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COLLEGE OF HORTICULTURE, PUNE

B.Sc. (Hons.) Horticulture

Semester III (New)

H/FS-234 (1+1)

TEMPERATE FRUIT CROPS

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NAME OF STUDENT_____

REGISTRATION NO. :_____

YEAR: 20 -

INDEX

Course No.: H/FS-234

Title: Temperate Fruit Crops

Credits : 2 (1+1)

Semester : III (New)

CERTIFICATE

This is to certify that Mr / Miss .....

Reg. No. ..... student of semester III, B.Sc. (Hons.) Horticulture has completed all exercises in Course No. H/FS-234 (Temperate Fruit Crops) during the academic session .....

Date:

Course Teacher

Practical No. 1 **Date:**

NURSERY MANAGEMENT PRACTICES

A nursery is a managed site, designed to produce seedlings grown under favorable conditions until they are ready for planting or Nursery is a place where seedling, sapling or any other planting materials are raised. Nursery management practices includes…

1. **Nursery disease and their management**: The seedling stress symptoms like damping off, wilt, root rot, rust and powdery mildew are caused by pathogen infection and results in stunted growth of seedlings. These pathogens may be soil, seed or air borne in nature. Nurseries established in the recently cleaned land hardly invite parasitic organisms. Stunted growth of seedlings indicates the loss of soil fertility, excess watering and dumping of seedlings in shady areas. As a preventive measure sterilization of nursery mixture, pre-treatment of seeds with fungicide such as Captan can control the disease. If the disease occurs, the casual pathogen may be identified by expression of symptoms and accordingly fungicide may be applied.

   Integrated nursery disease management

   - Selection of apparently healthy seeds/propagules for seedling production.
   - Seed dressing with 0.2% Carbendazim / Methyl thiophanate / Benomyl / Thiram.
   - Sowing in sterilized/fumigated, clean beds and adequate watering
   - Using sterilized budding knife, secateurs, and scissors during budding and grafting.
   - Transplanting seedling after root dip for 3-5 min in 0.02% Carbendazim solution.

- Healthy planting material maintenance by keeping them under proper sunlight, watering and clean environment.
- Frequent examination of seedling health and removal of diseased stocks.
- Foliar spray of 0.2% Carbendazim / Dithane M-45 at regular interval.

2. **Nursery pests and their management**: A major injury to nursery stock is also caused by various groups of insects. These insect pests have been divided into three categories viz., major nursery pests (white grubs, cutworms, termites and crickets), minor nursery pests (defoliators, sapsuckers, grasshoppers) and non-insect pests (nematodes and vertebrate pests). Generally the damage caused by the insects may be controlled by maintaining better sanitation of the nursery area, adoption of suitable cultural practices and need based application of chemical and biological pesticides.
3. **Water management in nursery**: The single most important factor in germination and seedling production is water but too much water can be just as harmful as too little water. The quantity of water required depends on the size of the nursery, the kind of soil, the species, the number of seedlings and the irrigation method practiced. To avoid drying of seedlings, a reliable and continuous supply of water should be ensured by the facility of storage of water for at least 3 days supply. It is also necessary to ensure the quality of water used for irrigation. Normal pH water area the best suited, while water with more than pH of 7 favors attacks of 'damping off' fungi. Watering preferably in the mornings and avoiding the mid-day period when the sun will cause excessive evaporation. The visible symptoms of over watering are slight to severe yellowing and stunted growth. Wilting is one of the early signs of under watering. Hand watering with cans fitted with a rose spray or knapsack

mist nozzles are the obvious methods for small nurseries. The ideal system for large nurseries is overhead sprinkler irrigation as it is easily controlled and provides the most uniform method for the application of water.

4. **Weed management in nursery**: Weeds are any plants present in the cultivation area which is out of our interest. They compete with the seedlings for nutrients, water and light and suppress the growth of young plants because the weeds are usually more vigorous and grow at a faster rate. The most troublesome are grasses or dicotyledonous plants that grow from a root stock. If such a weed is cut off at the ground level, it will sprout again and continue to grow from the carbohydrates stored in its root tissue hence the need to remove the whole plant. Since it is more difficult to eradicate weeds after they have invaded seedlings growing in containers and in transplant beds, both the potting soil and the pre-filled containers may be watered in advance so that the germinated weeds can be removed in advance of transplanting. For this purpose, containers should be filled up to 4 weeks in advance of transplanting or direct sowing operations if weed free potting soil is not available. A thick hedge around the nursery helps keep out weed seeds that is otherwise brought in by wind.
5. **Nutrient Management in Nursery**: Sixteen plant food nutrients are essential for proper seedling development. Each is equally important to the plant, yet each is required in vastly different amounts. Among them the primary (macro) nutrients (nitrogen, phosphorus, and potassium) are most frequently required in nursery. Any deficiency of nutrients will be expressed by seedlings through deficiency symptoms; accordingly the relevant fertilizer should be applied as per requirement. For general nutrient support, FYM and compost are mostly used in nurseries. It greatly reduces the need for chemical fertilizers and, when mixed with

small amounts, dilutes the fertilizer, making it available in much larger useful quantities. Adding of well decomposed manure in the nursery mixture will assure the production of quality and healthy seedlings. In order to boost the rhizome growth, phosphorous must be added while application of urea will resulted for good vegetative/ foliar growth of seedlings. Meanwhile, using of bio-fertilizers such as Azatobactor, Azospirillum and Phosphobacteria @ 5 to 10 g and vermicompost, VAM @ 10 to 50 g per container raised seedlings are also suggested to boost the growth of seedlings.

Practical No. 2 **Date:**

DESCRIPTION AND IDENTIFICATION OF VARIETIES OF TEMPERATE FRUIT CROPS (POME & NUT)

1. Apple (*Malus* pumilla / Mallus *domestica*)

- **As per season:**

Season	Himachal Pradesh	Jammu & Kashmir	Uttar Pradesh
Early	Tydeman's early	Irish peach Benoni	Fenny, Benoni
Mid	Starking Delicious Royal Delicious Red Delicious Top red	American mother Queens apple	McIntosh
Late	Golden delicious Yellow Newton	Lal ambri	Rymer

- **Scab resistant varieties:**

1. Prima
2. Sir prize
3. Liberty
4. Freedom
5. Coop 12
6. Coop 13

- **Hybrids:**

1. Lal ambri- Red Delicious x Ambri
2. Sunehari- Ambri x Green Delicious
3. Ambred- Red Delicious x Ambri
4. Ambrich- Rich red x Ambri

- **Pollinizing varieties:**

1. Red gold
2. Golden delicious
3. Winter banana
4. Granny smith
5. Golden spur
6. McIntosh
7. Tydeman's Early

SN	Varieties	Description
1	Red delicious	It was introduced in H.P. fruits, mature in 3rd week of Aug. fruits are long, conical shape, all over the surface.
2	Starking delicious	It is bud sprout of delicious tree fruit mature in 2nd week of Aug.
3	Ambri	Original as chance seedling. Long keeping quality 4-5 months under ordinary conditions and 10 months in cold storage
4	McIntosh	Susceptible to scab, pre-harvest fruit drop is heavy

2. Pear (*Pyrus communis*)

Pear varieties belong to three groups:

1. European 2. Asian 3. Hybrids

Again classified

a. Early (Early China, Seckel, Fertility)

b. Mid-season (Bartlett, Star King Delicious)

c. Late ripening (Comice, Hardy, Conference)

A. **Varieties for high hills:**

Early	Mid	Late
Early china	Barlett	Hardy
Seckel	Starking delicious	Conference, Comice

B. For low hills and valley areas of Himachal Pradesh

1. Patharnakh 2. Keiffer
3. China pear

C. For Uttar Pradesh

1. Max red Bartlett 2. Hardy
3. William Bartlett 4. Gosh Baghu
5. Baggugosha (Also known as Bartlett). Inter-specific hybrid

D. For South India

1. Keiffer
2. Bone of jurcy

E. For Punjab

1. Nashpati
2. Smith
3. Athat naakh
4. Kieffer

F. For Plains

1. Kashmiri pear
2. Patharnakh
3. Le Conte. A Hybrid variety
4. China Gola
5. Victoria
6. Thumb pear (Chusni): Early, fruits available from 1st June.

G. **Jammu & Kashmir:**

1. Hardy
2. China Sand Pear
3. Favourite
4. William Bartlett and
6. China Pear

H. **South India:**

1. Kieffer *(P. communis xP. Pyrifolia)*
2. Bonne of Jersey
3. Beurre Hardy

I. Pollinizing cultivars:

1. Fertility
2. Conference
3. Flemish Beauty
4. Keiffer

SN	Varieties	Description
1	Bartlett	This variety suitable for plain and hill areas. Fruits stats ripening from first week of Aug. the keeping quality is poor. It is heavy and regular crop per fruit is fit for canning.
2	Conference	Fruits are medium sized and pyriform skin is green with rusted patches.
3	Patharnakh	Late season variety of Chinese group fruits are light yellowish in colour. Keeping quality is very good.
4	Nashpati	Grow successfully in the plains. Flesh is gritty it is self fruit, variety does not require cross pollination.

