Lecture-4

CLIMATE AND SOIL FOR HORTICULTURE CROPS

The Climate and soil have an important role played in the growth of the plant. Fruit growers should know the effect of various soil and climatic conditions on fruit growing. Horticulture crops cannot be grown in all type of soil and climate. Hence zone wise cultivation is made. Climate includes several parameters like temperature, rainfall, atmospheric humidity, wind, hail, light, whereas soil covers such factors as moisture supply, texture, chemical composition and soil temperature.

Soil:

Horticulture crops require soils as growing medium. It provides mechanical support, nutrients and water to the plant growth. The demand of Horticultural crops is mainly water, nutrients and growth hormones. The number of factors affects roots absorbing nutrients and moisture. To ensure development of an efficient root growth. The soils must contain adequate supply of air, water and low bulk density. Most of the Horticulture crops need well drained soil and cannot tolerate water logging. Therefore deep and well drained soils, free from hard sub soils, are needed for growth of the plant. While examining the soil, more attention is paid to its physical conditions rather than its chemical composition. Soil may defined as "superficial earth crust which function as store house of reservoir of water and nutrient at the same time providing the necessary physical support to the plant".

Properties of Soil:

Soil are mainly classified as physical as well as chemical properties of mostly influenced mineral matter of the soil and by the soil particles like sand, silt and clay.

Sandy soils feel gritty when rubbed between your fingers. Silts feel smooth a little like flour most clays are sticky and mouldable.

Sand Particles

Course sand = 0.2 to 2 mm in diameter.

Fine sand 0.02 to 0.2 mm in diameter

Silt = 0.002 to 0.02 mm in diameter.

Clay =<0.002 mm in diameter

On the noemunt of small sine and the relatively large surface area, they exhibit colloids property and are capable of increasing the water as well as nutrient retention capacity of the anil in a typical so there should be the proper proportion of these soil particles.

It is possible to alter the physical condition of the soil by adding organic matter. This improves the stratum and texture of the suit

Physical properties of soil

Soil Structure

It should be uniformly favorable for water penetration, soil aeration and drainage. It has different layers therefore soil profile pits have to be taken and the structure

Soil Aeration and Drainage:

Soil aeration is helpful for the growth of aerobic organisms in the soil to produce metabolic activities of this organism. Fruits and vegetables require well-drained soil. Poor performance was observed due to poor aeration and drainage. Therefore well-drained soil is essential. Extreme wet and dry soil should be an islet.

Water Table

The availability of water at a certain depth is called as water table. A high percentage of water can rise in water logging which effects on growth of the plants. Therefore, water depth should not be more than 2m throughout the year,

Soil Texture:

In the case of Horticulture crops generally required medium textured soil. Fine and coarse textured soil should be avoided.

Soil Temperature:

Soil temperature affects the root activity and is influenced by aeration and drainage. In cold soil chemical and biological activities, a slow availability of nutrients like N. P. K. and Ca is limited

India has diversified climates from temperate to tropical climates. So, India has been divided into 3 horticultural zones. They are:

- **TROPICAL ZONE**
- **SUB-TROPICAL ZONE**
- **TEMPERATE ZONE**

1. **TROPICAL ZONE:** Entire South India below the Vindhya hills comes under this zone. This zone is again sub-divided in to 3 sub-zones. They are:

- **Central tropical zone**
- **Southern tropical zone**
- **Coastal tropical humid zone**

Central tropical zone: States of Maharastra, Orissa, Southern part of Madhya Pradesh (Chattishgarh) and Telengana area of Andhra Pradesh comes under this zone.

Fruit crops recommended: Mango, Cashew, Citrus, (Sweet Orange, Mandarin orange, and limes), Grape, Guava, Sapota, Banana, Sithapahal, Fig, Ber, Pomegranate, Jamun, and Jackfruit.

Southern tropical zone: Andhra Pradesh excluding Telengana, Tamilnadu, Kerala and Karnataka states comes under this zone.

