Practical manual

SILVICULTURE
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Practical syllabus

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Date: **Course Teacher**

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Practical-1

Objective: To visit and observe the floristic composition and growth parameter in Jhansi /Lalitpur/ Shivpuri division.

Required material :-…….

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Procedure: Area is divided into different aspects (North, South, East and west). In each aspect 10 quadrates of size 10 m × 10 m for trees were laid out randomly Within each quadrate (10 m × 10 m), one sub-quadrates of size of 5 m × 5 m for shrubs and 1 m × 1 m for herbs were laid out. Density of trees was calculated by counting trees in each sample plot. Diameter of each tree in the sample plot was determined by tree calliper or tap. Density of shrubs was calculated by counted plants of different species in each sub-plot. The diameter of shrub was calculated by using digital calliper. While in case of herbaceous vegetation, each quadrate was segregated species wise and identified with the help of herbarium at IGFRE and Forestry experts, FRI Dehradun scientists, Journals and research books.

Parameters which are studied under floristic composition assessment are:

Basal Area (m^2 ha^{-1})

The cross-sectional area of shrubs and herbs falling in the recording unit was determined by the formula as below:

Basal area = $\pi d^2/4$ .....(1)

Where: d = Diameter

***Per cent frequency (% F)*:** This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage occurrence. It was studied by sampling the study area at several places at random and recorded the name of the species that occurred in each sampling units. It is calculated by the equation:

$$\text{Percent frequency (\% F)} = \frac{\text{Number of quadrates in which the species occurred}}{\text{Total number of quadrates studied}} \times 100 \text{ -----.....(2)}$$

***Density (No. ha^{-1})*:** Density is an expression of the numerical strength of a species where the total number of individuals ofeach species in all the quadrate is divided by the total number of quadrate studied. Density is calculated by the equation:

$$\text{Density (D)} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates studied}} \text{ (3)}$$

***Importance value index (IVI)*:** This index is used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative dominance are summed up together and this value is designated as the Importance Value Index (IVI) of the species (Curtis, 1959).

IVI = Relative Basal Area (RBA) + Relative Density (RD) + Relative Frequency (RF) - (4)

Relative density: Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species and can be calculated as:

$$\text{Relative density (RD)} = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100 \text{ ---------- (5)}$$

Relative frequency: The degree of dispersion of individual species in an area in relation to the number of all the species occurred.

$$\text{Relative Frequency (RF)} = \frac{\text{Number of occurrences of the species}}{\text{Number of occurrences of all species}} \times 100 \text{ ---------- (6)}$$

Relative dominance (Relative basal area): Dominance of a species is determined by the value of the basal cover. Relative dominance is the coverage value of a species with respect to the sum of coverage of the rest of the species in the area.

Relative basal area (RBA) =

Total basal area of a species/ Total basal area of all the species x 100

The total basal area was calculated from the sum of the total diameter of immerging Stems. In trees, poles and saplings, the basal area was measured at breast height (1.37m) and by using the formula πr^2, but in case of herbaceous vegetation it was measured on the ground level by using calipers.

PARAMETER WHICH ARE STUDIES UNDER DIVERSITY INDICES

Similarity (S) and dissimilarity (D) indices: Indices of similarity (S) and dissimilarity (D) were calculated by using formulae as per Mishra (1989) and Sorensen (1948).

$$\textbf{Index of Similarity (S)} = \frac{2C}{A+B} \text{ ---------- (8)}$$

Where, A = Number of species in community A
B = Number of species in community B
C = Number of common species in both the communities

$$\text{Index of Dissimilarity (D)} = 1\text{-}S \text{ ---------- (9)}$$

Species richness, diversity and dominance indices: The Species richness was calculated by using the method „Margalef"s index of richness" (Dmg) (Magurran, 1988)

$$Dmg = (S-1) / \ln N \text{ ---------- (10)}$$

Where, S = Total number of species.
N = Total number of individuals per hectare.

Species diversity and dominance were evaluated by using the following methods. Shannon"s diversity index and Simpson"s index of dominance was calculated using important value index (IVI) of the species.

Shannon-Wiener (1963) Index of diversity: The formula for calculating the Shannon-weaver Index of diversity is H

$$= -\sum pi \ln pi \text{ ---------- (11)}$$

Where, H = Shannon Index of diversity
pi = the proportion of important value of the i^{th} species

(pi = ni/N, ni is the important value index of i^{th} species and N is the important value index of all the species).

Simpson (1949) index of dominance: The equation is used to calculate Simpson"s index was

$$D = \sum (pi)^2 \text{----------(12)}$$

Where, D = Simpson index of dominance.

Pi = The proportion of important value of the i^{th} species (pi = ni/N, ni is the important value index of i^{th} species and N is the important value index of all the species).

Observation

Plant data recorded from the Field observation.

	S. No	Name of plant species	Diameter (cm)	Girth (cm)	Basal Area
Quadrate-1					
Quadrate-2					

Floristic composition of different plant species

S. No	Name of species	Total no.o plants	Total Quadrants occurrenc	BasalAre	Relative Density	Relative frequency	Relative Dominance	IVI
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

12								
13								
14								

Relevant of studies the floristic composition of species in area.

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Conclusion:

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Practical-2

Objective: To visit and enlist the tree species and their propagation method of MPTs in different nursery found in bundelkhand region.

Material Required:-

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The multipurpose tree species (MPTs) is a plant species that is purposefully grown so as to provide two or more than two products and also service function like shelter, shade, land sustainability of the land-use system. Many woody perennial species may be 'multipurpose' in one kind of system but 'single purpose' in another.

Criteria:

- Wider adaptability to local climatic conditions.
- Thin and sparse crown that allows sunlight enter into the system
- Capacity to withstand various management practices like coppicing, lopping and pollarding etc.

Propagation :

A mother plant is simply the reproduction or propagation of a plant from a source. In most cases, one of two approaches is used:

(1) **Sexual propagation**: sexual propagation involves reproducing plants from seed.

(2) **Asexual or vegetative.** Asexual or vegetative propagation involves starting a new plant from a plant's vegetative portion. vegetative propagation is more beneficial than growing seedlings. Propagation can be achieved by grafting, cuttings, coppicing or in vitro propagation. For several species propagation occurs in nature often create clonal populations that are very huge.

METHODS OF VEGETATIVE PROPAGATION

(a)The root suckers-The root produce buds from which aerial stem arise. frequently several feet from main stem.

(b) Rhizome- A rhizome is a modified stem structure in which the main axis of the plant grows horizontally just below or on the surface of the ground s. This method is often used for the propagation of bamboos.

(c) Layering- layering is the induction of root branches which are still attached to the parent trees. A new branch as such slightly wanded. girlded or ringled is brought in touch with the soil and when root are developed to branch it is detached to grow as a new plant on its own root system. Layering may be (i) Tip layering (ii) Simple layering (iii) Serpentine or compound layering and (iv) Trench layering.

(d) Cuttings- Several plant parts like Coppice shoot branch. Stem. culms. leaf can be used for the propagation through cuttings. Stem or branch cuttings is piece of stem/ branch/twig generally 10-20 cm long and 4-10 mm diameter of known genetic sources depending on the species and usually not more than 1- 10 yrs. In age and the most practiced method of propagation by cuttings. The cuttings are placed in a moist rootings culture medium to produce adventitious roots and grow as independent plants.

Observation:-

1.Forest division:-…….

2.Range : …….

3. Composition: ……

4. Area : ……

List of tree species with their propagation method

S.No	Name of species	Scientific name	Family	Method of propagation	Remark
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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24					
25					

Conclusion:

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Practical-3

Objective: To visit and assess the influence of site factors on forest composition and structure

Material Required :.....

Composition: Composition refers to the biodiversity of an ecological system, including the variety of genes, species, communities, and ecosystems. Structure refers to the physical arrangement of various physical and biological components of an ecological system. The analysis of forest composition and structure for this Final EIS will be focused primarily on the community and landscape levels.

Forest composition: It refers to all plant species found in a stand or landscape, including trees, shrubs, forbs, and grasses. It also refers to forest communities at the stand or landscape level whose canopies may be dominated by a single tree species or contain a mixture of species. Forest age is used to reflect one of the primary structural attributes of a particular landscape. It provides some measure of horizontal structure in terms of amounts and distribution of various successional stages. Additionally, individual stands can range from relatively simple to relatively complex in terms of their composition and vertical structural diversity.

They can be composed of trees of a single age or of trees with multiple age cohorts within the same stand.

Factors which influence vegetation

There are four major factors which influence the nature and growth of vegetation. These are: climate, soils, nature of the surface, *and* man. *Where the factors are favourable, plants grow well, where they are not, plant growth is slowed down.*

Climatic factors:- These include temperature, rainfall, insolation and winds.The most critical of these factors are **temperature** and **rainfall** and a proper balance must be maintained between the two for plants to grow well. An example, in cold lands, plants growth is impossible below 6°C no matter how heavy the rainfall is. That is why, in the temperate lands, plants grow well only in the summer when temperatures rise beyond this critical level, but shed their leaves and remain dormant in the winter when temperature drop below 6°C. In the cold tundra region, there is no plant life most part of the year.