3. Persian Walnut (*Juglans rejia*)

- Most of the existing plantations are of seedling origin which have been grouped in 4 categories,
  1. Paper-shelled
  2. Thin-shelled
  3. medium-shelled and
  4. Hard-shelled

A. Varieties for Jammu &Kashmir

1. Lake English
2. Opex Caulchry
3. Drainovsky

B. Varieties for Himachal Pradesh

1. Gobind
2. Eureka
3. Placentia
4. Wilson
5. Kashmir Budded

C. Varieties for Uttar Pradesh

1. Chakrata selections.

SN	Varieties	Description
1	Chico	It is protogynous cultivar and its pollinator could be 'serr' it is sensitive to blight.
2	Chandler	This cultivar is very appreciated for its nuts and kernel quality.
3	Fernor	Nuts and kernels are of high quality derived from their common parental frenquette.
4	Franquette	Its importance depands on its nuts and kernel quality This cultivar has high chilling requirement.

4. Pecan-nut (*Carya illinoensis*)

1. **Mahan:**
   - Early-maturing, vigorous, prolific-bearer.
   - Protogynous cultivar. (With the stigma receptive to pollen before the pollen of same flower is released)
   - Nuts are large, nut size (20 nuts/kg i. e. 50 g/nut).
2. **Burkett:** Nut size (23 nuts/kg). Prone to fruit drop. Used as rootstock.
3. **Western Schley:** Nut size (26 nuts/kg).
4. **Stuart:**
   - Resistant to scab disease. Nut size is large (23 nuts/kg).
   - It should be planted with a protandrous cultivar (Pollens shed before the stigma receptivity).
5. **Western:**
   - Self-pollinated.
   - Recommended for high-density planting.
   - Susceptibility to scab.
6. **Desirable:**
   - Resistant to scab.
   - Recommended for high-density planting.
7. **Mohawk:** Mature early. Nuts large (16–23 nuts/kg) and attractive.
8. **Cheyenne:**
   - Dwarf type growth. Ideally suited to HDP.
   - Nuts are excellent for shelling, 25–32 nuts/kg.
9. **Chicksaw:**
   - Suitable for high-density plantings.
   - Nut size is 25–32 nuts/kg.
10. **Wichita:** Nuts medium-sized; 20–30/kg. Kernel 60%.
11. **Nellis:** Used as rootstock

5. Queens land nut/ Australian nut / (*Makadamia integrifolia*)

o Kakea	2. Ikaika
3. Keaau	4. Keauhou
5. Kau	6. Purvis
7. Makai	8. Mauka
9. Beaumont	10. Nelmak 1 and Nelmak 2 (hybrids)

6. Hazal Nut (*Corylus avellana*)

1. Barcelona	2. Trebizond
3. Kentish Cob are popular cultivars.	4. Red Filbert
5. Kentish Filbert	6. Atlas
7. Cosford Cob	8. Hemples
9. Person's Prolific	10. Tonollo
11. Du Chilly	12. Brik Nut
13. Du Province	14. White Aveline
15. Knight's Large	16. Purple Leaved

7. Chestnut (*Castanea sativa*)

- chestnut trees can be grown by grafting them onto oak rootstocks

Botanical description & identification of temperate fruit crops (Pome &Nut)

SN	Fruit crop	Family	Propagation method	Rootstock	Type of fruit
1	Apple (*Malus* pumilla/ Mallus *domestica*)	Rosaceae	Chip budding, Tongue grafting	- Crab apple or self-pollinizing varieties - Diploid cultivars like Golden Delicious, Granny Smith, Yellow Newton - Dwarfing- M 9 - Semi dwarfing- M 4, M 7, MM 106 - Semi vigorous- MM 111 - Vigorous- Morton 793	Pome (A fleshy fruit with several seed chambers, this formed from an inferior ovary, the seeds not embedded in pulp)
2	Pear (*Pyrus communis*)	Rosaceae	-'T' or Shield budding, -Tongue & veneer grafting	*Pyrus pashia, P. pyrifolia* Dwarfing- Quince (*Sedona oblonga*)	Pome
3	Persian Walnut (*Juglans rejia*)	Juglandaceae.	Tongue/ cleft grafting	Walnut seedlings	Nut (One seeded fruit)
4	Pecan-nut (*Carya illinoensis*)	Juglandaceae	-Seeds, -Tongue grafting -Patch, Angular/ring budding.	Burkett and Nellis or from seedling trees	Nut
5	Queens land nut/ Australian nut/ Macadamia (*Makadamia integrifolia*)	Proteaceae	-Wedge grafting, -Seed	Queens land nut seedlings	Nut
6	Hazal Nut (*Corylus aveliana*)	Betulaceae	-Seed -Suckers, -Cuttings, -Layering, -Shield, cleft budding, -Tongue & crown graftin	Hazal nut seedlings	Nut
7	Chestnut (*Castanea sativa*)	Betulaceae	By seed, Grafting	Chestnut seedlings	Nut

Practical No. 3 Date:

DESCRIPTION AND IDENTIFICATION OF VARIETIES OF TEMPERATE FRUIT CROPS (BERRY & OTHERS)

1. Persimmon (*Diospyrous kaki*)

- Japanese varieties show wide variations in size, shape & colour.
- These are broadly classified into 2 major groups

i. Non-astringent cultivars

- Cultivars having dark coloured flesh are sweet and non-astringent, and may be eaten before they become soft.
- Only one non-astringent cultivar, Fuyu, grown in subtropical climate.
- This has reddish, flesh flattened, sweet and mellow.
- Other non-astringent cvs. of world

1. Izu	4. Jiro	7. Suruga
2. Maekawa Jiro	5. Matsumoto Wase Fuyu	8. Fuyu Hana
3. Ichikikei Jiro	6. Hana Fuyu	9. 20th century

Astringent cultivars

- Hachiya is astringent cultivar grown in India.
- This is a leading commercial cultivar of California.
- It is usually seedless but may also contain one or two seeds.
- Skin glossy, deep orange-red; flesh deep yellow, astringent until soft, rich and sweet when ripe.
- The fruits ripen as well off the tree as on the tree.
- Both groups sub-divided in to two based on pollination response
  a. Astringent & pollination constant.
  b. Astringent & pollination variant.
  c. Non astringent & pollination constant.
  d. Non astringent & pollination variant.

2. Kiwifruit (*Actinidia deliciosa*)

- Dioecious plant (it bears pistillate and staminate flowers separately on different plants).

i. **Abbott**

- Early flowering and early maturing cultivar.
- Oblong, medium-sized, fruits are covered with dense hairs.
- Very sweet in taste.

ii. **Bruno**

- Fruits tapering in shape towards the stem end.
- Fruits longest among all the cultivars.
- Dark brown having very dense, short and bristly hair.
- Bearing is very heavy.

ii. **Hayward**

- Most popular cultivar of the world
- Fruit is broad and flat.
- Superior in flavour.

iii. **Monty**

- Late-flowering cultivar but fruit maturity is not late.
- Highly prolific bearer.
- Higher acidity and medium sugar content.

Pollinizing cultivars:

i. **Tomuri**

- Good pollinizer for Hayward and Monty.

ii. **Allison**

- Used for pollinizing different cultivars.

3. Peach (*Prunus persica*)

- **Classification of peach cultivars**

a. **Table cultivars**:

- S'hould be yellow fleshed, freestone.
- Alexander, Redheven

b. **Canning cultivar**:

- Should be yellow fleshed, clingstone with a small non splitting pit.
- Uniform size, devoid of red colour at the pit.
- Mature uniformly.
- Certex, Halford, Golden Bush

c. **For dehydration**:

- For dehydration, fruits may be freestone, white fleshed
- Sharbati

d. **Low chilling cultivars**:

- The peach cultivars do not require more cold for breaking dormancy.
- Early Amber, Early Grande Flordabelle, May Gold

e. **Nectarine cultivars**:

- Mostly preferred for table purpose.
- Annqueen, Sunred, Sunrise, Sunripe

A. Himachal Pradesh:

1. Alton	6. July Elberta	11. Early Glow
2. World's Earliest	7. Kanto 5	12. Stark Early
3. Early White Giant	8. Shimizu Hakuto	13. White Giant
4. Redhaven	9. Sunhaven	14. Starking Delicious
5. Stark Red Gold	10. Candor	15. J.H. Hale self un-fruitful Stark

B. J ammu & Kashmir:

1. Peshwari
2. Quetta
3. Elberta
4. Saharanpur Prabhat
5. J.H. Hale
6. Smith

C. Uttar Pradesh:

1. Early Candor
2. Redhaven
3. Sunhaven
4. July Elberta
5. Alexander
6. Crawford Early
7. Parrot Delux
8. J.H. Hale
9. Peregrine

D. *Tarai* Region:

1. Safeda Early Cream
2. SRE 6

E. Cold areas of dry temperate regions of Uttar Pradesh:

1. Prairie Dawn
2. Praire Rambler
3. Praire Rose

F. Subtropical Regions of North India:

1. Flordasun
2. Dawn Rambler
3. Dawn Rose

G. Temperate Reagion :

1. Prairie Down
2. Prairie Rambler.

➢ Cvs. ripen before onset of rains are suited for commercial cultivations.