Fruit crops recommended: Mango, Coconut, Banana, Cashew, Sapota, Pineapple, Mangosteen, Breadfruit, Jackfruit, Sitaphal, Areca nut, Rubber, Pepper, Turmeric, Clove, Nutmeg, Cocoa, Coffee, Citrus (Sweet Orange, Mandarin orange, and limes).

Coastal tropical humid zone: Areas covering all along the coast of different states of peninsular India up to about 160 km inside to the sea shore line. The climate will be always humid and warm. Temperature will not be mild in winter when compared to southern tropical zone.

Fruit crops recommended: Coconut, Banana, Cashew, Jackfruit, Mango, and Pineapple.

2. **SUB-TROPICAL ZONE:** The area above the Vindhya hills comes under this zone. Occasionally frost occurs in this zone. This zone is sub-divided into TWO sub-zones basing on the direction. They are:

North-Western Subtropical zone: States like Rajasthan, Punjab, Haryana, Gujarat, Parts of Bihar, U.P, M.P and west Bengal comes under this zone.

Fruit crops recommended: Litchi, citrus (sweet orange, mandarin oranges), dates, guava, sapota, Papaya, phalsa, fig are some typical subtropical fruits grown but other tropical fruits like Mango, jack, banana can also be grown etc.

North-eastern sub-tropical zone: Areas like parts of UP, Bihar, West Bengal, Assam, Meghalaya, Manipur, Nagaland, Mizoram, Arunachal Pradesh, and Tripura. **Fruit crops recommended:** Litchi, Citrus (Sweet Orange, Mandarin oranges), Dates, Guava, Sapota,Papaya, Phalsa, Fig, Mango etc.

3. **TEMPERATE ZONE:** Areas comes in this zone are Jammu and Kashmir,Kulu,Katrain,Kangra valleys of Punjab, parts of Himachal Pradesh and kuman hills and also high altitude regions in South India-Nilagiris and Palani hills of TamilNadu.This zone frequently experiences frosts.

   This zone is further sub-divided in to two sub zones based on elevation. They are:

   A. Higher elevation

   B. Lower elevation

   A. Higher elevation: Elevation ranges from 1500—2500 m MSL.

   Fruit crops recommended: Apple, Pears, Walnut, Almond, Cherry and Strawberry etc.

   B. Lower elevation: Elevation ranges from 1200—1500 m MSL.

   Fruit crops recommended: Peaches, Persimmons, Japanese plum etc.

Planning of Agro-climatic zones of India

Several attempts have been made to delineate major agro-ecological regions in respect to soils, climate, physiographic and natural vegetation for macro-level planning on a more scientific basis. They are as follows.

1. **Agro-climatic regions by the erstwhile Planning Commission**
2. **Agro-climatic zones under National Agricultural Research Project (NARP)**

3. Agro-ecological regions by the National Bureau of Soil Survey & Land Use Planning (NBSS & LUP)

Agro-climatic regions by the erstwhile Planning Commission:

The erstwhile Planning Commission (Present NITI Aayog) taking into account several scientific studies, on regionalisation of the agricultural economy recommended developing agricultural planning based on agro-climatic regions under seven plan 1989. For resource development, the country has been broadly divided into **fifteen agricultural regions** based on agro-climatic features, particularly soil type, climate including temperature and rainfall and its variation and water resources availability. These are further divided into more homogeneous 72 sub-zones. Fourteen regions were in the main land and the remaining one in the islands of Bay of Bengal and the Arabian Sea.

Agro-climatic zones under National Agricultural Research Project (NARP):

National Agricultural Research Project (NARP) was launched by ICAR for initiating agricultural research in the agro-climatic zones of the country The main objective was to analyze the agro-ecological conditions and cropping patterns in various zones, and develop a program that could directly address the primary obstacles to agricultural growth in each zone. This program would be based on natural resources, major crops, farming systems, production constraints, and the prevailing socio-economic conditions of the area. The primary focus was on generating new technologies. To achieve this goal, the country was divided into 127 agro-climatic zones under the National Agricultural Research Project (NARP).

