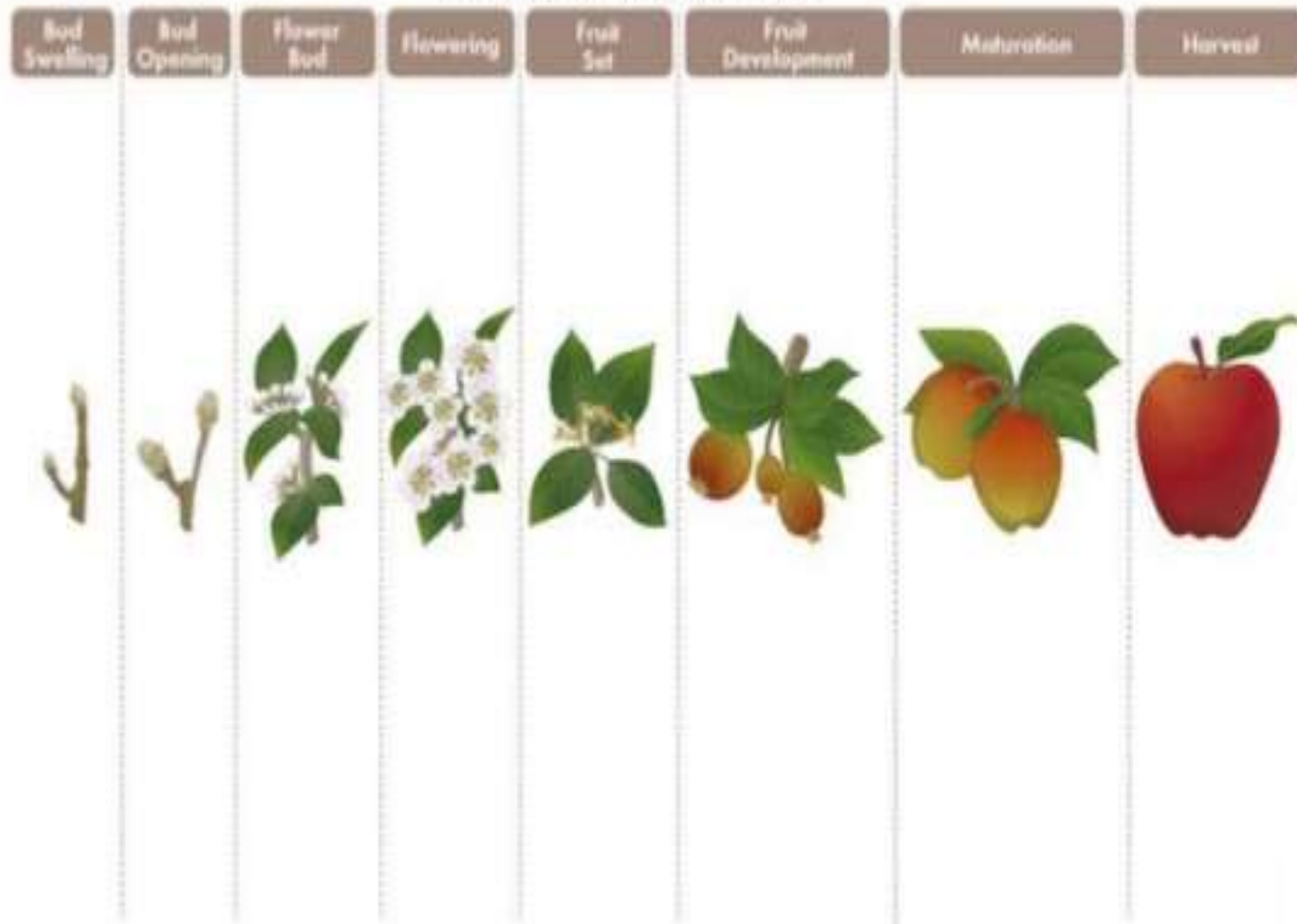


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Life cycle of apple fruit crop



Harvesting and Yield

- ▶ The orchard **start bearing from 8th** and the economic life of an apple tree exceeds upto 30 years.
- ▶ The level of productivity varies form elevation to elevation. Production stage extends up to even forty years depending upon agro-climatic condition.
- ▶ Apple being a **climacteric fruit**, the maturity period does not coincide with ripening.
- ▶ The fruits are usually harvested before they are fully ripe.
- ▶ **Maturity index**:-.colour change, starch index should be 1-2.(starch iodine test)
- ▶ The **average yield** of different apple varieties in the state of Uttaranchal is very low (5-6 tonnes/ha.) as compared to that in Himachal Pradesh and Jammu & Kashmir which is around 11-13 tonnes/ha. (vide **Table 1**).

Plant protection measure

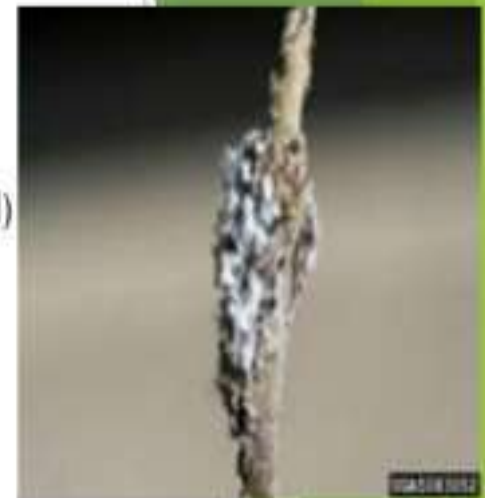
Woolly aphid:- *Eriosoma lanigerum*(most devastating disease in world)

Symptoms of damage

- ▶ Nymphs and adults suck the juice from bark of the trunk or fruits
- ▶ Weakening and death of the smaller plants

Management

- ▶ Use resistant root stocks M 778, M 779, MM 14, MM 110, MM 112
- ▶ Spray dimethoate 30 EC 0.06% or methyl demeton 25 EC 0.025%
- ▶ Predator of aphid-Aphilenus mali



San Jose scale : *Quadraspidiotus perniciosus*

Symptoms of damage

- ▶ The infested region in bark becomes reddish pink
- ▶ Purple discolouration on fruits.