S N	Varieties	Description
1	Red top, Cander, Coridinal	For table purpose, the cultivars should be yellow fleshed, free stone regular producer and relatively free from fuzz
2	Cortex, Golden bush	For table purpose, the cultivars should have yellow flesh, free stone, small non-spliting pit.

4. Plum (*Prunus salicina*)

- In India Japanese varieties are planted.

State	Early	Mid season	Late varities
Himachal Pradesh			
a. High hills	Sweet ea.ly, Kelsey, Methley	Starking Delicious, Satsuma, Burbank	Mariposa
b. Mid hills	Sant rosa, Beauty	Frontier, Kanto 5	Mariposa, Red ace
c. Low hills	Aluncha purple, Titron	-	-
Uttar Pradesh	Jamuni, Serrler, Titron, Cloth of Gold	Howe, Zardula, Heart, Victoria	Late yellow, Mariposa
Jammu & Kashmir	Saharanpuri white, Plum Frist, Ramgarh, Sharps, Early Subza	Formosa, Maynard, Burbank, Santa Rosa	Satsuma, Golden Gage
Panjab	Satluj purple	Titron, Kala amritsari	Alubukhara

Pollinizing varieties:

The dependable pollinizer varieties are ...

1. Wickson
2. Lorada
3. Santa Rosa
4. Red Heart
5. Elephant heart

SN	Varieties	Description
1	European plum	These are variety with high sugar content, which can be dried along with stone. eg. French, German, Italian sugar.
2	Damson plum	Used for culinary purpose
3	Simen plum	Used as parent in breeding programme of Japanese plum

5. Apricoat (*Prunus armeniaca*)

For Himachal Pradesh

A. Mid hills

1. New castle
2. Early Shipley
3. Shakarpara

B. High hills

1. Kaisha
2. Nugges
3. Royal
4. Nari

C. Dry temperate

1. Charmaga
2. Suffaida
3. Shakarpara
4. Kaisha

For Uttar Pradesh

1. Chaubattia kesria
2. Chaubattia alankar
3. Charmagz
4. Kaisha
5. Moorpark
6. Turkey.

For Jammu & Kashmir

a. Ladakha

1. Khante
2. Halman

b. Kashmir

1. Turkey
2. Australian
3. Narmu

New promising varieties for mid hills.

a. Early maturing

1. Baiti
2. Beladi

b. Late maturing

1. Farmingdale
2. Alfred

6. Almond (*Prunus dulcis/ Amygdalus communis*)

A. For Jammu and Kashmir:

1. Makhdoom
2. Parbat
3. Shalimar
4. Waris
5. Afghanistan seedlinh

B. For dry temperate zone

1. Neplus – ultra
2. Texas

C. For high & mid hills

1. I x L
2. Merced
3. Non-pareil

D. For low hills & vally areas areas of Himachal Pradesh:

1. Katha
2. Neplus- ultra
3. Drake
4. Katha
5. Peerless and
6. Neplus Ultra.

E. The almonds of seedling origin are divided into 4 groups.

i. paper-shelled (Romali)

ii. soft-shelled

iii. semi-soft-shelled and

iv. hard-shelled.

F. Polliniser Variety:

Varity Peerless good polliniser for Non Pareil

7. Strawberry (*Fragaria ananasa*)

- In India exotic cultivars are grown except 'Kalimpong Local' which is originated in West Bengal.

1. **Chandler:** Fruits are large, flesh and skin firm and flavour excellent. On an average, berry weighs 15–18g.
2. **Selva:** A day-neutral cultivar, produce off-season fruits.
3. **Tioga:** An early-maturing.

4. Torrey: Dessert quality excellent, processing quality good

5. Sweet Fern: It is a day-neutral, early-ripening and over-bearing cv.

6. Pajaro: It is very successful under summer system.

7. Charlee	8. Cameroza
9. Belrubi	10. Premier
11. Red Coat	12. Local Jeolikot
13. Dilpasand	14. Bangalore
15. Florida 90	16. Katrain Sweet,
17. Pusa Early Dwarf and	18. Blakemore are also grown.

8. Sweet Cherry (*Prunus avium*)

- All varieties are divided into 2 groups.

1. Heart group

- Fruit is heart-shaped having soft and tender flesh.
- Colour of fruit varies from dark with reddish juice to light coloured with colourless juice.

2. Bigarreaus group

- Fruit roundish, colour of fruit and juice varies from dark to light red.

A. Jammu & Kashmir:

1. Black Heart	2. Early Purple Black Heart,
3. Guigne Noir	4. Gross Lucenta

B. Himachal Pradesh:

1. Bing,	2. Sue
3. Sam	4. Stella

C. Uttar Pradesh:

1. Bedford	2. Prolific	3. Black Heart

D. Universal donor varieties:

1. Stella	2. Vista,	
3. Vic	4. Seneca	5. Vega

Botanical description & identification of temperate fruit crops (Berry & others)

SN	Fruit crop	Family	Propagation method	Rootstock	Type of fruit
1	Persimmon (*Diospyrous kaki*)	Rosaceae	-Whip graft- small stock -Cleft and Veneer grafting-larger stock, -'T' budding	-In India *Diospyros lotus* is used as the root stock. -Other root stock *D. Kaki & D. virginiana*	Berry (Fleshy fruit without a stone produced from a single flower containing one overy)
2	Kiwifruit (*Actinidia deliciosa*)	Dillenianceae	-Cutting, -Whip & tongue grafting	Kiwi seedlings	Berry
3	Peach (*Prunus persica*)	Rosaceae	-Tongue grafting, -'T' & ring budding	Peach seedlings. Plum, apricot, almond seedlings & wild peach seedlings 'Behmi' (*Prunus mira*)	Drupe/Stone(A fruit with a fleshy exocarp and a hard stony endocarp about each seed)
4	Plum (*Prunus salicina*)	Rosaceae	-Tongue grafting, -Chip, 'T' budding -In Punjab - Own-rooted plants of Kala Amritsari	Clonal rootstock-Myrobalan B plum -Sandy loam soil -Peach & cuttings of Kabul Green Guage 'Zardalu' (wild apricot) Dwarf- Pixy	Drupe
5	Apricoat (*Prunus armeniaca*)	Rosaceae	Tongue grafting, 'T' budding, Chip budding	Wild apricot (*Chuli*) & wild peach seedlings Heavy soils and excessive soil moisture- Myrobalan plum	Drupe
6	Almond (*Prunus dulcis/ Amygdalus communis*)	Rosaceae	Shield budding	Bitter or sweet almond seedlings. Peach also used	Drupe
7	Strawberry (*Fragaria ananasa*)	Rosaceae	Runners, Crowns, Tissue culture	-	Aggregate (Etaerio of drupes)
8	Sweet Cherry (*Prunus avium*)	Rosaceae	Toung grafting,	- Locally know "Paja" (*Prunus cerasoides*) is commonly used -Mazzard and Mahaleb -Clonal rootstocks Colt & Mazzard F12/1	Drupe

Practical No. 4 **Date:**

MANURING AND FERTILIZATION OF TEMPERATE FRUITS (POME AND NUT)

1. Apple:

Year	FYM (kg/plant)	N (g/plant)	P (g/plant)	K (g/plant)
1	10	70	35	70
2	20	140	70	140
3	30	210	105	210
4	40	280	140	280
5	50	350	175	350
6	60	420	210	420
7	70	490	245	490
8	80	560	280	560
9	90	630	315	630
10	100	700	350	700

- 10 kg FYM & 700:350:700 g NPK/plant stabilized after 10 years.
- FYM along with phosphorous and potash should be given during Dec-Jan.
- Nitrogen is applied in two split doses, the first 20-25 days before bud break and second after fruit set.
- Excessive pre-harvest drop of fruit due to magnesium deficiency.
- Boron deficiency may cause blind bud in apple.
- In orchards with well established Cycles of 'on' and 'off' years. The fertilizer doses should be reduced by 50 percent during off years.

2. Pear:

- In hills, the recommended does for 10 years old plant is 100 kg farmyard manure, 700 g N, 350 g P_2O_5 and 700 g K_2O.
- The farmyard manure, P and K are applied before snowfall in December.
- Half of N is added 3 weeks before flowering (February) and the rest half just after fruit set (April).