Agro-ecological regions by the National Bureau of Soil Survey & Land Use Planning (NBSS & LUP):

The National Bureau of Soil Survey & Land Use Planning (NBSS&LUP) came up with twenty agro-ecological zones based on the growing period as an

integrated criteria of effective rainfall, soil groups, delineated boundaries adjusted to district boundaries with a minimal number of regions. Subsequently, these twenty agro-ecological zones were sub- divided into 60 sub-zones.

What are the Primary Objectives of Agro-Climatic Zone Classification?

- To optimise agricultural production.
- To increase farm income.
- To generate more rural employment.
- To make judicious use of the available irrigation water.
- To reduce the regional inequalities in the development of agriculture.

The geographical area of India is divided into 15 agro-climatic regions. These are further divided into more homogeneous 72 sub-zones. The 15 agro-climatic zones are:

- **Zone 1** – Western Himalayan Region: Jammu and Kashmir, Uttar Pradesh
- **Zone 2** – Eastern Himalayan Region: Assam, Sikkim, West Bengal and all North-Eastern states
- **Zone 3** – Lower Gangetic Plains Region: West Bengal
- **Zone 4** – Middle Gangetic Plains Region: Uttar Pradesh, Bihar
- **Zone 5** – Upper Gangetic Plains Region: Uttar Pradesh
- **Zone 6** – Trans-Gangetic Plains Region: Punjab, Haryana, Delhi and Rajasthan
- **Zone 7** – Eastern Plateau and Hills Region: Maharashtra, Uttar Pradesh, Orissa and West Bengal
- **Zone 8** – Central Plateau and Hills Region: MP, Rajasthan, Uttar Pradesh

- **Zone 9** – Western Plateau and Hills Region: Maharashtra, Madhya Pradesh and Rajasthan
- **Zone 10** – Southern Plateau and Hills Region: Andhra Pradesh, Karnataka, Tamil Nadu
- **Zone 11** – East Coast Plains and Hills Region: Orissa, Andhra Pradesh, Tamil Nadu and Pondicherry
- **Zone 12** – West Coast Plains and Ghat Region: Tamil Nadu, Kerala, Goa, Karnataka, Maharashtra
- **Zone 13** – Gujarat Plains and Hills Region: Gujarat
- **Zone 14** – Western Dry Region: Rajasthan
- **Zone 15** – The Islands Region: Andaman and Nicobar, Lakshadweep

Distinct Features of Climatic Zones:

Zone 1 – Western Himalayan Region

- It includes Jammu and Kashmir, Himachal Pradesh and Kumaun-Garhwal areas of Uttarakhand.
- It shows great variation in relief. The summer season is mild (July average temperature 5°C-30°C) but the winter season experiences severe cold conditions (January temperature 0°C to -4°C).
- The amount of average annual rainfall is 150 cm. Zonal arrangement in vegetation is found with varying heights along the hill slopes.
- This zone is having highest area (45.3%) under forests.
- Valleys and duns have thick layers of alluvium while hill slopes have thin brown hilly soils.

- The region has perennial streams due to high rainfall and snow-covered mountain peaks of Ganga, Yamuna, Jhelum, Chenab, Satluj and Beas.
- They provide irrigation water to canals and cheap hydel power for agriculture and industries.
- Maize, wheat, potato, barley are important crops.
- Temperate fruits like apples and pears are produced in some parts of Jammu and Kashmir and Himachal Pradesh.

Zone 2 – Eastern Himalayan Region

- The Eastern Himalayan region consists of Sikkim, Darjeeling area (West Bengal), Arunachal Pradesh, Assam hills, Nagaland, Meghalaya, Manipur, Mizoram and Tripura.
- It is characterised by rugged topography, thick forest cover and sub-humid climate (rainfall over 200 cm; temperature July 25°C-33°C, January 11°C-24°C).
- The soil is brownish, thick layered and less fertile.
- Shifting cultivation (Jhum) is practised in nearly 1/ 3 of the cultivated area and food crops are raised mainly for sustenance.
- Rice, potato, maize, tea and fruits (orange, pineapple, lime, litchi etc.) are the main crops.

Zone 3 – Lower Gangetic Plains Region

- This region spreads over eastern Bihar, West Bengal and Assam valley. Here the average amount of annual rainfall lies between 100 cm-200 cm. Temperature for July month varies from 26°C-41°C and for January month 9°C-240C.
- The region has adequate storage of groundwater with a high water table. Wells and canals are the main sources of irrigation.