In hot dry lands where the temperature is adequate all the year round for plant growth, rainfall becomes the critical factor. In these lands, where rainfall is light and below 25cm per annum, even this little amount is lost by evaporation, so deserts prevail. where it is moderate and seasonal, grasslands occur while heavy rainfall all year round gives rise to forest.

Temperature and rainfall affect not only the density of the plant cover, but also the types and abundance of plant species. Certain trees like Iroko, Obeche and Mahogany are tropical species because they tolerate high temperatures and heavy rainfall. Pines, oak and poplar, which can thrive in lower temperatures, are found in the temperate region. Also, the colder the climate, the fewer the plant species that can survive. Hotter, wetter climates have infinitely more plant species.

Winds affect vegetation too. Persistent strong winds in one direction may permanently disfigure trees and bend them in the direction may permanently disfigure the trees and bend them in the direction of the winds. In the African savannas, strong winds from diverse directions force the plants to adopt and umbrella shape and thus show a thin edge to the wind.

Sunlight also affects vegetation. As we know, plants need sunlight to grow well. That is why the leaves and branches always grow towards the source of light. We say that they are *positively heliotrophic*,

It i s for these reason that , in the tropical rainforests, some trees pierce through dense canopy of the leaves of the leaves of other trees and grow really tall in search of sunlight. It is for this reason too, that farmer cut down some trees and lob off branches of others on their farms before they plant their crops. This makes the crops get enough sunlight to grow well.

Soil factors: - Soil factors, otherwise called **edaphic facors**, are also relevant. The actual thing about rainfall that matters to plants is not the amount that has fallen, but the quantity that remains in the soil to become available to plant roots. The nature of relief and soils is therefore important to vegetation in this regard. A soil that retains water supports denser vegetation than one that does not . Also, different types of soils determine the types of plants that grow on them. Thus, oil palms grow well on the acidic soils of eastern Nigeria, while mangroves thrives on the waterlogged soild of the Niger Delta.

Topographic Factors

Factors of landforms, known as **geomorphic factors**, affect plant growth in at least three ways.

- First, where every other thing is equal, steep slopes, which have rapid run-off, have less dense vegetation than more time to sleep into the soil.
- However, since we know that highlands induce orographic precipitation, the windward side of highlands, where more rain falls, supports denser vegetation than the drier leeward side. That is why, for instance, the Adamawa Highlands in Nigeria have richer vegetation than the leeward side of Cameroun Mountains.
- Thirdly, very high mountains have an arrangement of vegetation all their own. The warmer slopes with deeper soils are normally forested. The middle slopes have shrubs and grass, while temperate ferns predominate on the cold hilltops where the soils are thin. Some mountain peaks, even in the equatorial region, like the Kilimanjaro Mountain (always) and the Cameroun Mountain (sometimes), are clad with snow.

Biotic factors

Biotic factors relate to man and his animals, and they affect vegetation too. Whereas animals graze and destroy vegetation, man can destroy as well as grow plants. He cuts down trees to give way to roads, houses, factories and other cultural features. He burns bushes for farming, and harvests timber from the forests. However, man also alters the plant cover of a place by planting more trees either as ornamental, crop plantations, farms or forest reserves

Table1. Parameters of site factors to be recorded

S.N.	Parameters	Description
	Data on environmental factors	
	A. Topographic Factors	
	i. Elevation	
	ii. Slop	
	iii. Aspect	
	B. Edaphic Factors	
	i. Soil pH	
	ii. EC	
	iii. OM	
	iv. Soil Texture	
	v. Soil moisture	
	C. Climatic Factors	
	i. Average temperature,	
	ii. Average relative humidity,	
	iii. light intensity	
	iv. Average Rainfall	
	D. Biotic factors	

	i. Population of Man and major activities	
	ii. Population of animal and major activities	

Growth parameters of vegetation to be recorded

S.No	Name of woody vegetation	Dbh(cm)	GbH	Height
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Conclusion:

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Practical-4

Objective:- To visit and observe the site quality of given forest site

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site generally refers to the totality of environmental conditions that exist at a specified location. Site is an abstract concept which combines a multitude of environmental factors affecting tree growth into a unified
classification.

Soil productivity is a measure of the capacity of a soil to grow plants. This capacity is influenced by the soil's chemical and physical properties, which include its texture, structure, organic matter content, nutrients, and acidity. Measurement of these properties directly can be time consuming and require a good deal of expertise

The environmental factors that influence growth include:

1. climatic factors, e.g. air temperature, humidity, radiant energy, precipitation, wind;
2. soil factors, e.g. physical and chemical properties, soil moisture, soil microorganisms;
3. topographic factors, e.g. slope, elevation, aspect;
4. competitive factors, e.g. other trees and lesser vegetation, animals, man.

All the above factors combine within one climatic region to create *sites*.

Site survey and classification are important in forest management for several reasons:

- Estimates of yield can often be improved if the quality of the site is known.
- Management planning can be improved when homogeneous land areas are delineated on maps. Better documentation of these areas will also reduce the potential loss of information that follows the movement or retirement of experienced field staff.
- Estimates of site can be used to identify land that is more (or less) appropriate for different uses. Hence better land use policies and practices are encouraged.

Site is a useful concept in plantation forestry where it is used to delineate areas of different productivity. The factors which have the greatest bearing on productivity in a region are used in the delineation. As these factors may vary from region to region, the variables used to define site may also vary between regions.

In the context of timber management, site quality can be defined as:
the potential of the site to produce timber given a particular species or forest type.

site quality has meaning only for the species or species composition occurring and being managed at the particular location. Of course, extremes exist which provide absolute limits for all species, e.g. latitudinal and altitudinal range limits for trees.

It is vital that forest managers measure and interpret site reliably because together with stand density, the quality of the site largely controls product size, quantity and value. Thus, it partly

determines the investment justified in managing a forest stand. With respect to afforestation policy, reliable site evaluation is of importance for three major purposes:

1. Evaluation of land for purchase.
2. Siting of species.
3. Forecasting the productivity capabilities of planted stands.

Accurate and reliable site maps are essential under intensive forest management. These maps are the basis of all yield forecasting and yield regulation, and all thinning, pruning, fertilizer application and other tending and protection strategies relate to them.

As site maps are used to determine thinning and related logging priorities, they must be made before the time of first thinning, i.e. at age approximately 9-10 years.

Site quality is not easy to assess. The factors of the site and the plants themselves are interacting and interdependent making it difficult to assign cause and effect relationships.

Much effort has been directed towards investigating environmental characteristics in an attempt to find some single environmental factor to serve as a reliable indicator of site quality. Though this approach is practical, it frequently leaves unassigned a sizable amount of the variation in site.

Site can be evaluated in two general ways:

- Measuring one or more of the site factors considered closely associated with tree growth. This approach evaluates site in terms of the environmental causal factors themselves.
- Measuring some characteristics of the trees or lesser vegetation considered sensitive to site. This approach assesses site from the effects of the environment on the vegetation.

Table1. Parameters of site factors to be recorded

S.N.	Parameters	Description
	Data on environmental factors	
	E. Topographic Factors	
	iv. Elevation	
	v. Slop	
	vi. Aspect	
	F. Edaphic factors	
	vi. Soil pH	
	vii. EC	
	viii. OM	
	ix. Soil Texture	
	x. Soil moisture	
	G. Climatic Factors	
	v. Average temperature,	
	vi. Average relative humidity,	
	vii. light intensity	
	viii. Average Rainfall	
	H. Biotic factors	
	iii. Population of Man and major activities	
	iv. Population of animal and major activities	

Growth parameters of vegetation to be recorded

S.No	Name of woody vegetation	Dbh(cm)	GbH	Height
1				
2				
3				
4				
5				
6				
7				
8				
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10				

Conclusion:

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Practical-5

Objective : To enlist and Classify the Indian forest in to Sixteen types of forest with species composition

Classification of Natural Vegetation of India is primarily based on spatial and annual variations in rainfall. Temperature, soil and topography are also considered.

India"s vegetation can be divided into 5 main types and 16 sub-types as given below.