Management

- ▶ Summer spray with phosalone 50 EC 0.05% or fenitrothion 50 EC 0.05%
- ▶ Winter spray with diesel oil emulsion at 8-12 l/ tree (diesel oil 4.5 l, soap 1 kg, water 54 -72 l)



Disease

Scab - *Venturia inaequalis*

Symptoms

- ▶ Symptom appears on leaves and fruits.
- ▶ On lower side of the leaf lesion appear as olivaceous spots which turn dark brown to black and become velvety.
- ▶ On young foliage, the spots have a radiating appearance with a feathery edge.

Management

- ▶ Clean cultivation, collection and destruction of fallen leaves and pruned materials in winter to prevent the sexual cycle.
- ▶ Spray Tridemorph 0.1% before flowering.
- ▶ Spray Mancozeb 0.25 % at bearing stage
- ▶ **Note**:-scab epidemic in J&K in 1972-73 and HP in 1978-79.



Fire blight- *Erwinia amylovora*

Symptom

- ▶ The initial symptom usually occurs on leaves, which become water soaked, then shrivel turn brownish to black in colour and fall or remain hanging in tree.

Management

- ▶ Removal and destruction of affected parts.
- ▶ Spray with Streptomycin 500 ppm.



Physiological disorder

disorder	causes	Symptom	management
Water core	B _o deficiency		Borax apply
Bitter pit	Ca deficiency		CaCO ₃ apply.
Rosset leaf	Zn deficiency		ZnSO ₄ apply

Post harvest technology



Post harvest technology



Common Mistakes-Avoided!

- Appropriately packed in crates
- Segregation of apples
- Stored at controlled temperature (18°C)
- Trained staff to handle fruits
- Effective Supply chain

Constraint in apple cultivation

- ▶ Large number of **old orchards** (more than 30 years old) are showing decline in terms of growth and fruit yield.
- ▶ choice of **wrong pollinizers** and their inadequacy in number often result to low productivity.
- ▶ The need for injecting new blood into the apple industry through **spread of new cultivars** (spur types, color mutants, strains of Gala, Red Fuji; scab resistant cultivars, bud sport selections of Royal Delicious, and some of the promising hybrids) **is urgently felt**.
- ▶ The **low chilling cultivars** and promising cultivars **identified need further spread**.
- ▶ Technologies like **use of clonal rootstocks, introduction of renewal pruning techniques and micro nutrient applications** have **not** been transferred and adopted at a satisfactory level.
- ▶ The **water and fertilizer use efficiency is generally poor**. Also, spring frost and hailstorms are adverse weather parameters leading to low productivity
- ▶ **Apple scab disease** has been the major plant protection problem in apple

- ▶ . For checking entries of diseased material in the free areas of U.P. and North-Eastern Hills, strict **quarantine and selection of elite disease-free mother plants are very essential**. Often it is not followed strictly
- ▶ in apple for which biological and serological **indexing/detection procedures have been developed**.
- ▶ . **Limited quantity of virus-free budwood** is also being supplied.
- ▶ Extreme care is now required to be taken to multiply quality planting material (in apple alone approximately 2 million plants/year) for establishing new plantations
- ▶ Most of the **orchardists still sell their crop at flowering to contractors** as there is no well organized marketing system
- ▶ . **Transportation** in the hills itself is problematic
- ▶ . **Post-harvest management problems** originating from poor harvesting (strip picking) and improper packing system (non CFB boxes) and lack of proper pre-cooling and cold storage facilities result in huge (25-30%) loss of fruits
- ▶ Capacity of the **processing sector is also inadequate**.
- ▶ . The **existing processing units are quite old** and they require modernization for which substantial investment is required.

Future thrust in apple

- ▶ Both North-West and North-Eastern regions of India offer large areas ideally suitable for cultivation of apple.
- ▶ **Widening the Cultivar Base**
- ▶ Scientific water management and practicing proper training and pruning of trees including introduction of renewal pruning techniques, will make significant impact on increased production .
- ▶ There is immense scope for increasing various processed products of apple.
- ▶ For rapid multiplication of germplasm tissue culture method can be adopted
- ▶ Govt should help for loan and marketing to encourage farmer.

conclusion

- ▶ apple contribute significantly to the horticulture economy of India.
- ▶ Apple production dominates the scene and systematic cultivation and marketing of apple can change the rural economy in the hills of North-Western India.
- ▶ New vision and concerted efforts are required for change in variety mix, supply of quality planting material from elite clones on indexed clonal rootstocks.
- ▶ High density planting, water management including micro-irrigation, integrated plant nutrient management and IPM strategy for plant protection are some of the areas which need greater R&D focus.
- ▶ Adoption of post-harvest management practices and infrastructure development for grading, packaging, pre-cooling and storage of the produce needs focused developmental attention.
- ▶ Value addition and export promotion, particularly of apple are drawing due attention of the developmental agencies in India.

Thank You