- The problem of waterlogging and marshy lands is acute in some parts of the region.
- Rice is the main crop that at times yields three successive crops (Aman, Aus and Boro) in a year.
- This zone accounts for about 12% of the country's rice production.
- Jute, maize, potato, and pulses are other important crops. Planning strategies include improvement in rice farming, horticulture (banana, mango and citrus fruits), pisciculture, poultry, livestock, forage production and seed supply.

Zone 4 – Middle Gangetic Plains Region

- It incorporates eastern Uttar Pradesh and Bihar (except the Chotanagpur plateau). It is a fertile alluvial plain drained by the Ganga River and its tributaries.
- The average temperature of July month varies from 26°C- 41°C and that of January month 9°C-24°C.
- **This zone consists of 12 districts of eastern Uttar Pradesh and 27 districts of Bihar plains. Eastern U.P. has been further sub-divided into nine regions based on the heterogeneity in soil, land use, topography and climatic factors.**
- **The rainfall is high and 30% of the gross cropped area is irrigated and the cropping intensity is 142%.**
- The amount of annual rainfall lies between 100 cm and 200 cm. The region has vast potential of groundwater and surface runoff in the form of perennial rivers which is utilised for irrigation through tube wells, canals and wells.
- Rice, maize, millets in Kharif season; wheat, gram, barley, peas, mustard and potato in Rabi season are important crops.

Zone 5 – Upper Gangetic Plains Region

- This zone consists of 32 districts of Uttar Pradesh divided into three sub-zones of Central, North- West and South –West U.P. The zone has 144% cropping intensity.
- The climate is sub-humid continental with July month's temperature between 26°-41°C, January month's temperature between 7°- 23°C and average annual rainfall between 75 cm- 150 cm.
- The soil is sandy loam. It has 131 per cent irrigation intensity and 144 per cent cropping intensity.
- Canal, tube wells and wells are the main source of irrigation. This is an intensive agricultural region where wheat, rice, sugarcane, millets, maize, gram, barley, oilseeds, pulses and cotton are the main crops.

Zone 6 – Trans-Gangetic Plains Region

- The Trans Ganga Plain consists of Punjab, Haryana, Delhi, Chandigarh and Ganganagar district of Rajasthan.
- **The major characteristics of the area are: highest net sown area, highest irrigated area, least poverty level, high cropping intensity (170%) and high ground water utilization.**
- Rice-wheat system is prevalent. There is need to evolve short duration genotypes and also to diversify of cropping.
- The climate has semi-arid characteristics with July month's temperature between 26°C and 42°C, January temperature ranging from 7°C to 22°C and average annual rainfall between 70 cm and 125 cm.
- Private tube wells and canals provide principal means of irrigation.
- Important crops include wheat, sugarcane, cotton, rice, gram, maize, millets, pulses and oilseeds etc.

Zone 7 – Eastern Plateau and Hills Region

- It comprises the Chotanagpur plateau, Rajmahal Hills, Chhattisgarh plains and Dandakaranya.
- The region enjoys 26°C-34°C of temperature in July, 10°C-27° C in January and 80 cm-150 cm of annual rainfall.
- Soils are red and yellow with occasional patches of laterites and alluviums.
- The region is deficient in water resources due to plateau structure and non-perennial streams.
- Rainfed agriculture is practised growing crops like rice, millets, maize, oilseeds, ragi, gram and potato.

Zone 8 – Central Plateau and Hills Region

- This region spreads over Bundelkhand, Baghelkhand, Bhander plateau, Malwa plateau and Vindhyachal hills.
- The climate is semi-arid in the western part to sub-humid in the eastern part with temperature in July month 26°C-40°C, in January month 7°C-24°C and average annual rainfall from 50 cm- 100 cm.
- Soils are mixed red, yellow and black growing crops like millets, gram, barley, wheat, cotton, sunflower, etc.
- The region has a dearth of water resources.