Classification of forest

A. Moist Tropical Forests	B. Dry Tropical Forests	C Montane Sub-Tropical Forests:	D. Montane Temperate Forests	E. Alpine Forests
1. Tropical Wet Evergreen	1. Tropical Dry Evergreen	1. Sub-tropical Broad-leaved Hill Forests:	1. Montane Wet Temperate	1. Sub-Alpine
2. Tropical Semi-Evergreen	2. Tropical Dry Deciduous	2. Sub-tropical Moist Pine Forests	2. Himalayan Moist Temperate	2. Moist Alpine scrub
3. Tropical Moist Deciduous	3. Tropical Thorn	3. Sub-tropical Dry Evergreen Forests:	3. Himalayan Dry Temperate	3. Dry Alpine scrub
4. Littoral and Swamp				

A. Moist Tropical Forests:

1. Tropical Wet Evergreen Forests or Rain Forests: Climatic Conditions: Annual rainfall exceeds 250 cm The annual temperature is about 25°-27°C The average annual humidity exceeds 77 per cent and The dry season is distinctly short. Characteristics: Evergreen: Due to high heat and high humidity, the trees of these forests do not shed their leaves together. Lofty: The trees often reach 45 – 60 metres in height

Thick Canopy: From the air, the tropical rain forest appears like a thick canopy of foliage, broken only where it is crossed by large rivers or cleared for cultivation. All plants struggle upwards (most ephiphytes) for sunlight resulting in a peculiar layer arrangement. The entire morphology looks like a green carpet when viewed from above. EpiphytesLess undergrowth: The sun light cannot reach the ground due to thick canopy. The undergrowth is formed mainly of bamboos, ferns, climbers, orchids, etc.

Distribution:

- Western side of the Western Ghats (500 to 1370 metres above sea level).
- Some regions in the Purvanchal hills.
- In the Andaman and Nicobar Islands.

Timber:

Hardwood: The timber of these forests is fine-grained, hard and durable.

It has high commercial value but it is highly challenging to exploit due to dense undergrowth, absence of pure stands and lack of transport facilities

Plant Species: The important species of these forests are mahogany, mesua, white cedar, jamun, canes, bamboo etc.

2. Tropical Semi-Evergreen Forests: They are transitional forests between tropical wet evergreen forests and tropical deciduous forests. They are comparatively drier areas compared to tropical wet evergreen forests.

Climatic Conditions:

Annual rainfall is 200-250 cm Mean annual temperature varies from 24°C to 27°C The relative humidity is about 75 per cent

The dry season is not short like in tropical evergreen forests.

Distribution: Western coast, Assam, Lower slopes of the Eastern Himalayas, Odisha and Andamans.

Characteristics

The semi-evergreen forests are less dense.

They are more gregarious [living in flocks or colonies – more pure stands] than the wet evergreen forests.

These forests are characterized by many species. Trees usually have buttressed trunks with abundant epiphytes. Buttressed Trunks.

Important species: laurel, rosewood, mesua, thorny bamboo – Western Ghats, white cedar, Indian chestnut, champa, mango, etc. – Himalayan region

Timber: Hardwood: Similar to that in tropical evergreen forests except that these forests are less dense with more pure stands(timber industry here is better than in evergreen forests).

3 Tropical Moist Deciduous Forests:

Climatic Conditions:

1. Annual rainfall 100 to 200 cm.
2. Mean annual temperature of about 27°C 3. The average annual relative humidity of 60 to 75 per cent.
4. Spring (between winter and summer) and summer are dry.

Characteristics;

1. The trees drop their leaves during the spring and early summer when sufficient moisture is not available.
2. The general appearance is bare in extreme summers (April-May).
3. Tropical moist deciduous forests present irregular top storey [25 to 60 m].
4. Heavily buttressed trees and fairly complete undergrowth.
5. These forests occupy a much larger area than the evergreen forests but large tracts under these forests have been cleared for cultivation.

Distribution: Belt running along the Western Ghats surrounding the belt of evergreen forests

.• A strip along the Shiwalik range including terai and bhabar from 77° E to 88°• E.,Manipur and Mizoram., Hills of eastern Madhya Pradesh and Chhattisgarh., Chota Nagpur Plateau. Most of Odisha. Parts of West Bengal and Andaman and Nicobar islands.

Timber: These provide valuable timer like Teak

.• The main species found in these forests are teak, sal, laurel, rosewood, amla, jamun, bamboo, etc.

It is comparatively easy to exploit these forests due to their high degree of gregariousness (more pure stands).

4 Littoral and Swamp Forests:

- They can survive and grow both in fresh as well as brackish water (The mixture of seawater and fresh water in estuaries is called brackish water and its salinity can range from 0.5 to 35 ppt).
- Occur in and around the deltas, estuaries and creeks prone to tidal influences (delta• or tidal forests).
- Littoral (relating to or on the shore of the sea or a lake) forests occur at several places• along the coast. Swamp forests are confined to the deltas of the Ganga, the Mahanadi, the Godavari, the Krishna and the Cauvery.
- Dense mangroves occur all along the coastline in sheltered estuaries, tidal creeks, backwaters, salt marshes and mudflats. It provides useful fuel wood.
- The most pronounced and the densest is the Sunderban in the Ganga delta where the predominant species is Sundri (Heriteera).

Timber:

- It provides hard and durable timber which is used for construction, building purposes and making boats.

- The important species found in these forests are Sundri, agar, rhizophora, screw pines, canes and palms, etc.

B Dry Tropical Forests:

1. Tropical Dry Evergreen Forests:

Distribution: Along the coasts of Tamil Nadu.

- **Climatic Conditions:**

- Annual rainfall of 100 cm [mostly from the north-east monsoon winds in October - December].
- Mean annual temperature is about 28°C.
- The mean humidity is about 75 per cent.
- The growth of evergreen forests in areas of such low rainfall is a bit strange.

Characteristics:

- Short statured trees, up to 12 m high, with complete canopy.
- Bamboos and grasses not conspicuous.
- The important species are jamun, tamarind, neem, etc.
- Most of the land under these forests has been cleared for agriculture or casuarinas plantations.
- Distribution:
- Casuarina is the most popular farm forestry in the states of Andhra Pradesh, Tamil Nadu, West Bengal, Odisha, Maharashtra, Gujarat, and Karnataka.

Benefits:

- Reduces damage in the event of natural calamities.
- Line planting in the coastal areas helps in controlling the wind force.
- It is also used for tourism promotion in view of its ornamental appearance.
- It provides top quality firewood.
- The wood is suitable for paper pulp and useful raw material for the manufacture of paper for writing, printing, and wrapping.
- It is got some serious medicinal values as well.

Wasteland development: The characteristics which make it a suitable species for wasteland development include adaptability to wide range of habitats, fast growth, salt tolerant, drought resistant, ability to reclaim land and stabilize sand dunes. Intercrops such as groundnut, cucumber, watermelons, sesamum, and pulses can also be raised along with the plantation.

2 Tropical Dry Deciduous Forests:

Climatic Conditions: - Annual rainfall is 100-150 cm.

Characteristics: -These are similar to moist deciduous forests and shed their leaves in dry season. The major difference is that they can grow in areas of comparatively less rainfall.

They represent a transitional type – moist deciduous on the wetter side and thorn forests on the drier side. They have closed but uneven canopy.The forests are composed of a mixture of a few species of deciduous trees rising up to a height of 20 metres.

Undergrowth: Enough light reaches the ground to permit the growth of grass and climbers.

Distribution: They occur in an irregular wide strip running from the foot of the Himalayas to Kanniya kumari except in Rajasthan, Western Ghats and West Bengal.

The important species are teak, axlewood, rosewood, common bamboo, red sanders, laurel, satinwood, etc. Large tracts of this forest have been cleared for agricultural purposes. These forests have suffer from over grazing, fire, etc.

3 Tropical Thorn Forests:

Climatic Conditions:

- Annual rainfall less than 75 cm.
- Humidity is less than 50 per cent.
- Mean temperature is 25°-30°C.

Characteristics:

- The trees are low (6 to 10 metres maximum) and widely scattered.
- Acacias and Euphorbias are very prominent.• The Indian wild date is common. Some grasses also grow in the rainy season.

Distribution:

- Rajasthan, south-western Punjab, western Haryana, Kachchh and neighbouring parts of Saurashtra.
- Here they degenerate into desert type in the Thar desert.
- Such forests also grow on the leeside of the Western Ghats covering large areas of Maharashtra, Karnataka, Telangana, Andhra Pradesh and Tamil Nadu.
- The important species are neem, babul, cactii, etc.

C Montane Sub-Tropical Forests:

1. Sub-tropical Broad-leaved Hill Forests:

Climatic conditions: Mean annual rainfall is 75 cm to 125 cm.

- Average annual temperature is 18°-21°C.
- Humidity is 80 per cent.

Distribution: Eastern Himalayas to the east of 88°E longitude at altitudes varying from 1000 to 2000 m.

Characteristics:

- Forests of evergreen species.
- Commonly found species are evergreen oaks, chestnuts, ash, beech, sals and pines. Climbers and epiphytes [a plant that grows non-parasitically on a tree or other plant] are common.
- These forests are not so distinct in the southern parts of the country.
- They occur only• in the Nilgiri and Palni hills at 1070-1525 metres above sea level.
- It is a "stunted rain-forest" and is not so luxuriant as the true tropical evergreen.
- The higher parts of the Western Ghats such as Mahabaleshwar, the summits of the Satpura and the Maikal Range, highlands of Bastar and Mt. Abu in the Aravali Range carry sub-types of these forests.