- Calcium and zinc deficiency cause development of mis-shapen fruits. Boron deficiency cause corking of fruits.
- The deficiency of Zn and Fe on young foliage can easily be controlled by spraying 0.4-0.5 % Zinc sulphate and Ferrous sulphate respectively during April.

3. Walnut:

- Walunt is not generally being applied with fertilizers for achieving higher yields of quality fruits, application of fertilizers is very essential.
- For Jammu and Kashmir areas a does of 250 g. of N, 60 g. of P and 250g of K is recommended to 10 years old tress.
- Full does of P and K & half of N is applied 2 weeks before expected bloom Rest of the half quantity of N should be applied into weeks & equal doses 3 weeks after fruit set and during early July.
- For correcting Zn deficiency 0.4 % Zinc sulphate should be applied as a foliar spray.

4. Pecan:

- Apply 500 g NPK mixture (15:15:15)/year to a year old tree. (75g NPK/plant)
- Trees of 16 years age and above 100kg FYM every year in December.
- 8 kg mixture to the full bearing. (1200 g NPK/plant)
- The fertilizer should be applied in early spring.
- Pecan trees are very much prone to Zn and Mn deficiency
- Foliar application of zinc sulphate & manganese sulphate each @ 0.5%.

5. Queensland nut:

- 40–50 kg FYM, 450 : 150 : 500 g of NPK/tree/year.

Practical No. 5 **Date:**

MANURING AND FERTILIZATION OF TEMPERATE FRUITS (BERRY & OTHERS)

1. Persimmon:

- Persimmon does not require high fertilizer doses.
- Up to 3 years age require complete fertilizer (11:4:14) before bud-break.
- 3-4 lighter follow-up urea application at monthly intervals at peak growing.
- Once trees begin cropping, an application of complete fertilizer is applied 4-6 weeks before harvesting.
- Magnesium deficiency causes leaf drop.
- Foliar sprays of 2-3% $MgSO_4$.
- Mn deficiency leaves drop early
- Foliar spray of 0.3–0.5% $MnSO_4$.

2. Kiwi:

- After 5 years 20 kg FYM, 900:600: 900 g NPK/Plant/year.
- The N fertilizer should be applied in 2 equal doses, half in January–February and the rest after fruit set in April–May.

3. Peach:

- Altogether 10 nutrient elements viz., N, P, K, Ca, Mg, Fe, Zn, B, Cu and Mn play a vital role in growth and development of peach.
- In peach, leaf tissue analysis is considered important for assessing the nutrient status of plants.
- Procedures for examining nutrient status of peaches are sampling of mature leaves including petioles from mid portion or near base of current seasons terminal growth.

- For fully grown tree (6 yrs) – 40 kg FYM, 500:250:700 g NPK/tree / year.
- Whole quantity of FYM along with P and K is given during Dec-Jan.
- ½ N before flowering (in spring) & ½ a month later if irrigation is available.
- Under rainfed, N applied in one lot 15 days before budbreak.
- Susceptible to Fe deficiency, foliar application of 0.5-1.0% $FeSO_4$.

4. Plum:

- In HP 7 years and above 40 kg FYM, 500:250:700 g NPK/plant
- The farmyard manure along with full dose of P and K should be applied during December and January.
- Half dose of N is applied in spring before flowering and
- Remaining half N a month later.
- Deficiency of Boron in plum results in
    1. Misshapen fruits.
    2. Corky spots develop on the fruit as a result of which it cracks.
    3. Terminal buds fail to develop,
    4. leaves become dark green and boat like,
    5. Die back of shoots occurs under severe deficiency.
- Spraying of 0.1% boric acid in June.

5. Apricot:

- Apricot removes a large quantity of nutrients from the soil. Requiring replenishment with both organic manure and chemical fertilizers the manures requirement depends upon age of tree.
- Trees 7 years old or more 40 kg FYM, 500:250:200 g NPK/tree.
- December–January FYM along with full dose of P and K.
- Nitrogen in 2 doses: first half 2–3 weeks before flowering.
- Remaining half a month later, if irrigation facilities are available.

- Under rainfed conditions, the second half dose of N should be applied at the onset of monsoon or through 1 or 2 foliar sprays of urea 0.5% after fruit set.
- Initial 2–4 years, pea, bean, soybean & cowpea enrich soil & give returns.

6. **Almond** :
   - Almond is a heavy feeder requiring proper fertilization for maximum yield analysis of soil and leaves is necessary however the following does of nutrient is recommended for almonds growing in Jammu and Kashmir.
   - 2-3 kg Ammonium Sulphate and 1-2 kg Super Phosphate/tree
   - The nitrogen should be split in 2 – 3 does.
   - First half does should be supplied along with 'P' and 'K' a fortnight before expected bloom; second does (one-fourth of total quantity) may be applied about 3 week after fruit set and third does in June-July.

7. **Strawberry**:
   - There are different recommendations for strawberry grown in different states in India
   - In Maharashtra 10-15 t FYM/ha and 120:100:75 kg NPK/ha is recommended
   - The farmyard manure should be mixed in soil at time of preparation of planting bed.
   - The N should be applied in 2 split doses; half in September or after the establishment of plants in September–October.
   - And the remaining half before blooming.
   - Foliar spraying of N & K_2O (0.5%) and P_2O_5 (0.2%), 4 times between August and February is also advised.

8. Cherry:

- Cherry requires all essential nutrients for better growth and quality fruits.
- Since fruit development and vegetative gown occurs simultaneously. It has high demand for mineral.
- The amount of manure and fertilizer to be applied is influenced by the age of size of tree.
- 10 yrs & above 60 kg FYM, 2 kg CAN (N), 1.6 kg SSP (P) &1 kg MOP (K)
- FYM should be applied in December along with a full dose of SSP & MOP.
- Half dose of N is applied in spring before flowering & other ½ one month later.
- Due to zinc deficiency the fruits become abnormally small in size.
- Foliar spray of zinc sulphate rectify the deficiency.
- Manganese deficiency develop intervenal chlorosis. Manganese sulphate.
- Boron deficiency may result in hard, shriveled and blochy fruits. Borax.
- Fertilizers are broadcast in tree basin about 30 cm away from the tree trunk.

Practical No. 6 **Date:**

PLANTING SYSTEMS

Methods of planting systems:

1. Square
2. Rectangular
3. Hexagonal
4. Diagoanl or Quincunx
5. Contour

1. Square:

- Plant to plant and row-to-row distance is same.
- Tree is planted at each corner of squares.
- Easy to layout and facilities intercropping.
- Cultivation is possible in two directions.

2. Rectangular:

- Layout is same as in square system.
- Plant to plant and row-to-row distance however are not same.
- Number of trees/ha is more.

3. Hexagonal:

- Trees are planted at each corner of an equilateral triangle.
- Six trees from a hexagon with 7^{th} tree in the centre hence also known as septaple system.
- Commonly followed where land is very expensive and fertile and irrigation facilities are available.
- Accommodates 15 % more trees than the square system.
- It is difficult to layout and intercultural operations become difficult.

4. Diagoanl or Quincunx:

- Same as the square system with an additional tree in the center of each square.
- Central tree is a filler tree and is of short duration.
- Followed where the permanent trees have more planting distance and when they are slow growing.
- Plant population is nearly double than square system.

5. Contour:

- Commonly followed in hilly regions where the land slopes are high.
- The trees are planted along the contour lines at right angles to the slops.
- Planting marking should be done from the bottom to the top.
- Generally the planting distance is not same.

Exercise: Draw diagrams of planting systems

Practical No. 7 **Date:**

PREPARATION AND USE OF GROWTH REGULATORS (POWDER FORM)

Preparation of hormonal powder:

- For preparation of hormonal powder, the required quantity of hormone is weighed precisely with the help of sensitive balance.
- It is dissolved in ½ litre ethanol, methanol or acetone in a beaker. This material is poured into one kilogram of talc taken in mortar and mixed thoroughly with a glass rod.
- After mixing, the mixture is kept open in air for few hours. The alcohol will evaporate soon, after which, the dried talc is ground to a fine powder.
- This fine powder should be kept in air tight containers to avoid moistening and can be used as and when required.

Powders dip method:

- In this method also basal ends of cuttings are dipped in the hormonal powder which carries (talc) for some time.
- After treatment of cuttings, extra amount of powder adhering to the cuttings should be removed by shaking and cuttings are immediately inserted into the rooting medium.
- For effective rooting, the cut ends of the cuttings should be moistened before the treatment and care should be taken that extra powder adhered to cuttings should be shaken off, otherwise, it may cause adverse effect on the rooting process.
- Seradix, Rootex or many other formulations are available in the market as powders.
- It is useful for propagation through cutting and layering.