Zone 9 – Western Plateau and Hills Region

- This comprises the southern part of the Malwa plateau and Deccan plateau (Maharashtra).

- This is a region of the respective soil with July temperature between 24°C-41 °C, January temperature between 6°C- 23°C and average annual rainfall of 25 cm-75 cm.
- This zone is known for the best quality oranges, grapes and bananas. The area under fruit crops is about one lakh hectares.
- Net sown areas are 65 per cent and forests occupy only 11 per cent.
- Only 12.4 per cent of the area is irrigated.
- Jowar, cotton, sugarcane, rice, bajra, wheat, gram, pulses, potato, groundnut and oilseeds are the principal crops.
- The area is known for its oranges, grapes and bananas.

Zone 10 – Southern Plateau and Hills Region

- It incorporates southern Maharashtra, Karnataka, western Andhra Pradesh and northern Tamil Nadu.
- The temperature of July month lies between 26°C to 42°C, that of January month between 13°C-21°C with annual rainfall between 50 cm-100 cm.
- The climate is semi-arid with only 50 per cent of the area cultivated, 81 percent of dryland farming, and low cropping intensity of 111 per cent. Low-value cereals and minor millets predominate.
- Coffee, tea, cardamom and spices are grown along the hilly slopes of the Karnataka plateau.

Zone 11 – East Coast Plains and Hills Region

- This region includes the Coromandel and Northern Circar – the important Coastal plains of India.
- Here the climate is sub-humid maritime with May and January's temperatures ranging from 26°C-32°C and 20°C-29°C respectively and annual rainfall of 75 cm-150 cm.

- The soils are alluvial, loam and clay facing the menacing problem of alkalinity.
- The region accounts for 20.33 per cent of rice and 17.05 per cent of groundnut production of the country.
- Main crops include rice, jute, tobacco, sugarcane, maize, millets, groundnut and oilseeds.

Zone 12 – West Coast Plains and Ghats Region

- This region extends over the Malabar and Konkan coasts and the Sahyadris and is covered by laterite and coastal alluvials.
- This is a humid region with annual rainfall above 200 cm and average temperatures of 26°C-32°C in July and 19°C-28°C in January.
- Rice, coconut, oilseeds, sugarcane, millets, pulses and cotton are the main crops.
- The region is also famous for plantation crops and spices which are raised along the hill slopes of the Ghats.

Zone 13 – Gujarat Plains and Hills Region

- This region includes Kathiawar and fertile valleys of the Mahi and Sabarmati rivers.
- It is an arid and semi-arid region with average annual rainfall between 50 cm-100 cm, and monthly temperature between 26°C-42°C in July and 13°C-29°C in January.
- Soils are regur in the plateau region, alluvium in the coastal plains and red and yellow soils in Jamnagar
- Groundnut, cotton, rice, millets, oilseeds, wheat and tobacco are the main crops.
- It is an important oilseed producing region.