2 **Sub-tropical Moist Pine Forests:**

Distribution;

- Western Himalayas between 73°E and 88°E longitudes at elevations between 1000 to 2000 metres above sea level.
- Some hilly regions of Arunachal Pradesh, Manipur, Naga Hills and Khasi Hills. Timber: Chir or Chil is the most dominant tree which forms pure stands. It provides valuable timber for furniture, boxes and buildings. It is also used for producing resin and turpentine.

3 **Sub-tropical Dry Evergreen Forests**:

Distribution: Found in the Bhabar, the Shiwaliks and the western Himalayas up to about 1000 metres above sea level.

Climatic Conditions:

- Annual rainfall is 50-100 cm (15 to 25 cm in December-March).
- The summers are sufficiently hot and winters are very cold.

Characteristics:

Low scrub forest with small evergreen stunted trees and shrubs.

Olive, acacia modesta and pistacia are the most predominant species.

D Montane Temperate Forests:

1. **Montane Wet Temperate Forests:**

Climatic Conditions:

- Grows at a height of 1800 to 3000 m above sea level
- Mean annual rainfall is 150 cm to 300 cm.
- Mean annual temperature is about 11°C to 14°C and the Average relative humidity is over 80 per cent.

Distribution: Higher hills of Tamil Nadu and Kerala, in the Eastern Himalayan region. **Characteristics:**

These are closed evergreen forests. Trunks have large girth.
Branches are clothed with mosses, ferns and other epiphytes.
The trees rarely achieve a height of more than 6 metres.
Deodar, Chilauni, Indian chestnut, birch, plum, machilus, cinnamomum, litsea, magnolia, blue pine, oak, hemlock, etc. are important species.

2 **Himalayan Moist Temperate Forests**:

Climatic Conditions:

Annual rainfall varies from 150 cm to 250 cm.

Distribution: Occurs in the temperate zone of the Himalayas between 1500 and 3300 metres.

Cover the entire length of this mountain range in Kashmir, Himachal Pradesh, Uttarakhand, Darjeeling and Sikkim.

Characteristics:

- Mainly composed of coniferous species.
- Species occur in mostly pure strands
- Trees are 30 to 50 m high.
- Pines, cedars, silver firs, spruce, etc. are most important trees
- They form high but fairly open forest with shrubby undergrowth including oaks, rhododendrons and some bamboos.

Timber: It provides fine wood which is of much use for construction, timber and railway sleepers.

3 Himalayan Dry Temperate Forests:

Climatic Conditions: Precipitation is below 100 cm and is mostly in the form of snow.

Characteristics: Coniferous forests with xerophytic shrubs in which deodar, oak, ash, olive, etc are the• main trees.

Distribution: Such forests are found in the inner dry ranges of the Himalayas where south-west monsoon is very feeble. Such areas are in Ladakh, Lahul, Chamba, Kinnaur, Garhwal and Sikkim.

E. Alpine Forests: Altitudes ranging between 2,900 to 3,500.

These forests can be divided into:

(1) sub-alpine;
(2) moist alpine scrub and
(3) dry alpine scrub.

1. Sub-alpine:

The sub-alpine forests occur lower alpine scrub and grasslands.

It is a mixture of coniferous and broad-leaved trees in which the coniferous trees attain a height of about 30 m while the broad leaved trees reach only 10 m. Fir, spruce, rhododendron, etc. are important species.

2. Moist alpine scrub : The moist alpine scrub is a low evergreen dense growth of rhododendron, birch etc.which occurs from 3,000 metres and extends up to snowline.

3**. Dry Alpine Scrub:** The dry alpine scrub is the uppermost limit of scrub xerophytic, dwarf shrubs, over 3,500 metres above sea level and found in dry zone. Juniper, honeysuckle, artemesia etc. are important species.

Observation

1.Forest division:-…….

2.Range : …….

3. Composition: ……

4.Area : ……

Parameter to be recorded

S.N	Name of Site	Major forest type	Sub forest type	Name of tree species	Character of vegetation	Climate	Distribution	Soil condition	Topography
1.						1. Mean temperature :- 2. Rainfall :…. 3. Humidity 4. Atmospheric pressure : 5. Wind speed		Soil colour:- Soil type Texture:	
2						1. Mean temperature :- 2. Rainfall :…. 3. Humidity 4. Atmospheric pressure : 5. Wind speed		Soil colour:- Soil type Texture:	

Conclusion:

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Practical:-6

Objective: To observe the composition of different forest, found inJhansi forest division.

FOREST COMPOSITION

It refers to all plant species found in a stand or landscape, including trees, shrubs, forbs, and grasses. It also refers to forest communities at the stand or landscape level whose canopies may be dominated by a single tree species or contain a mixture of species.

Objective: the main objective of study forest composition is to study the effect of anthropogenic activity on the composition of forest of that area.

Classification of forest base on composition: On the basis of the number of species present, the forest is classified into–

1. Pure forest: Pure forest is defined as a forest composed of almost entirely of one species, usually to the extent of not less than 80%. It is called pure crop or stand.

2. Mixed forest: Mixed forest is defined as a forest composed of trees of two or more species intermingled in the same canopy; in practice, and by convention, at least 20% of the canopy must consist of species other than principal one. the species composing the mixture may be distinguished as principal, accessory and auxiliary.

a) **Principal species:** the species first in importance in a mixed stand either by frequency, volume or silviculture value.

b) **Accessory species:** a useful species of less value than the principal species, which assists in the growth of the latter and influences to a smaller degree the method of treatment.

c) **Auxiliary species:** a species of inferior quality or size, of relatively little silvicultural value or importance, associated with the principal species.

Observation:

1. **Forest Division :**.....
2. **Range:** .....
3. **Composition of forest (Pure/Mixed):**.....
4. **Area (ha):** .....
5. **Forest composition brief**

Location	Forest type	Over storey			Under storey			
		Principal species	Accessory species	Auxiliary species	Shrubs	Herbs	Grass	climber

6. Management strategies used by the Forest Department.

Conclusion:

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Practical-7

Objective: To study about the different habits of plant on forest floor.

Plants may be classified into the following three categories based on habits.

1. **Herb-** It is a plant whose stem is always green and tender and i ts height is usually below one metre. According to the span of life, herb is called annual herb, biennial herb andperennialherb.
2. **Shrub-** It is a woody perennial plant, having persistent and woody stem and less definitely from a tree in its low stature and its habit of branching from the base. Generally, many shrub species attain height of about 1- 6 m.
3. **Tree-** It is a large woody perennial plant having a single well- defined stem (bole or trunk) and a more or less definite crown. Usually tree attains more than 6 metre in height, depends up on species and growing habits. Trees height is more in evergreen forest than deciduous forest.

Materials required: 1. Measurement tape/ wooden scale, 2. Field note book

Methodology/ Procedure :.....

.....

.....

Observation Table:

S. No.	**Habit**	**Common name**	**Scientific name**	**Height (m)**
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Conclusion: .....

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Practical: 8

Objective: **To study different developmental stages of tree growth and itsstructure**.

Tree growth starts from the seed germination stage till maturation until the death of the tree. Growth may be horizontal and vertical. Diameter growth is considered as horizontal growth and height growth is considered as vertical growth. Height growth is fast at the early stage of plan t growth from seedling to pole and later the height growth will almost stagnate at the mid age. However, rapid diameter growth starts from pole stage, especially after stagnating height growth. Further, growth of trees depends upon several environmental factors like site, climate, topography, physical and chemical properties of soil, species competition, space, *etc.* These factors not only affect the growth but also the tree structure like crown, bole, root, *etc.,*

The first stage of tree's recognized as small seedling which grows by increase in length and diameter of its shoot and root. As the shoot grows upwards, its developments develop branches and foliage. The root grows downward and develops lateral roots and its branches. Thus, the seedling grows not only by increase in size of its shoots and roots. Therefore, increase in size is commonly referred to as growth or increment and formation of new organs is referred to as development.

There are broadly four growth stages identified through which a plant passes to attain a mature tree stage. These are as follows:

i) Seedling
ii) Sapling
iii) Pole
iv) Tree

Seedling stage: It is the first stage after germination till it reached a height of one meter. There are mainly three parts identified at this stage which are: - the embryonic root - the embryonic shoot, and - the cotyledons (seed leaves) Once the photosynthesis starts in seedlings, it stops taking energy from stored food reserve in seeds. The apical meristems start growing and give rise to the root and shoot. The first true leaves expand and can often be distinguished from the round cotyledons however; shape may vary from species to species. While the plant is growing and developing additional leaves, the cotyledons eventually grow old and fall off. The seedling grows and begins to develop woody characteristics. The stems harden, change color, and develop a thin protective bark. The stem may bend or develop branches that reach toward light. Seedlings compete for nutrients, water sunlight, and space. At this stage the tree is susceptible to many threats that include fire, flood, drought, disease, insect attacks, and animals.