Practical No. 8 **Date:**

PREPARATION AND USE OF GROWTH REGULATORS (LANOLIN PASTE)

Preparation of hormonal paste:

- For preparing hormonal pastes, the required quantity of the hormone is weighed accurately and dissolved completely in a few drops of alcohol.
- The required quantity of lanolin (wool fat, a product similar to grease and is greenish-yellow in colour) is weighed and heated slightly in a beaker under gentle flame.
- When the lanolin is slightly liquefied the dissolved hormone is poured in it.
- The mixture is dissolved thoroughly with constant stirring with a glass rod. The mixture is allowed to cool down.

The paste is ready for use. Until use, the paste may be kept for few months in a cool dry place but one should prefer to use fresh paste.

Precaution:

- First of all check the expiry date of the hormone powder.
- The weight should be taken precisely, preferably on electronic balance.
- Proper solvent should be used to avoid precipitation.
- Hormones deteriorate under high temperature, so store in cool and dry place.
- Hormones are photosensitive; therefore they must be stored in dark or amber colored bottles.
- Use hormonal solutions for treatment of cuttings and lanolin paste for layers.

Lanolin paste method:

- As described under preparation of hormonal paste, the paste of growth regulators made in lanolin is applied to the girdled portion of a layer or stool for inducing rooting in them.
- Solutions should be prepared fresh. If required to store for some time use, refrigerators.
- The treated cuttings should be planted with the help of some stick to make hole, so as to avoid removal of solution from basal end of cutting.
- This technique is most commonly used for laboratory experiments to obtain clue for theoretical and practical significance of a particular compound on a physiological process.

Practical No. 9 **Date:**

INTERCULTURAL OPERATIONS IN PLUM, PEACH & NUT CROPS

Plum:

- Weeds are a problem in the plum crop. They must be removed by hoeing or applying chemical herbicides. The basins are kept clean by hand-weeding or applying weedicides and mulch, while the rest of the orchard floor is kept under permanent sod.
  - ✓ Application of Atrazin or Diuron @ 4.0kg/ha in April as pre-emergence.
  - ✓ Gramoxone @ 2 litres/ha or Glyphosate @ 800ml/ha as post-emergence.
- Clean basin + permanent sod in the orchard is most common practice.
- Mulching of tree basins is done with 10–15cm thick hay in March. Black alkathene mulch is beneficial.
- Pruning in the plum crop can be done after the first year. Pruning improves the growth of the plants.
- The thinning of fruits is also an important activity in plum farming. Usually, the plum trees beat too many fruits. It can result in the smaller size of the fruit. For that, the fruits must be thinned.
- Intercropping can be done in the plum field for up to five years. Various crops such as vegetables and legume crops can be intercropped with the plum.

Peach:

- The weeds in the peach farm must be removed when they emerge. They can be removed by manual or chemical methods. Application of herbicides is the best option for control of weeds.
- Minimum soil tillage ie the desirable cultural practice in peach orchards.
- Tillage therefore confined is mainly to light hoeing or shallow ploughing.
  - ✓ Simazine and Atrazine (2.9kg/ha), Turbacil (0.8kg/ha) as pre-emergent and
  - ✓ Paraquat (4.0 litres/ha) and Glyphosate (4.32kg/ha) as post-emergent.
- The peach trees must be pruned heavily at regular intervals.
- Intercropping of peach can be done to add extra income. Crops such as vegetables, lentils, chili, French bean, ginger, rice etc can be used as intercrop with the peach crop.
- The interspaces in a young orchard can be economically utilized by growing short duration crops till the peaches are come into bearing.The intercrops should be Short duration, Shallow rooted, Non exhaustive, Should maintain soil conditions, Improve soil fertility, Preferably leguminous type, suitable crops are Cowpea, soyabean, turmeric, pineapple Exhaustive crops like Okra and onion should be avoided
- In cover cropping a pure or mixed stand of densely spaced herbaceous plants is grown to cover the soil for a part or whole of the year.
- Cover crops reduces soil erosion, run off and leaching, help to maintain the organic matter contain, increase the rate of infiltration, serve as an indicator of moisture and nutrient deficiencies, suitable cover crops are rye, peas, millet, vetch (One type of fodder), barley, alfalfa (Green fodder), coastal Bermuda.
- In green manuring short duration legumes are grown and incorporated into the soil by tillage prior to flowering of the legumes. Greem manuring

improves soil condition and soil fertility, suitable crops are peas, beans, fenugreek, lentils, dhaincha, cowpea, sunhemp, oats, green/ black gram.

- Advantages of mulches are conserve moisture, check weed growth, regulate soil temperature, prevent soil erosion. Mulching material of organic origin supply most of the plant nutrients and organic matter in soil. Plant origin material like straw, leaves and crop residues

Walnut:

- To check the growth of weeds, you need to do manual weeding or apply weedicides at regular intervals.
- Mulching is a great method to reduce weeds and to conserve water.
- In walnut farming, pruning and thinning at regular intervals is important for healthy growth of the plants into trees.

Pecan:

- The weeds must be controlled in the early stages and chemicals and manual methods are followed and especially in the abroad countries they are followed by different techniques for controlling weeds.
- Soil should be raked just for absorb more nutrients. But it is accosted effective process also.
- Keep the basins weed free by cultivating regularly and aited against rats.
  - Diuron and simazine 2–5kg/ha.
  - Paraquat at 1kg/ha.
  - Some cover crops can be grown during summer and winter seasons, especially on hill slopes to check soil erosion

Practical No. 10 **Date:**

TRAINING IN APPLE AND PEAR

Training in apple and pear:

- Tree training is a practice involving various techniques.
- This is employed to control tree shape, size and productivity.
- Develop a tree that is easily accessible.
- Well exposed to sunlight.
- Capable of producing high quality fruits at an early age.
- Upright growing habit pear can be trained as pyramids, bushes or cordons (A tree on a single stem) if the stock is Quince.

Modified central leader system:

- The early years in the life of an apple tree are most important insofar as the training is concerned.
- Standard apple and pear trees are trained to modified leader.
- In this a leader develops on the young tree until it reaches a height of 2-3 meters when its growth is restricted.
- Laterals are selected to ascend in a spiral fashion up to the central leader and are cut back until the proper number and distribution of branches have been obtained.
- Plants are pruned 50-60 cm above ground level at time of planting.
- During 1st year 2-3 well spaced scaffold (pole type) limbs are selected.
- Lowest at 30 cm from ground & 10-15 cm apart in spiral fashion.
- Advanced systems of training:

Advanced systems of training:

1. Spindle bush:

- It is a small, conical, central leader tree of only 2 m height and maximum diameter of 1.5 m.
- Horizontal fruiting laterals are trained about 0.4 m above the soil.
- With little pruning and horizontal bending of laterals, these spindles start early cropping.
- The tree is grown on dwarfing rootstocks such as M9

2. Palmette:

- This method has been widely adopted in modern commercial planting in Italy, France and other European parts.
- Rows are spaced 5-6 m apart with a distance of 3-4 m between trees.
- The height of tree will remain around 5 m.

3. Dwarf pyramid:

- The dwarf pyramid is common in England and other parts of the continent for dwarf or semi-dwarf apple trees.
- It is a low headed, compact, central leader tree.
- The lowest branch arises at a distance of 30-35 cm from the ground surface.
- It has 20-30 primary branches well distributed in all the directions around the main stem.
- Height is kept 2 m and spread between 1-2 m.

4. The pillar:

- Like the dwarf pyramid, the pillar consists of an erect central stem.
- There is not any necessity to restrict the height when more vigorous rootstock is used other than M9.

- The height of fully grown pillar 2-3 m.
- No branches are formed as such, the stem becomes furnished with shoots, but these are shortened drastically once they are three years old, so that more young shoots are formed from the stubs.
- Shoots are produced and retained each year so that there are always someone year and two year old shoots on the stem when the three year old ones are shortened back.

5. Head and spread:

- Modification of the modified leader system, commonly used in USA.
- In this, branches in groups of 4-5 are formed in tiers on the main trunk, with more space in between.
- This is in contrast to modified leader, where branches are selected continuously at different height throughout the length of the central stem/main trunk.
- The first tier of 4-5 branches are formed at a height of 60-75 cm from the soil surface.
- Subsequent tiers are developed 60 cm apart.
- This system is adopted for dwarf and semi-standard cultivars.

Practical No. 11 **Date:**

PRUNING IN APPLE AND PEAR

Pruning in apple and pear:

- Pinching unwanted shoots.
- Start pruning at top of tree
  - Cut upward growing limbs back
  - Remove crowded
  - Dead broken &
  - Diseased branches

Pruning of young bearing trees:

- Pruning is an essential operation for growth and flowering in apples/pear.
- Amount of pruning relates to quality and quantity of fruit yield in apple.
- Excessive pruning, especially dormant tipping of new shoots, will stimulate growth and inhibit flower bud formation and thus delay fruiting.
- In excessively vigorous trees, dormant pruning limited to cuts which are necessary & if convenient, supplemental pruning in summer.
- At this stage, spreading of branches of apple trees along with judicious pruning will encourage fruiting.