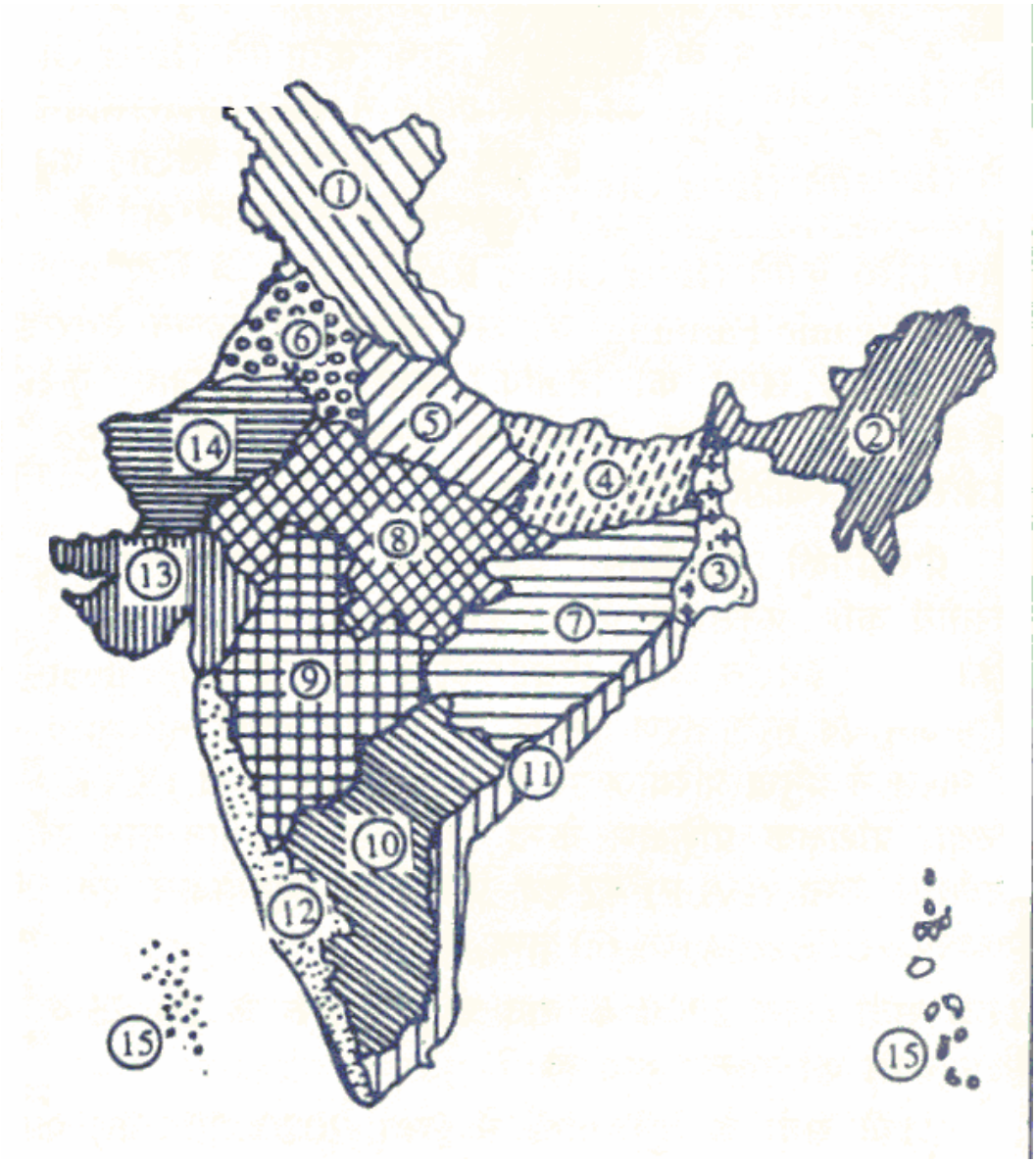
Zone 14 – Western Dry Region

- It comprises western Rajasthan west of the Aravallis.
- It is characterised by hot sandy desert, erratic rainfall (annual average less than 25 cm), high evaporation, contrasting temperature (June 28°C- 45°C, and January 5°C-22°C), absence of perennial rivers, and scanty vegetation.
- Groundwater is very deep and often brackish.
- Famine and drought are common features.
- The land-man ratio is high. Forest area is only 1.2 per cent. Land under pastures is also low at 4.3 per cent.
- Cultivable waste and fallow lands account for nearly 42 per cent of the geographical area.
- Net irrigated area is only 6.3 percent of the net sown area which is 44.4 percent of the geographical area.
- The land-man ratio is high (1.73 ha/person).
- Bajra, jowar, and moth are the main crops of Kharif and wheat and gram of Rabi.
- Livestock contributes greatly to desert ecology.

Zone 15 – The Islands Region

- The island region includes Andaman-Nicobar and Lakshadweep which have typically equatorial climates.
- The annual rainfall is less than 300 cm, the mean July and January temperatures of Port Blair being 30°C and 25°C respectively.
- The soils vary from sandy along the coast to clayey loam in valleys and lower slopes.

- The main crops are rice, maize, millets, pulses, areca nut, turmeric and cassava.
- Nearly half of the area is under coconut.
- The area is covered with thick forests and agriculture is in a backward stage.



Map of Agroclimatic Zone of India