Saplings stage: Sapling is defined as a young tree from the time when it reaches about one meter (3 feet) in height till the lower branches begin to fall. A sapling is characterized by the absence of dead bark and its vigorous height growth. As the tree starts to get taller, the main trunk thickens and lateral branches arise. A sapling has all the characteristics of a fully grown tree, however, lacks only in size and reproductive abilities. A sapling is characterized by the absence of dead bark and vigorous height growth.

1. **3) Pole stage:** It is defined as a young tree from the time when the lower branches begin to fall off to the time when the rate of height growth begins to slow down and crown expansion becomes marked. Appearance of Reproductive stage. It is a stage between sapling and tree stage when lower branches start to fall off and crown expansion is conspicuous. Generally, poles are greater than four inches but less than eight inches in diameter. Depending on the species, trees in the pole stage could be as tall as 30 feet.

4**) Tree stage:** It is the stage of growth beyond the pole stage when the rate of height growth begins to slow down and crown expansion becomes marked.

It is the final stage of a plant individual when height growth gets slow down but expansion of the crown becomes more prominent. Tree is the stage of growth beyond the pole stage. With favourable conditions, a sapling or pole will grow into a mature tree (>8 inches DBH). During this stage, each tree will grow as much as its species and site conditions will permit. In addition, flowers develop, reproduction ensues, fruits form, and seed dispersal can occur. Trees provide the maximum environmental benefits to people during this stage. At this stage, the crown gets a prominent shape. The crown is defined as, "the upper branchy part of a tree above the bole (L S Khanna 1999 Principles and Practice of Silviculture)". It contains live branches and foliage. Crown shape has importance in silviculture because it indicates the amount of growing space that is needed to maximize timber production. Further, it also controls light to ground surface and accordingly microclimate is defined inside the forest.

Adult tree features: Single stem, bark cover over stem, taproot spread through few primary roots, some secondary roots and many tertiary/ minute roots or root hairs, well developed crown through main branches on the principal stem, each branch conta ining leaves, flowers and fruits/pods, seeds. Following picture is describing the tree structure.

.**Materials required** ……

Procedure: Visit to forestry experimental/demonstration area and record different developmental stages of trees like seedling, saplings, poles and tree in different species.

Observation Table

S. No	Tree stage	Name of species	S. No	Reproductive stage	Name of species
1	Seedling	1. 2. 3 4. 5.	1	Flower bud	1. 2. 3 4. 5.
2	Sapling	1. 2. 3 4. 5.	2	Flowering/Blooming	1. 2. 3 4. 5.
3	Pole	1. 2. 3 4. 5.	3	Fruit setting	1. 2. 3 4. 5.
4	Tree (Adult)	1. 2. 3 4. 5.	4	Immature fruiting	1. 2. 3 4. 5.
5			5	Mature fruiting	1. 2. 3 4. 5.

Conclusion:

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Practical: 9

Objective: To study different planting methods (techniques)/ entire.

Material used: .....

PLANTING TECHNIQUES:- **Planting is also restored to for filling up felled patches of previous year plantation or some old natural regeneration area.Planting is generally done with the seedling raised in nursery.**

Methods of planting- **Entire planting is the method of planting, in which entire plant is lifted from nursery and planted out in the field**

Entire planting with naked root-

i) **The pit should have the sufficient in size.**
ii) **The Pit contains the entire root system without doubling the tap root.**
iii) **The plant should be held in vertical position by collar in the center of pit.**
iv) **The collar should be kept about 10 cm above the general ground level so that when the soil pressed or it subsides due to rain water, it does not below the ground level.**
v) **The soil should be pushed from the sides, keeping the lateral roots in their natural position.**
vi) **The plant should be covered upto collar keeping the soil sloping all direction.**
vii) **The test of good planting is that the plant cannot be pulled out easily.**

Planting seedling raised in nursery with ball of earth

I. **The pit should be big enough to contain the ball of plant.**
II. **When planting, the grass or banana leaf wrapping should remove and the plant put in the pit to see if the depth of pit is not too big.**
III. **If pit is big, the plant should be taken out and the pit filled with dug up earth to a point, so that the plant in it, will be about 5 cm above the ground level.**
IV. **After filling the earth, it should be pressed well with hands. Then the ball with plant should be placed vertically in thecentre of pit.**
V. **When fill is completed up to edge of the ball, the soil filled should be sloped outside.**
VI. **It should than the pressed thoroughly by feet with damaging the ball of earth.**

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Observation: ……

1. Name and location of the plantation area: ……

2. Date:……..……..

3. Area (ha):……..……..

4. Field work:

S. No	Plant species		Entire planting		Pitsize	Spacing	
	Common name	Scientific name	Root length	Shoot length		Row to row	Plant to plant
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

5. **Advantage of entire plantation**: ……..……

……..……

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6. **Conclusion**: ……..……

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Practical: 10

Objective- To execute the field preparation by marking, alignment and stacking in planting site.

Material Required: .....

FIELD PREPARATION

I. Field preparation for a plantation includes clearance for planting and it involves, bush cutting, soil and moisture conservation works in 'nalas', construction of vegetative or stone check dams, marking of pits for planting of saplings etc.

II. In addition, demarcation of boundary wall or fencing and inspection paths should be made to facilitate the movement of people engaged in plantation works.

III. This work should be completed by the end of November.

IV. *Lantana, Eupatorium* and other invading weeds and shrubs should be uprooted.

V. On developing the site for planting, care should be taken to retain all indigenous species of trees and shrubs that are naturally growing in the area. They should not be cut and burnt along with weeds and thorny species.

VI. The planting design, location of plantation and size of plot is to be verified with review of Maps and aerial photo.

Marking & Digging of Pits

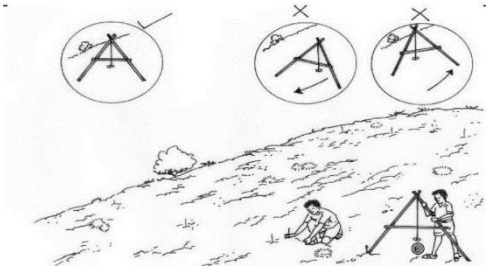
I. After clearing the land sites for digging of pits, plantation should be marked on ground using a measuring tape to ensure the desired spacing.

II. Wooden pegs or bamboo sticks shall be placed at the spot just at the centre of the pit.

III. Pits of the size 30 cm × 30 cm and 30 cm depth should be dug.

IV. Pits should be deep enough to ensure that the roots of the plants do not curl up once the planting material is placed in it.

V. The soil dug from the pits should be dumped close to the pit. While digging stones, roots of trees, grass or shrubs, if any, should be removed so that while filling the dug-up earth back in the pits these are not mixed with the soil.



VI. The spacing of pits varies according to the planting scheme for different areas.

VII. Generally, the spacing between pit to pit, distances between lines is around 2.5mtr x 2.5mtr along the contour line.

VIII. It may not be possible to follow this spacing strictly due to presence of boulders or trees.

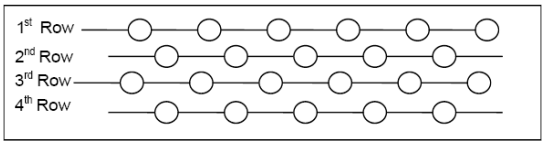
IX. No pit should be dug within the vicinity of five meters from a tree.

X. It is better for complete the pitting works within end of March for better weathering of soil. The spacing between the pits should however, not be less than 2.5mtr x 2.5mtr.

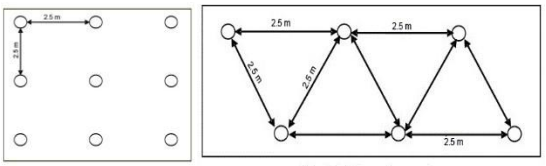
XI. The size of pits may vary for urban plantation, Bald hill plantation, Avenue plantation, and Bamboo plantation.

XII. Pits should always be dug along the contour lines.

Procedure of making the contour lines: Adjust 'A' frame on the slope to bring plumb line/string to the centre of the A -frame (Point E). Mark spot on the slope. These spots will form a contour line. Distance between contour Hedgerows should be approximately 4 m - 6 m.



Alignment of pits in areas with undulating topography: The pits in the second line should be dug in such a way that they fall between the pits dug in the first line as shown i.e., staggered. The triangular planting method, which is specially practiced in the hills, checks the flow of rain water and facilitates its percolation in the ground.