Pruning of bearing trees:

- When trees approach max. height, spreading is no longer necessary.
- Pruning is conducted during dormant season with following objectives.
  - To limit tree size and control shape.
  - To thin out competing branches, improve light penetration and spray coverage, facilitate work in the trees.
  - To eliminate weak, unproductive wood.
  - To eliminate or head back excessively vigorous wood.
  - To remove broken or diseased branches.
  - After 10 years need thinning out by cutting back the spur bearing fruit buds to half their size.

Practical No. 12 **Date:**

TRAINING IN PLUM, PEACH AND NUT CROPS

Training in plum:

- Trees are trained to open centre system.
- The top is heated back to 60cm to stimulate lateral branches.
- During first summer 3-5 branches 15cm apart are selected, first 30 cm from ground level.
- The central leader is headed back.

Training in peach:

- Modified leader & open centre systems followed.
- If sunlight is limiting factor, vase or open centre system of training is used.
- In this system, at the time of planting, stem is cut to a height of 60–80 cm from the ground level and only 3-4 branches are allowed to develop on it.
- In the following dormant season, these 3-4 branches arising in opposite directions with wide angled crotches are headed back.
- The unwanted branches are thinned out.
- In II year, 5-7 secondary limbs on main scaffolds selected & headed back.
- On secondary scaffold, diseased, weak & dry shoots thinned out and 2-3 secondary laterals are selected.
- All the side branches growing towards ground, centre of tree or vertically straight should be thinned out.
- Main stem kept clear up to 45cm above ground.

Training in nut crops:

1. **Makadamia:**

- Pruning to form a tree with a single main stem and framework of horizontal branches.
- In each of the 3 leaf axils of a node, 3 buds are found in a vertical row.
- All the 3 upper buds get activated and start growing straight when a stem is pruned.
- One of these is allowed to grow while the other 2 are clipped off which induces the buds below them to grow in a horizontal direction.

2. **Walnut**:

- Modified central leader system is most ideal.
- Trained on signal stem up to 1 - 2 m on which 5 - 6 scaffold branches should be retained at almost uniform distance spirally.

3. **Pecan nut**:

- Trained in central leader system.
- The lowest branch should be kept at a height of 1m from the ground level.
- Other subsequent branches spaced spirally at distance 30-35cm one above.

Practical No. 13 **Date:**

PRUNING IN PLUM, PEACH AND NUT CROPS

P uning in plum:

- Pruning is necessary for spur renewal & 75-80% removal of new growth in each season.
- All the cut ends after pruning should be covered with fungicidal paste to prevent entry of disease organisms.

Pruning in peach:

- Pruning has two components thinning out and heading back of the shoots.
- Require heavy and regular pruning because fruiting occurs laterally only on previous season's growth which bears only once in its life time.

Pruning in nut crops:

1. **Makadamia:**
   - Pruning to form a tree with a single main stem and framework of horizontal branches.
   - From time-to-time weak and damaged branches, if any, are removed.
2. **Walnut**:
   - Pruning is not being practiced in our country, as almost plantation is of seedling origin.
   - However, receive some kind of pruning while harvesting by thrashing the limbs with wooden poles.
   - It is however a crude method which needs to be modified.
   - Water sprouts developing from the rootstock should be pinched back.

3. Pecan nut:

- Once framework is established, very little pruning is done in matured trees.
- Only dried & broken branches removed & overcrowded branches thinned.

4. Hazel nut:

- Bearing trees must not be pruned until the male flowers have shed pollen.
- Suckers and older laterals should be removed.
- Light pruning is advocated.

Practical No. 14 **Date:**

WORKING OUT ECONOMICS FOR APPLE AND PEAR

Cost of production and returns from apple cultivation

Establishm nt cost of an apple orchard:

The **establishment cost** of an apple orchard includes all the cost incurred by the farmer during the initial year of establishment of the apple orchard and during its gestation period. The initial cost includes all the expenses incurred by the farmer from jungle cutting to planting the apple saplings and application of manures and fertilizer in its initial year of establishment. The **maintenance cost** includes the cost incurred by the farmer for two or three years for the maintenance of the apple orchard till the trees start bearing fruits. The average cost incurred for the initial establishment of an apple orchard is presented in Table 1.

Table 1: Average initial establishment cost of one hectare apple orchard

Sr. No.	Cost component	Per ha	%
I	Land Preparation (a+b+c)	95,000	59.37
	a) Jungle Cutting	15,000	9.38
	b) Fencing	40,000	25.00
	c) Digging and filling of pit	40,000	25.00
II	Planting Material	40,000	25.00
III	Manures and Fertilizer(a+b)	16,000	10.00
	a) Cost of Farm Yardmanure	6000	3.75
	b) Cost of Fertilizer	10,000	6.25
IV	Labour Cost for application of Manures and Fertilizers	9000	5.62
	Total	1,60,000	100.00

Source: Calculated from Field Survey, 2013-14

Table 2: Maintenance cost of an apple orchard during its gestation period

(per ha)

Sr. No.	Cost component	I Year	II Year
I	**Labour cost**		
	i) FYM Application	1500	1500
	ii) Fertilizer Application	3000	3000
	iii) Plant Protection Chemical	1000	1000
	iv) Pruning and training	1800	1800
	v) Weeding	3600	3600
	vi) Watch and Ward	48000	48000
	Total Labour Cost	58900	58900
II	**Material Cost**		
	i)Manure	7000	7000
	iii)Fertilizer	10300	10300
	iii) Plant Protection Chemical	3600	3600
	Total material Cost	20900	20900
	Total Cost(I + II)	79800	79800

Source: Calculated from Field Survey, 2013-14

The **total establishment cost** of one hectare apple orchard till its bearing age was calculated by adding the initial establishment cost and the maintenance cost incurred during its gestation period. Thus, the total establishment cost of one hectare apple orchard which comprised of the initial establishment expenditure and the maintenance cost during its gestation period was found to be `3,19,600 and it consisted of 50 percent initial establishment cost and 50 percent maintenance cost during its gestation period.

Cost of Production and Returns from Apple Cultivation

Apple is a perennial fruit crop and it requires heavy investment for the establishment of an apple orchard and its annual maintenance. The bearing of an apple tree begins from the third year of planting and continues up to 17-20 years. The annual share of the establishment cost was included in the fixed cost. Variable cost included the cost of inputs like manures, fertilizers, plant

protection chemicals etc and the cost of labour for weeding, pruning, application of manures, fertilizers and plant protection chemicals, harvesting, watch and ward etc. Table 3 shows the annual average cost of production for one hectare apple orchard in the study area.

Table 3: Annual average cost of production in one hectare apple orchard

Sr. No.	Cost Component	Amount (Rs./ ha)	Percentage of Total Cost
A	**Variable Cost**		
I	**Material Cost**		
	i)Manure	7000	
	iii)Fertilizer	10,300	
	iii) Plant Protection Chemical	3,600	
	Total material Cost	20,900	21.82
II	**Labour cost**		
	i) Application of FYM, Fertilizer, Plant Protection Chemical, pruning and training	10,900	
	vi) Watch and Ward	48,000	
	Total Labour Cost	58,900	61.49
	Total Variable Cost (I+II)	79,800	83.31
B	**Fixed Cost (Annual share of establishment cost)**	15,980	16.60
C	**Total cost of Production(A+B)**	95,780	100.00

Source: Calculated from Field Survey, 2013-14

Table 3 reveals that variable cost constituted 83.31 percent of the total cost of production. Labour cost for the application of fertilizers, manures and plant protection chemicals, watch and ward constituted a major share of 61.49 percent of the total cost of production. The material cost for the purchase of fertilizers, farm yard manure, pesticides constituted 21.82 percent of the total cost of production. The fixed cost which included the annual share of establishment cost was estimated to be 16.68 percent of the total cost of production. The bearing of an apple tree begins from the third year of the plant and the fruiting continues up to 20 years. As the age of the tree increases the

production of fruit also increases till the tree attains maturity up to 15 years and then it starts declining gradually up to 20 years. The annual average cost of production for one hectare apple orchard was found to be Rs. 95,780 per hectare. The annual averag e yield of apples was found to be 2692 kg/ha/year of the sampled orchards. The a erage price of apple realised by the farmers during the study period was found to be `60 per Kg. Therefore, the annual average total value of apple production of the sampled farmers was estimated to be Rs. 1,61,520 per hectare. Thus, the annual average net income was estimated to be `65,740 per hectare, it appears to be profitable for the farmers to grow apple in the study area.

Financial Feasibility of Investment in Apple Cultivation

The investment in apple orchard was tested using the project evaluation technique such as net present value, benefit cost ratio, pay back period and internal rate of return. The internal rate of returns, pay back period, benefit cost ratio and net present value for one hectare apple plantation is presented in Table-4.