Field Exercise:

1. Name and location of visiting site:.....

2. Date of visit: .....

3. Purpose of visit:.....

4. Area (ha):.....

5. Field work:

S. No.	Tree species		Spacing		Pattern of planting	Other informatio
	Common name	Scientific name	Row to row	Plant to plant		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Management strategies used by respective authority: ……

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Conclusion: ……

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Practical: 11

Objective: To study singling procedure for improve tree form and also accelerate linear and straight growth of selected stem.

Material used - Sharp cutting tools.

SINGLING

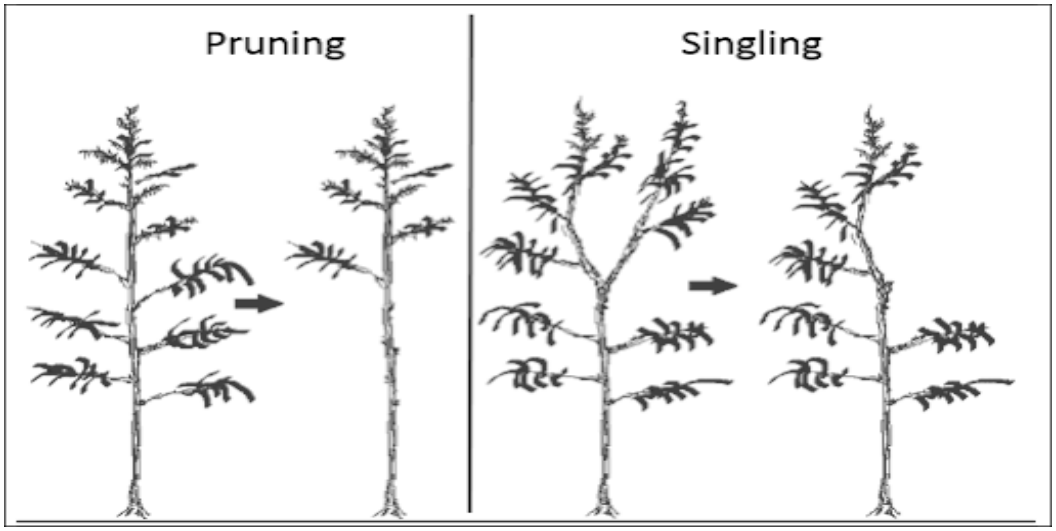
Singling is a tending operation performed in the early stages of the life of a tree when it is 2-4 m tall. Where forked or multiple stems are reduced to a single stem to improve tree form and to accelerate linear and straight growth. It is applied in coppice system.

Objective of singling:

i. To improve the quality and growth of the remaining uncut stem,
ii. To reduce stocking density,
iii. To produce some fuel wood from cut stems.

Procedures of Singling:

i. When several stems are produced – single them by selecting the strongest and/or straightest,
ii. Singling should be done gradually to minimize the stress to the remaining stems,
iii. With coppice regrowth e.g. after harvesting broadleaved trees, multiple new shoots are frequently produced from the cut stump. Select 1 or 2 of these and remove the others,
iv. After being damaged e.g. by snow, wind, frostor grazing, some young trees may develop a forked stem. Singling is used to select the beststem and remove the other.
v. In degraded forests forked or multiple-stemmed trees have often been left after the better treeshave been harvested,
vi. Singling is an opportunity to improve the growing stock as well as producing some fuel wood and poles.



Field Exercise:

1. **Name and location of Singling site:**.....
2. **Date of Singling:**.....
3. **Purpose of Singling:**.....
4. **Area (ha):**.....
5. **Field work:**

S. No	Species		Spacing for		Pattern of planting
	Common name	Scientific name	Row to row	Plant to plant	

6. **Management strategies used by respective authority:** .....

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7. Conclusion: .....

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Practical: 12

Objective:- To exercise and give the suitable comments on weeding and cleaning practice in Nursery and planting site

In all regeneration areas, whether natural or artificial, the individuals of the unwanted species appear much earlier than those of the desired species. Any unwanted plant that interferes with the growth of the individual of favored species' is called a weed. Therefore, removal of weeds, interfering or likely to interfere with the seedlings of the favoured species. Regardless of whether they are woody or herbaceous, whether their crowns are above, at the same level or below those of the seedlings of the desired species, are called weeding. Weeding must be done before

I. Weeds have started the suppressing the desire seedling.
II. The seedling has stopped growing.

Season of weeding- weeding's are done in plantations during the rains and stopped by the end of September. But, in nurseries, where the object is to produce plants of proper size in the shortest possible time. weeding's are done even in spring and as often as necessary thereafter.

Number of weeding- The number of weeding to be done in a particular year depends upon the intensity of weed growth and the rate of growth of seedlings of the favoured species. Even in other plantations, three weeding are usually done in the first year, two in the second year and one in the third years, though with fast-growing species, one or two weeding is adequate.

Duration of weeding- The duration i.e., the number of years for which weeding should be done also varies with species,the rate of growth, intensity of weeds and the local conditions.

Generally, weeding is carried out for 3 years though fast-growing species may require weedings for one or two per years only.

Methods of weeding: There are three common methods are

Manual weeding -It is by far the commonest method. It includes cut away the competing vegetation. The operation is usually more effective if some hoeing involving turning over the soil rather than scrapping off the weeds is also carried out. Manual weeding needs little skill and supervision and can be carried out on all sites in almost all the weather conditions with all species. Manual weeding as noted above is restricted to line or spot weeding patterns.

Mechanical weeding: In mechanical weeding, a machine operates between the rows of trees and cultivates the ground by harrowing or shallow ploughing and outs/turns down the weed growth. The machine is pulled by a tractor, so it is workable only when the spacing of rows is at least 3 m. Weeds in the rows get missed which can be eliminated by supplementing hand weeding close to the plants. This method is quite effective in hot, dry weather with dry soils as in moist soils, or when it rains soon after the operation. the roots may quickly re- establish. Such cultivation may also increase the rainfall percolation and reduce evaporation from the soil, which is of considerable significance areas with a marked dry season.

Chemical weed control: Herbicides have been extensively used in conifer plantations since chemicals which kill grasses and herbs are unlikely to damage coniferous trees. Only pesticides which are bio-degradable and can be broken down easily in the environment. (Organophosphates and carbamates) should be used. Foliar sprays of brush killer (2. 4, 5 -T and 2, 4 -D) has been observed to be effective in controlling Lamana weed in Pine plantations.

Biological weed control: Biological control is still another method in which diseased organism or insect is used which is harmless to the desired plants but kills weed.

Use of parasitic plants. A moth borer (*Cactoblastis cactorum*) from Argentina was found which attacked only cactus and no other plants. In India. Biological control of exotic weeds *of Lantana, Mikania micrantha and Eupatorium* spp. have been attempted to be introducing exotic insects.

CLEANING

Cleaning is an important tending operation which carried out in the sapling crop, involving the removal or topping of inferior growth including individuals of the favoured species and climbers etc. when they are interfering with the better grown individuals of the favoured species. Cleanings are normally carried out throughout the sapling stage of the favoured species in order to help them to develop into straight and well-grown poles. Cleaning is done keeping in view the site, species and the locality factors. In dry areas only partial cleaning should be carried out. Fast-growing species over top other species and do not need many cleanings. Cleanings may also to be modified according to the light requirements of the crop.

Season of cleaning-

i. Growth period of the flavored species.
ii. Cleanings should be done during the rains but where this is not possible, they may be done during summers and winters.

Frequency's- Frequency of cleanings depends upon the density of shrubs and their rate of growth after cutting. If the shrubs are dense and grow faster, cleanings are done every year; otherwise, they are done at an interval of some years.

Method of Cleanings: Cleaning may be done either selectively round the stems forming the future crop, in which case they are called selective cleaning, or over the whole area depending upon the silvicultural requirement of the species and cost considerations. The following operations are usually done in cleaning:

- Cutting back of shrubs and rank herbaceous growth interfering with the growth of saplings of the desired species as well as itsvaluable associates;
- Cutting back of the individuals of inferior species when interfering with the growth of better Species;
- Cutting back of the malformed or diseased individuals of the desired species.

Field exercise.(Weeding)

1. Name of the field:... .....

2. Date:.....

3. Field work:

S. No	Weed		Family	Season of weeding	Number of weed	Any other information
	Common name	Scientific name				
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Why weeding is important in forest nursery .....

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Conclusion:.....

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Field Exercise: (Cleaning)

1. Name and location of Cleaning site:.....

2. Date of Cleaning:.....

3. Purpose of Cleaning :.....

4. Area (ha) : .....

5. Field work:

Sr n	species		Spacing for		Pattern of planting	Dominant weed at planting site	Cleaning method	Comments
	Common name	Scientific name	Row to row	Plant to plant				

Management strategies used by respective authority: .....

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Conclusion:.....

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Practical -13

Objective: - To visit and study about the different stage of hydrosere in Bundelkhand region

HYDROSERE

Hydrosere originating in a pond starts with the colonization of some phytoplankton which is pioneer plant community, and finally terminates into forest, which is a climax community together with component of vegetation.

Phytoplankton stage.

I. They constitute the pioneer community.
II. Blue green algae, diatoms and bacteria etc are the first organisms to colonise the primitive medium of the pond
III. The soil is very much reduced with a pH value of not more than 5.00.

IV. They grow multiple and grow for some time.

Rooted submerged stage:

I. As the result of death and decomposition of phytoplankton and their mixing with the silt, brought from surrounding land by rain water and by wave action of pond water.
II. There is develop a soft mud at the bottom of the pond.
III. This new habitat which tends to be a bit shallower and where light penetration may be now occur easily becomes now easily become now suitable for growth of the root submerged hydrophytes example- Hydrilla Myriophyllum, and Elodea.
IV. These plants bring about further build-up of the substratum as a result of their death and decay.
V. When the water level, decrease making the pond shallower.
VI. This new habitat is replacing these plants way to another type of plants which are floating leave type.

Rooted floating stage:

I. Water depth is almost 2- 5 feet.
II. These plants colonise the habitat with rhizomes.
III. They all are rooted hydrophytes with their large leave floating on water surface
IV. Example Nelumbo, Aponogeton, Trapa and Monochora.
V. Free floating species as Azolla, Lemma wolffia, Pistia and spirodella are also become associated with rooted plants due availability of salt and other minerals in abundance.
VI. Due the shallowness of pond, the decomposition of organic matter formed due to death of these plants bring about further build thesubstratum.

Thus, floating species sooner or later disappear from the area.

Reed- swamp stage

I. In this stage, plant community are rooted but most parts of their shoots remain exposed to air e.g., Typha, Scirpus and phragmites.
II. They have developed the rhizome and form a dense vegetation.
III. The water level is by now very much reduced and finally becomes unsuitable for the growth of amphibious.

Sedge-meadow stage:

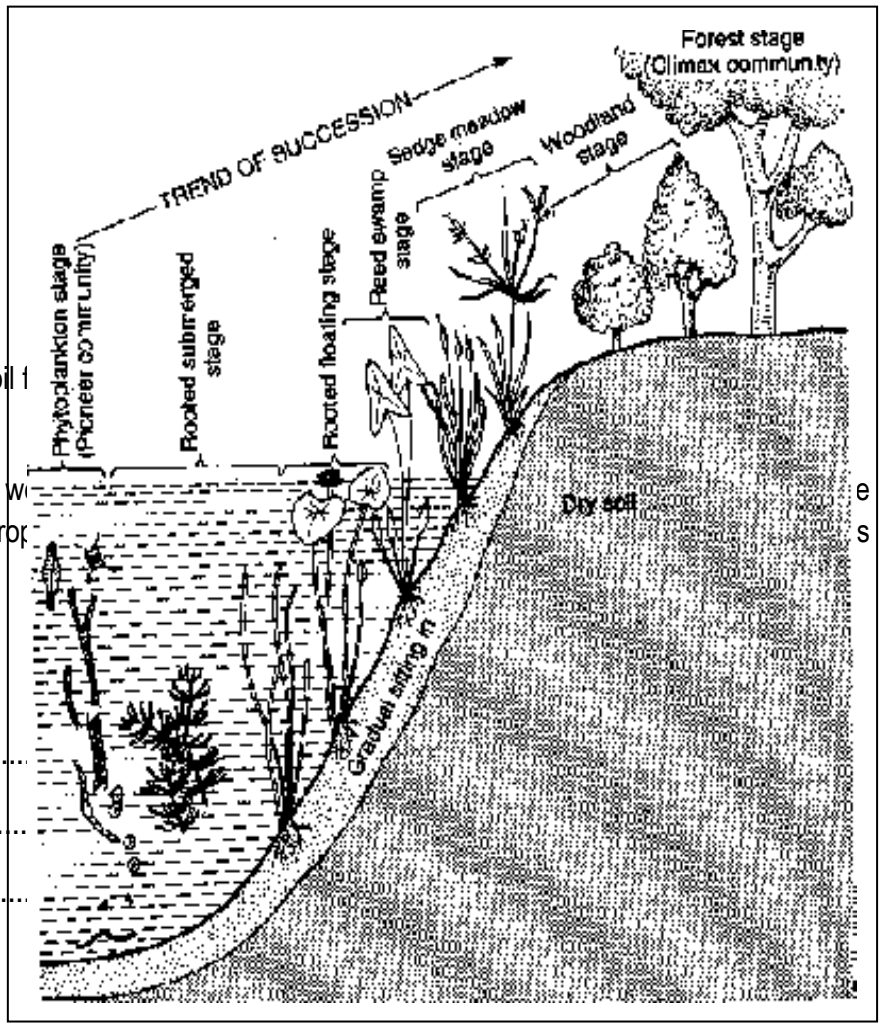
I. Due to successive decrease in water level and further change in substratum, the species like Carex, Juncus and Eleocharis colonise the area.
II. They form a mat like vegetation towards the centre of pond with help of their much-branched rhizomatous system.
III. AS the high rate of transpiration, there is much rapid loss of water and sooner or later the mud is exposed to air as a result of whichnutrients like ammonia and sulphide become oxidised to nitrates and sulphates.

Thus, mesic condition approaches the area and marshy vegetation disappears gradually.

Woodland stage:

- By the time of disappearance of marshy vegetation, Soil become drier for most of the time of year.
- This area is now invaded by terrestrial plants Example Salix and cornus as shrub and Populus and Almus as tree.
- By this time, there is much accumulation of humus with rich flora of micro-organism.

Thus, mineralisation of the soil f



Forest stage:

This is the climax community. The w e with heavy rainfall, there develop trop s of Alnus, Acer and Quercus.

Field Exercise:

1. **Name and location of the .....**
2. **Date:.....**
3. **Area (ha):.....**
4. **Field work:**

Sr.no	Plant species		Phytoplankton stage.	Rooted submerged stage:	Reed- swamp stage	Sedge-meadow stage:	Sedge-meadow stage:
	Common name	Scientific name					
1							
2							
3							
4							
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8							
9							
10							

5. Important species ……..……

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6. Conclusion: ……

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Practical -14

Objective :- To visit and study about the different stage of hydrosere in Bundelkhand region

Material Required :- ……

Xerosere originating on bare rock surface the original substratum is deficient in water and lacks of organic matter, having only minerals in disintegrated unwanted state, the pioneer to colonise this primitive substratum is crustose type of lichens and through a series of successive seral stage of succession finally terminates into forest which constitute the climax community. The succession initiating from the dry land is called as Xeroarch. Xeroarch or Xerosere is further categorized into Lithosere, defined as the succession sequence which begins from the rock surfaces. The succession sequence in the growth and development of lithosere community includes following stages

1. Crustose Lichens stage:

- ✓ In this stage, the substratum colonized by this pioneer is very poor in moisture and organic matter, subjected to extreme temperate.
- ✓ The pioneer community is composed of lichens species such *as Rinodina, Rhizocarpon and Lacanorma*. This stage is also called as **Crustose** and the species of this stage can tolerate desiccation.
- ✓ These above-mentioned species produce acids which bring about weathering of rocks.
- ✓ The dead organic matter of lichens becomes mixed with the small particle of rock.

However, this process is very slow. These lichens are then replaced by foliose lichens,

Foliose lichen stage:

- ✓ This initial formation of soil in depressions of rocks supports the growth of lichens called **foliose lichens** such as, *ParmeliaDermatocarpon* etc., which have large leaf like thalli.
- ✓ The above lichens species can absorb and remain water and are able to accumulate dust particles which help in the further buildup of the substratum.
- ✓ These above newly invaded foliose lichens aggregate more soil particles as well as water leading to formation of thin soil layer onrocks.

2. Moss stage:

- ✓ The development of thin soil on rock surface especially in the crecices, favours the growth of some xerophytic mosses.
- ✓ *Grimmia and Polytrichum* are the moss which invades in an area due to the thin layer of soil on rock surfaces.
- ✓ After some time, these mosses will accumulate more soil particles, water and organic matter and leads to colonization of moistureloving mosses such as *Bryum, Hypnum* etc. and thus called as moss stage of succession.
- ✓ After their successful growth, they compete with lichens.
- ✓ Due to death and decay, there is further addition of organic matter in the soil.

And, the thickness of soil layer now increases.

3. Herb stage:

- ✓ Moss when decomposed into organic matters forming a mat over fragmented rock and provide a substratum for the seed germination of annual grasses such as *Aristicla, Eleusin, Poa* etc.
- ✓ The death and decay of these grasses leads to replacement of the vegetation by perennial grasses such as *Heteropogon,Cymbopogon* etc.
- ✓ Invasion of small animals were also encountering at his stage of succession.