Table 4: Financial feasibility of investment in apple orchard in the study area

Sr. No.	Measure	Unit
1	Pay Back Period	6.1 (years)
2	Net Present Value (At 7.5% discount rate)	41,9,862 (per hectare)
3	Benefit Cost Ratio (At 7.5% discount rate)	1.4
4	Internal Rate of Return	18.8 (percent)

Source: Calculated from Field Survey, 2013-14

The net present value and benefit cost ratio was calculated at 7.5 percent discount rate which represented the opportunity cost of capital. The pay back period was found to be 6.1 years which means that the orchardist would gain back the initial investment made during the establishment period at 6.1 years of the orchard. The pay back period was long because the productivity of apples in the region was low. The net present value from one hectare of apple orchard at

7.5 percent discount rate was found to be Rs.41,9,862. The positive and high net present value indicates the worthiness of investment in an apple orchard. The benefit cost ratio at 7.5 percent discount rate was estimated at 1.4 which means that the apple farmer would earn `1.4 for each rupee they invest in apple orchard. The Internal rate of return from one hectare of apple orchard was found to be 18.8 percent which was more than the opportunity cost of capital. Thus, all the four criterions revealed that investment in apple orchard was highly remunerative and a profitable economic activity in the study area.

Cost of production and returns from pear cultivation

TABLE 1: Per hectare initial year cost of pear-orchard of small farmers

SN	Cost component	Unit	Cost (Rs)	Quantity	Cost (Rs.)	(%)
A	**Labour Cost**					
1	Land clearing and development	Man days	250.00	16	4000.00	33.90
2	Digging of pits	Pit	15.00	200	3000.00	25.42
3	Filling of pits	Pit	6.00	200	1200.00	10.17
4	Manures & fertilizer application	Man days	250.00	2	500.00	12.71
5	Plant protection	Man days	250.00	4	1000.00	8.47
6	Planting and plant support	Pit	5.50	200	1100.00	9.32
Total labour cost					11800.00 (52.92)	100.00
B	**Material Cost**					
1	Plant material (including transportation)	Tree	10.50	200	2100.00	25.89
2	Manures	Tree	6.25	200	1250.00	15.41
3	Fertilizers and other materials	Tree	12.60	200	2520.00	31.07
4	Plant protection	Tree	8.70	200	1740.00	21.45
5	Miscellaneous Hectare		1.00	500	500.00	6.17
Total Materials Cost					8110.00 (36.37)	100.00
C	**Interest on working capital 12%**		19910.00		2389.20 (10.71)	
Total cost (A+B+C)					**22299.20**	**100.00**

Source: Computed data based on field data Figures in the brackets are percentages to the respective column totals

Per Hectare Maintenance Cost Incurred by Small Farmers in Pear Cultivation during Non-Bearing Stage

(Rs. per hectare)

SN	Particulars	1 Year	2 Year	3 Year	4 Year	5 Year	6 Year	7 Year
I	**Variable cost** Labour	500 (20.70)	500 (15.77)	750 (18.12)	1000 (19.08)	1500 (22.19)	2250 (25.25)	2750 (28.74)
	Manures and Fertilizers	1050 (43.48)	1595 (50.32)	2015 (48.67)	2255 (43.03)	2595 (38.39)	3025 (33.95)	3460 (36.15)
	Insecticides and Pesticides	755 (31.26)	825 (26.03)	985 (23.79)	1095 (20.90)	1595 (23.59)	2050 (23.00)	2270 (23.72)
	Other Maintenance cost	110 (4.55)	250 (7.89)	390 (9.42)	890 (16.98)	1070 (15.83)	1585 (17.79)	1090 (11.39)
	Total	2415 (100.0)	3170 (100.0)	4140 (100.0)	5240 (100.0)	6760 (100.0)	8910 (100.0)	9570 (100.0)
II	**Interest on working capital** (12%)	290	380	497	629	811	1069	1148
III	**Fixed cost** Land Revenue, Cess & other taxes	10 (0.07)	10 (0.07)	10 (0.07)	10 (0.07)	10 (0.07)	10 (0.07)	10 (0.07)
	Annual Share of Establishment cost	558 (4.17)	558 (4.17)	558 (4.17)	558 (4.17)	558 (4.17)	558 (4.17)	558 (4.17)
	Depreciation on implements, building etc	800 (5.98)	800 (5.98)	800 (5.98)	800 (5.98)	800 (5.98)	800 (5.98)	800 (5.98)
	Rental Value of Owned land	12000 (89.77)	12000 (89.77)	12000 (89.77)	12000 (89.77)	12000 (89.77)	12000 (89.77)	12000 (89.77)
	Total	13368 (100.0)	13368 (100.0)	13368 (100.0)	13368 (100.0)	13368 (100.0)	13368 (100.0)	13368 (100.0)
	Total cost of Production (I+II+ III)	16073	16918	18005	19237	20939	23347	24086
	Returns from Intercrops	11543	9044	8957	Nil	Nil	Nil	Nil
	Net Returns	-4530	- 7874	-9048	-19237	-20939	-23347	-24086
	Ratio of total cost of production To variable cost	15.03	18.74	22.99	27.24	32.28	38.16	39.73

Source: Computed data based on field data Figures in the brackets are percentages to the respective column

Per Hectare Maintenance Cost Incurred by Small Farmers in Pear Cultivation during Bearing Stage

Particulars	Variable cost Labour	Manures and fertilizers	Insecticides and pesticides	Other maintenance cost	Total	Interest on working capital (12%)
8th Year	2950 (29.65)	3510 (35.28)	2370 (23.82)	1119 (11.25)	9949 (100.0)	1194
9th Year	3125 (29.38)	3780 (35.54)	2480 (23.32)	1250 (11.75)	10635 (100.0)	1276
10th Year	3780 (33.06)	3815 (33.36)	2550 (22.30)	1290 (11.28)	11435 (100.0)	1372
11 to 15 Years	3960 (33.56)	3880 (32.88)	2590 (21.95)	1370 (11.61)	11800 (100.0)	1416
16 to 20 Years	4550 (32.42)	4600 (32.78)	3270 (23.30)	1615 (11.51)	14035 (100.0)	1684
21 to 25 Years	5050 (30.42)	5600 (33.73)	3950 (23.80)	2000 (12.05)	16600 (100.0)	1992
26 to 30 Years	5100 (30.26)	5700 (33.82)	3980 (23.61)	2075 (12.31)	16855 (100.0)	2023
31 to 40 Years	5855 (32.33)	5970 (32.97)	4015 (22.17)	2270 (12.53)	18110 (100.0)	2173
Particulars	**Fixed cost land revenue, cess & other taxes**	**Annual share of establishment cost**	**Depreciation on implements, building etc**	**Rental value of owned land**	**Total**	**Total (I + II + III)**
8th Year	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	24511
9th Year	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	25279
10th Year	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	26175
11 to 15 Years	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	26584
16 to 20 Years	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	29087
21 to 25 Years	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	31960
26 to 30 Years	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	32246
31 to 40 Years	10 (0.07)	558 (4.17)	800 (5.98)	12000 (89.77)	13368 (100.0)	33651
Particulars	**Marketing Cost /ha**	**Total (I+II+III+IV)**	**Yield in Tonnes**	**Gross Returns**	**Net Returns (B– A)**	**Net Returns per tonnes**
8th Year	21718	46229	20.45	65808	19579	957.41
9th Year	27198	52477	25.61	82413	29936	1168.92
10th Year	30692	56867	28.90	93000	36133	1250.28
11 to 15 Years	35843	62427	33.75	108608	46181	1368.33
16 to 20 Years	36809	65896	34.66	111536	45640	1316.79
21 to 25 Years	34165	66125	32.17	103523	37398	1162.51
26 to 30 Years	32975	65221	31.05	99919	34698	1117.49
31 to 40 Years	31223	64874	29.40	94609	29735	1011.39

Practical No. 15 **Date:**

WORKING OUT ECONOMICS FOR PEACH

Cost of Production and Returns from Peach Cultivation

Table 1: Age-wise cost and returns of peach in different sizes of orchards

(Rs / ha)

Age	Below 1 ha		1-2 ha		Above 2 ha		Overall	
years	Cost	Returns	Cost	Returns	Cost	Returns	Cost	Returns
1	15431	0	16543	0	16880	0	16285	0
2	10297	0	10629	0	11188	0	10705	0
3	12474	0	12704	0	13631	0	12936	0
4	12873	0	12701	0	13098	0	12891	0
5	13094	21579	13371	22651	14636	24551	13700	22927
6	13468	22758	13744	24901	14356	28763	13856	25474
7	14247	26862	14521	25324	14368	31982	14379	28056
8	14284	28766	14997	29779	15393	36825	14891	31790
9	15249	32061	15624	34688	16381	40882	15751	35877
10	15667	36548	15943	38406	16409	44649	16006	39868
11	16077	38754	16342	41099	17355	48662	16591	42838
12	15375	38844	16053	43872	17015	46047	16148	42921
13	15662	37655	14629	41883	16042	42577	15444	40705
14	15872	39253	13720	40673	14354	38061	14649	39329
15	14115	39564	14722	39449	13162	39542	14000	39518
16	14022	38751	14433	41772	13465	32701	13973	37741
17	13741	32836	14071	37240	14509	30658	14107	33578
18	13394	29735	13667	34662	12965	30981	13342	31793
19	12878	29706	13209	32763	11350	29874	12479	30781
20	11387	28618	12081	26884	12763	27554	12077	27685
21	12077	27642	11541	25339	12357	25984	11658	26322
22	11352	21567	10774	20839	10734	21865	10620	21443
23	10044	18278	10497	17774	10030	21087	10190	19046
24	9864	14569	10164	16271	9732	16645	9920	15828
25	8753	12497	9459	14559	9135	13842	9116	13633

Note: Inter-cropping during establishment (pre-bearing) period of peach orchards is a common practice in Punjab and Uttarakhand.