4. Shrub stage:

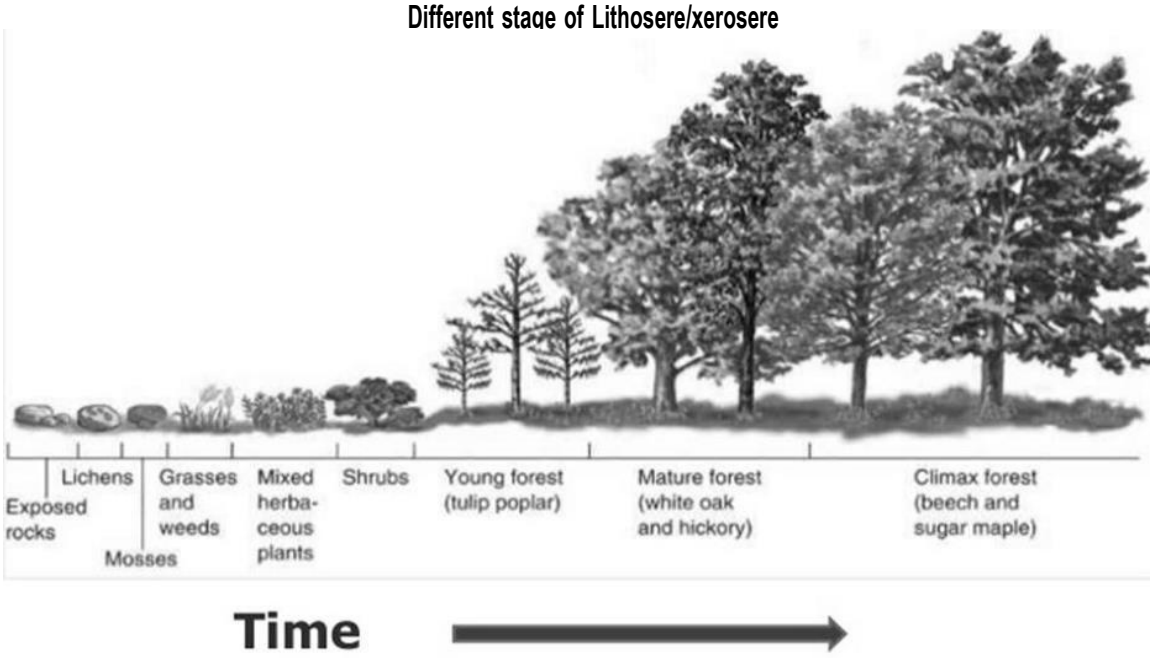
- ✓ Due to much accumulation of soil,the habitat becomes suitable for shrubs which migrating in the area.
- ✓ Colonization of shrub such as *Zizyphus, Caparis and Rhus* are favourable of rock weathering and mineralization.
- ✓ Shrubs are larger than herbs in size with deep root penetration and further leading to soil formation *via* rock weathering.
- ✓ The soil is further enriched by the dense shrubby growth. these in turn are finally replaced by trees which makes climax

community.

5 .Forest stage:

- ✓ The environmental is now favourable for the colonization of hard and stunted trees requiring sunlight for growth.
- ✓ Mesophytic type of vegetation is supported by the environmental factors and thus leads to an equilibrium, stable and steady state ofsuccession between biotic community and environment. **There develops finally a forest community,**
- ✓ In region of moderate rainfall, there is develop tropical deciduous forest or monsoonforest.

Different stage of Lithosere/xerosere



Ecological Succession – The progressive change in species composition of an ecosystem over time

Field Exercise:

1. Name and location of Rocky site :……..……..……

2. Date:……..……

3. Area (ha):……

6. Field work:

Sr.no	Plant species		Crustose Lichens stage:	Moss stage	Herb stage:	Shrub stage	: Forest stage
	Common Name	Scientific name					
1							
2							
3							
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Importance species ……..……

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6. Conclusion: ……

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Practical -15

Objective: To study different thinning operation used in forestry

Material used: .....

THINNINGS

It is the reduction of trees in an immature stand for the purpose of improving the growth and form of the trees that remain without permanently breaking the canopy of future trees.

Aims of thinning:

To distribute the growth potential uniformly

- To increase the net yield from a unit area.
- To obtain earlier returns from thinned materials.
- To reduce the rotation
- To produce different size timber as per seq.

How much to thin: The ground area available to each tree influences its growth. Thinning regimes are calculated on a trees-per-hectare basis. Thinning may not result in even distances between trees; however, trees should not be too close (2.5meters), otherwise competition will restrict growth. On the other hand, spacing between trees greater than12m apart are likely to under use the available area and waste valuable land.

Basis of thinning in regular forest: Tree classification basis and Statistical basis

Tree Classification Basis

i. Before planning the nature and intensity of thinning the preference between the intensity of thinning and quality of thinning should be decided.
ii. The trees remaining after the thinning should be able to compensate for the loss in increment by trees removed in thinning.
iii. There will be an optimum stocking for a given site and species.
iv. Individual trees are classified by height and size of crown and thinning is decided on the basis of which classes of trees are fit to be removed for maintaining the desired qualitative and quantitative nature of the thinning.
v. The main purpose of the thinning is to release more space for future development of trees; the freedom of crown is the guiding factor for thinning purpose.
vi. The retention of trees per unit should be decided first and then the number of trees to be removed should be marked accordingly.
vii. The development of crown and stem are the deciding factor for sub-classification of the dominance classes of trees for the given site and species.

Tree classification in regular forests is done as under:-

1) **Dominant trees:** These crowns extend above the general level of the canopy. They receive full light from above and some light from the sides. Generally, they have the largest, fullest crowns in the stand (Figure 5.5).
2) **Codominant trees**: These crowns make up the general level of the canopy. They receive direct light from above, butlittle or no light from the sides. Generally they are shorter than the dominant trees.

3) **Intermediate trees:** These crowns occupy a subordinate position in the canopy. They receive some direct light from above, but no direct light from the sides. Crowns are generally narrow and/or one-sided, and shorter than the dominant and codominant trees.
4) **Suppressed trees (Overtopped trees)**: These crowns are below the general level of the canopy. They receive no direct light. Crowns are generally short, sparse, and narrow.

Statistical basis:

- In regular plantations the density and site quality vary considerably ad it is not possible to define crown and canopy classes.
- For this the number of trees to be retained per unit area and their spacing should be numerically fixed.
- After fixing the number of trees per unit area the remaining trees can be marked and removed.

Thinning in Regular crops:

1) **Mechanical thinning** (also called stick thinning): A thinning in which the trees to be cut are selected by some rule of thumb, e.g., trees in alternate diagonals or rows, alternate trees in alternate rows or every second, third, etc., line or a minimum spacing gauged by a standard stick.
2) **Ordinary thinning** (Also called low thiningor German thinning or thinning from below): The method of thinning in common use that consists in the removal of inferior individuals of a crop, starting from the suppressed, then taking the dominated and lastly some of the dominants.
3) **Crown thinning** (High thinning or French thinning or thinning from above): A method in which thinning is primarily directed to the dominant trees in a regular crop, the less promising ones being removed in the interest of the best available individuals; the dominated and suppressed stems are retained if they are not dead, dying and diseased.
4) **Free thinning** (devised by Heck): A method of thinning in which attention is concentrated on evenly spaced selected stems (called elites or alphastems) which are retained until maturity or till the last thinning or two, thinning being directed to the removal of other stems hindering their optimum development.
5) **Maximum thinning:** It is the modification of Heck's free thinning developed by Gehrhardt. It is defined as a method of thinning which ' aims at putting as high a proportion possible of the total potential increment of the area on the retained stems; from an early stage the number of such stems limited to the minimum that can fully utilize the growing tree. It is heaviest form of free thinning so that there are no trees other than elites. As the thinning is extremely heavy, it may result in deterioration of site due to exposure, infestation of the area with shrub growth, production of knotty timber.
6) **Advance thinning** (also Craib's thinning): A thinning done in a regular crop in anticipation of suppression. It was developed by Craiband O' Connorfor wattle and pine plantation in South Africa. Thinning is done after the trees have been adversely affected by the competition of their neighbours. It should be done before competition actually sets in.
7) **Thinning in irregular crops:** Selection Thinning is applied in irregular crops. A method of thinning directed to obtain and/or maintain selection composition in a crop, with all diameter classes adequately represented.' It is carried out in all canopyclasses removing the trees of the following characteristics:

- Dead, dying and diseased trees
- Inferior trees which restrict the development of their neighbors from all sides
- Trees which are less valuable than their neighbors
- Trees which are of no special importance as regards desirable crop mixture presented.

Field Exercise:

1. Name and location of the plantation area:.....

2. Date:.....

3. Area (ha):.....

7. Field work:

Sr.no	Plant species		Thinning Type applied	Number of plants removed	Area(ha	Any other information
	Common name	Scientific name				
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8. Important of thinning in regular forest: ……..……

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6. Conclusion: ……

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