The expenditure includes only maintenance costs of trees after deducting returns from inter crops. Cotton, wheat, pulses, oilseeds, jowar and vegetables are the important inter-crops grown in the peach orchards. The economic productive life of peach orchards was up to 24 years in the study area.The

average cost and gross and net returns from peach orchards have been presented in Table 3. It shows that the net returns over maintenance cost and over total cost were Rs 14,655 and Rs 7,921respectively. The ratio of returns to maintenance cost worked out to be 2.09 for peach orchards. The ratio of returns to maintenance cost has been worked out to be 2.31 for kinnow mandarin grown in Punjab. The comparative economics of this competing crop of kinnow has been worked out for tractor-operated farms which have electric motor or diesel engine as source of irrigation. The opportunity cost of land and other scarce resources used in the cultivation of this competing crop were also taken into account (Gangwar *et al.*, 2005). Therefore, it was concluded that peach cultivation was more profitable than the competing crop. The study has revealed that peach cultivation in Punjab and Uttarakhand was a profitable venture.

Economic Evaluation of Peach Cultivation:

The economic productive life as well as profitability of peach orchards were calculated with the help of different investment appraisal methods and project evaluation techniques. The benefit-cost (B-C) ratio, net present value (NPV) and minimum income required for taking decision on replantation of orchards based on the present value summation methods and annual amortization method along with IRR and payback period have been presented in Table 4. The discounted and amortized values of returns were calculated at the rate of 12 per cent, because the financial institutions advance short-term loan to the peach growers/farmers at this rate of interest. A perusal of Table 4 revealed that the payback period was 8 years. The NPV worked out to be Rs 44, 807, the benefit-cost ratio as 1.409 and internal rate of return (IRR) as 22.20 under the present value summation method. Under the amortization method also, the NPV and B-C ratio were similarly at Rs 42,877 and 1.281, respectively. Both these measures clearly indicated that peach cultivation in Punjab and Uttarakhand was a profitable venture. Peach cultivation could be a vital alternative for crop

diversification endeavours, if infrastructure facilities were developed for scientific post-harvest handling, storage, packaging, transportation and marketing. Comparison of Two Investment Appraisal Methods -A comparison of the results obtained from the two appraisal methods revealed that the amortization method had slightly underestimated the benefit-cost (B-C) ratio and present (capital) value of the peach orchard; however, the difference in B-C ratios was not large (Table 4). There was a wide difference in income calculated under present value method and amortization method. The amortization method suggested an income of more than Rs 6,734 over the maintenance cost for retaining the peach orchards, as this income was enough to meet amortized establishment cost. The present value method required an income of more than Rs 5,713 for retaining the old peach orchards. Hence, the present value method appeared more realistic as the peach orchards have to compete with other crops, viz. kinnow, vegetables, cotton, wheat, paddy, oilseeds and sugarcane in the study area. In view of the fact that

Table 2: Measures of investment worth per hectare of peach orchards

Sr. No.	Measure of investment worth	Size of the orchards in ha (n=25)			
		Up to 1ha	1 – 2 ha	Above 2 ha	Overall
1	Payback period (years)	8	8	7	8
2	Net present value (Rs)				
a.	Discount rate = 6%	1,06,930	1,20,446	1,33,562	1,20,313
b.	Discount rate = 9%	64,539	73,856	84,858	74,517
c.	Discount rate = 12%	37,728	43,782	52,909	44,807
3	Internal rate of returns (%)	20.98	21.72	23.80	22.20
4	Benefit cost ratio				
a.	Discount rate = 6%	1.615	1.684	1.740	1.681
b.	Discount rate = 9%	1.305	1.543	1.606	1.545
c.	Discount rate = 12%	1.353	1.402	1.470	1.409
5	Uniform annual return (Rs)	4,810	5,582	6,746	5,713

Table 3: Average costs and return from peach orchards (Rs/ ha)

Sr. No.	Particulars	Amount	Per cent
1	Establishment cost amortized over25 years @ 12 per cent per year	6,734	
2	Average maintenance cost	13 482	
3	Total cost per year	20,216	100.00
4	Average gross income per year	25,886	
5	Net income per year	5,670	

Peach orchards have long productive life like other fruit crops and that it is difficult to collect information on costs and returns for all the years as required in the present value summation method, the amortization method is more useful and convenient. The annual amortized establishment cost could be treated as fixed cost in the case of other commercial crops to know the net income during any year of peach orchard. Of course, the establishment cost during pre-bearing period has to be collected and analyzed for both the years

Practical No. 16

Date:

WORKING OUT ECONOMICS FOR NUT CROPS

Economic Costs and returns of Establishing Standard- Density hazelnut orchard 6 x 6 m spacing

S N		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	year 11	Full Prod.
	Income												
1	Yield Kg/acre	0.00	0.00	33.75	128.25	198.00	297.00	495.00	540.00	720.00	900.00	1035.00	1260.00
2	Price Rs./Kg	135.55	135.55	135.55	135.55	135.55	135.55	135.55	135.55	135.55	135.55	135.55	135.55
3	Gross income	0.00	0.00	4574.81	17384.29	26838.90	40258.35	67097.25	73197.00	97596.00	121995.00	140294.25	170793.00
	Variable cost												
4	Field prepapration	562.42	33.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Trees	42822.00	3965.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Sowdust Match	231.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Paints Trees	1220.00	1220.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Fertilizers	5912.73	841.19	1261.48	1681.77	2102.67	6134.16	2943.25	7391.37	3784.44	4204.73	8236.22	10958.65
9	Chemicals	741.15	1666.52	2127.07	1613.45	1607.96	1809.26	2009.95	3243.37	2211.25	2211.25	2211.25	2469.28
10	IPM Scouting	0.00	0.00	0.00	156.77	156.77	156.77	156.77	156.77	156.77	156.77	156.77	156.77
11	Nutrient Analysis	0.00	0.00	0.00	137.25	0.00	76.25	137.25	0.00	0.00	137.25	76.25	70.15
12	Rodent Materials	427.00	427.00	427.00	427.00	427.00	427.00	427.00	427.00	427.00	427.00	427.00	427.00
13	Hired labours	13941.55	6650.83	6512.36	5099.60	4352.35	4356.62	5223.43	5462.55	5223.43	5223.43	5223.43	6311.06
14	Harvest wash & Dry Nuts	0.00	0.00	103.09	391.01	603.90	823.50	1509.75	1647.00	2196.00	2745.00	3156.75	3843.00
15	Shop	422.12	422.12	422.12	422.12	422.12	422.12	422.12	422.12	422.12	422.12	422.12	422.12
16	Machine Costs	8713.24	5021.52	10825.67	10586.55	10044.87	10121.73	9352.52	9970.45	9352.52	9352.52	11411.27	10684.76
17	Misc. & Overhead	5976.78	1619.55	1734.23	1640.90	1577.46	1945.90	1774.49	2297.87	1901.98	1990.43	4801.92	2827.35
18	Operating Interest	1595.15	430.05	460.55	436.15	419.07	516.67	471.53	610.00	505.08	528.87	1274.90	750.91
19	Total Variable Cost	82565.94	22297.33	23873.57	22592.57	21714.17	26789.98	24428.06	31628.50	26180.59	27399.37	37397.88	38921.05
20	Gross income - VC	-82565.94	-22297.33	-19298.76	-5208.28	5124.73	13468.37	42669.19	41568.50	71415.41	94595.63	102896.37	131871.95
	Fixed Cost												
21	Insurance	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	2994.49	3071.35
22	Properti tax	305.00	305.00	305.00	305.00	305.00	305.00	305.00	305.00	305.00	305.00	305.00	305.00
23	Total cash fixed cost	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49	3299.49
24	Total cash cost	85865.43	25596.82	27173.06	25892.06	25013.66	30089.47	27727.55	34927.99	29480.08	30698.86	40697.37	42220.54